The National Academies of
SCIENCES · ENGINEERING · MEDICINE

GULF RESEARCH PROGRAM

GRP overview to ICCOPR

December 14, 2016

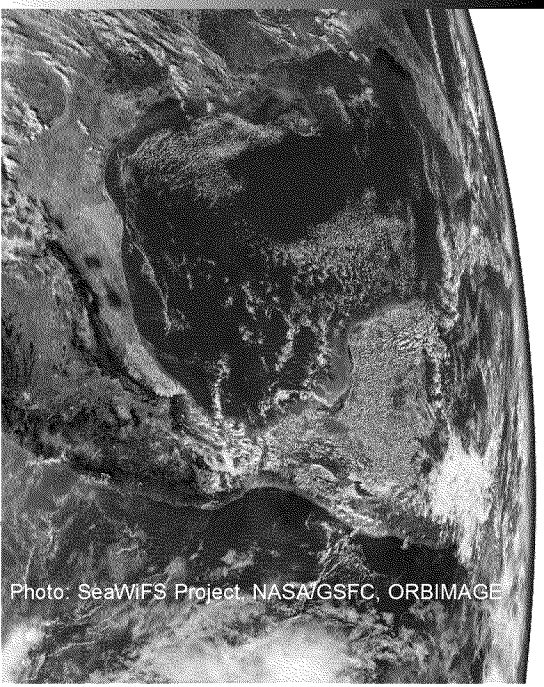


Photo: SeaWiFS Project, NASA/GSFC, ORBIMAGE

GULF RESEARCH PROGRAM
INNOVATE | EDUCATE | COLLABORATE

The Gulf Research Program

- A $500 million, 30-year program (2043) managed by the National Academies. Funds grants, fellowships, and other activities
- Directed to operate in three areas:
  - Oil system safety
  - Human health
  - Environmental resources
- Directed to work via three mechanisms:
  - Research & development
  - Education & training
  - Environmental monitoring
- Guided by *Strategic Vision* (2014)
- and 20+ member Advisory Board (pro bono service)

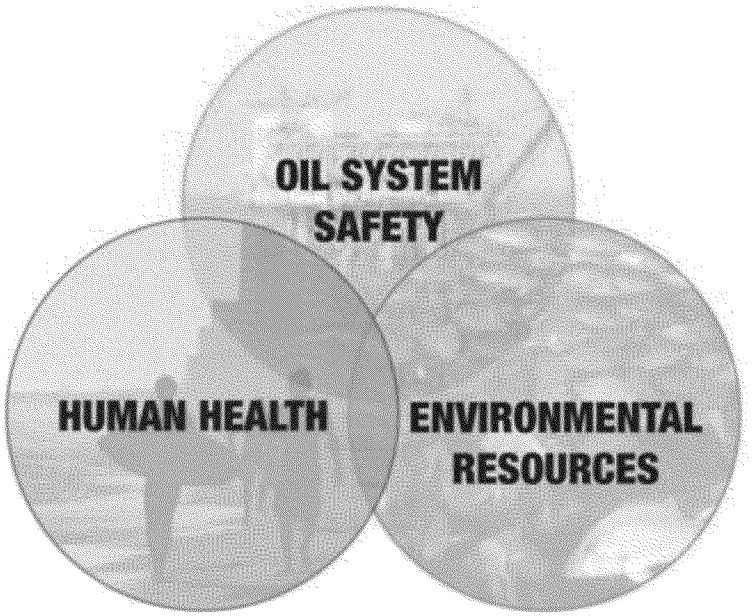
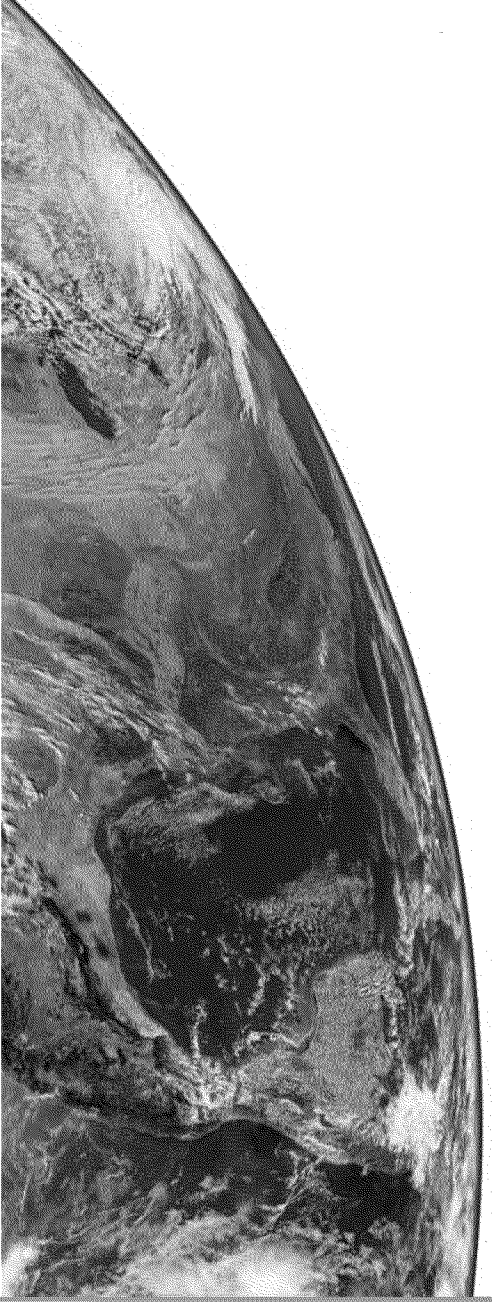


Photo credits: Background photos ©iStock

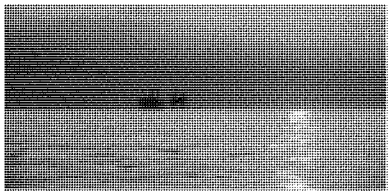
Strategic Vision Core Elements

- Long-term, Cross Boundary Perspective
- Science to Advance Understanding
- Science to Serve Community Needs
- Synthesis and Integration
- Coordination and Collaboration
- Leadership and Capacity Building

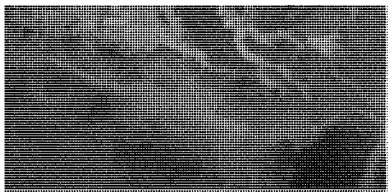


Program Initiatives & Lasting Impacts

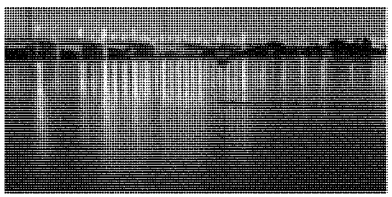
Program Initiatives



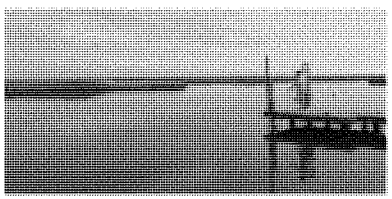
- Reducing risk in offshore oil and gas operations



- Observation and monitoring for healthy ecosystems and coastal communities



- Planning and action for healthy and resilient coastal communities



- Building capacity to address cross-boundary challenges

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Reducing risk in offshore oil and gas operations

Comprehensive risk awareness can help both industry and regulators to better anticipate, reduce, and avoid risks in the offshore oil and gas environment. In collaboration with others, the GRP is working to identify risk-management approaches that can prevent oil spills, loss of life, and harmful exposures related to offshore oil and gas drilling, production, and transportation.

Photo : ©iStock/nielubieklonu

Reducing risk in offshore oil and gas operations

Featured Activities:

- **2017 Research and Development Grants: advancements in fundamental science and technology that reduce or result in a better understanding of the systemic risks leading to uncontrolled hydrocarbon release**
- Evaluation of the Use of Dispersants in Oil Spill Response: Sponsoring a study to assess the effects and efficacy of dispersants as an oil spill response tool.
- 2016 Exploratory Grants: Scenario planning to advance safety culture and minimize risk in offshore oil and gas operations
- 2015 Exploratory Grants: Exploring approaches for effective education and training of workers in the offshore oil and gas industry and health professions
- 2014 Education and Training Opportunity Analysis Workshop

Photo : ©iStock/nielubieklonu

Preventing the Next Spill: Understanding Systemic Risk in the Offshore Oil and Gas Environment

- 2017 Research & Development Grant Opportunity
- Up to $10 Million available
- Projects up to 3 years
- LOIs due February 1
- Full Proposals due April 12
- Funding Announced Fall of 2017

Preventing the Next Spill: Understanding Systemic Risk in the Offshore Oil and Gas Environment

- Formation Rock Mechanics
- Well site data: Identification of precursors
- Kick detection system
- Riser gas unloading
- Cementing/wellhead sealants
- Integrity of abandoned wells
- Seafloor hydrocarbon detection technology
- Enhancing Decision Making Capabilities

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Evaluation of the Use of Dispersants in Oil Spill Response

- Assess the state of our knowledge about dispersant effectiveness and the fate of untreated oil , chemical dispersants, and chemically dispersed oil
- Evaluate and summarize research on the acute and chronic (sub lethal) effects of chemical dispersants. chemically dispersed oil, and untreated oil at realistic environmental exposure levels.
- Identify the research protocols and standards that would: i) increase the applicability of lab-based measurements to the field and ii) improve the comparability of research findings from different laboratories;
- Compare the benefits and limitations of dispersant application to the use of other clean-up methods (e.g. no-action, mechanical recovery, burning, and chemical herders in combination with burning); and
- Assess the adequacy of the existing information to support risk-based decision-making or net environmental benefit analysis of response options under a variety of spill scenarios and recommend a "roadmap" of research and modelling to address identified information gaps.

Reducing risk in offshore oil and gas operations

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Photo : ©iStock/nielubieklonu

2016 Exploratory Grants – Awardees

Topic : Scenario Planning to Advance Safety Culture and Minimize Risk in Offshore Oil and Gas Operations

- **Collaborative modeling with fuzzy cognitive maps: A novel approach to achieving safety culture – $407,000** PD: Antonie Jetter, Ph.D., Portland State University
- **Developing a systems-theoretic, cross-disciplinary, scenario-based approach to reducing risk in offshore oil and gas operations – $231,000** PD: Nancy Leveson, Ph.D., Massachusetts Institute of Technology (MIT)
- **Factoring in the human in offshore operations: Forces for scenario planning – $199,000** PD: Ranjana Mehta, Ph.D., Texas A&M University
- **Virtual reality offshore operations training infrastructure: Enhancing expert containment, decision making, and risk communications – $383,000** PD: Saeed Salehi, Ph.D., University of Oklahoma

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Reducing risk in offshore oil and gas operations

Evolving Activity:

Oil and Gas Stakeholders Convening Activity

- Developing a network with industry and supporting organizations
- Small gathering last year with COS, OESI, SSI, RPSEA to listen to research needs and perceptions of risk
- Grow this group substantially for 2 meetings this year
- Provide a neutral mechanism for open conversation between stakeholders

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Observation and Monitoring for Healthy Ecosystems and Communities

Managers and decision makers can better anticipate and mitigate environmental change and community and ecosystem disruptions with timely, accurate observation and monitoring information. We are working with others to improve how researchers and practitioners collect, interpret, and use monitoring and observing information. Our current areas of interest include the deep waters of the Gulf of Mexico, community resilience, and environmental restoration.

Photo: NASA image courtesy Norman Kuring, Ocean Color Team

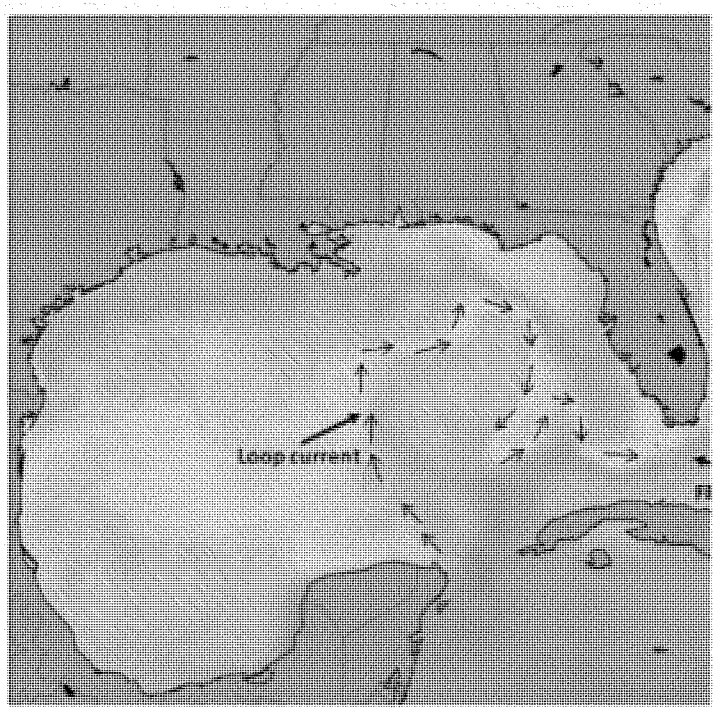
Observation and Monitoring for Healthy Ecosystems and Communities

Featured Activities:

- **2017 Loop Current Study: Develop recommendations to design suite of activities—including research, observations, and analyses—needed to characterize Loop Current dynamics and improve the effectiveness of modeling efforts.**
- 2016 Synthesis Grants: Scientific synthesis connecting environmental, social, and/or health data to improve monitoring of human impacts of offshore oil and gas development *or* to improve health risk and exposure assessment.
- 2015 Consensus Study: *Effective Monitoring to Evaluate Ecological Restoration in the Gulf of Mexico* (report released in July 2016).
- 2015 Synthesis Grants: Synthesis of existing environmental monitoring data to inform efforts to restore and maintain the Gulf of Mexico's ecosystem services *or* enhance understanding of the Deep Gulf or its physical and biological connectivity to coastal communities
- 2014 Environmental Monitoring Opportunity Analysis Workshop

Photo: NASA image courtesy Norman Kuring, Ocean Color Team

Advancing Understanding of Gulf of Mexico Loop Current Dynamics



- GRP sponsored expert report from the National Academies
- Summarize existing scientific understanding of physical forces that shape and energize the LC
- Determine critical information needed to better understand the variability
- Assess capacity of current technology and modeling efforts to meet the needs
- Design a field campaign to fill the gaps
- Identify opportunities for collaboration and joint sponsorship
- Completed in 2017

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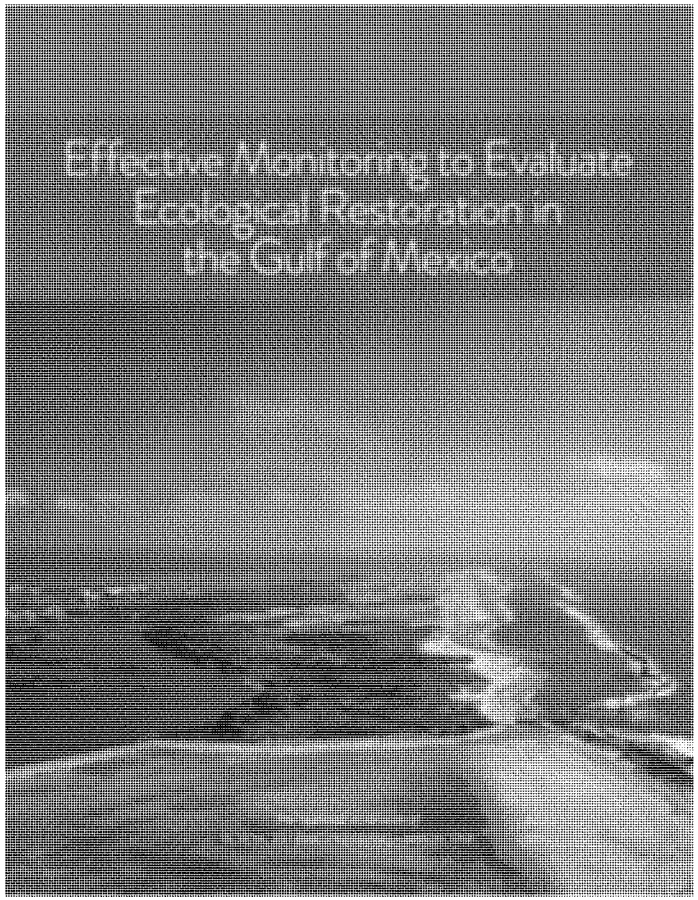
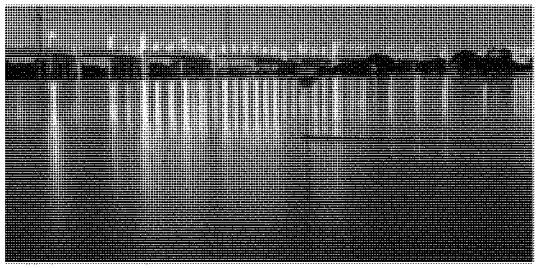
Effective Monitoring to Evaluate Ecological Restoration in the Gulf of Mexico



- Identifies best practices for monitoring and evaluating restoration activities to improve performance of restoration programs and increase effectiveness and longevity of restoration projects
- Provides general guidance for restoration monitoring, assessment, and synthesis that can be applied to most ecological restoration supported by these major programs given their similarities in restoration goals
- Offers specific guidance for subset of habitats and taxa to be restored in the Gulf including oyster reefs, tidal wetlands, and seagrass habitats, as well as a variety of birds, sea turtles, and marine mammals

(available at www.nationalacademies.org/gulf/resources)

Planning and Action for Healthy and Resilient Coastal Communities



Natural disasters, climate change impacts, and other environmental stressors, such as those resulting from oil spills, present complex challenges to the health and well-being of coastal communities and to the integrity of the environments upon which they depend. In collaboration with others, the GRP will support the work of researchers, communities, and public- and private-sector actors to enhance the resilience of coastal communities to the adverse impacts of environmental challenges in ways that also improve well-being.

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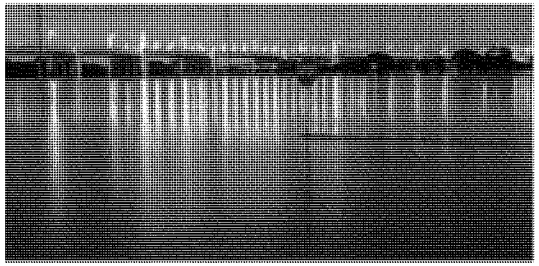
Planning and Action for Healthy and Resilient Coastal Communities



Featured Activities:

- 2016 Research and Practice Grants: Broad call for scientifically-valid research and practice projects that will develop information, test strategies, and provide evidence that can be used by communities to enhance their resilience to the adverse impacts of climate change, severe weather, and major environmental disasters, in ways that also improve well-being. (Developed and funded in collaboration with RWJF)
- 2016 Capacity Building Grants: Enhancing community networks that improve coastal environments, health, and well-being
- 2016 Exploratory Grants: Helping communities impacted by offshore oil and gas operations plan for, mitigate, and adapt to environmental change
- 2014 Community Resilience and Health Opportunity Analysis Workshop

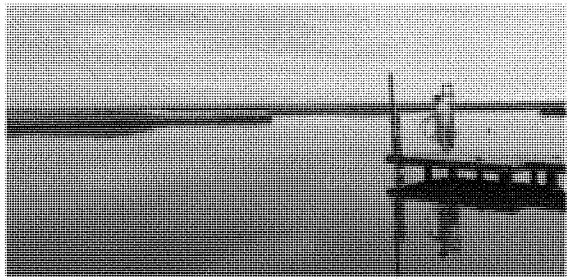
Photo: ©iStock/stretchc

2016 Exploratory Grants – Awardees

Topic: Informing Coastal Community Planning and Response to Environmental Change in Regions with Offshore Oil and Gas Operations

- **Enhancing community resilience and optimizing oil spill response through the participatory design of a decision support system – $460,000** Project Director (PD): Tony Grubesic, Ph.D., Arizona State University
- **Building coastal community subject matter expert capacity through an innovative "citizen science" program to collect quantitative beach dynamic and tar ball data for oil spill planning and response in coastal regions with offshore oil and gas operations – $481,000** PD: Mark Kulp, Ph.D., University of New Orleans
- **Multidisciplinary knowledge integration to support Louisiana coastal indigenous communities' response to natural and technological disasters and adaptation to climate change – $312,000** PD: Tara Lambeth, Ph.D., The University of New Orleans Center for Hazard Assessment, Response and Technology (UNO-CHART)
- **Can deliberative discussions lay a foundation for integrated decision-making networks? – $259,000** PD: Susan Lovelace, Ph.D., South Carolina Sea Grant Consortium
- **Advancing a societal impact assessment framework for oil and gas operations in the Northern Gulf of Mexico – $250,000** PD: Richard McLaughlin, Ph.D., Harte Research Institute, Texas A&M University, Corpus Christi

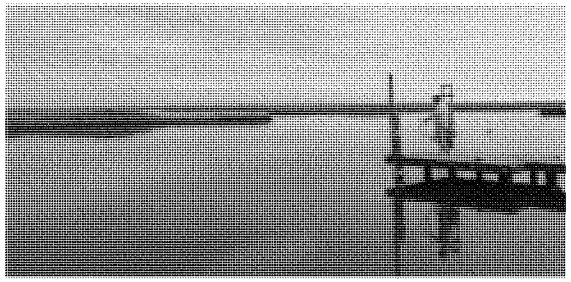
Building Capacity to Address Cross-Boundary Challenges



Collaboration and communication among individuals in communities, industry, universities, and the public sector are essential to understanding and addressing the interwoven scientific, social, and environmental challenges associated with offshore oil and gas operations. By supporting the development of new approaches, tools, and education and training experiences, the GRP seeks to foster cross-boundary leadership and capacity for solving complex challenges in coastal regions along the U.S. outer continental shelf.

Photo by Kelly M. Darnell

Building Capacity to Address Cross-Boundary Challenges



Featured Activities:

- 2017 Open Science for Synthesis Training: A training event that will revolve around scientific computing and scientific software for reproducible science.
- 2016 Capacity Building Grants: Enhancing community networks that improve coastal environments, health, and well-being
- 2015-Ongoing: Science Policy Fellowships
- 2015-Ongoing: Early Career Research Fellowships
- 2014 Education and Training Opportunity Analysis Workshop

Photo by Kelly M. Darnell

Fellowships

Early-Career Research Fellowships

- Facilitate academic, intellectual, and professional development of individuals who have outstanding scholarship promise
- Recognize early-career researchers for past performance and future potential for substantial contributions to advancing scientific understanding
- Provide funding and mentorship at critical pre-tenure phase of fellows' academic careers

Science Policy Fellowships

- Provides valuable experience at science-policy interface through one-year placement on staff of state environmental, natural resources, oil and gas, or public health agency; or regional offices of relevant federal agencies.
- Fellows participate in and contribute to state or federal policymaking process. Duties vary by placement but can include analysis and synthesis of scientific information to support policy development, writing policy memos, and drafting legislation.

2017 Fellowships

Applications open December 1, 2016

Applications due February 22, 2017

- **Early-Career Research Fellowship:** applicants must hold an assistant professor (or equivalent position) at a U.S. college, university, or research institution
- **Science Policy Fellowship:** Doctoral students or those who completed their graduate degree on or after September 1, 2012. Eligible degrees: MA/MS, PhD, ScD, MPH, MD, or DVM
- **Open to a broad range of disciplines:** social and behavioral sciences, health and medicine, engineering, earth and life sciences, relevant interdisciplinary fields
- Applicants must be a U.S. citizen, U.S. national, lawful permanent resident, or an individual with deferred action status

www.nationalacademies.org/gulf/fellowships

Lasting Impacts

1. Engage **multiple generations of scientists**, through fellowships grants, and other career building activities, in research and policy making.
2. Catalyze long-term monitoring and research that will advance scientific understanding of **deep water ecosystems and processes** in the Gulf of Mexico
3. Support long-term monitoring and research to improve the science and practice **environmental restoration and restoration monitoring**
4. Participate and provide leadership in an **oil system safety** network of stakeholders
5. Strengthen the science and practice of **coastal community resilience** in regions along the US outer continental shelf through research and capacity building
6. Encourage and develop capacity for **scientific synthesis** (e.g., integration of data and methods; application of scientific research) to improve the safety of energy production and protect human well-being and the environment

What does all this mean for ICCOPR?

- There is overlap in our objectives. We're looking to fill research gaps that would either prevent oil spills from happening or minimize the effect on the environment and on coastal communities, if and when spills do occur.
- We're listening to you and to the offshore oil and gas community as to what critical research gaps might be a good fit for GRP funds.
- The word "Collaborate" is part of our logo. We can't do this all on our own and we're looking for ways to work together with industry, with industry-supporting organizations, with academia and with regulatory agencies.

Thank you!

Gulf Research Program

gulfprogram@nas.edu

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Comparative Toxicity of Oil Spill Mitigation Products in Estuarine Organisms: Mesocosm and Laboratory Exposures

Ph.D.

NOAA, National Ocean Service, National Centers for Coastal Ocean Science, Charleston, SC

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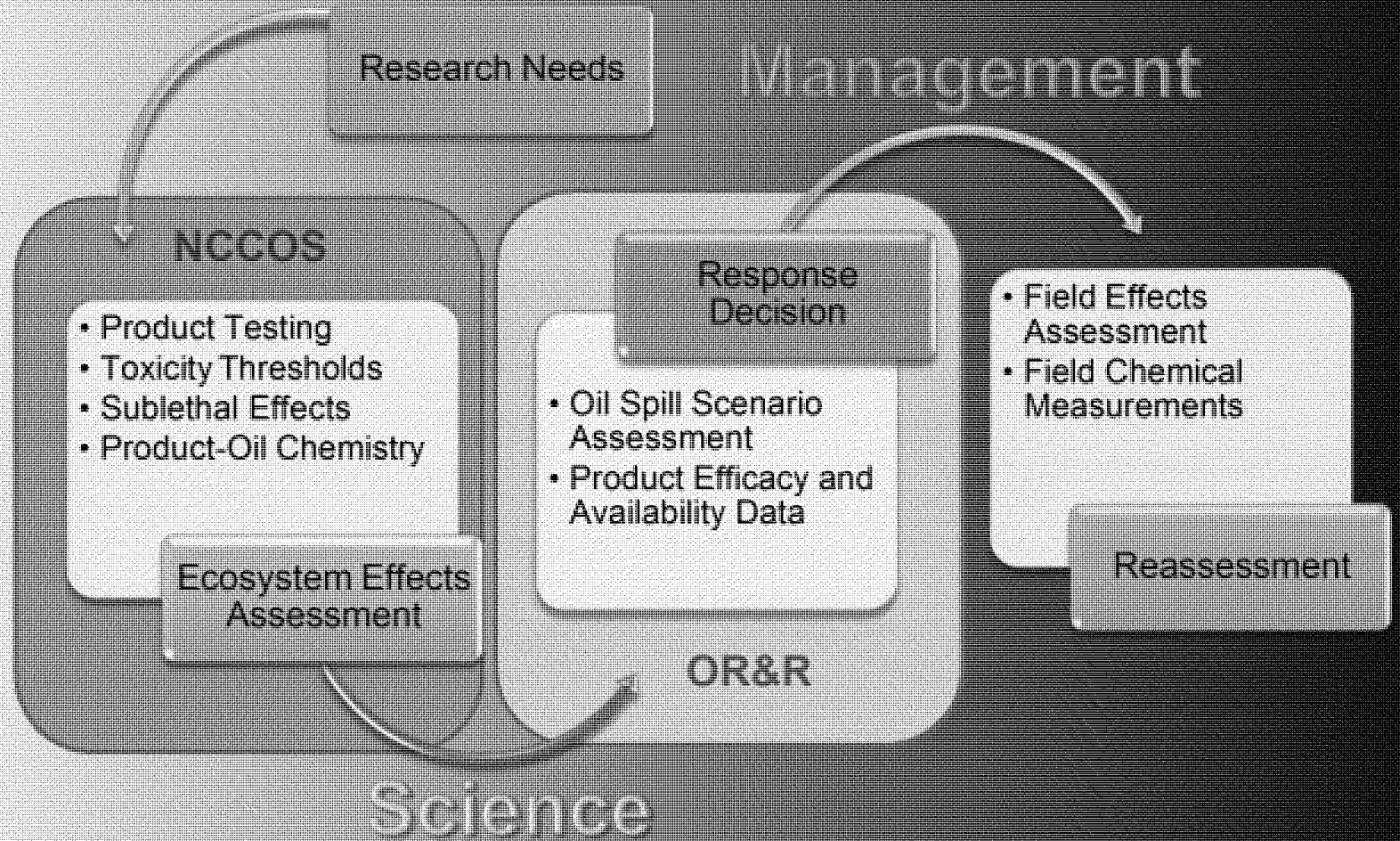
ence to Support Management

Delivering [illegible] science solutions
for stewardship of the nation's ocean and coastal resources
in direct support of NOS priorities, offices and customers
to sustain thriving coastal communities and economies



ICCOPR 12/14/16

Research Team

Michael Fulton

Marie DeLorenzo, Peter Key, Ed Wirth,

Paul Pennington, Katy Chung, Jan Moore,

Emily Pisarski, Brian Shaddrix, Joe Wade,

West, James Daugomah, Cynthia Cooksey, JD Dubick

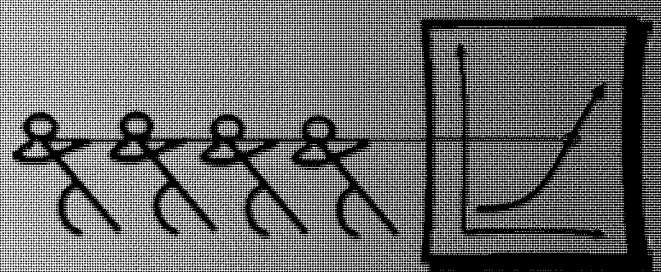
Students

NOAA Hollings Students: Charlotte Eckmann, Pamela Betancourt, Elaina Graham, Jeffrey Good

NSF REU Students: Alfre Wimberley, McCall Calvert

College of Charleston Students: Sarah Baxter, Michelle Franco, Hannah Rutter, Millie Thomas, Janessy Frometa, Casey Hughes

University of South Carolina: Jamileh Soueidan, Laura Thompson



Significance of Study

- According to the EPA, approximately 20,000 oil spills are reported per year in the U.S.
- NOAA goal of understanding ecosystem responses to stress in order to inform response and restoration decisions
- NOS Office of Response and Restoration, EPA, U.S. Coast Guard

Oil Mitigation Strategies

Methods

- Booming
- Skimming
- In-situ Burning
- Manual Removal/Cleaning
- Vegetation Cutting/Removal

Chemical Methods

§ Dispersants

§ Shoreline Cleaning Agents

§ Emulsifiers/Solidifiers

§ Bioremediation Products

Oil Spill Dispersants

- Applied to surface slicks, also injected at depth during DWH
- Blend of surfactants (interact with oil) and solvents (dissolve in water)
- Promote mixing in water column
- Increase the surface area exposed to microbial activity

Corexit 9500

- Dispersant used in the Deepwater Horizon oil spill
- Approximately 7 million liters applied over 84 days
- Applied at surface and at depth

Finasol OSR 52

- On the EPA approved list of dispersants
- Currently being stockpiled for future oil spills
- Fewer toxicity data available

Shoreline Cleaners / Surface Washing Agents

* Chemical cleaning agents designed to promote rapid release of stranded oil from a shoreline or substrate surface, including mangroves, salt marsh vegetation, sediments, and hard substrates such as seawalls
* Three products selected for study:
  * [illegible] (surfactants with non-enzymatic proteins)
  * [illegible] (d-Limonene based)
  * [illegible] (biosolvent from vegetable oil)

Research Need

- Dispersants and shoreline cleaners can be valuable tools to mitigate oil spills, but they may have potential toxic effects on coastal species
- Environmental effects testing of these products has been limited
- Aquatic toxicity will depend on product constituents, type of oil, field conditions, and application proficiency
- Decisions as to where and when individual products will be utilized depend on understanding the efficacy, environmental fate, and environmental effects of these compounds

Arrows Cable www.counterspill.org

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Objectives of Study

1) Compare toxicity of two oil spill dispersants; Corexit and Finasol
2) Compare toxicity of Corexit and Finasol dispersed oil treatments
3) Compare toxicity of three shoreline cleaner products; Accell Clean SWA, PES-51, and Cytosol
4) Compare toxicity of shoreline cleaner products combined with oil

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* Compare sensitivity among species and life stages
* Determine median lethal (LC50) toxicity values
* Use laboratory and salt marsh mesocosm exposures
* Measure sublethal endpoints
* Compare amount of petroleum hydrocarbons dissolved into water

METHODS

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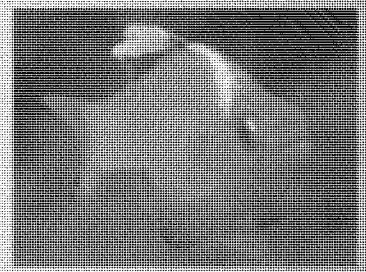
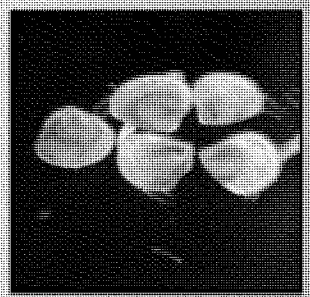
Estuarine Test Species

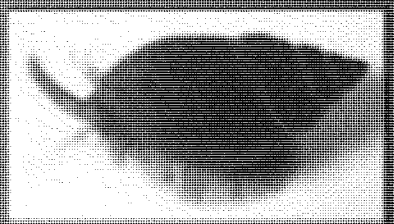


Sheepshead Minnow
Cyprinodon variegatus

Grass Shrimp
Palaemonetes pugio

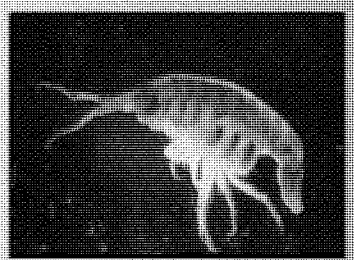


Hard Clam
Mercenaria mercenaria

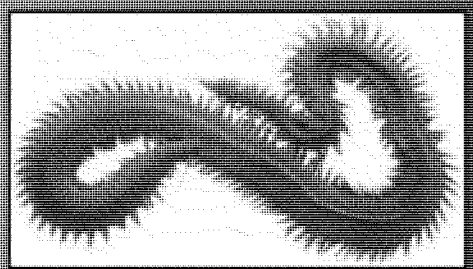


Mud snail
Ilyanassa obsoleta

Mysid
Americamysis bahia



Amphipod
Leptocheirus plumulosus



Polychaete
Neanthes sp.

Laboratory Testing

- Products Alone
- "CEWAFs"

- Non-static renewal
- Nominal concentrations plus seawater control
- 16 h light: 8 h dark, 25°C, 20‰

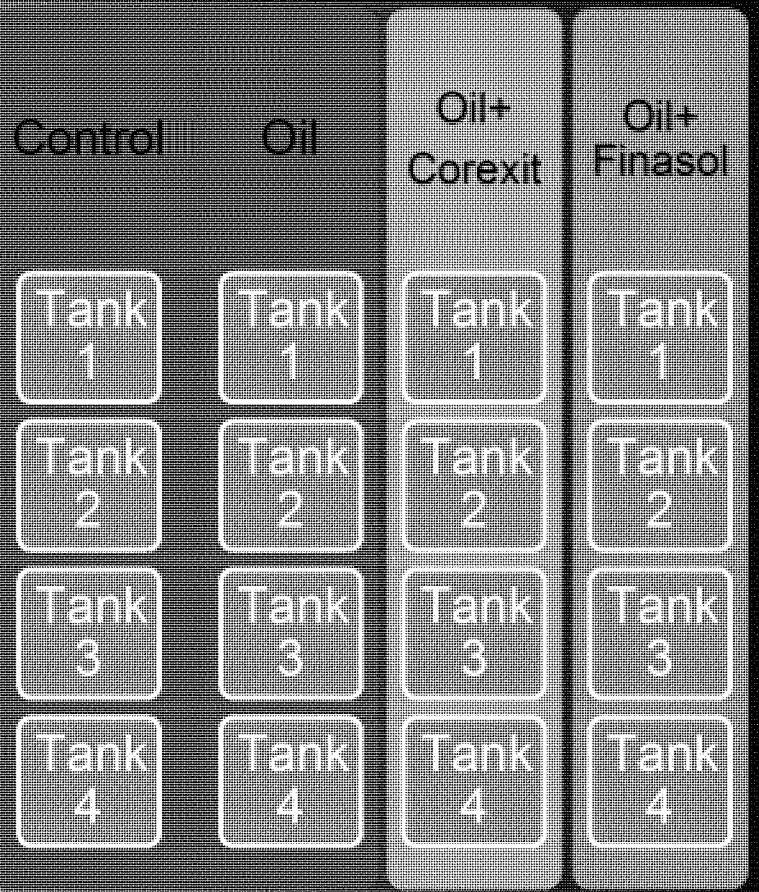
- 20 ‰ seawater added, stirring min. vortex; 25 g/L unweathered LSC oil added; 1:20 dispersant:oil; 1:10 SWA:oil added
- Stir (25% vortex) for 18 h; let sit for 6 h
- Open bottom outlet, dispense into collection container, without disturbing slick layer

Mesocosm Testing

- Simulated salt marsh mesocosm testing of oil and oil and mitigation product mixtures
- Replicate tanks of estuarine sediments, marsh grass, estuarine fauna (fish, shellfish, benthic species)
- Brackish salinity (20 ‰) with semi-diurnal tidal flux and natural temperature / light conditions

Dispersant Mesocosm Design

- Treatments: weathered LSC oil, Corexit dispersed oil, Finasol dispersed oil, control
- Dosing conducted as oil slick scenario, where oil and/or dispersed oil is introduced at the water surface
- Repeated dosing (3x) to simulate a saltmarsh being re-oiled over a period of time due to incoming tides
- Biological and chemical endpoints similar to the laboratory bioassays; additional post-exposure assessments
- Impacts to salt marsh vegetation (growth and survival) and sediment biomass also assessed
- 15 d exposure



Pipeline Cleaner Mesocosm Design

- Oil applications (0, 12, 24 h); 74 mL each; total 222 mL each sump
- Tiles per sump, one removed to measure oil pre-cleaner application
- 48 h after oiling, cleaners applied directly to the substrates using a hand sprayer
- 8 sprays per tile side, total 192 mL each sump
- 30 min cleaner soak time, followed by seawater rinse (1L per tile side, total of 8L each sump
- Control and oil-only treatments received an equivalent application of water only
- 30 d exposure

Control	Oil	Oil+ PES-51	Oil+ Cytosol	Oil+ Accel Clean
Tank 1	Tank 1	Tank 1	Tank 1	Tank 1
Tank 2	Tank 2	Tank 2	Tank 2	Tank 2
Tank 3	Tank 3	Tank 3	Tank 3	Tank 3
Tank 4	Tank 4	Tank 4	Tank 4	Tank 4

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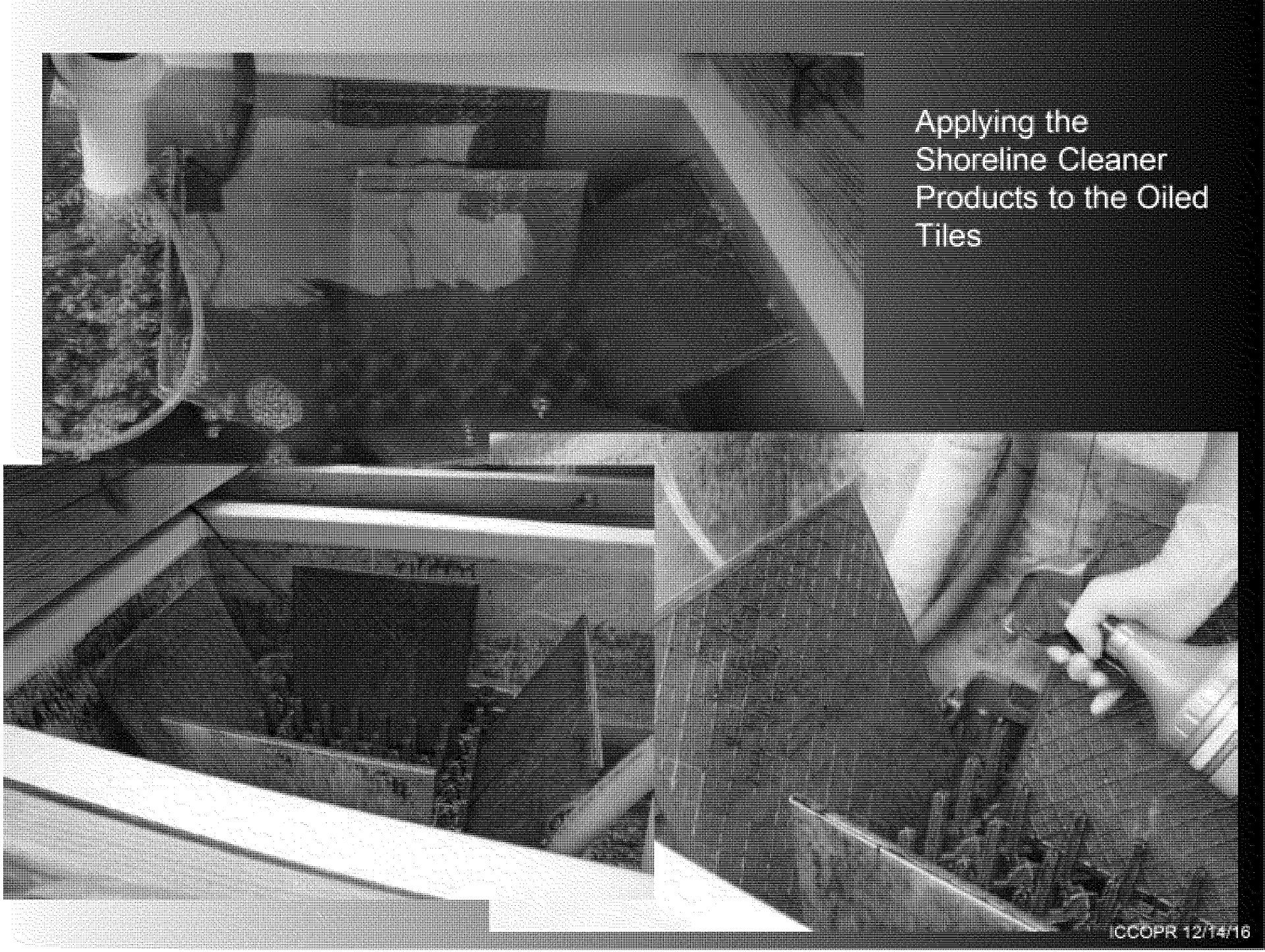
Applying the Shoreline Cleaner Products to the Oiled Tiles
ICCOPR 12/14/16

RESULTS

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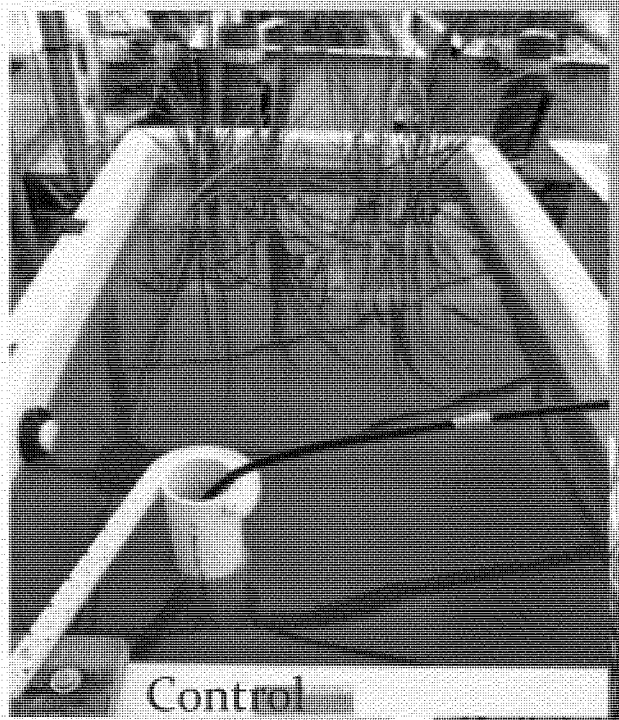
Summary: Dispersants Alone

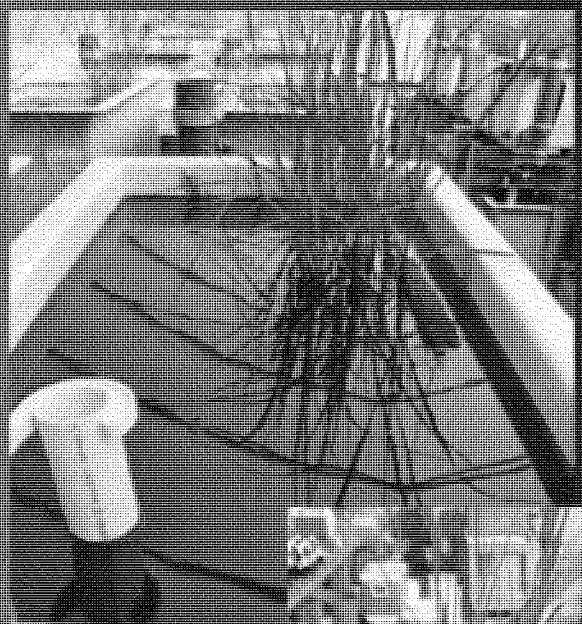
* LC50 values for Corexit with the estuarine species ranged from 9.85 mg/L to 702.41 mg/L; practically nontoxic to slightly toxic (EPA 5-step toxicity scale)
* LC50 values for Finasol ranged from 3.81 mg/L to 105.26 mg/L; slightly toxic to moderately toxic (EPA 5-step toxicity scale)
* Acute toxicity of Finasol was generally 3-5 times greater than that of Corexit for the estuarine species tested
* Larval and juvenile life stages were the most sensitive for both dispersants; decreased embryo hatching success
* Increased lipid peroxidation activity in shrimp, indicates cellular membrane damage

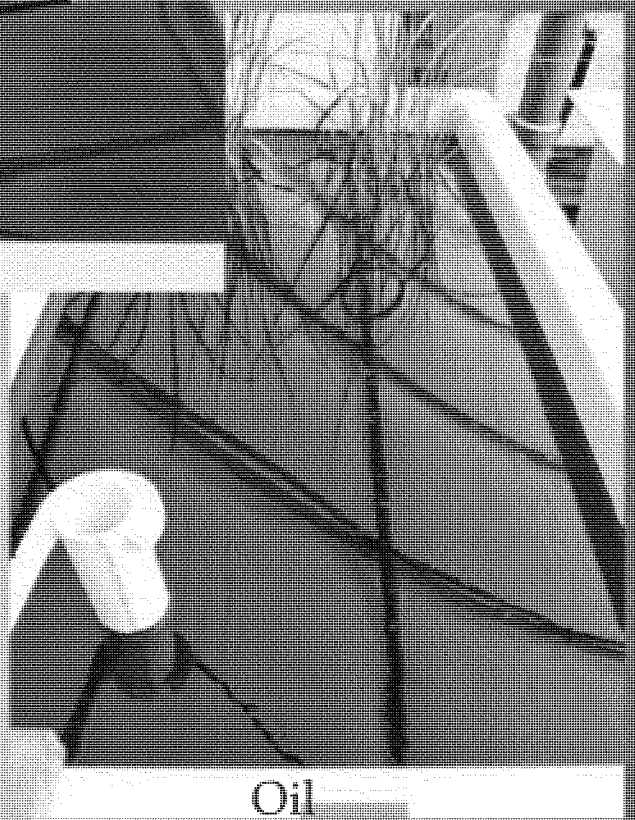
Summary: Dispersant CEWAFs

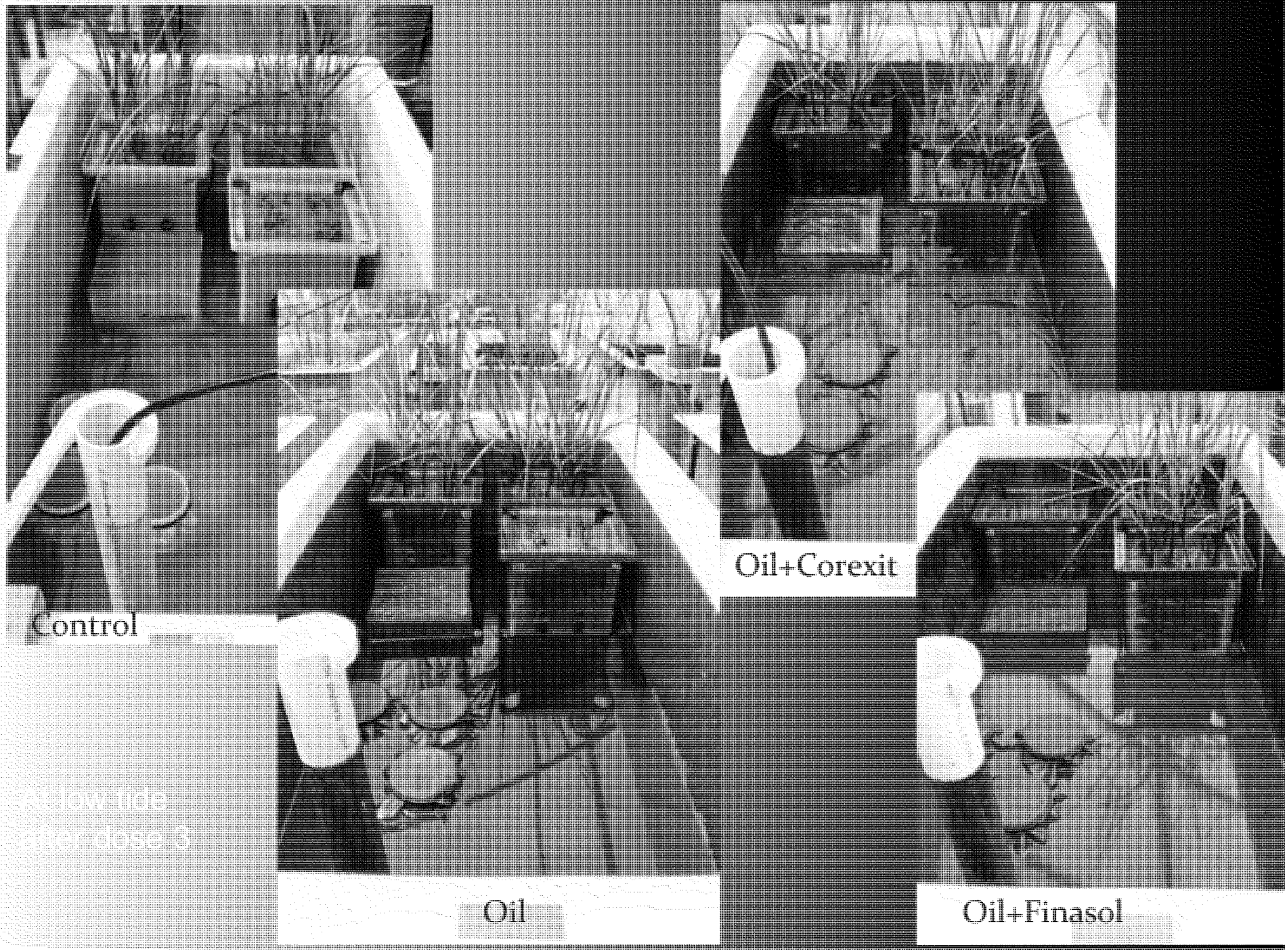
* Opposite trend in toxicity compared with dispersants alone
  * Dispersants alone, Finasol was more toxic
  * In CEWAFs, Corexit-CEWAF was more toxic
* Likely due to different amount of oil each dispersant delivers into water
  * detected TEH concentrations were 620 mg/L and 54 mg/L in the Corexit and Finasol 100% CEWAFs, respectively
  * greater bioavailable fraction of oil present in Corexit-CEWAF than Finasol-CEWAF
* Decreased embryo hatching
* Increased p450 enzyme activity in fish, indicates hydrocarbon metabolism
* Decreased lipid peroxidation activity in fish and snails, indicates cellular membrane damage

Dispersant on Mesocosm Results





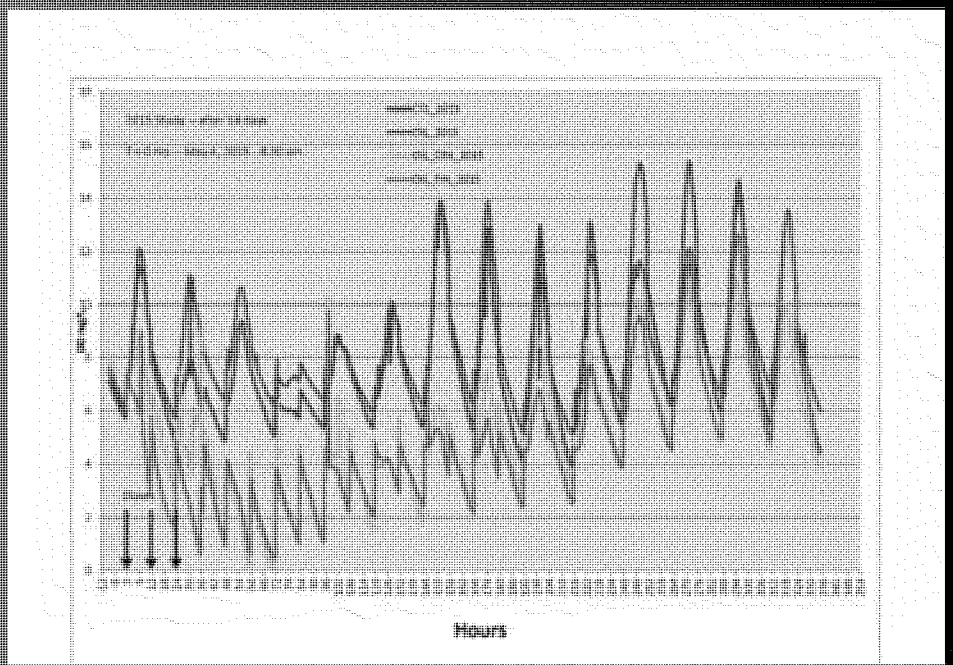




Low tide
Exposure 3

Corexit Mesocosm Results

- Significant decrease in Spartina growth in oil and both dispersed oil treatments
- Spartina in oil and both dispersed oil treatments had almost no regrowth in cut sediment trays



Chemically dispersed oil treatments had hypoxia

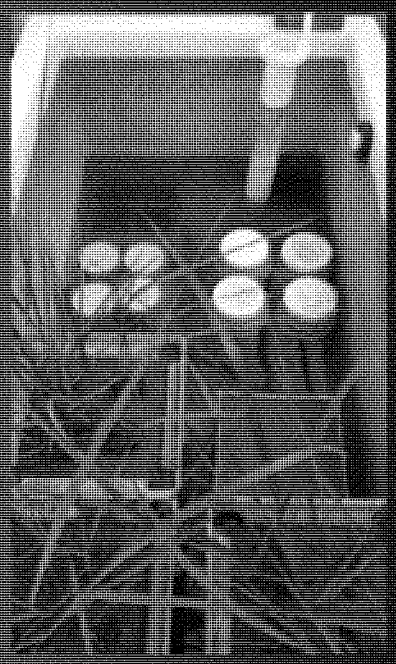
Dispersants Mesocosm Results, cont.

* Greater animal mortality in dispersed oil treatments than in oil alone treatment
* Shrimp and clams most sensitive to oil alone, fish least
* Decreased juvenile clam growth
* Changes to sediment community composition
* Significant induction of fish p450 enzyme activity in oil treatment

Water hydrocarbon concentrations higher in dispersed oil treatments than oil alone treatment

Partitioning of hydrocarbons into sediment

Both water and sediment concentrations decreased rapidly



Shoreline Cleaner Products Alone Results Grass Shrimp

- Cytosol not toxic at concentrations up to 10,000 ppm, appeared to exceed solubility in seawater
- 96h LC50 values determined for adult grass shrimp similar to those determined for mysids (54 and 59 ppm for Accell and PES-51, respectively)
- Larvae more sensitive life-stage

ppm	Cytosol	Accell	PES 51
Adult	>10,000	44.18	38.75
Larvae	>10,000	75.26	114.66

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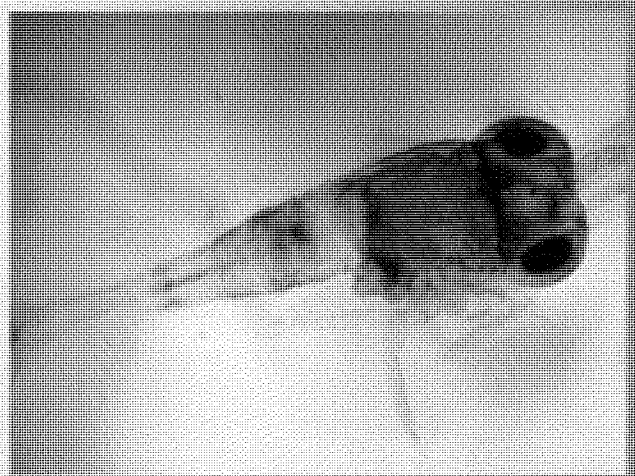
Shoreline Cleaner Products CEWAF Results Grass Shrimp

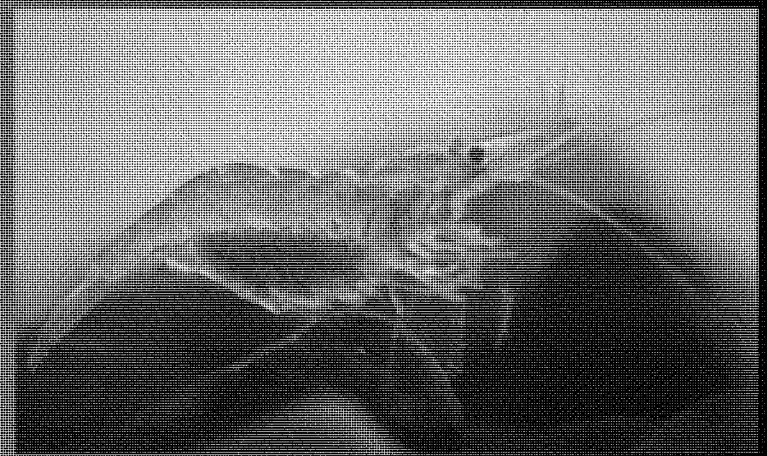
- Shrimp mortality greater with Accell Clean than with PES-51
- Most likely due to greater solubility of hydrocarbons in the Accell preparation

% CEWAF	Accell-Oil	PES 51-Oil
Adult	20.25%	>100%
Larvae	11.96%	>100%

al Shrimp Development Study

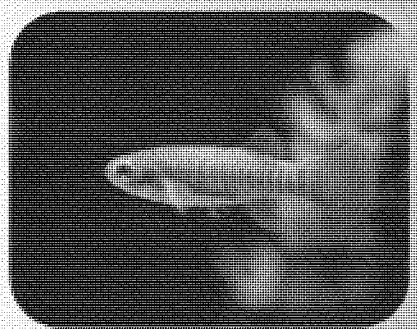
- In progress
- Larval shrimp moved to clean seawater after shoreline cleaner exposure
  - Number of molts
  - Time to post-larval stage
  - Growth (by weight)
  - Ecdysteroid (molting hormone)

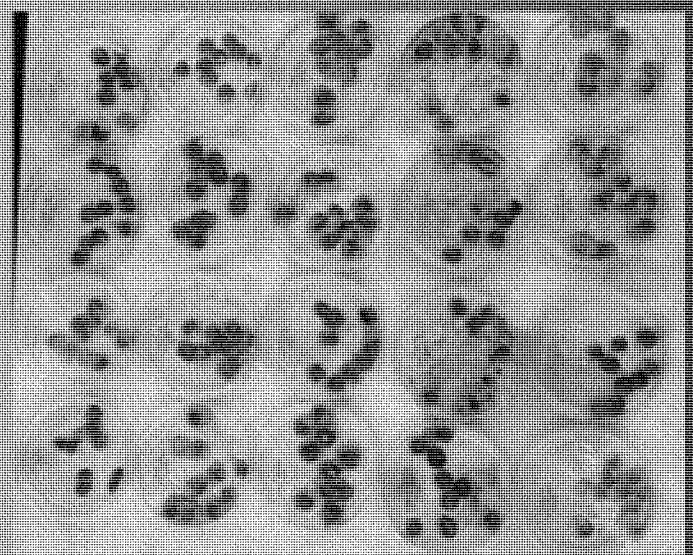




Marine Cleaner Mesocosm Results

- Oil+Accell treatment had greatest mortality of fish, snails, polychaetes and amphipods
- Oil+Accell treatment had decreased clam growth
- Oil+Accell treatment had highest bacterial densities

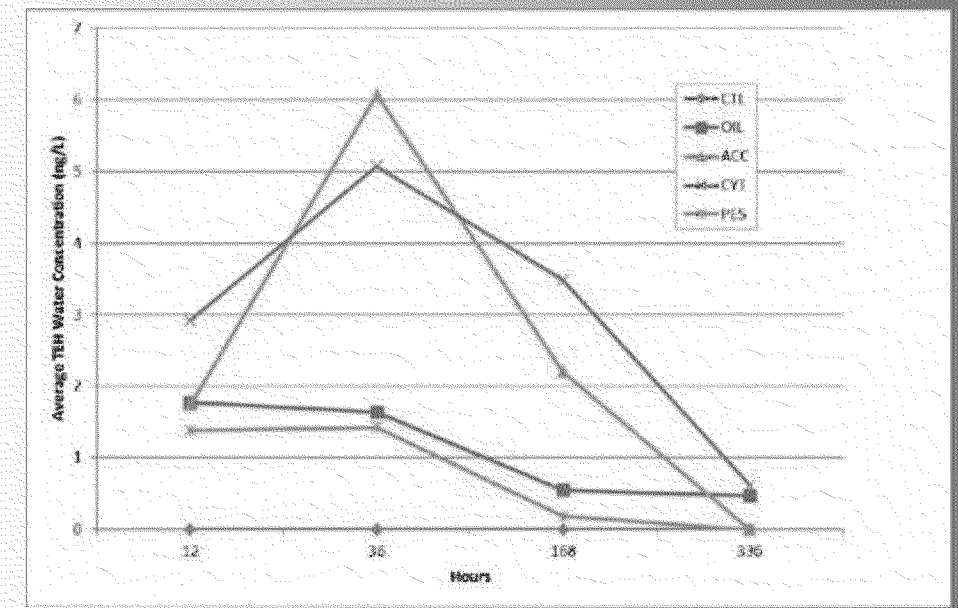


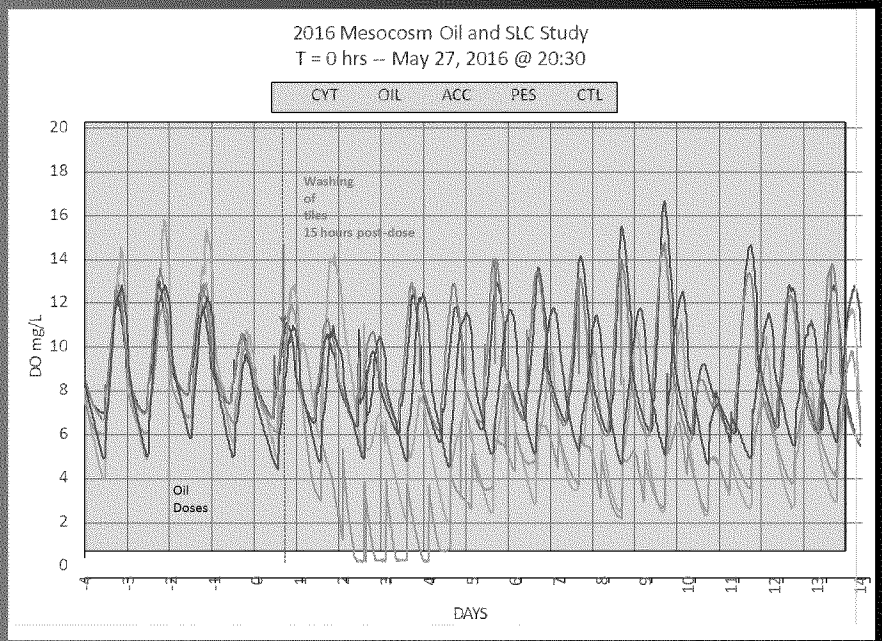


Shoreline Cleaner Mesocosm Results, cont.

Oil+Accell treatment had highest concentrations of water column TEH and total PAHs

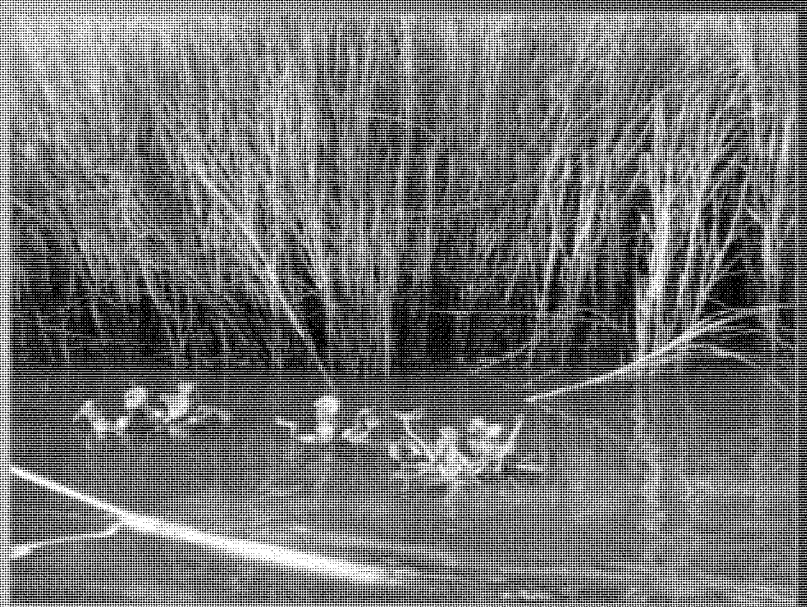
§ Oil+Accell treatment had hypoxia 24-96 hours post substrate washing





Bioline Cleaner Research Progress…

- Product efficacy testing in the laboratory
- Microbial community assessment – molecular analysis
- Chemical analysis – SWA laboratory tests
- Laboratory shrimp cellular markers and larval development assays



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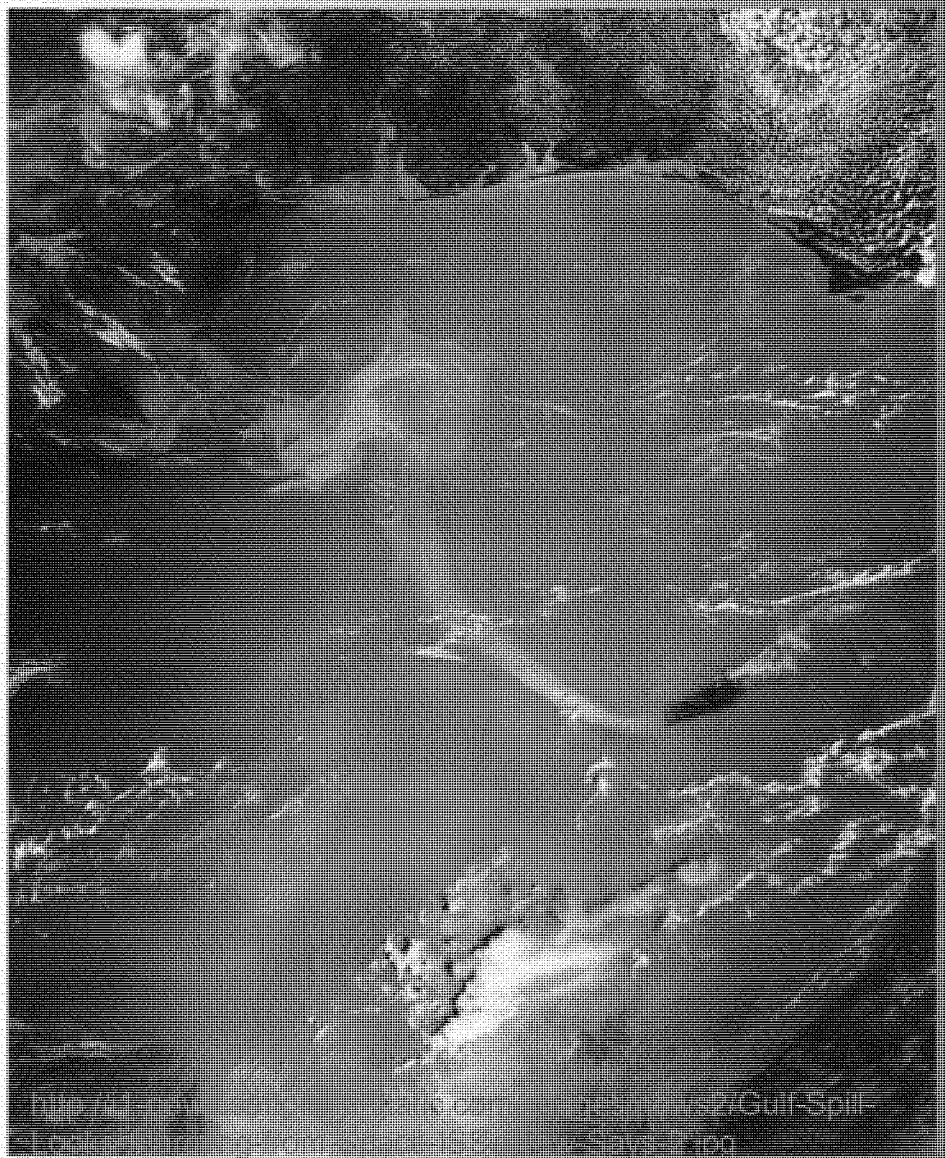
Conclusions

- Mitigation product toxicity is compound and species specific
- different products elicit different chemical interactions with oil that will affect bioavailability and toxicity of oil compounds to aquatic species
- Shellfish early life stages most sensitive to dispersants
- Oil and dispersed oil impacted marsh plant growth
- Increased bacterial growth and decreased dissolved oxygen observed with products that increase hydrocarbon content in water column
- New toxicity thresholds for estuarine species adds to available data for oil spill mitigation products

ure of Oil Spill Response



- Each oil spill scenario is unique, so having a battery of remediation strategies available with scientific data to support safe and beneficial use is essential
- Additional research needs: UV light-oil sheen interactions, bioremediation products
- Information on toxicity to sensitive estuarine species will allow managers to make informed decisions regarding the use of oil remediation chemicals

Thank you. Any Questions?

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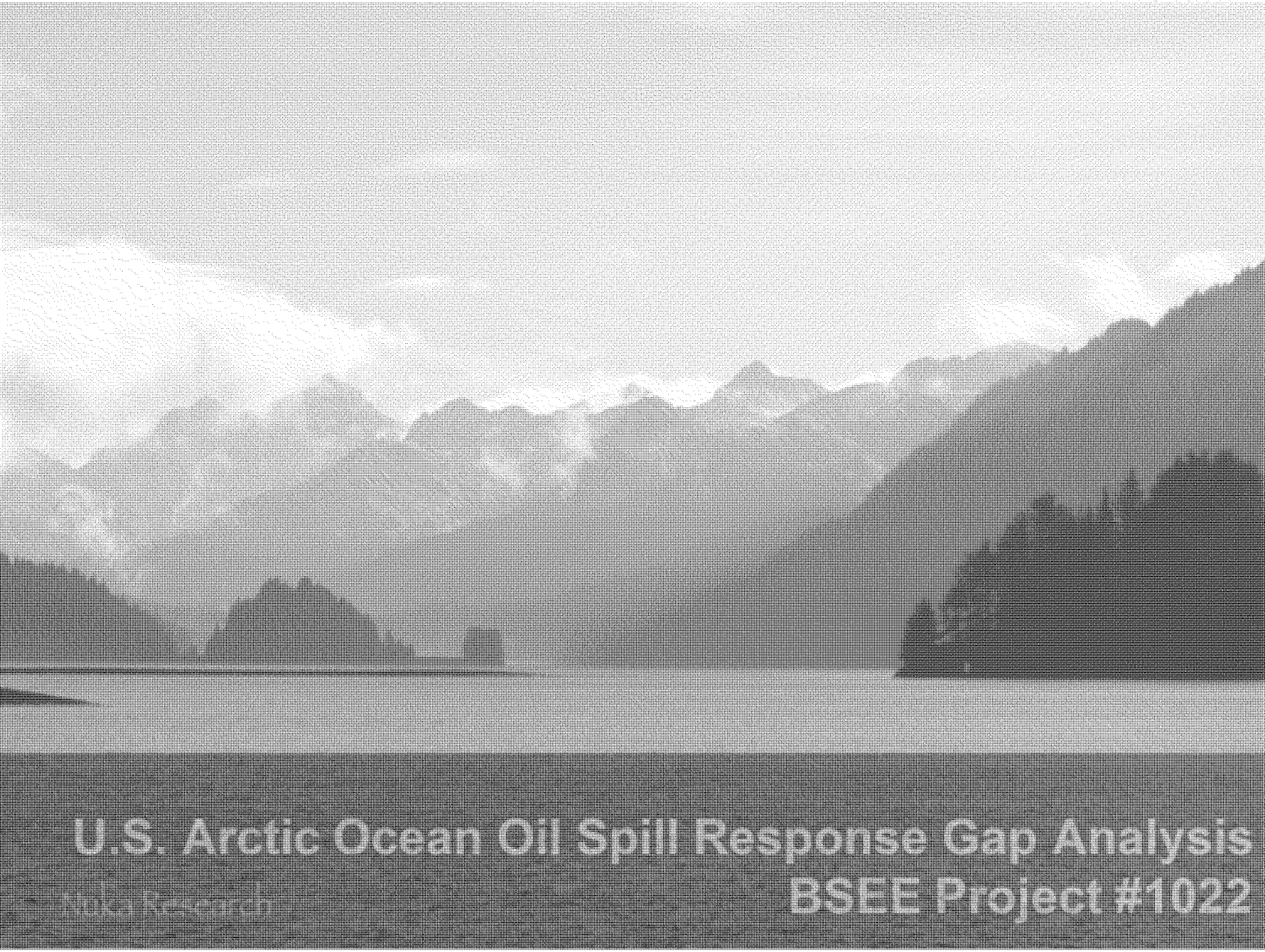


U.S. Arctic Ocean Oil Spill Response Gap Analysis

BSEE Project #1022

Response gap/viability

* How often could you expect environmental conditions to preclude response to an oil spill in a given location? **(gap)**

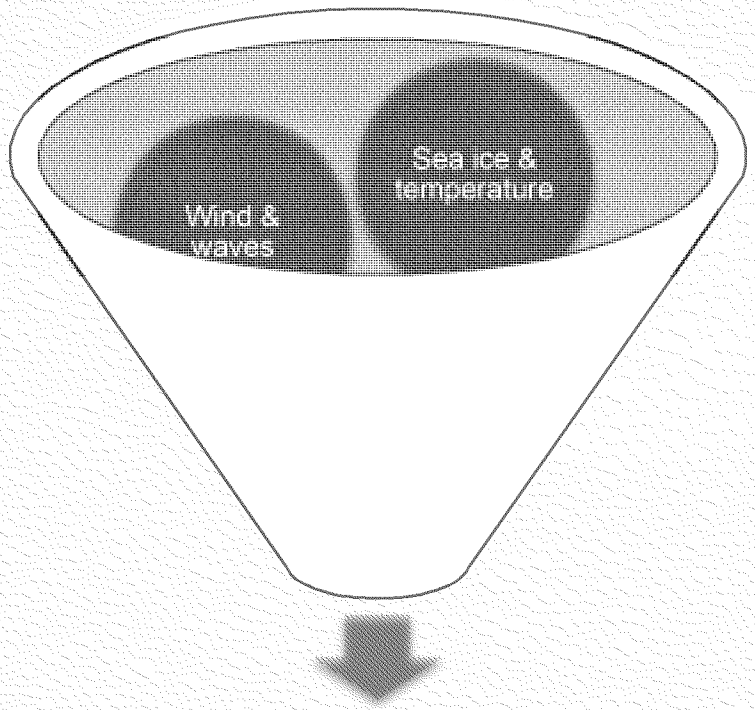
* How often could you expect to respond to an oil spill based on environmental conditions? **(viability)**

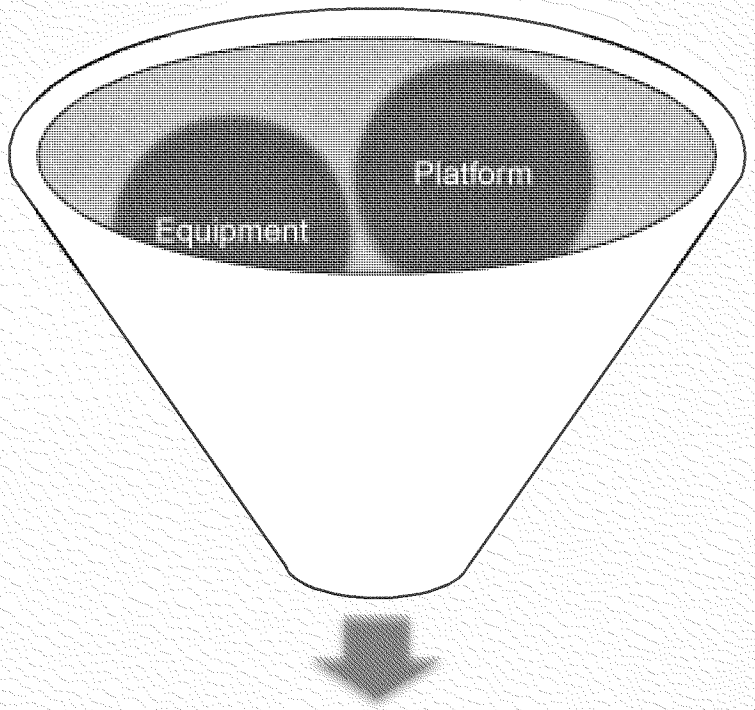
Why?

* Test planning assumptions
* Consider tactic selection
* Explore seasonal variations
* Identify best “bang for the buck” improvements

Why not?

* Predict likelihood of an oil spill
* Predict outcome of a response
* Consider consequences of a spill to the environment or people
* Predict the *effectiveness* of a response
* Assess oil type
* Assess logistics needs or equipment availability



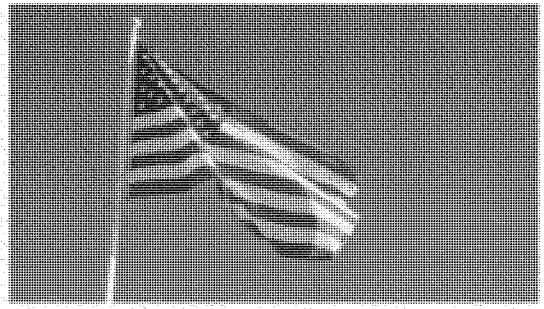


Historical Env'l Conditions

Response Limits

IF…	THEN THE HOUR IS…
…*any* single environmental factor is ruled RED	RED (not favorable)
…*all* environmental factors are ruled GREEN	GREEN (favorable)
…at least one factor is YELLOW and all others are GREEN or YELLOW (or, all other options)	YELLOW (marginal)

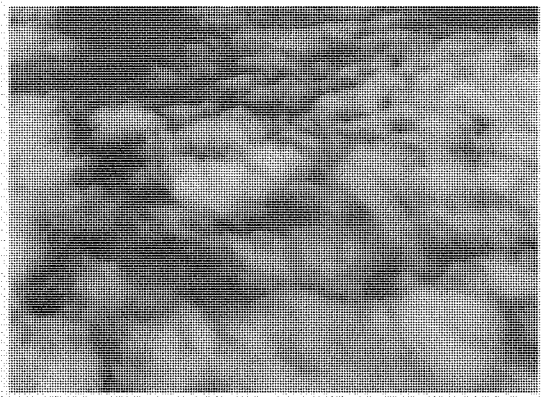
Env'l Conditions



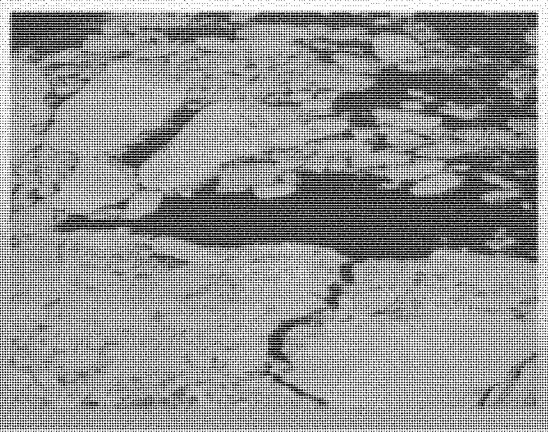
WIND SPEED

WIND CHILL

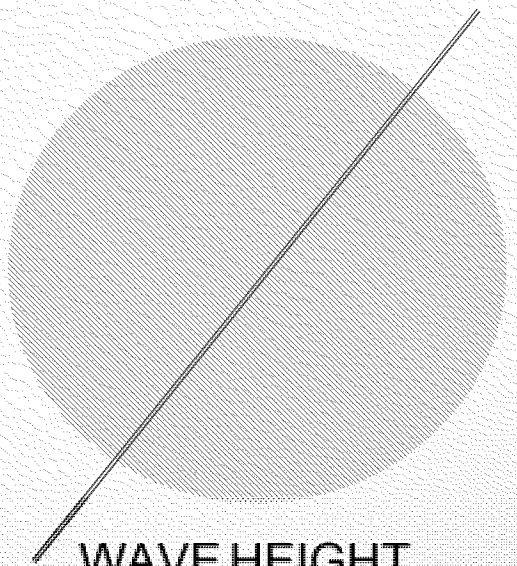
VESSEL ICING



VISIBILITY
- Horizontal visibility
- Cloud ceiling
- Daylight/darkness

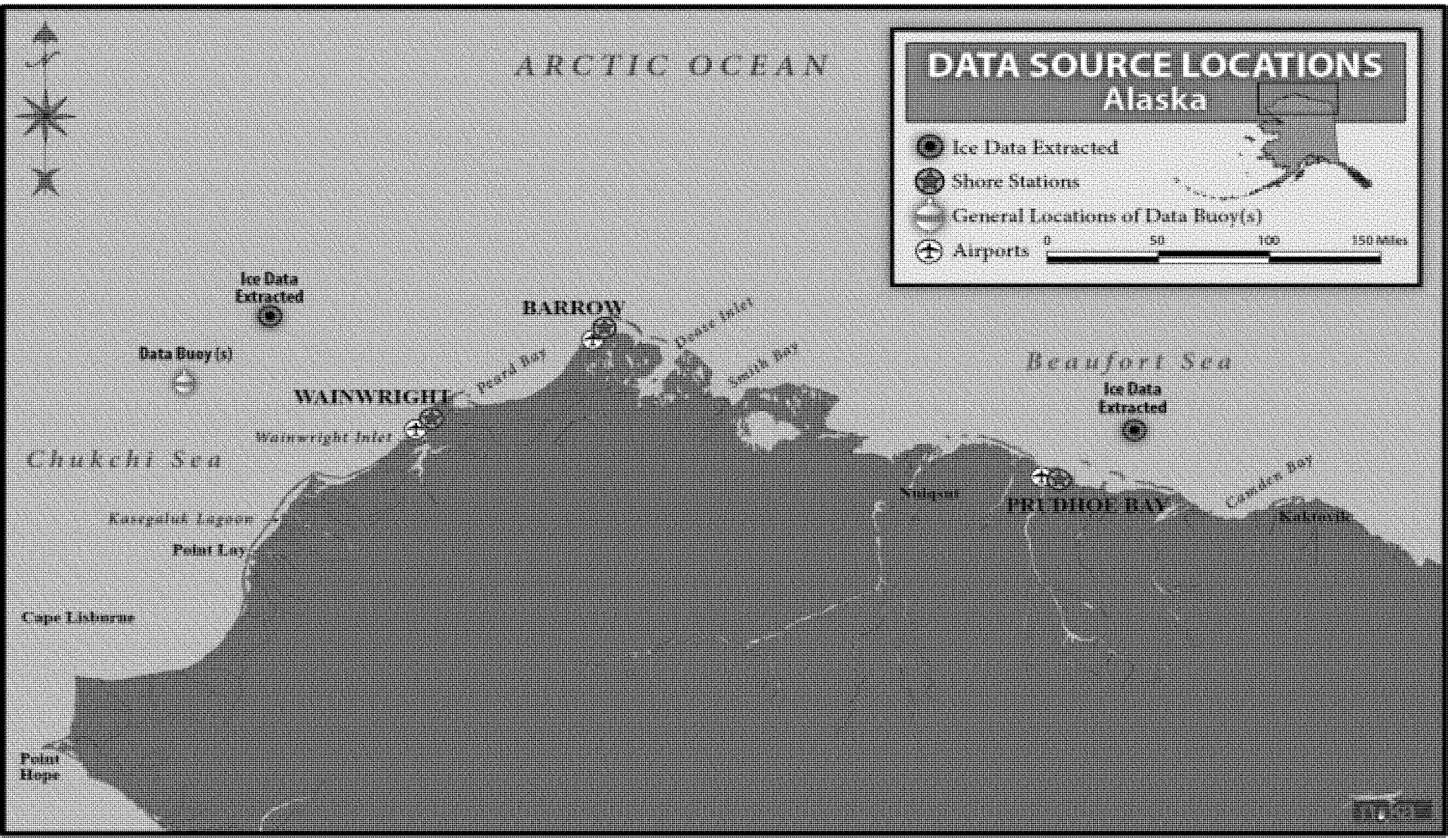


SEA ICE COVERAGE



WAVE HEIGHT
WAVE STEEPNESS

Data Sources

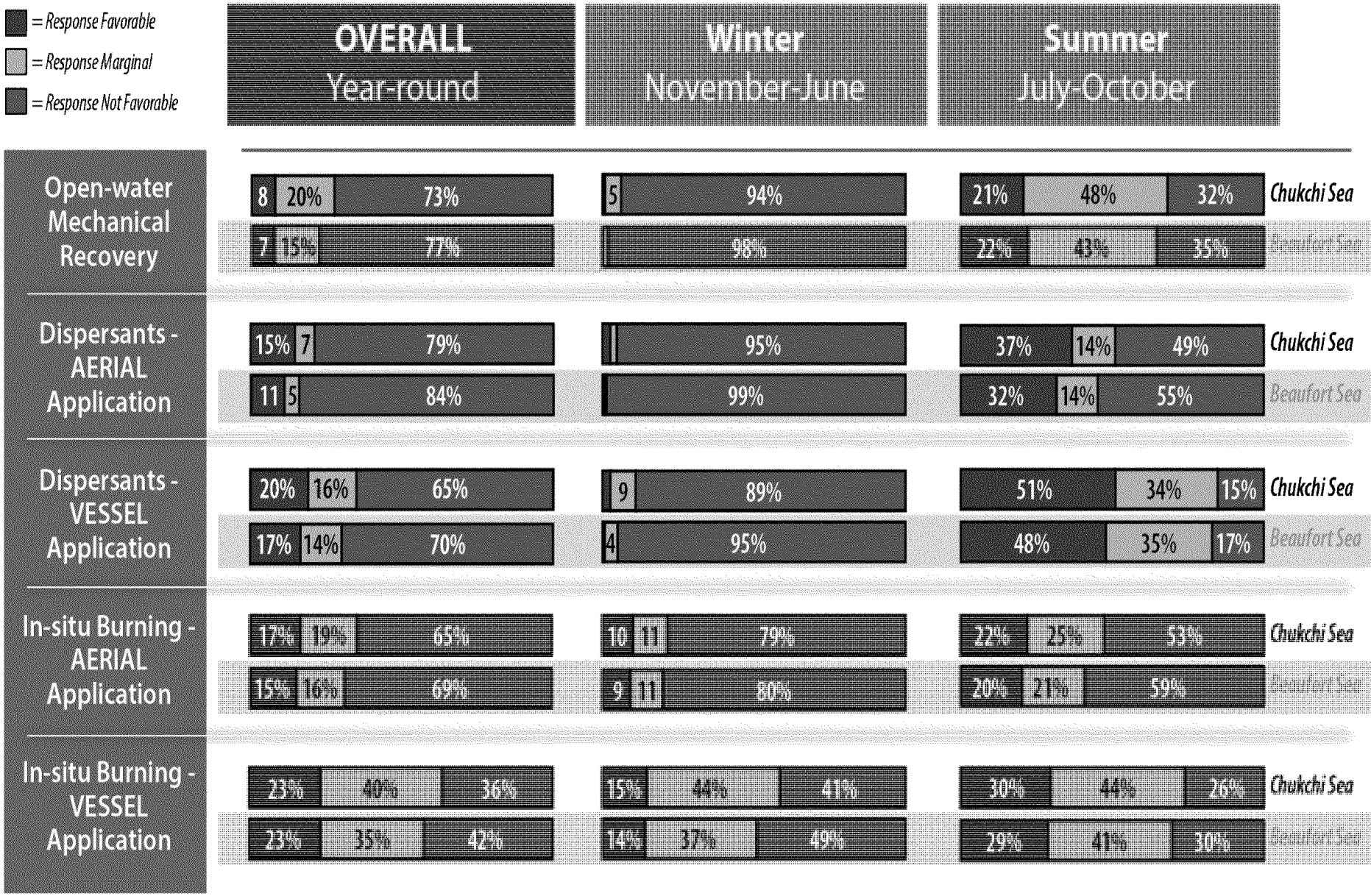


Response Systems

* Mechanical recovery
* Dispersants – aerial application
* Dispersants – vessel application
* ISB – aerial ignition
* ISB – vessel ignition

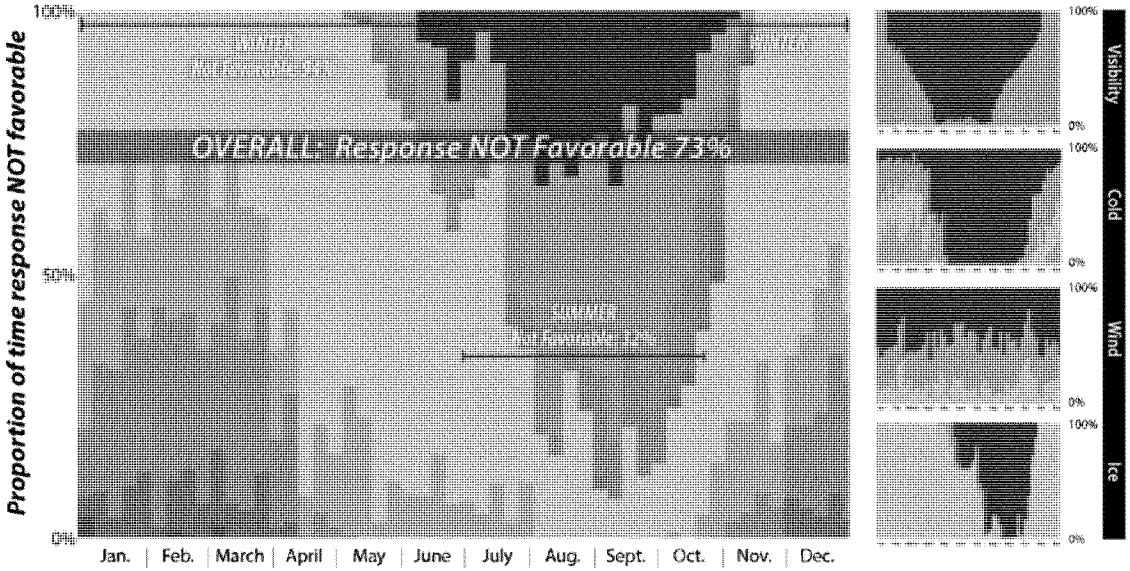
System Limits

* Previous studies
* Review:
  - Alaska response tactics manuals
  - Arctic Council's EPPR Field Guide
  - Operator response plans for area
  - Literature
* Input from BSEE, ADEC, USCG

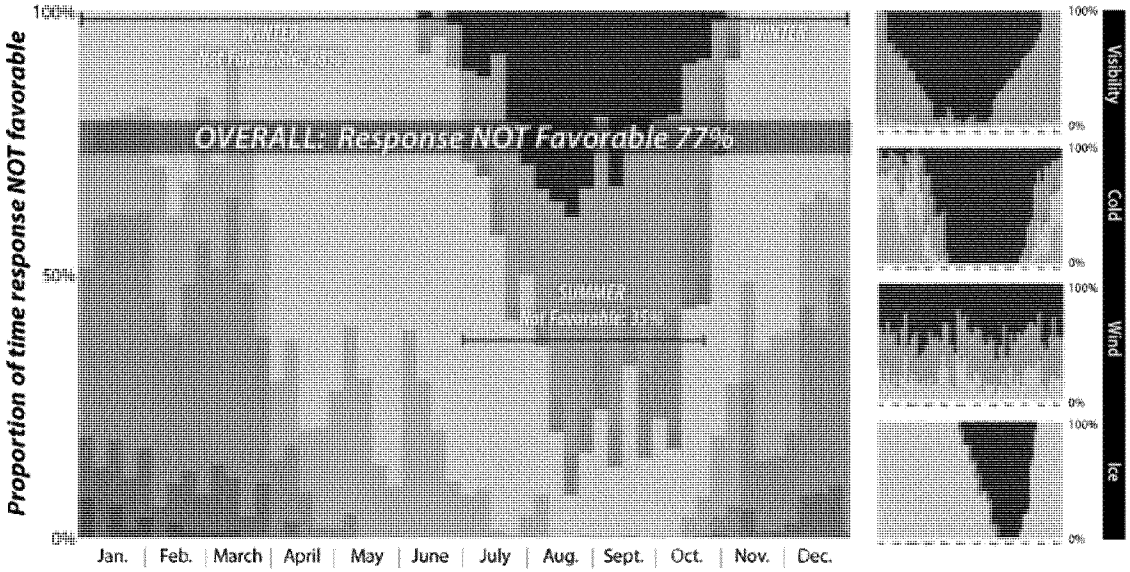

= Response Favorable
= Response Marginal
= Response Not Favorable
OVERALL
Year-round
Winter
November-June
Summer
July-October
Open-water Mechanical Recovery
8 20% 73%
5 94%
21% 48% 32%
Chukchi Sea
7 15% 77%
98%
22% 43% 35%
Beaufort Sea
Dispersants - AERIAL Application
15% 7 79%
95%
37% 14% 49%
Chukchi Sea
11 5 84%
99%
32% 14% 55%
Beaufort Sea
Dispersants - VESSEL Application
20% 16% 65%
9 89%
51% 34% 15%
Chukchi Sea
17% 14% 70%
4 95%
48% 35% 17%
Beaufort Sea
In-situ Burning - AERIAL Application
17% 19% 65%
10 11 79%
22% 25% 53%
Chukchi Sea
15% 16% 69%
9 11 80%
20% 21% 59%
Beaufort Sea
In-situ Burning - VESSEL Application
23% 40% 36%
15% 44% 41%
30% 44% 26%
Chukchi Sea
23% 35% 42%
14% 37% 49%
29% 41% 30%
Beaufort Sea

Open-water Mechanical Recovery

Chukchi Sea Location



Beaufort Sea Location



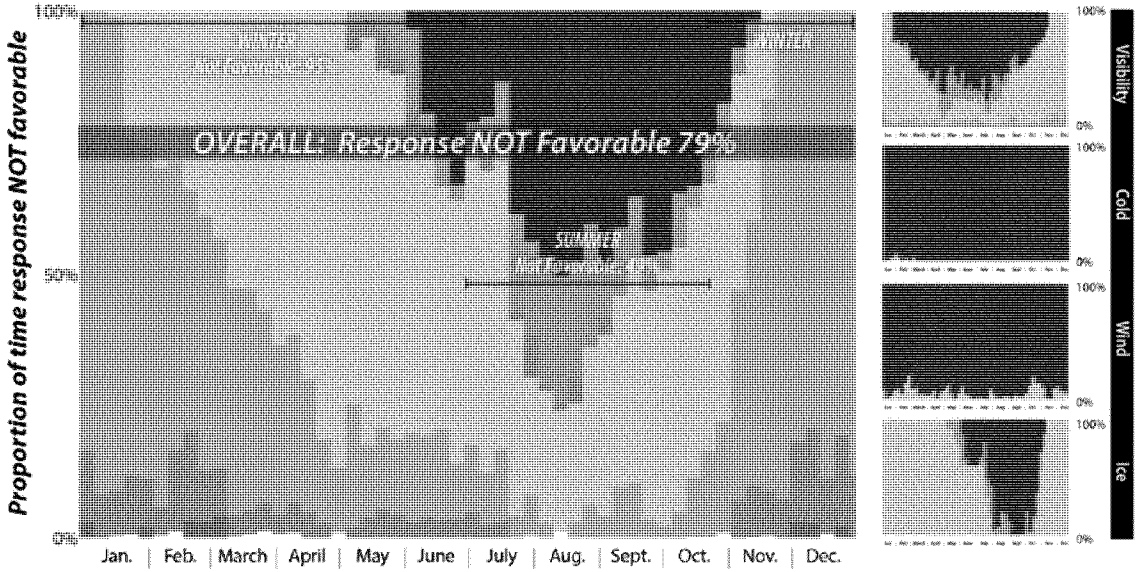
FAVORABLE — all conditions green

MARGINAL — one yellow condition, others green → all yellow conditions

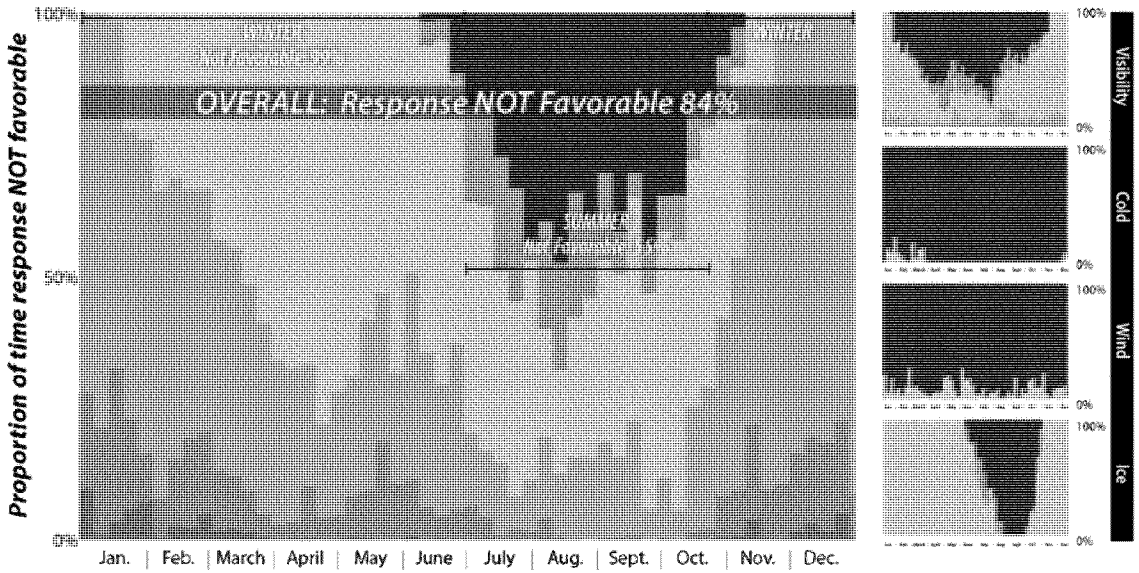
NOT FAVORABLE — one red condition → all red conditions

Dispersants - AERIAL Application

Chukchi Sea Location



Beaufort Sea Location



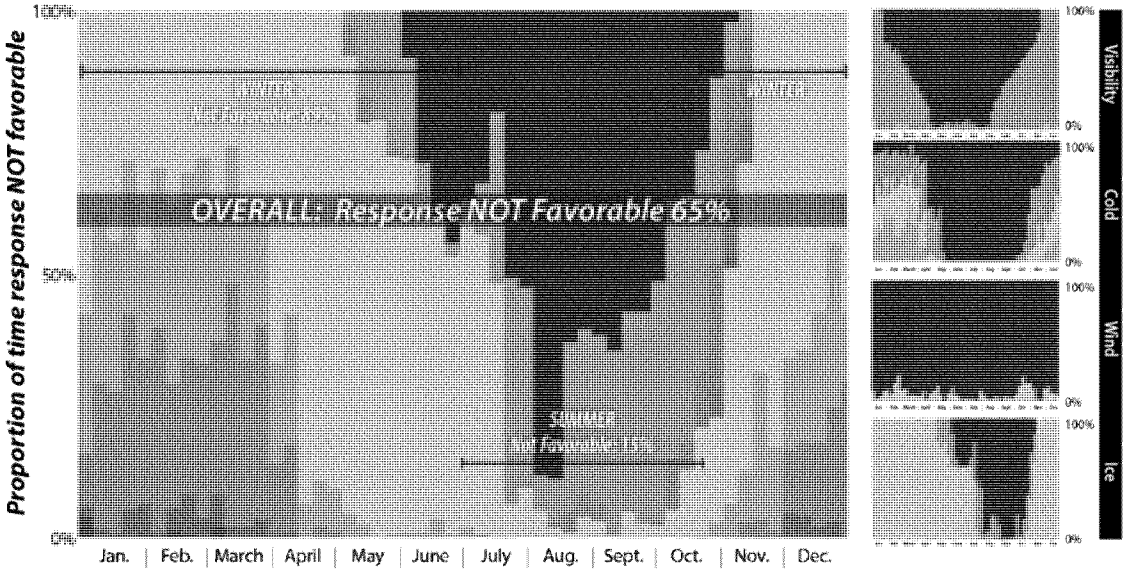
FAVORABLE
all conditions green

MARGINAL
one yellow condition, others green → all yellow conditions

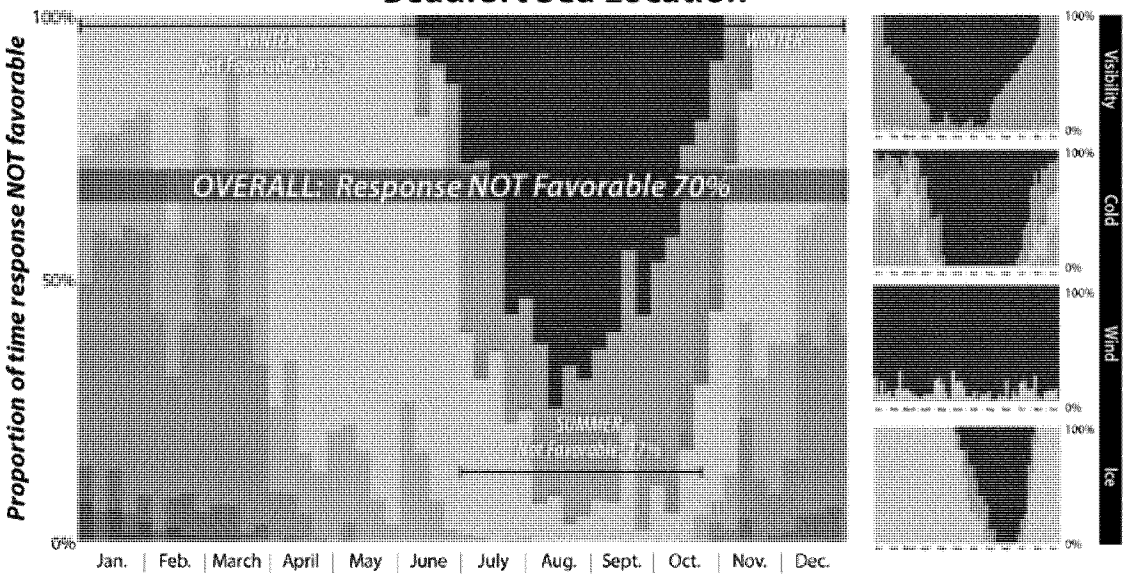
NOT FAVORABLE
one red condition → all red conditions

Dispersants - VESSEL Application

Chukchi Sea Location



Beaufort Sea Location



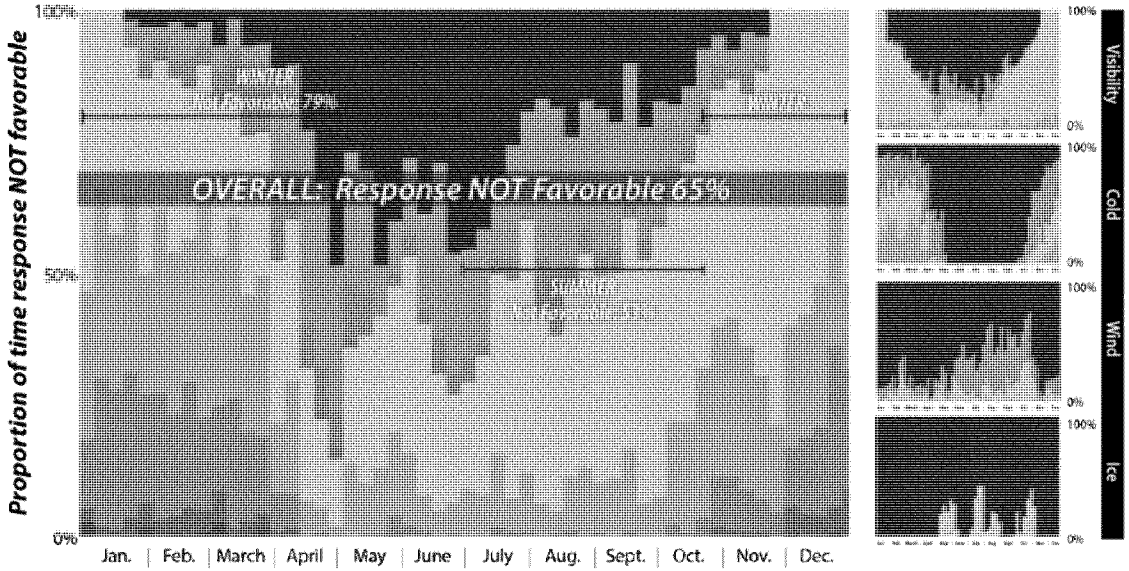
FAVORABLE
all conditions green

MARGINAL
one yellow condition, others green → all yellow conditions

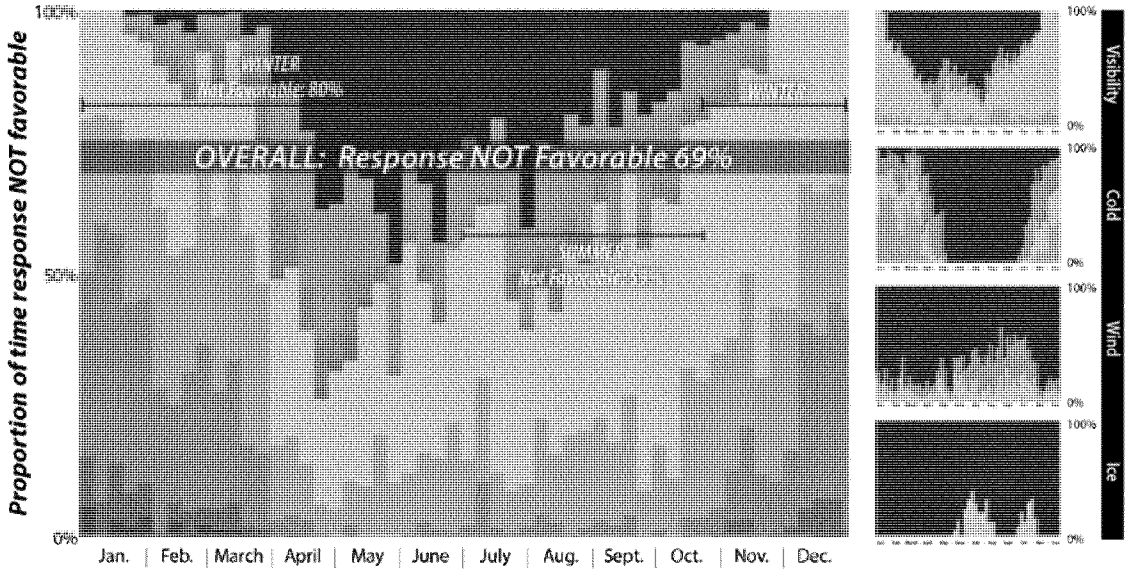
NOT FAVORABLE
one red condition → all red conditions

In-situ Burning - AERIAL Application

Chukchi Sea Location



Beaufort Sea Location



FAVORABLE
all conditions green

MARGINAL
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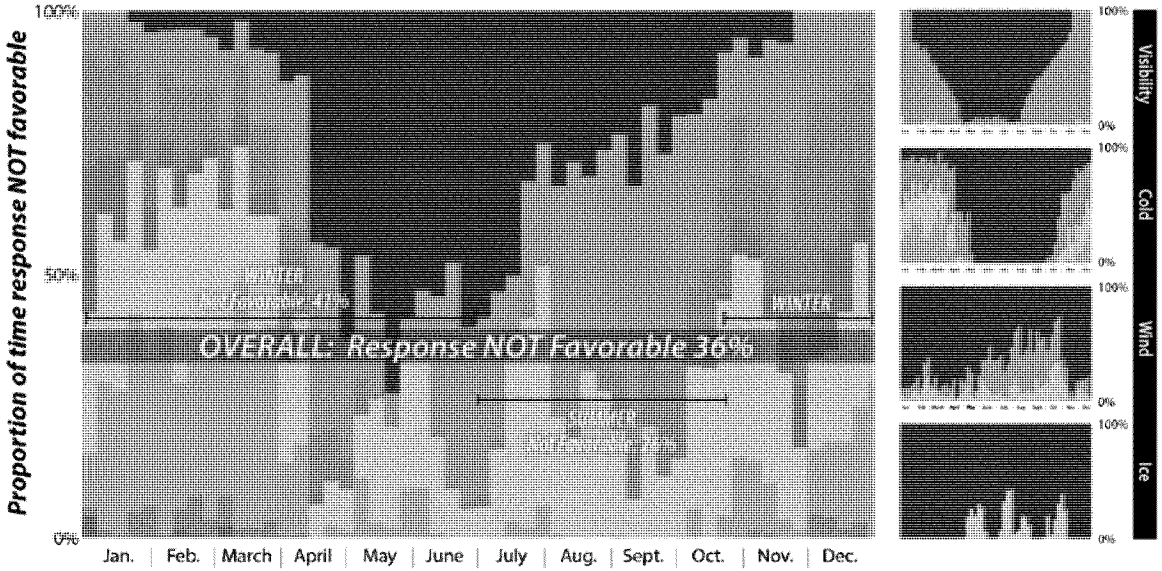
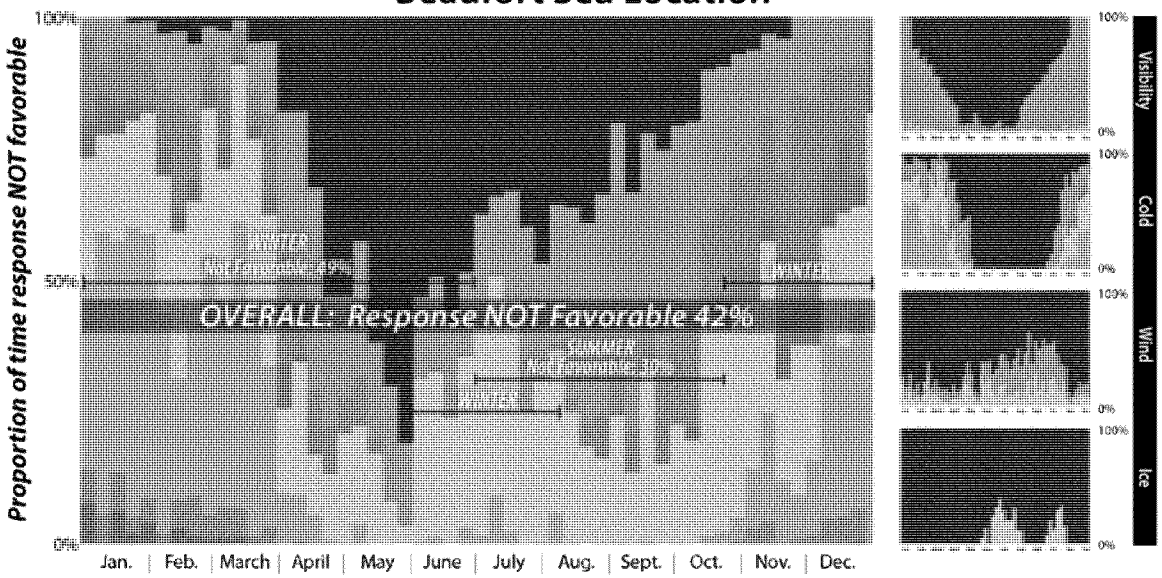
NOT FAVORABLE
one red condition → all red conditions

In-situ Burning - VESSEL Application

Chukchi Sea Location



Beaufort Sea Location

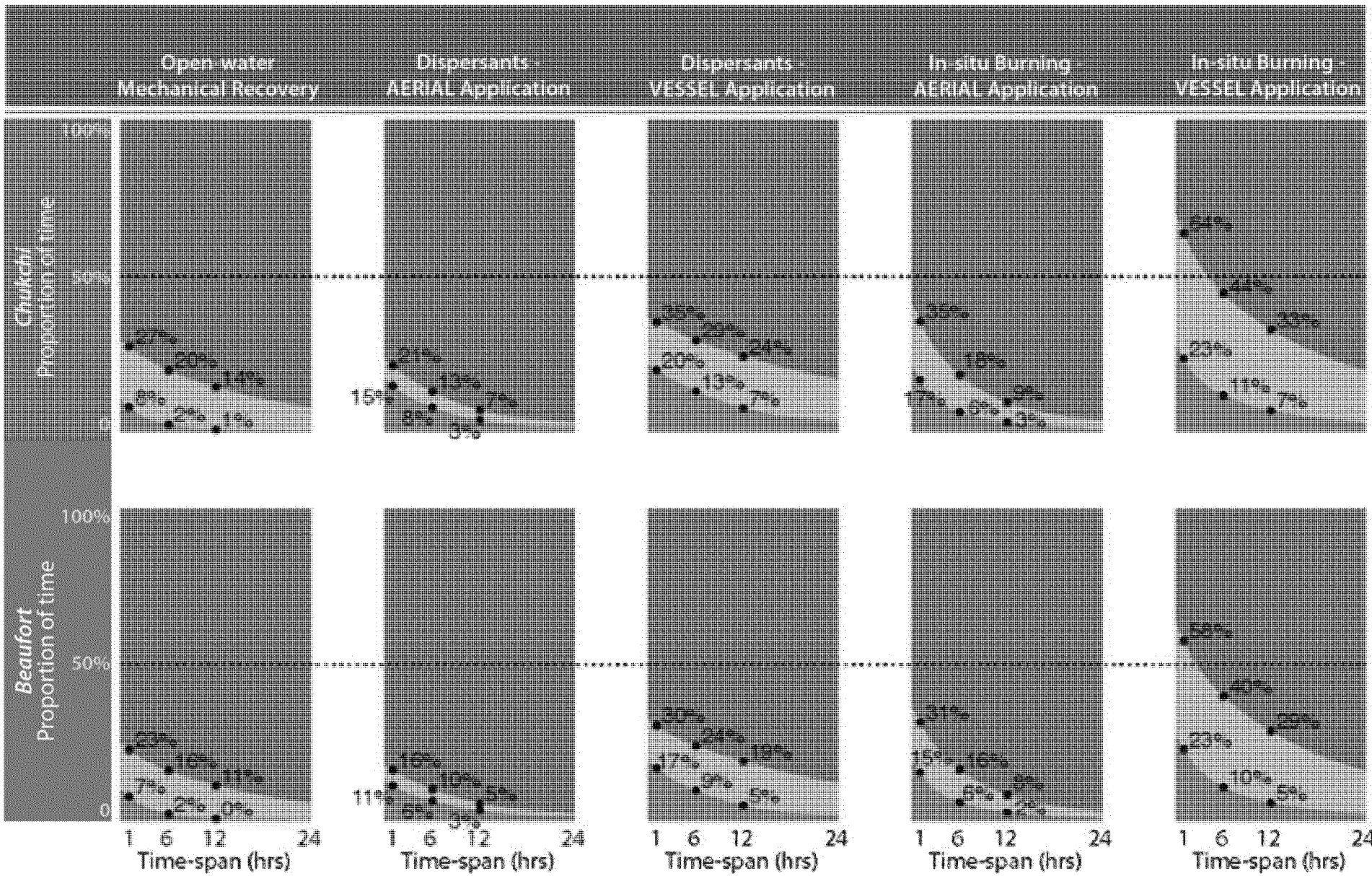


FAVORABLE
all conditions green

MARGINAL
one yellow condition, others green → all yellow conditions

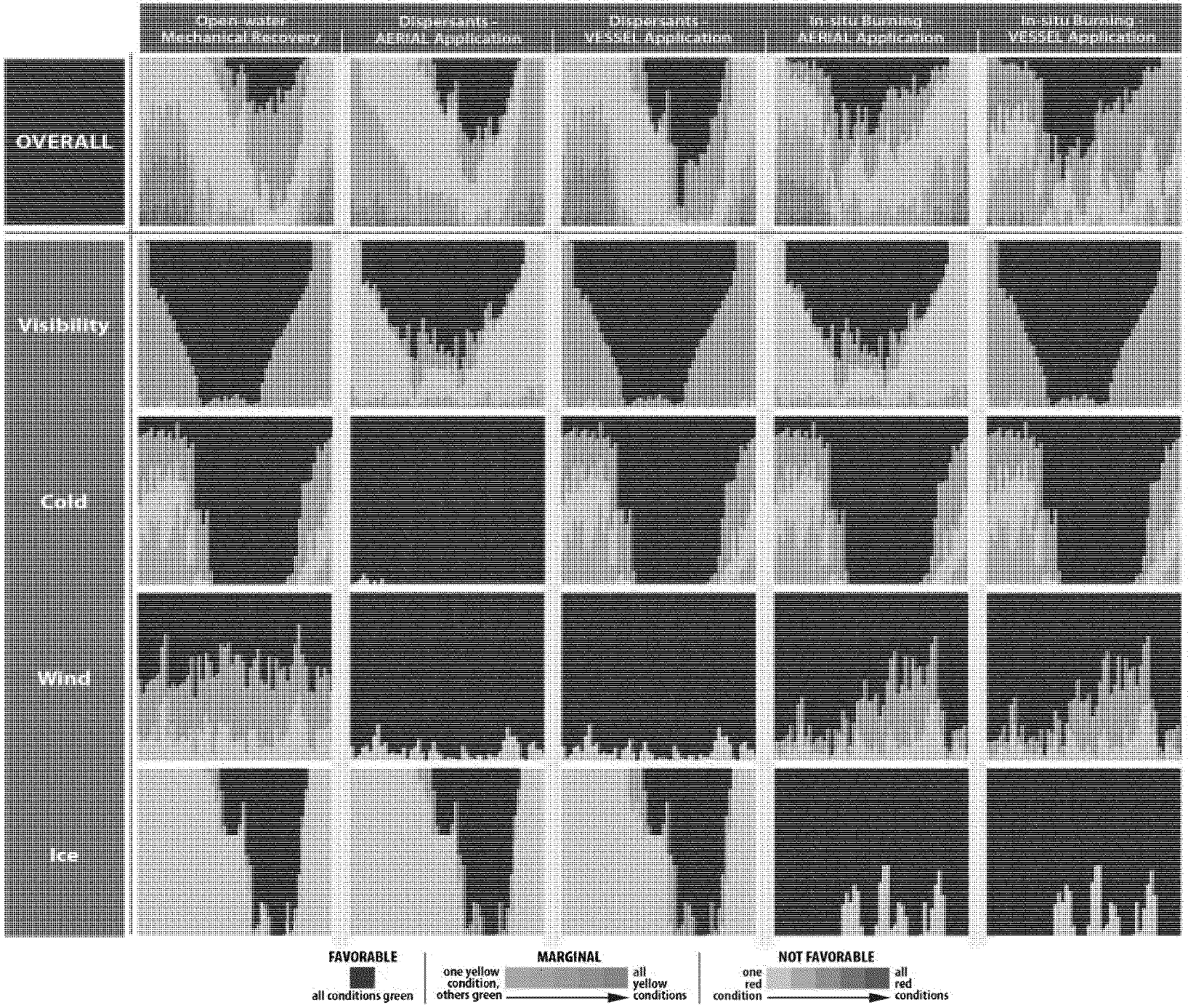
NOT FAVORABLE
one red condition → all red conditions

Time-window sensitivity

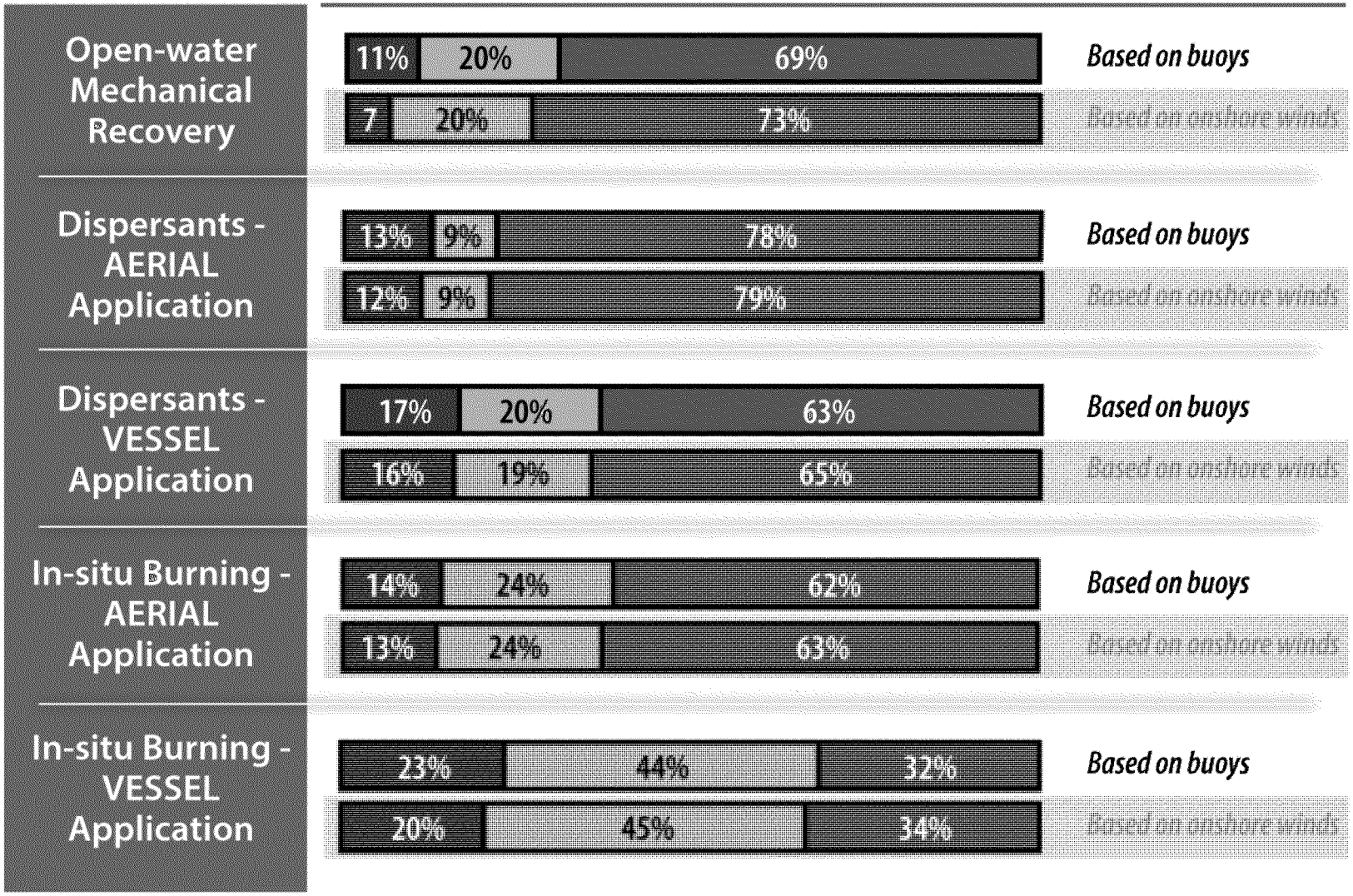


= Response Favorable
= Response Marginal
= Response Not Favorable

	Winter November-June			Summer July-October			
Open-water Mechanical Recovery	5	94%		21%	48%	32%	Chukchi Sea
		98%		22%	43%	35%	Beaufort Sea
Dispersants - AERIAL Application		95%		37%	14%	49%	Chukchi Sea
		99%		32%	14%	55%	Beaufort Sea
Dispersants - VESSEL Application	9	89%		51%	34%	15%	Chukchi Sea
	4	95%		48%	35%	17%	Beaufort Sea
In-situ Burning - AERIAL Application	10	11	79%	22%	25%	53%	Chukchi Sea
	9	11	80%	20%	21%	59%	Beaufort Sea
In-situ Burning - VESSEL Application	15%	44%	41%	30%	44%	26%	Chukchi Sea
	14%	37%	49%	29%	41%	30%	Beaufort Sea


Open water Mechanical Recovery
Dispersants - AERIAL Application
Dispersants VESSEL Application
In-situ Burning AERIAL Application
In-situ Burning VESSEL Application
OVERALL
Visibility
Cold
Wind
Ice
FAVORABLE
all conditions green
MARGINAL
one yellow condition, others green
all yellow conditions
NOT FAVORABLE
one red condition
all red conditions

Results @ Chukchi Sea – Modeled vs buoy waves



Recommendations

* Better documentation of response limits
  - Protocol
  - Sea trials
* Better data on environmental conditions
* Incorporate add'l tactics & time periods
  - SMART, storage transfer, tracking & surveillance

Other studies

* **Prince William Sound (2006-2008)**
* **Canadian Beaufort and Davis Strait (2011)**
* **Northern British Columbia (2012)**
* **Aleutian Islands (2014)**
* **Barents Sea (2014)**
* **Greenland (2015)**
* Circumpolar Arctic (in process – BSEE project)

Gulf of Mexico (in process – BSEE project)

Conclusion

* Broken ice was not as common as expected (lots of attention in spill response community)
* Different plans needed for different seasons
* Ability to sustain a response is much different than ability to mount a response (based on weather alone)
* What you get out is based on what you put in
  - Limits
  - Env'l data

Thank you

Tim Robertson & Sierra Fletcher

Nuka Research and Planning Group, LLC

www.nukaresearch.com

Bureau of Safety and Environmental Enforcement

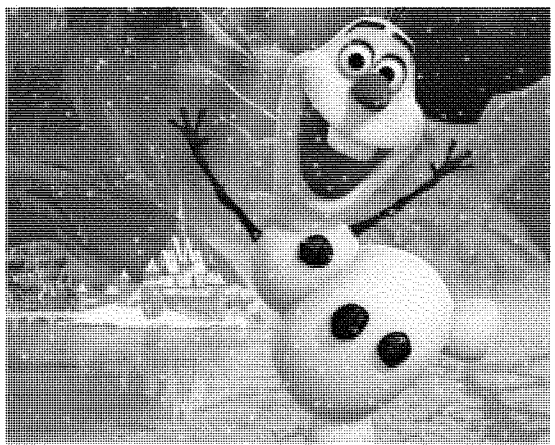
BSEE Agency Update to ICCOPR – Oil Spill Response Research

Timothy Steffek
Lori Medley
December 14, 2016

"To promote safety, protect the environment and conserve resources offshore through vigorous regulatory oversight and enforcement."

Personnel Issues

Lori will attend only **1** more ICCOPR meeting!



Recent Ohmsett Activities

Ohmsett

Procurement for the Operation and Maintanence of OHMSETT

BSEE

PROCUREMENT INFORMATION

- Announcements
- RFP
- FedBizOpps
  - RFI
  - Pre-Solicitation Notice

READING ROOM

- Government Furnished Equipment
- Program Information
- Site Information
- Video of Ohmsett Facility
- Other Information
  - Naval Weapons Station Earle
  - BSEE Homepage
  - BSEE Greening Policy

Contract Competition Home Page

Welcome to the Bureau of Safety and Environmental Enforcement (BSEE) website for the National Oil Spill Response Research & Renewable Energy Test Facility contract competition.

The purpose of this website is to provide information on the contract competition. The contract competition is to obtain the necessary supplies and services to operate, maintain and manage Ohmsett, the National Oil Spill Response Research & Renewable Energy Test Facility via contractor support.

Ohmsett is the National Oil Spill Response Research & Renewable Energy Test Facility located in Leonardo, New Jersey, on the grounds of Naval Weapons Station Earle (NWSE). Ohmsett is the only facility in the world where clients can conduct full-scale oil-spill response equipment tests with a variety of crude oils and refined petroleum products. Ohmsett provides a unique facility to conduct tests and develop new devices and techniques that detect, map, contain, and clean up oil spills. The Ohmsett facility is also used to test other marine equipment such as marine hydrokinetic devices. Ohmsett is a training facility which offers "hands on" training classes in oil spill response, confined space entry and viscous oil pumping techniques. Ohmsett also has specialized testing equipment/systems to: evaluate fire resistant containment boom using a propane burner system; test and evaluate dispersant effectiveness; and simulate cold/water/broken ice conditions for equipment testing, training and research.

The Bureau's goal is to enhance performance, reduce costs, introduce innovation and streamline procedures in the operation and maintenance of Ohmsett.

This website will be used to notify interested offerors of procurement and program information pertinent to the Ohmsett contract competition.

DOI.GOV USA.GOV Inspector General Disclaimer FOIA Accessibility Privacy

Recent Ohmsett Activities

Recently Completed Projects:

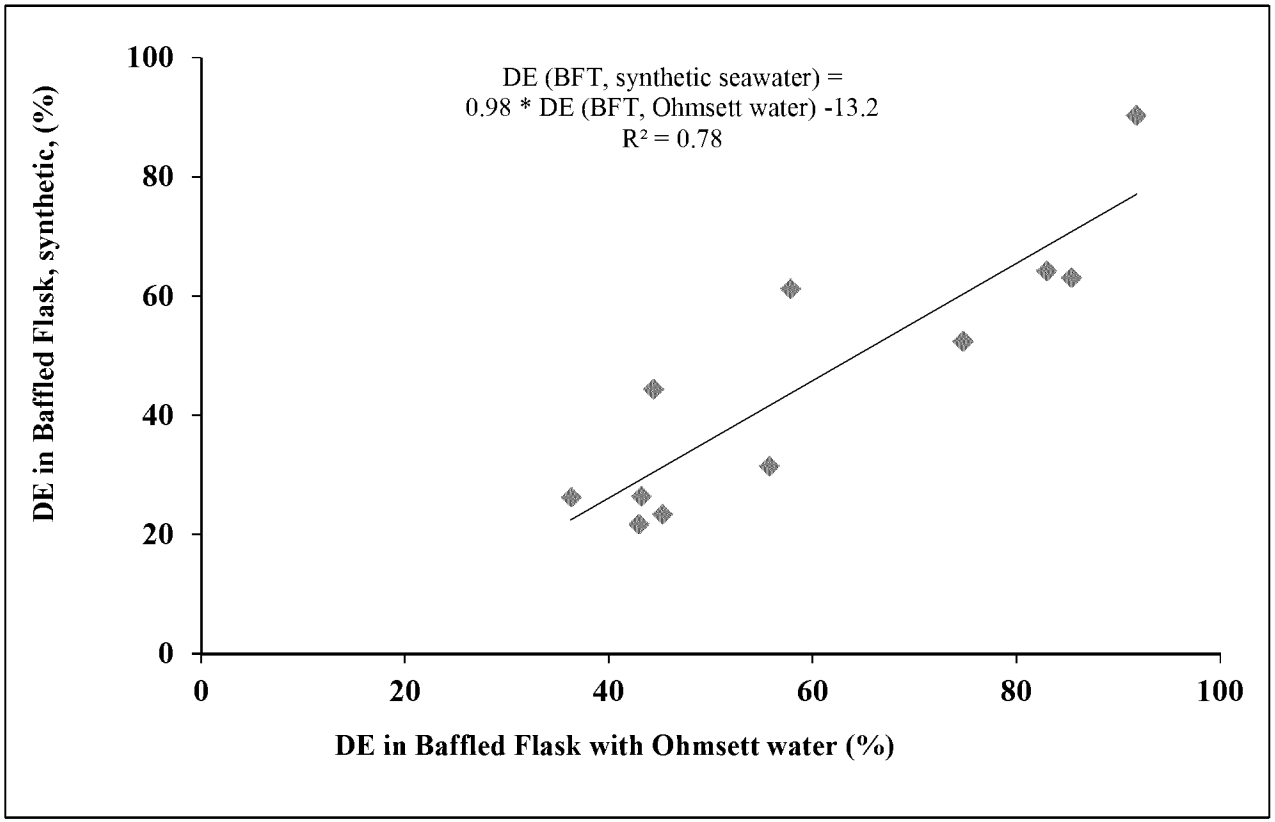
Solidifying the Scientific Capabilities of Ohmsett: Effect of Ambient Chemical Levels

OSRR # 1044 NJIT
PI: Dr. Michel Boufadel

Objective: This project evaluated the effect of residual surfactants and other ambient chemicals in the tank water, and their impact on dispersant testing in the Ohmsett tank.

Recently Completed Projects:

Solidifying the Scientific Capabilities of Ohmsett: Effect of Ambient Chemical Levels



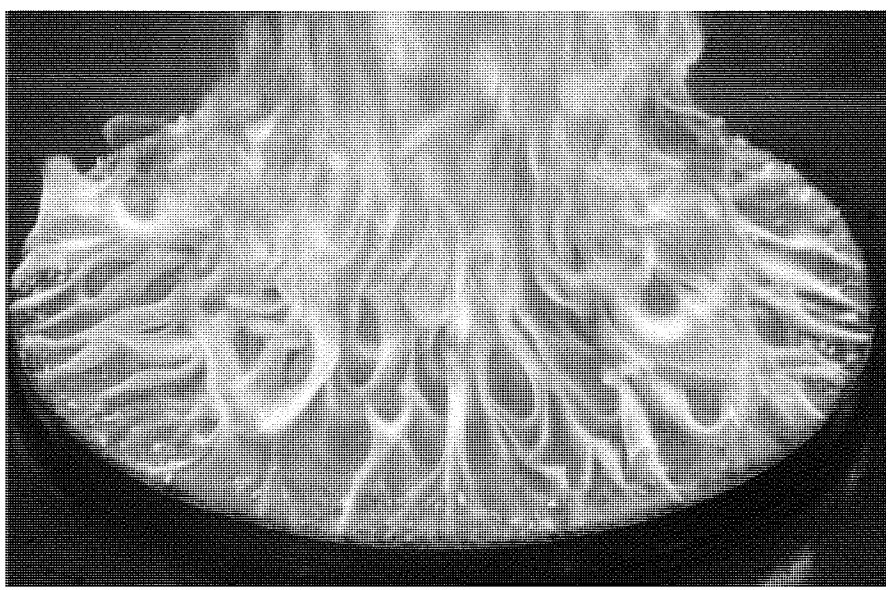
Hardness ($CaCO_3$)
Syn. Seawater
6500 mg/L
Ocean
6500 mg/L
Ohmsett (Apr 2015)
900 mg/L
Ohmsett (Oct 2015)
4650 mg/L

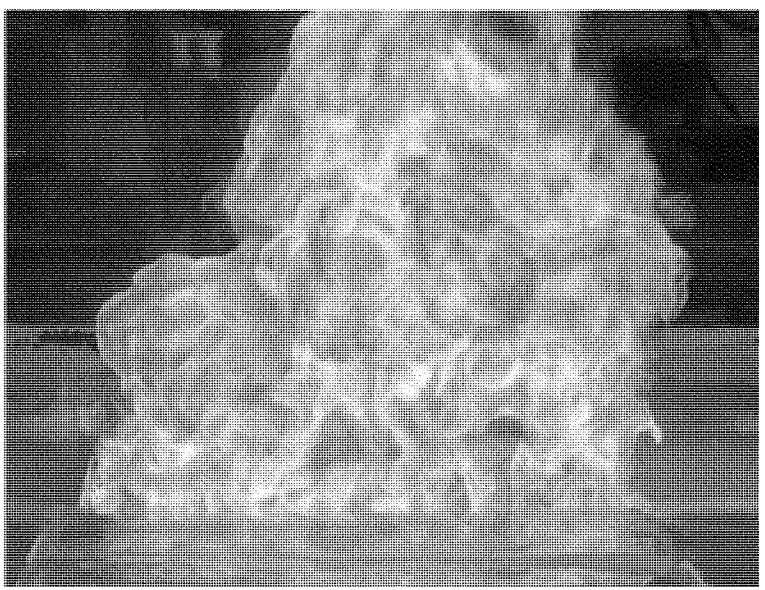
Recently Completed Projects:

Burning of Crude Oil in Ice Cavities - II

OSRR # 1036 Worcester Polytechnic Institute (WPI)
PI: Dr. Ali Rangwala

Objective: The objective of the study was to experimentally investigate flammability of crude oil slicks in cold conditions. Specifically, the ignition of oil, lateral cavity formation, and the burning behavior with wicking agents.





Recently Completed Projects:

Burning of Crude Oil in Ice Cavities - II

- Minimum energy for ignition and sustained burning of ANS oil and emulsions was independent of initial temperature of the oil and surrounding but rather a function of degree of emulsification.

- Igniters will need significant modification to work in the arctic. This is due to increased thermocapillary convection and thermal conductivity because of salt migration in oil-water.

- The heat transfer from the fuel layer is capable of melting the ice faster than the flame. A void is shaped in the circumference of the ice wall, referred to lateral cavity.

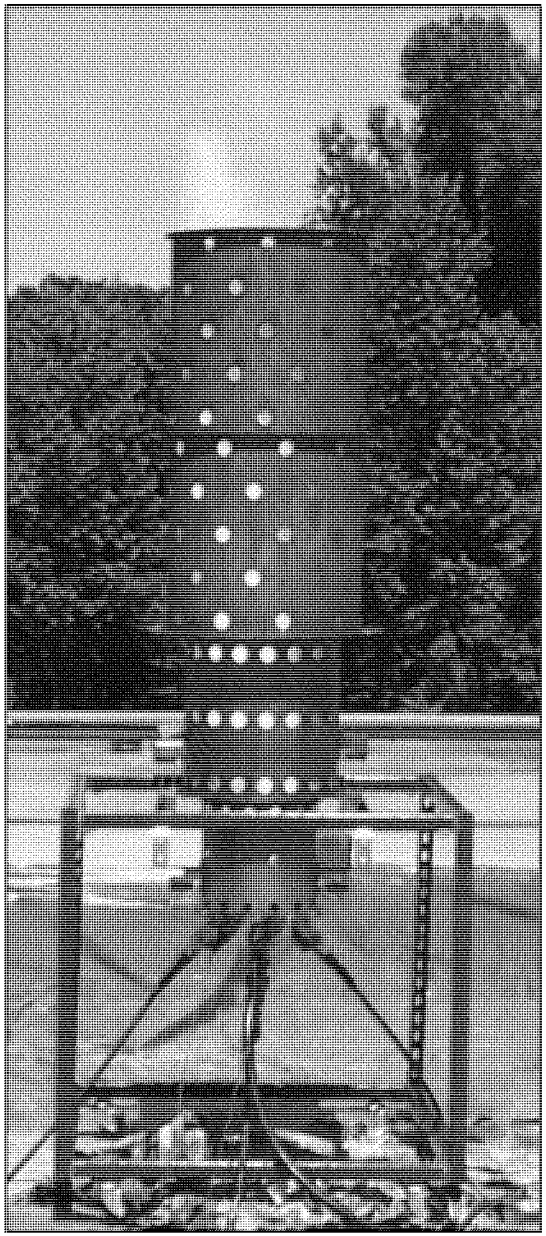
- Wicking agents generally show an improvement in the burning behavior of water-in-oil mixtures, in terms of burning rate and efficiency. Jute cloth shows the best enhancement on both the burning rate and efficiency even with the 40% emulsion.

Recently Completed Projects:

Development of a Low-Emission Spray Combustor for Emulsified Crude Oil

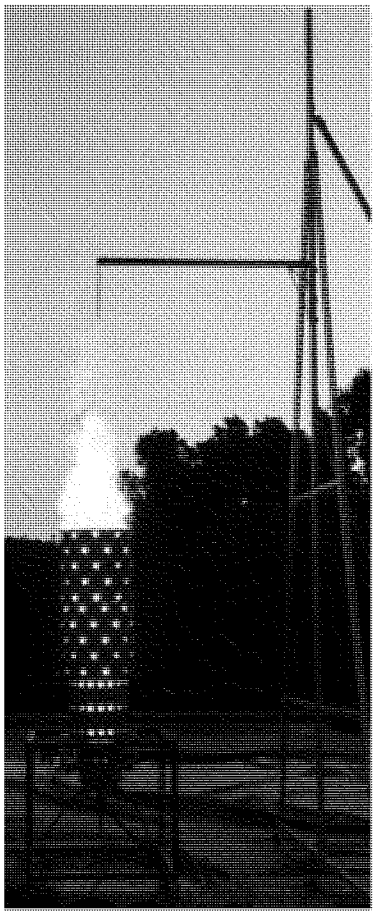
OSRR # 1061 Naval Research Laboratory
PI: Steven G. Tuttle

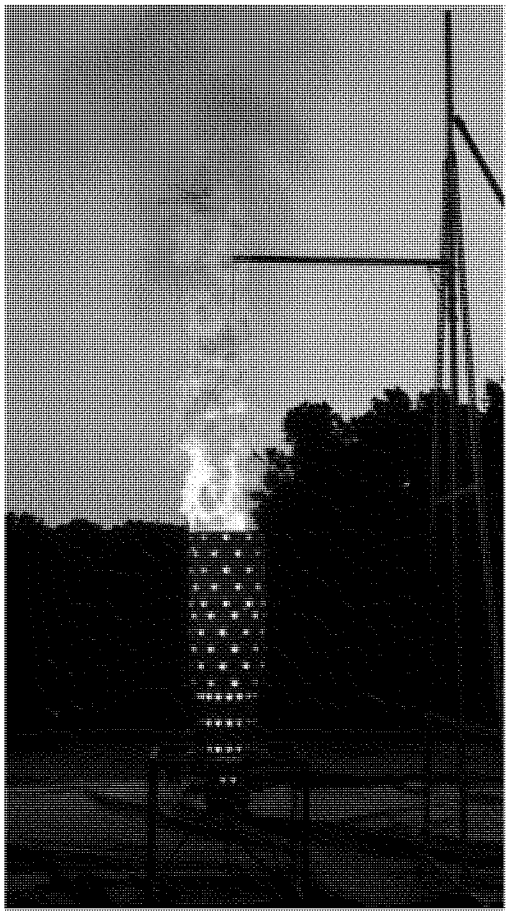
Objective: The objective of this project is to transition the Technology Readiness Level (TRL) of a low-emission, low pressure atomization and combustion process for emulsified crude oil from TRL 3 to TRL 5 by developing and refining the performance of a quarter and half-scale flow blurring atomizer spray burner.



Recently Completed Projects:

Development of a Low-Emission Spray Combustor for Emulsified Crude Oil





BSEE Website: www.bsee.gov

@BSEEgov

BSEEgov

Bureau of Safety and Environmental Enforcement

BSEEgov

"To promote safety, protect the environment and conserve resources offshore through vigorous regulatory oversight and enforcement."

On-going Research

NCP Product Schedule

- Surface Washing Agent and Solidifier Effectiveness Protocols
- Reference Oil DE, toxicity, chemical characterization

Oil Toxicity

- Slow stir WAF bioassay studies *c. dubia, a. bahia, p. promelas, m. beryllina*
- Baseline testing completed WCS and CLB, Dorado, Endicott

Crude Oil Simulant Development

- Phase 1: manuscript submitted
- Phase 2: production from nm to µm scale

EPA ORD Oil Research Program

On-going Research

Dispersion Effectiveness in hypersaline waters

- Tank testing complete
- Laboratory testing 75% complete

Diluted Bitumen Report

- WCS and CLB chemical characterization
- Biodegradation with 3 freshwater cultures
- Toxicity

EPA ORD Oil Research Program

Potential Projects

Oil detecting REMUS AUV, collaboration with WHOI

Oil Thickness Estimates using Lidar, collaboration with NRL and BSEE

Other Activities

- IOSC 2017 Planning Committee; GoMRI 2017 Conference Session Planning
- API SSDI workgroup evaluating hypothetical spill modeling scenarios in GoM
- NOAA-BSEE Oil Remote Sensing Assets testing
- FOSTERRS

NOAA ICCOPR Agency Report Science Coordination & External Research

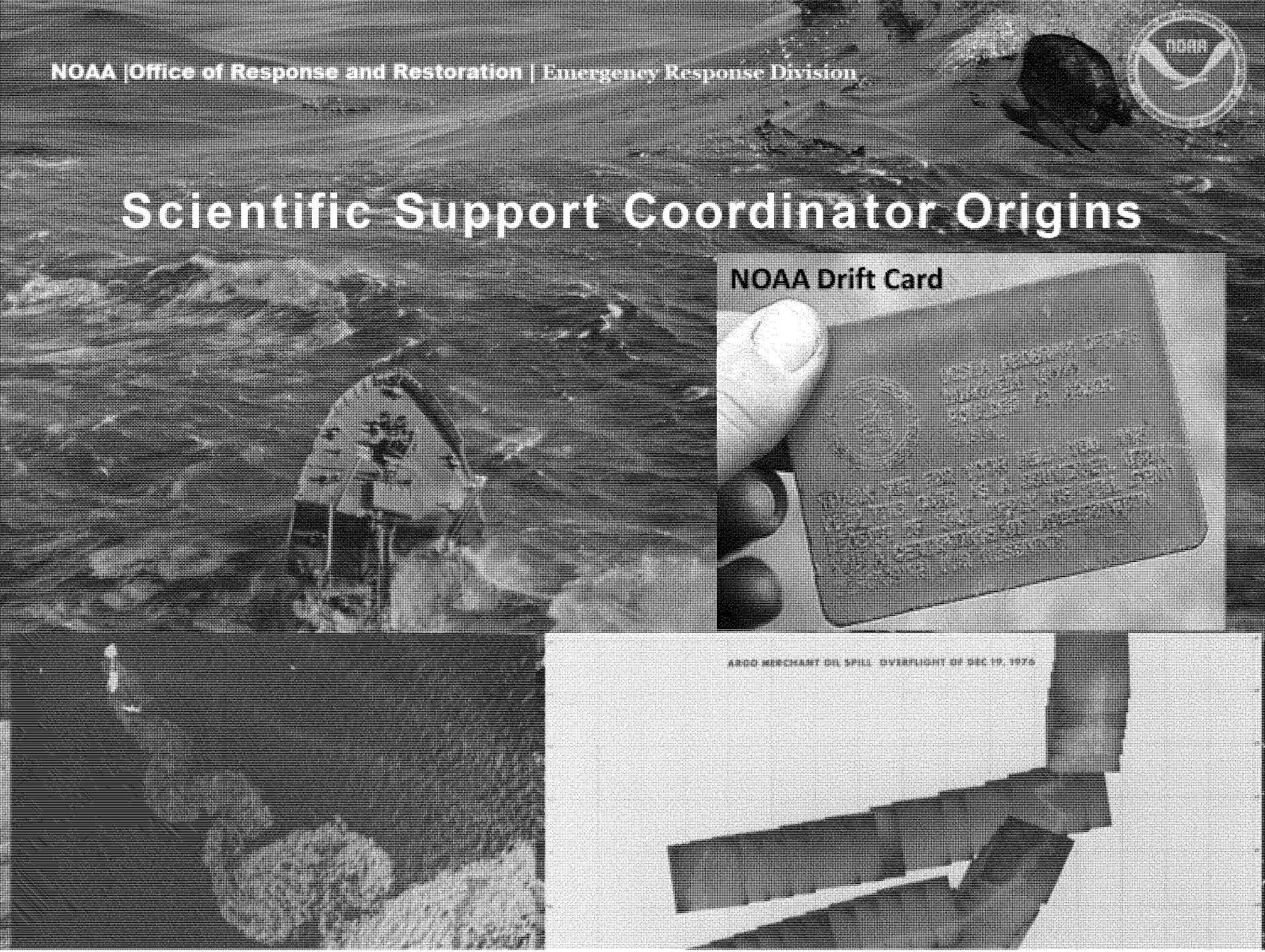
Scott Lundgren

Chief, Emergency Response Division
NOAA Office of Response and Restoration

Topics

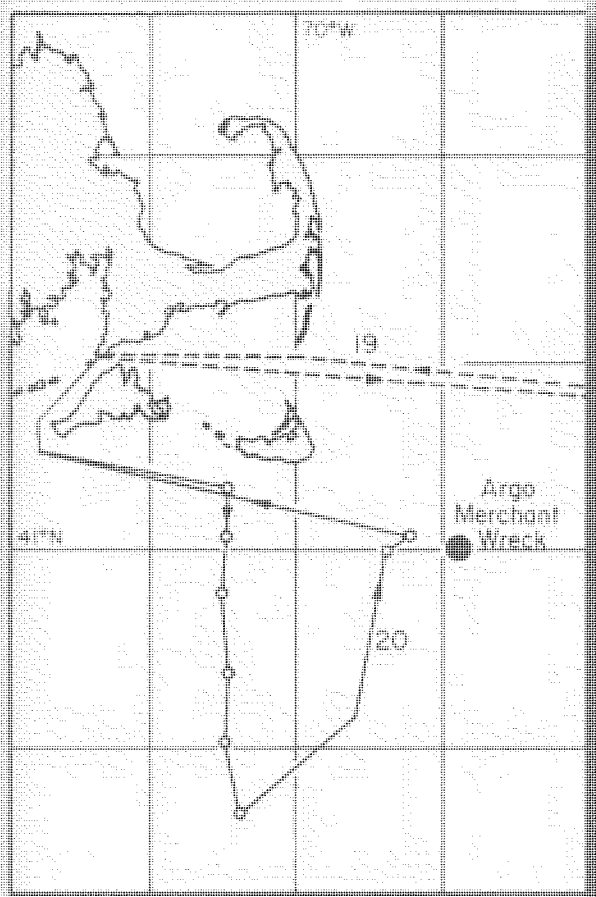
- Origins of Operational Scientific Support: Celebrating 40 years of NOAA Scientific Support on 15 Dec 2016
- Implications of a rapidly expanding oil spill research domain
- ICCOPR considerations
- NOAA efforts to enhance connections
- [redacted]

Scientific Support Coordinator Origins



Argo Merchant Science Coordination

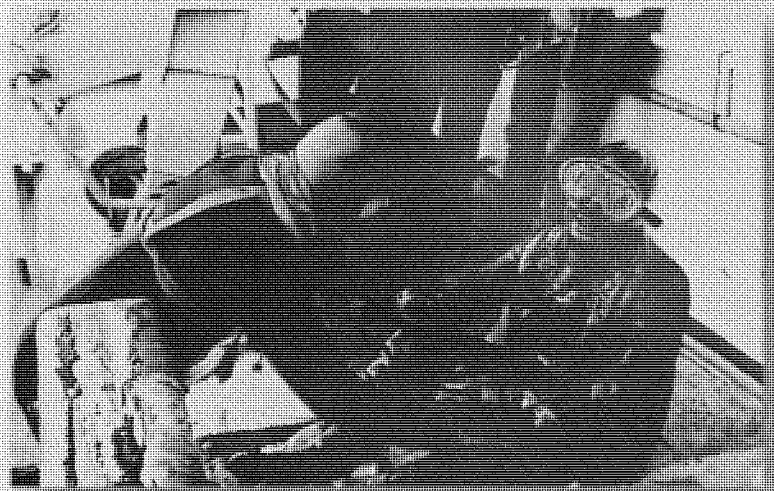
- 15 Dec 1976: Grounding, SOR team arrival
- 17 Dec: First Science Coordination Meeting
- 18 Dec: First discharges
- 20 Dec: Oceanus Cruise begins
- 21 Dec: Vessel breakup
- 100 Scientists from NOAA, USCG, NASA, Navy, DOI, Mass. URI, WHOI, MIT, USC, Manomet, MBL and others engaged in response. Several synthesis reports the following year.



Tracks of Oceanus cruises 19 and 20, late D

Research Priorities & General Conclusions

- Crisis Reaction
- Finding / tracking oil
- Oil Behavior
- Oil Spill Modeling and Forecasting
- Fisheries impacts
- Birds and Marine Mammals
- Human Dimensions



US Navy diver conducting survey under slick

General Conclusions:

- Prevailing NW winds spared shorelines
- Most of the oil went offshore and away from Georges Bank, minimizing environmental impacts

Argo Merchant Reports

Lessons Learned

- "The [NOAA] SOR team also was requested to aid the Coast Guard by providing an interface between the On-Scene Coordinator and the scientific community involved in research activities concerning the oil spill." |

  -Disaster Survey Report 77-1

- "The DOC/NOAA response in providing scientific investigations was invaluable to the OSC during the actual response efforts and in providing public information." ...

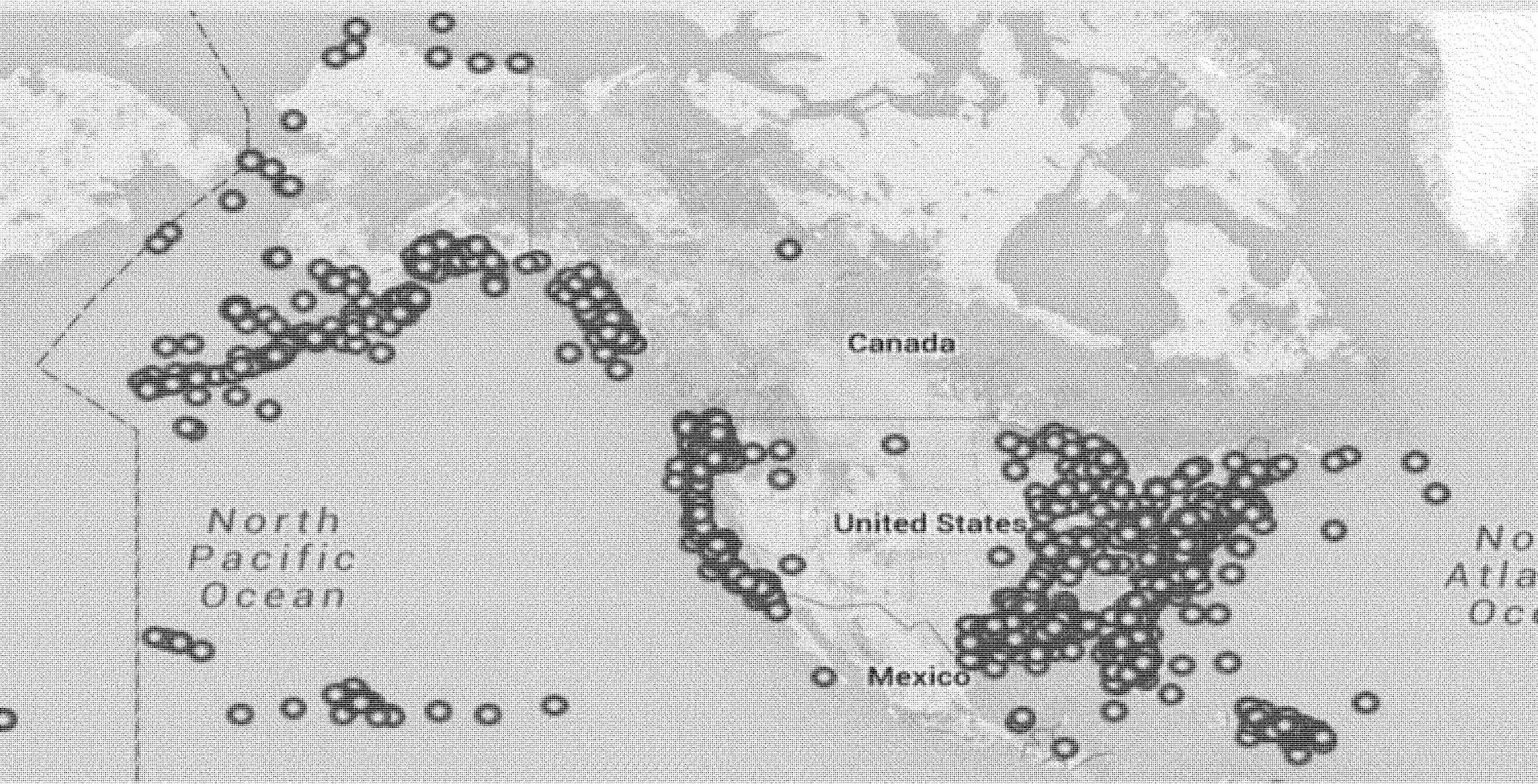
  "Each OSC should be assigned a scientific advisor ... for the duration of the response action to interface with the scientific community on scene...

  -The Argo Merchant Oil Spill On-Scene Coordinator's Report 1977

- Scientific Support Coordinator incorporated in the 1980 NCP.
  It now states: Scientific Support Coordinators (SSCs) may be designated by the OSC ... as the principal advisors for scientific issues, communication with the scientific community, and coordination of requests for assistance from state and federal agencies regarding scientific studies. The SSC strives for a consensus on scientific issues affecting the response, but ensures that differing opinions within the community are communicated to the OSC...

  - NCP Special Teams section, 40 CFR 300.145

Scientific Support since Argo Merchant



- Science support is even more critical today

> Current Issue > vol. 109 no. 50 > Jane Lubchenco, 20212–20221, doi: 10.1073/pnas.1204729109

CrossMark

click for updates

Science in support of the *Deepwater Horizon* response

Jane Lubchenco[a,1], Marcia K. McNutt[b], Gabrielle Dreyfus[a,2], Steven A. Murawski[a,3], David M. Kennedy[a], Paul T. Anastas[c,4], Steven Chu[d], and Tom Hunter[e,5]

Author Affiliations

Edited by Paul G. Falkowski, Rutgers, State University of New Jersey, New Brunswick, NJ, and approved October 26, 2012

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SUSTAINABILITY

How Science Stopped BP's Gulf of Mexico Oil Spill

Remote imaging of the failed blowout preventer, stress testing various containment devices as well as other high-tech tasks helped contain the Deepwater Horizon disaster

A challenging environment

- In confirmation testimony for Commandant, when asked about lessons learned from his experience in the Deepwater Horizon (DWH) incident that he would apply in another major disaster, ADM Paul Zukunft replied:

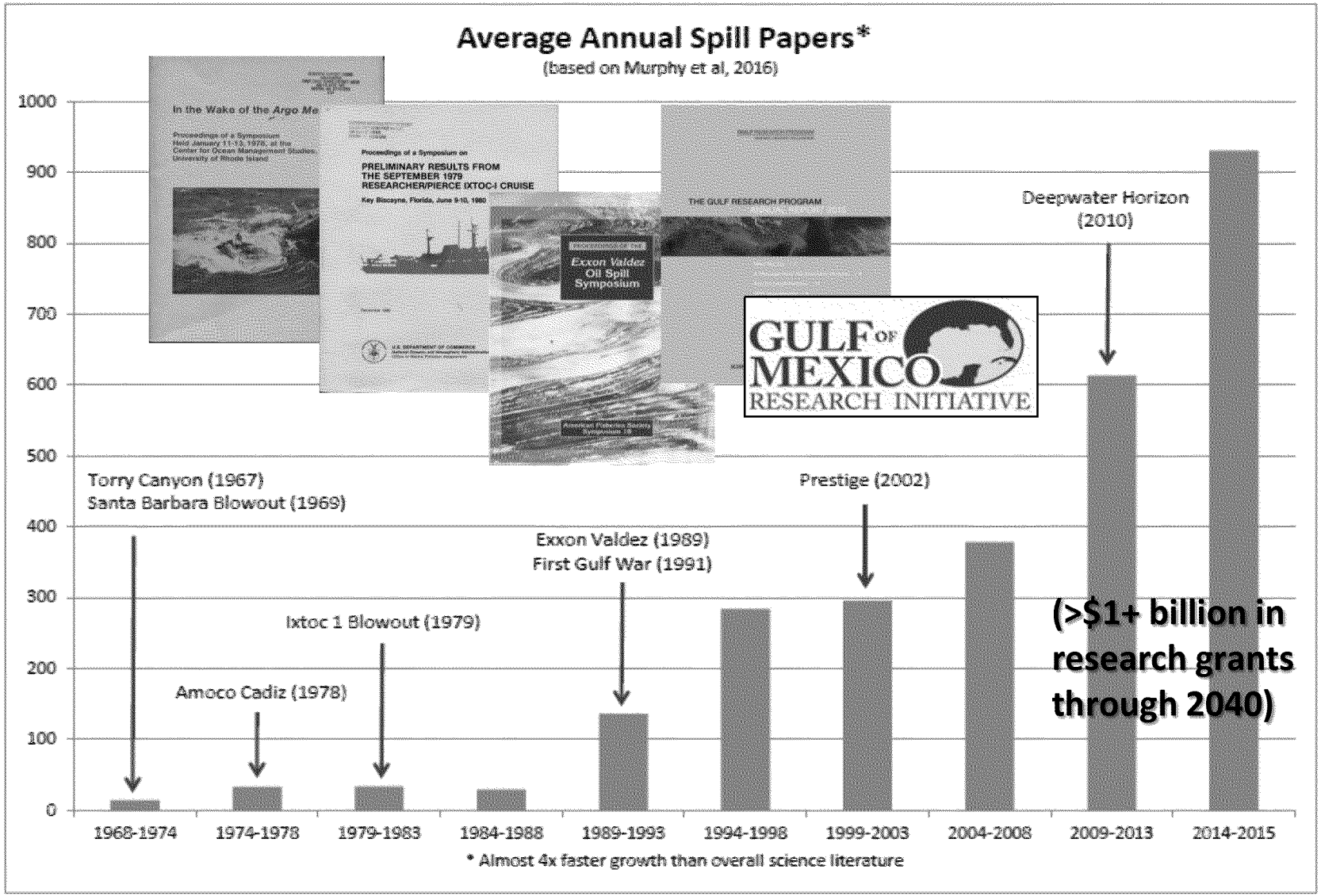
  "biggest challenge during the Gulf oil spill is whole of science."

- Much more external scientific engagement today:
  - For example, GOMRI: >1,000 scientists, 1,000 graduate students, 255 postdoctoral students, 42 states, 278 Academic institutions, 18 countries, 825 peer reviewed publications.

- Several other marine black swan events have also demanded substantial science engagement: Fukushima Daiichi nuclear plant, Indian Ocean Tsunami, Prestige Oil Spill

Spills: a Rapidly Expanding Domain

(Growth at 4x overall science literature)



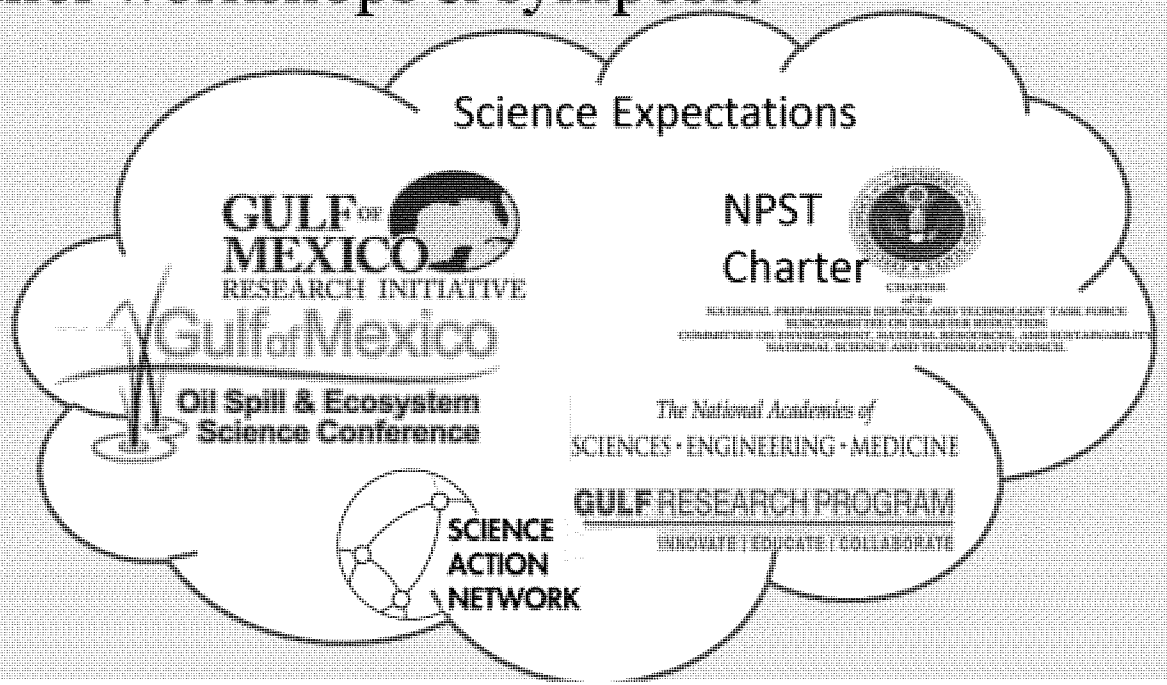
ICCOPR Considerations

- ICCOPR Focus on federal research
  - The relative fraction of federal funds to overall research funds differs by class and standing research area
  - Level of attunement of the wider community to ICCOPR and vice-versa?

- Appropriate synthesis mechanisms
  - Limited focused journals: Spill Science and Technology ceased in 2003
  - Maintaining literature currency: NOAA ERD Senior Scientist Effects of Pollution on Marine Organisms

What actions are we taking?

- Efforts to enhance external scientific support and themes within existing resources
  - National all hazards efforts
  - Science-focused spill conference central themes
  - Other workshops & symposia



Questions / Discussion

Scott Lundgren,
Chief, Emergency Response Division
Office of Response and Restoration
NOAA National Ocean Service

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240-533-0408
response.restoration.noaa.gov

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Backup Slides

National Preparedness Science & Technology

- Chartered group to enhance S&T application across national preparedness spectrum
- ERD contributing to a post-incident working group
  OSTP, DOC/NOAA /NIST, DOI/USGS /BLM,
  DHHS/NIEHS, EPA, DOD/USACE, DHS/FEMA, IDA
- Topics:
  - S&T engagement in command and coordination structures – NIMS refresh mention of Science & Technology Advisor
  - Lessons and examples from SSC role
  - Noting other agency methods of science reach-back
  - Access for science research

Gulf of Mexico
Oil Spill & Ecosystem
Science Conference 2017

February 6-9, 2017 Hyatt Regency Hotel, New Orleans

- GoMOSES Conference: February 6-9, 2017 in New Orleans
- OR&R Director is this year's Executive Committee Chair
- 2017 conference theme encourages researchers to consider the application of their results to practical use.

Using scientific research will be critical to informing planning, preparedness, response and recovery for future events. Connecting this to decision makers in the response and restoration communities will be key across conference topic areas.

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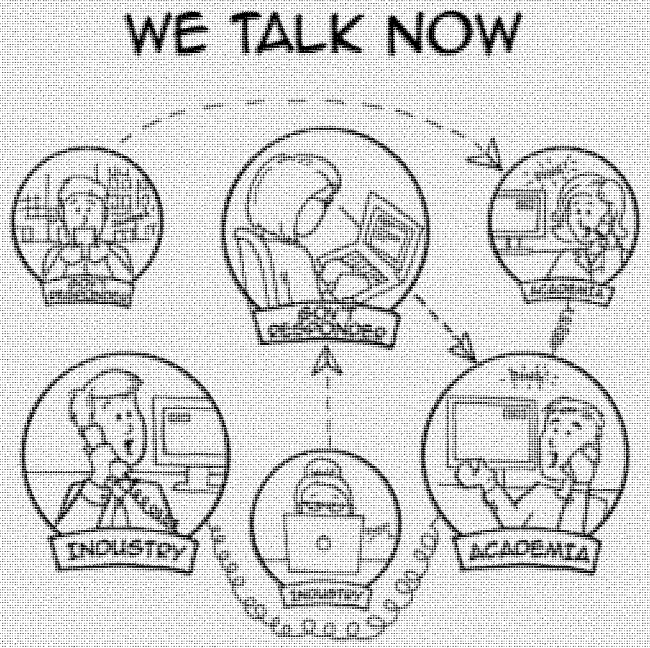
Other Venues / Planning Forums

- October 2016: Industry Technical Advisory Committee, WHOI
- November 2016 Clean Gulf: Spill Response and the Role of Environmental Research during Response Workshop
- February 2017 GoMOSES via Gulf SeaGrant: Exploring the intersection between oil spill science and response
- April 2017: American Academy of Arts and Sciences workshop on Science During Crisis
- Various SSCs and Area Committees: Approaches for engaging academic science
- **Large Scope** ∴ **Continuing engagements**



Source: Chris Reddy

Acquisition Directorate

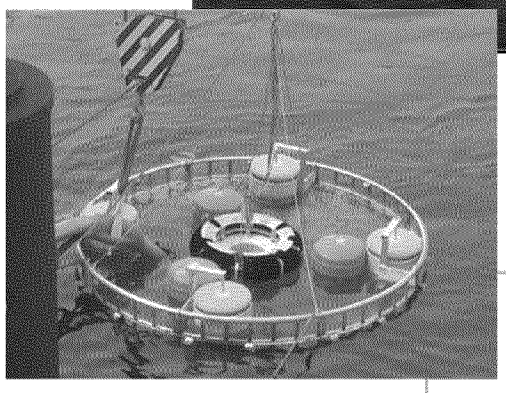
Research & Development

CG Research Update

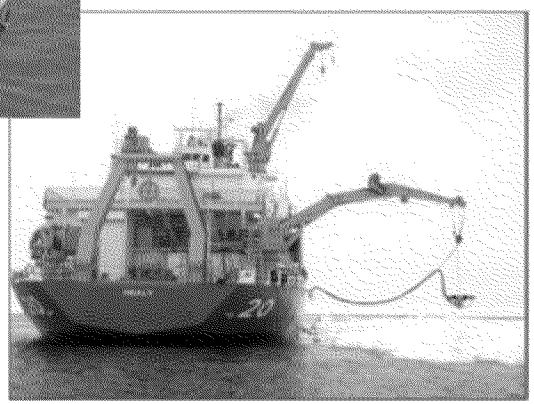
RDC Update (UNCLAS)
ICCOPR
December 14, 2016

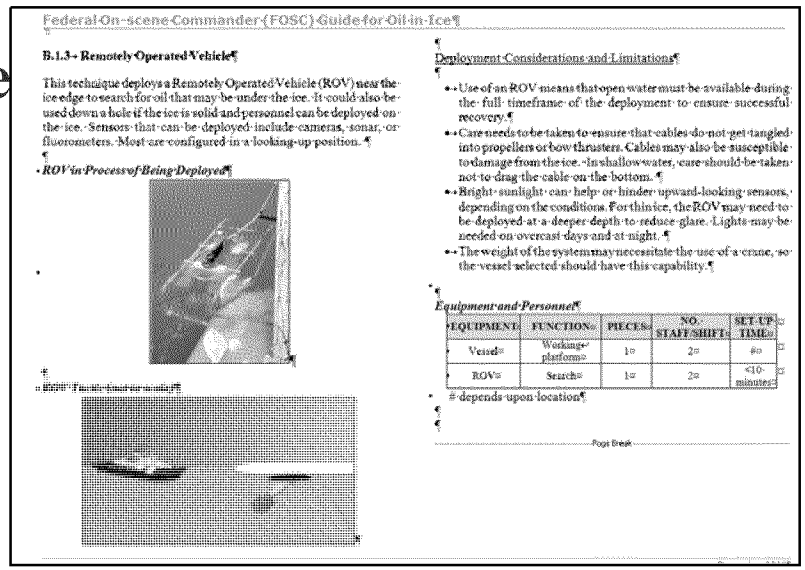
Project 4701 On-Scene Commanders Information
(with EPA Great Lakes Restoration Initiative GLRI)

Completion of Field Demonstrations



Draft Guide





Federal On-scene Commander (FOSC) Guide for Oil in Ice

B.1.3 Remotely Operated Vehicle

This technique deploys a Remotely Operated Vehicle (ROV) near the ice edge to search for oil that may be under the ice. It could also be used down a hole if the ice is solid and personnel can be deployed on the ice. Sensors that can be deployed include cameras, sonar, or fluorometers. Most are configured in a looking-up position.

ROV in Process of Being Deployed

Deployment Considerations and Limitations

- Use of an ROV means that open water must be available during the full timeframe of the deployment to ensure successful recovery.
- Care needs to be taken to ensure that cables do not get tangled into propellers or bow thrusters. Cables may also be susceptible to damage from the ice. In shallow waters, care should be taken not to drag the cable on the bottom.
- Bright sunlight can help or hinder upward-looking sensors, depending on the conditions. For thin ice, the ROV may need to be deployed at a deeper depth to reduce glare. Lights may be needed on overcast days and at night.
- The weight of the system may necessitate the use of a crane, so the vessel selected should have this capability.

Equipment and Personnel

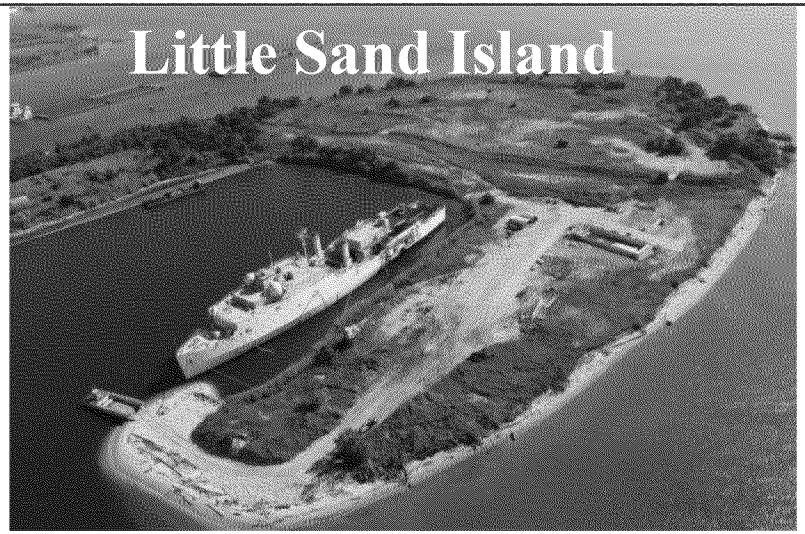
EQUIPMENT	FUNCTION	PIECES	NO. STAFF/SHIFT	SET-UP TIME
Vessel	Working platform	1	2	#
ROV	Search	1	2	<10 minutes

depends upon location

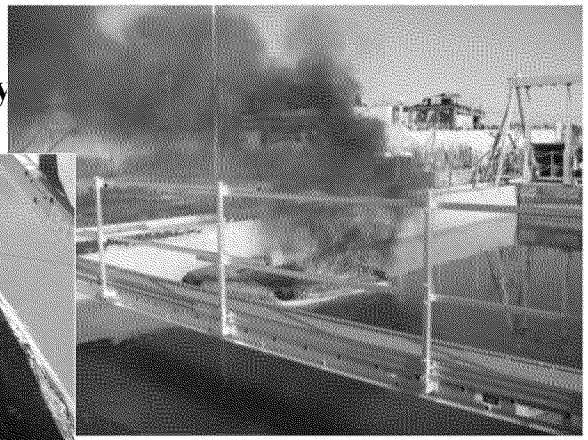
Page Break

Project 4704 Offshore In-situ Burning

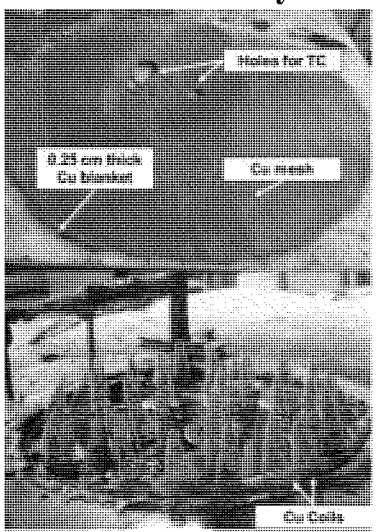
(Joint Maritime test Facility (JMTF) Mobile, AL with BSEE)

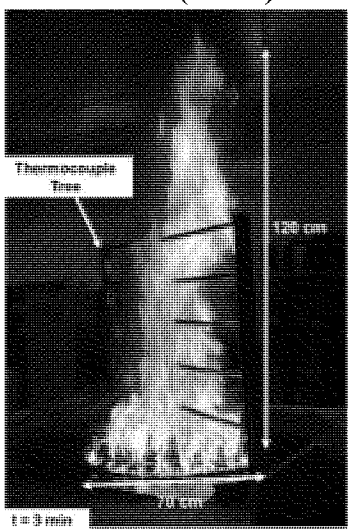


Pacific Northwest National Laboratory October 2016

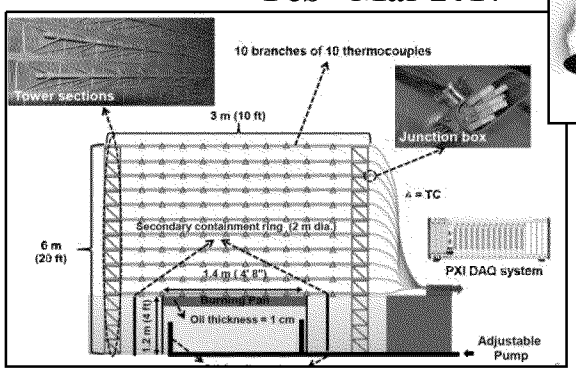


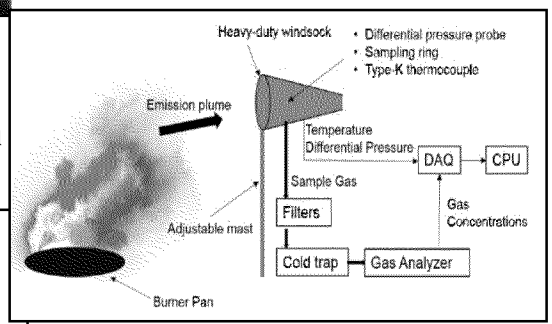
Worcester Polytechnic Institute (WPI)





JMTF Configuration Feb –Mar 2017





New Project Starts

4708 Oil Spill Response Technology Evaluation Process Research

- Developing improved method for evaluating technology between major spills by CG-MER
  - Use BSEE Technical Readiness Levels (TRL)
  - Use ideas from RDC Interagency Alternative Technology Assessment Program (*IATAP*) during Deepwater Horizon to evaluate process

4710 Nearshore and Inland Evaluation of the Effective Recovery System Potential (ERSP) Calculator

- Evaluate Potential Use of ERRP recently developed for Offshore by BSEE for Inland Spills
  - Workshop in 2017 to determine potential parameters
  - Determine if current software can be modified

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Other Projects and Partners

4702 Oil in the Water Column (With BSEE)

- Test for mitigation prototype Systems 5-9 December 2016 (enhanced sorbents) and January 2017 (air curtain)

4705 Response to Oil Sands Products (With GLRI)

- Mitigation of Oil Movement Along the Bottom – 3 Contracts Awarded (1 for offshore system and 2 for inland systems) to develop requirements and guidance
- Fresh Water Skimmer Tests 2017 – using oil sands products and 2 skimmers with ASTM-type procedure

4707 Shale Oil Preparedness and Response (With GLRI)

- Risk Assessment Reports being Reviewed by CG-MER

7609 Airborne Oil Spill Remote Sensing and Reporting (BSEE)

- Sensor Field Test July 2016 Report Completed

7935 Equipment Surge Risk Assessment Tool

- Finished conducting stakeholder interviews.

6210 Arctic Operations Support

- Use of CGC Healy June 30 – July 17, 2017
- Oil Spill Centric –
  - Unmanned surface vehicle detection and communications to D17
  - Other Equipment TBD

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2018 RDC Portfolio Development

Idea Submission Review (ISR) in DC: 12/7/2016 - 12/8/2016

Assessment of Prospective Portfolio (APP) at RDC: 4/5/2017 - 4/6/2017

Questions?

Interagency Coordinating Committee on Oil Pollution Research (ICCOPR)
FY17 First Quarter Meeting
Wednesday December 14, 2016 (9:00 AM – 3:15 PM)
U.S. Coast Guard Headquarters
Room 7P15-01
2703 Martin Luther King Jr. Ave, SE, Washington, DC
Conference Line: 202-475-4000 Access Code: 656 701 03#

AGENDA

9:00 – 9:15 AM	Welcome and Introductions Opening Remarks	CAPT Joe Loring Dr. Robyn Conmy
9:15 – 9:20 AM	General Updates/Announcements	
9:20 – 10:00 AM	National Academy of Sciences Gulf Research Program Update	Ms. Kelly Oskvig NAS GRP
10:00—10:40 AM	Ecotoxicity assessment of oil spill dispersants and surface washing agents in estuarine organisms	Dr. Marie DeLorenzo NOAA NCCOS
10:40—10:50 AM	BREAK	
10:50—11:30 AM	Estimating an Oil Spill Response Gap for the U.S. Arctic Ocean	Mr. Tim Robertson Ms. Sierra Fletcher NUKA
11:30 AM – 1:00 PM	LUNCH	
1:00-2:30	Member R&D Updates	Members
2:30-2:40 PM	Break	
2:40 – 2:50 PM	Intentional Release WG Update	Ms. Kirsten Trego
2:50 – 3:00 PM	New Business	Members
3:00 – 3:15 PM	Closing comments and adjourn	CAPT Joe Loring Dr. Robyn Conmy

Adobe Connect Webinar Site: https://urldefense.proofpoint.com/v2/url?u=https-3A__share.dhs.gov_r5m1r9mxmcq_&d=CwICaQ&c=0NKfg44GVknAU-XkWXjNxQ&r=G6a7yM9FDJA6pswEXXXknvupDETBTcOhcf9RdMre6xg&m=5_VeHVTYLFZFwzwhwUhL12vYbrHI_SXrSk3cxyz-s9w&s=sh24ggkcciHaHFTLyaKN_jrHx_IqRSN104dKKbmxF7I&e=

To: Abe Nachabe - USN[abe.nachabe@navy.mil]; Andrew Bruzewicz - USACE[Andrew.J.Bruzewicz@usace.army.mil]; Balsley, Alexander CIV[Alexander.Balsley@uscg.mil]; Barry Forsythe - FWS[barry_Forsythe@fws.gov]; Brian Zelenke - BOEM[brian.zelenke@boem.gov]; Brooks, Rebecca J LT[Rebecca.J.Brooks@uscg.mil]; Carnegie, Tammie R LT[Tammie.R.Carnegie@uscg.mil]; Chaves, Wendy[Wendy.G.Chaves@uscg.mil]; Crecy, Stacey L LCDR[Stacey.L.Crecy@uscg.mil]; Daniel Eldredge - USN[daniel.eldredge@navy.mil]; Dave Westerholm[dave.westerholm@noaa.gov]; David Lehman - DOT[David.Lehman@dot.gov]; David Moore - BSEE[david.moore@bsee.gov]; DiRenzo, Joseph CIV[Joseph.DiRenzo@uscg.mil]; Elena Melchert - DOE[Elena.Melchert@hq.doe.gov]; Erica Folio - DOE[Erica.Folio@Hq.Doe.Gov]; Fletcher, James E CIV[James.E.Fletcher@uscg.mil]; Frank Stone - USN[frank.stone@navy.mil]; Wilson, Gregory[Wilson.Gregory@epa.gov]; Hall, Gregory CDR (EDU)[Gregory.Hall@USCGA.EDU]; kurt.a.hansen@uscg.mil[kurt.a.hansen@uscg.mil]; Holly Herod - FWS[holly_herod@fws.gov]; James Merritt - DOT[james.merritt@dot.gov]; Jason Boehm - NIST[jason.boehm@nist.gov]; Jeff Ji - BOEM[Jeff.Ji@boem.gov]; Jenkins, Shannon R CIV[Shannon.R.Jenkins@uscg.mil]; John Farrell - ARC[jfarrell@arctic.gov]; John Kucklick - NIST [john.kucklick@nist.gov]; Joseph Levine - BSEE[joseph.levine@bsee.gov]; Kemp Skudin - USN[Kemp.skudin@navy.mil]; Kevin Easley - DOE[kevin.easley@hq.doe.gov]; Lori Medley - BSEE[Lori.Medley@bsee.gov]; Loring, Joseph B CAPT[Joseph.B.Loring@uscg.mil]; Maghini, Monica K CIV[Monica.K.Maghini@uscg.mil]; Michael Carter - DOT[michael.carter@dot.gov]; Michael Dean - USN[michael.s.dean@navy.mil]; Michael Green - NASA[michael.j.green-1@nasa.gov]; Nathan Lamie - USACE[Nathan.J.Lamie@usace.army.mil]; Ottenwaelder, Thomas A CDR[Thomas.A.Ottenwaelder@uscg.mil]; Platt, Jeffrey R LCDR[Jeffrey.R.Platt@uscg.mil]; Robert Smith - DOT[robert.w.smith@dot.gov]; Conmy, Robyn[Conmy.Robyn@epa.gov]; Conmy, Robyn[Conmy.Robyn@epa.gov]; SLundgren[scott.lundgren@noaa.gov]; Sligh, Kevin M CIV[Kevin.M.Sligh@uscg.mil]; Stephanie Bocek - USN[stephanie.bocek@navy.mil]; steve.lehmann@noaa.gov[steve.lehmann@noaa.gov]; Steven Cary - USACE[Steven.V.Cary@usace.army.mil]; Scott.A.Stoermer@uscg.mil[Scott.A.Stoermer@uscg.mil]; Timothy Steffek - BSEE[timothy.steffek@bsee.gov]; Tom Thompson - DOT[tom.thompson@dot.gov]; Trego, Kirsten R CIV[Kirsten.R.Trego2@uscg.mil]; Principe, Vanessa[Principe.Vanessa@epa.gov]; mark.g.vanhaverbeke@uscg.mil[mark.g.vanhaverbeke@uscg.mil]; Walter Johnson - BOEM[Walter.Johnson@boem.gov]; Wayne Yoder - DHS[wayne.yoder@dhs.gov]; Weaver, James (USCG)[James.D.Weaver@uscg.mil]; William Vocke - BSEE[william.vocke@bsee.gov]
Cc: Helinek, Sarah[Sarah.Helinek@csra.com]; Weissman, Rebecca[Rebecca.Weissman@csra.com]
From: Trego, Kirsten R CIV
Sent: Mon 11/7/2016 3:34:03 PM
Subject: ICCOPR Minutes FY16 Q4 Meeting
Minutes_ICCOPR FY16-4th Quarter_FINAL.pdf
ICCOPR_Minutes Enclosure_FY16Q4.pdf

Good morning ICCOPR Members:

Please find attached the finalized meeting minutes from the October 17 ICCOPR meeting.

The next ICCOPR meeting is scheduled for Wednesday, December 14 at Coast Guard Headquarters in Washington D.C. Agenda and details will be forwarded closer to date.

Thank you for your continued engagement, and look forward to seeing you at the next meeting.

Very Respectfully,
Kirsten

Ms. Kirsten R. Trego
Executive Director, Interagency Coordinating Committee on Oil Pollution Research (ICCOPR)
U.S. Coast Guard Headquarters, Office of Marine Environmental Response Policy (CG-MER-3)
2703 Martin Luther King Jr. Ave, SE
Washington, DC 20593-7516

Phone: 202-372-2269
Email: Kirsten.R.Trego2@uscg.mil
www.uscg.mil/iccopr

To: Loring, Joseph B CAPT[Joseph.B.Loring@uscg.mil]; Weaver, James (USCG)[James.D.Weaver@uscg.mil]; Scott.A.Stoermer@uscg.mil[Scott.A.Stoermer@uscg.mil]; Ottenwaelder, Thomas A CDR[Thomas.A.Ottenwaelder@uscg.mil]; Sligh, Kevin M CIV[Kevin.M.Sligh@uscg.mil]; Carnegie, Tammie R LT[Tammie.R.Carnegie@uscg.mil]; Crecy, Stacey L LCDR[Stacey.L.Crecy@uscg.mil]; Platt, Jeffrey R LCDR[Jeffrey.R.Platt@uscg.mil]; Brooks, Rebecca J LT[Rebecca.J.Brooks@uscg.mil]; Maghini, Monica K CIV[Monica.K.Maghini@uscg.mil]; Hall, Gregory CDR (EDU)[Gregory.Hall@USCGA.EDU]; Fletcher, James E CIV[James.E.Fletcher@uscg.mil]; kurt.a.hansen@uscg.mil[kurt.a.hansen@uscg.mil]; Balsley, Alexander CIV[Alexander.Balsley@uscg.mil]; DiRenzo, Joseph CIV[Joseph.DiRenzo@uscg.mil]; mark.g.vanhaverbeke@uscg.mil[mark.g.vanhaverbeke@uscg.mil]; Catanach, Curtis P CIV[Curtis.P.Catanach@uscg.mil]; Chaves, Wendy[Wendy.G.Chaves@uscg.mil]; Jenkins, Shannon R CIV[Shannon.R.Jenkins@uscg.mil]; dave.westerholm@noaa.gov[dave.westerholm@noaa.gov]; scott.lundgren@noaa.gov[scott.lundgren@noaa.gov]; steve.lehmann@noaa.gov[steve.lehmann@noaa.gov]; john.kucklick@nist.gov[john.kucklick@nist.gov]; jason.boehm@nist.gov[jason.boehm@nist.gov]; Elena.Melchert@hq.doe.gov[Elena.Melchert@hq.doe.gov]; Erica.Folio@Hq.Doe.Gov[Erica.Folio@Hq.Doe.Gov]; kevin.easley@hq.doe.gov[kevin.easley@hq.doe.gov]; david.moore@bsee.gov[david.moore@bsee.gov]; Lori.Medley@bsee.gov[Lori.Medley@bsee.gov]; william.vocke@bsee.gov[william.vocke@bsee.gov]; joseph.levine@bsee.gov[joseph.levine@bsee.gov]; Walter.Johnson@boem.gov[Walter.Johnson@boem.gov]; brian.zelenke@boem.gov[brian.zelenke@boem.gov]; Jeff.Ji@boem.gov[Jeff.Ji@boem.gov]; barry_Forsythe@fws.gov[barry_Forsythe@fws.gov]; holly_herod@fws.gov[holly_herod@fws.gov]; christina_kravitz@fws.gov[christina_kravitz@fws.gov]; michael.carter@dot.gov[michael.carter@dot.gov]; tom.thompson@dot.gov[tom.thompson@dot.gov]; robert.w.smith@dot.gov[robert.w.smith@dot.gov]; james.merritt@dot.gov[james.merritt@dot.gov]; David.Lehman@dot.gov[David.Lehman@dot.gov]; Steven.V.Cary@usace.army.mil[Steven.V.Cary@usace.army.mil]; Andrew.J.Bruzewicz@usace.army.mil[Andrew.J.Bruzewicz@usace.army.mil]; Nathan.J.Lamie@usace.army.mil[Nathan.J.Lamie@usace.army.mil]; Kemp.skudin@navy.mil[Kemp.skudin@navy.mil]; frank.stone@navy.mil[frank.stone@navy.mil]; abe.nachabe@navy.mil[abe.nachabe@navy.mil]; michael.s.dean@navy.mil[michael.s.dean@navy.mil]; Stephanie A. Brown[stephanie.a.brown@navy.mil]; Conmy, Robyn[Conmy.Robyn@epa.gov]; Principe, Vanessa[Principe.Vanessa@epa.gov]; Wilson, Gregory[Wilson.Gregory@epa.gov]; michael.j.green-1@nasa.gov[michael.j.green-1@nasa.gov]; wayne.yoder@dhs.gov[wayne.yoder@dhs.gov]; jfarrell@arctic.gov[jfarrell@arctic.gov]; Sarah.Helinek@csra.com[Sarah.Helinek@csra.com]; Rebecca.Weissman@csra.com[Rebecca.Weissman@csra.com]
From: Brooks, Rebecca J LT
Sent: Fri 5/13/2016 4:05:48 PM
Subject: 2nd Quarter Meeting Minutes -- Final
Minutes ICCOPR FY16-2nd Quarter Meeting_3_9_16_FINAL.pdf

Good morning ICCOPR,

Attached, please find the minutes from our 2nd Qtr meeting. Thanks and have a great weekend!

Very respectfully,

LT Becca Brooks
U.S. Coast Guard Headquarters STOP 7516
Office of Marine Environmental Response Policy (CG-MER-3)
2703 Martin Luther King Jr. Ave SE
Washington, DC 20593-7516
Phone: 202-372-2259

To: Principe, Vanessa[Principe.Vanessa@epa.gov]
From: Wilson, Gregory
Sent: Mon 3/28/2016 3:51:19 PM
Subject: RE: DRAFT ICCOPR 2nd-Quarter Meeting Minutes
Draft Minutes ICCOPR FY16-2nd Quarter Meeting_3_9_16_VP_GW.docx
Draft Minutes ICCOPR PWSRCAC 16 MAR 16 v1_VP_GW.docx

From: Principe, Vanessa
Sent: Friday, March 25, 2016 2:12 PM
To: Wilson, Gregory <Wilson.Gregory@epa.gov>
Subject: DRAFT ICCOPR 2nd-Quarter Meeting Minutes

A couple typos, and some questions.

To: Abe.nachabe@navy.mil[Abe.nachabe@navy.mil]; Andrew.J.Bruzewicz@usace.army.mil[Andrew.J.Bruzewicz@usace.army.mil]; Balsley, Alexander CIV[Alexander.Balsley@uscg.mil]; barry_Forsythe@fws.gov[barry_Forsythe@fws.gov]; Bowis, Meagan K LT[Meagan.K.Bowis@uscg.mil]; Carnegie, Tammie R LT[Tammie.R.Carnegie@uscg.mil]; christina_kravitz@fws.gov[christina_kravitz@fws.gov]; Conmy, Robyn[Conmy.Robyn@epa.gov]; Crecy, Stacey L LCDR[Stacey.L.Crecy@uscg.mil]; daniel.yuska@dot.gov[daniel.yuska@dot.gov]; dave.westerholm@noaa.gov[dave.westerholm@noaa.gov]; David.Lehman@dot.gov[David.Lehman@dot.gov]; david.moore@bsee.gov[david.moore@bsee.gov]; debbie.payton@noaa.gov[debbie.payton@noaa.gov]; DiRenzo, Joseph CIV[Joseph.DiRenzo@uscg.mil]; Elena.Melchert@hq.doe.gov[Elena.Melchert@hq.doe.gov]; Erica.Folio@Hq.Doe.Gov[Erica.Folio@Hq.Doe.Gov]; Fletcher, James E CIV[James.E.Fletcher@uscg.mil]; frank.stone@navy.mil[frank.stone@navy.mil]; Hall, Gregory CDR (EDU)[Gregory.Hall@USCGA.EDU]; kurt.a.hansen@uscg.mil[kurt.a.hansen@uscg.mil]; holly_herod@fws.gov[holly_herod@fws.gov]; jason.boehm@nist.gov[jason.boehm@nist.gov]; Jeff.Ji@boem.gov[Jeff.Ji@boem.gov]; Jenkins, Shannon R CIV[Shannon.R.Jenkins@uscg.mil]; jfarrell@arctic.gov[jfarrell@arctic.gov]; Jim Merritt[james.merritt@dot.gov]; john.kucklick@nist.gov[john.kucklick@nist.gov]; john.kucklick@noaa.gov[john.kucklick@noaa.gov]; Kemp.skudin@navy.mil[Kemp.skudin@navy.mil]; kevin.easley@hq.doe.gov[kevin.easley@hq.doe.gov]; Lori.Medley@bsee.gov[Lori.Medley@bsee.gov]; Loring, Joseph B CAPT[Joseph.B.Loring@uscg.mil]; Lundgren, Scott[Scott.R.Lundgren@uscg.mil]; mfocazio@usgs.gov[mfocazio@usgs.gov]; michael.carter@dot.gov[michael.carter@dot.gov]; michael.j.green-1@nasa.gov[michael.j.green-1@nasa.gov]; Maghini, Monica K CIV[Monica.K.Maghini@uscg.mil]; Platt, Jeffrey R LT[Jeffrey.R.Platt@uscg.mil]; Principe, Vanessa[Principe.Vanessa@epa.gov]; rachel.hardey.ctr@navy.mil[rachel.hardey.ctr@navy.mil]; robb.hyde@navy.mil[robb.hyde@navy.mil]; robert.w.smith@dot.gov[robert.w.smith@dot.gov]; Scott Lundgren NOAA[scott.lundgren@noaa.gov]; Stephanie A. Brown[stephanie.a.brown@navy.mil]; steve.lehmann@noaa.gov[steve.lehmann@noaa.gov]; steven.pearson@bsee.gov[steven.pearson@bsee.gov]; Steven.V.Cary@usace.army.mil[Steven.V.Cary@usace.army.mil]; Turner, Arden C CIV[Arden.C.Turner@uscg.mil]; mark.g.vanhaverbeke@uscg.mil[mark.g.vanhaverbeke@uscg.mil]; Vocke, William CIV[William.T.Vocke@uscg.mil]; Walter.Johnson@boem.gov[Walter.Johnson@boem.gov]; wayne.yoder@dhs.gov[wayne.yoder@dhs.gov]; Weaver, James (USCG)[James.D.Weaver@uscg.mil]; Wilson, Gregory[Wilson.Gregory@epa.gov]
From: Vocke, William CIV
Sent: Tue 8/25/2015 1:27:26 PM
Subject: Final Draft ICCOPR R&T Plan
Final Draft ICCOPR R&T Plan Based on Member comments 24AUG15.docx

Good morning ICCOPR members.

Thank you for your reviews of the different drafts of the ICCOPR R&T Plan. It has been a long time coming, but we are almost to the end of the process.

Attached for your final review is the Final Draft Oil Pollution Research and Technology Plan for Fiscal Years 2015-2021. This version includes revisions to the July 23, 2015 draft based on your review and comment. A comment adjudication matrix explaining the changes is being sent under separate cover for your information.

Any final comments are due to me by COB September 4, 2015. Your comments should focus on:
1. Are there any factual errors? If so, provide specific language to correct the error.
2. Is anything missing (i.e., critical organizations, etc.)? Again, provide specific language to add the missing information.
3. Are the resolutions of your comments acceptable? If not, contact me to discuss your concerns AND provide specific language that you find acceptable.
4. Are there typos/misspellings, etc. to correct? Please identify. We will have a tech editor go through the

plan, but we want to catch any as early as possible.

At this point, we will not be making changes to the overall approach or the report format/structure. Comments on these aspects will be deferred for consideration during development of the next version of the plan.

Steps forward:
4 September - Final comments due on the Draft Final
8-11 September - Final Edits completed
11 September - FINAL R&T Plan distributed for approval
TBD (~16th) September - ICCOPR Voting Meeting/Conference Call to approve the plan.

Thank you again for your efforts and support for developing a new version of the ICCOPR R&T Plan.

Bill Vocke
ICCOPR Executive Director
(202) 372-2019

To: Abe.nachabe@navy.mil[Abe.nachabe@navy.mil]; Andrew.J.Bruzewicz@usace.army.mil[Andrew.J.Bruzewicz@usace.army.mil]; Balsley, Alexander CIV[Alexander.Balsley@uscg.mil]; barry_Forsythe@fws.gov[barry_Forsythe@fws.gov]; Bowis, Meagan K LT[Meagan.K.Bowis@uscg.mil]; Carnegie, Tammie R LT[Tammie.R.Carnegie@uscg.mil]; christina_kravitz@fws.gov[christina_kravitz@fws.gov]; Conmy, Robyn[Conmy.Robyn@epa.gov]; Crecy, Stacey L LCDR[Stacey.L.Crecy@uscg.mil]; daniel.yuska@dot.gov[daniel.yuska@dot.gov]; dave.westerholm@noaa.gov[dave.westerholm@noaa.gov]; David.Lehman@dot.gov[David.Lehman@dot.gov]; david.moore@bsee.gov[david.moore@bsee.gov]; debbie.payton@noaa.gov[debbie.payton@noaa.gov]; DiRenzo, Joseph CIV[Joseph.DiRenzo@uscg.mil]; Elena.Melchert@hq.doe.gov[Elena.Melchert@hq.doe.gov]; Erica.Folio@Hq.Doe.Gov[Erica.Folio@Hq.Doe.Gov]; Fletcher, James E CIV[James.E.Fletcher@uscg.mil]; frank.stone@navy.mil[frank.stone@navy.mil]; Hall, Gregory CDR (EDU)[Gregory.Hall@USCGA.EDU]; kurt.a.hansen@uscg.mil[kurt.a.hansen@uscg.mil]; holly_herod@fws.gov[holly_herod@fws.gov]; jason.boehm@nist.gov[jason.boehm@nist.gov]; Jeff.Ji@boem.gov[Jeff.Ji@boem.gov]; Jenkins, Shannon R CIV[Shannon.R.Jenkins@uscg.mil]; jfarrell@arctic.gov[jfarrell@arctic.gov]; john.kucklick@nist.gov[john.kucklick@nist.gov]; john.kucklick@noaa.gov[john.kucklick@noaa.gov]; Kemp.skudin@navy.mil[Kemp.skudin@navy.mil]; kevin.easley@hq.doe.gov[kevin.easley@hq.doe.gov]; Lori.Medley@bsee.gov[Lori.Medley@bsee.gov]; Loring, Joseph B CAPT[Joseph.B.Loring@uscg.mil]; Lundgren, Scott[Scott.R.Lundgren@uscg.mil]; mfocazio@usgs.gov[mfocazio@usgs.gov]; michael.carter@dot.gov[michael.carter@dot.gov]; michael.j.green-1@nasa.gov[michael.j.green-1@nasa.gov]; Platt, Jeffrey R LT[Jeffrey.R.Platt@uscg.mil]; Principe, Vanessa[Principe.Vanessa@epa.gov]; rachel.hardey.ctr@navy.mil[rachel.hardey.ctr@navy.mil]; robb.hyde@navy.mil[robb.hyde@navy.mil]; robert.w.smith@dot.gov[robert.w.smith@dot.gov]; Scott Lundgren NOAA[scott.lundgren@noaa.gov]; Stephanie A. Brown[stephanie.a.brown@navy.mil]; steve.lehmann@noaa.gov[steve.lehmann@noaa.gov]; steven.pearson@bsee.gov[steven.pearson@bsee.gov]; Steven.V.Cary@usace.army.mil[Steven.V.Cary@usace.army.mil]; Turner, Arden C CIV[Arden.C.Turner@uscg.mil]; mark.g.vanhaverbeke@uscg.mil[mark.g.vanhaverbeke@uscg.mil]; Vocke, William CIV[William.T.Vocke@uscg.mil]; Walter.Johnson@boem.gov[Walter.Johnson@boem.gov]; wayne.yoder@dhs.gov[wayne.yoder@dhs.gov]; Weaver, James (USCG)[James.D.Weaver@uscg.mil]; Wilson, Gregory[Wilson.Gregory@epa.gov]
From: Vocke, William CIV
Sent: Thur 7/23/2015 7:54:27 PM
Subject: ICCOPR R&T Plan - DRAFT FOR MEMBER REVIEW
ICCOPR R&T Plan Draft for Members 23JULY2015 v1 line nmbr.docx
R&T Plan Comment Matrix 23JULY2015.xls

All,

It is with great pleasure (and much relief!) that I am forwarding the completed Draft ICCOPR Research and Technology Plan for FY2015-2021 for member review. This version incorporates revisions to individual chapters based on multiple rounds of review for individual chapters. Please take time to review this completed document and provide me with comments using that attached comment matrix. Comments are due August 7, 2015 COB. Once comments are addressed from this round of review, I will send out a final version for ICCOPR vote on adopting this Plan.

If you identify any critical issues, please contact me ASAP so we can address it as soon as possible. After our multiple reviews I hope we have addressed any critical issues. I am available anytime to discuss any concerns or suggestions.

I would like to extend my thanks to all the members and former ICCOPR members that have worked hard to develop the plan and provide comments on the drafts. In particular, I would like to recognize the members of the R&T working group for the extensive work evaluating the more than 900 research needs and narrowing them down into our 150 priorities. Participants in the R&T working group included Lori Medley, Robyn Conmy, Steve Lehmann, Elena Melchert, CDR Eric Miller, LT Sara Thompson, and Bill

Vocke, with the support of the University of New Hampshire.

Very respectively,
Bill Vocke
Executive Director
Interagency Coordinating Committee on Oil Pollution Research
U.S. Coast Guard
(202) 372-2019

To: Principe, Vanessa[Principe.Vanessa@epa.gov]
From: Vocke, William CIV
Sent: Thur 6/4/2015 3:10:16 PM
Subject: R&T Plan Ch 7&8
Ch 78 Member Draft 2015-05-13_OEM_5_27_15.docx

Hi Vanessa,

FYI - Attached are the changes made to Chapters 7&8 based on your comments.

Bill

To: Loring, Joseph B CAPT[Joseph.B.Loring@uscg.mil]; david.moore@bsee.gov[david.moore@bsee.gov]; kurt.a.hansen@uscg.mil[kurt.a.hansen@uscg.mil]; Jenkins, Shannon R CIV[Shannon.R.Jenkins@uscg.mil]; Lundgren, Scott[Scott.R.Lundgren@uscg.mil]; Vocke, William CIV[William.T.Vocke@uscg.mil]; Platt, Jeffrey R LT[Jeffrey.R.Platt@uscg.mil]; Conmy, Robyn[Conmy.Robyn@epa.gov]; Wilson, Gregory[Wilson.Gregory@epa.gov]; Principe, Vanessa[Principe.Vanessa@epa.gov]; wayne.yoder@dhs.gov[wayne.yoder@dhs.gov]; holly_herod@fws.gov[holly_herod@fws.gov]; christina_kravitz@fws.gov[christina_kravitz@fws.gov]; daniel.yuska@dot.gov[daniel.yuska@dot.gov]; michael.carter@dot.gov[michael.carter@dot.gov]; michael.j.green-1@nasa.gov[michael.j.green-1@nasa.gov]; Kemp.skudin@navy.mil[Kemp.skudin@navy.mil]; Stephanie A. Brown[stephanie.a.brown@navy.mil]; steve.lehmann@noaa.gov[steve.lehmann@noaa.gov]; robert.w.smith@dot.gov[robert.w.smith@dot.gov]; Steven.V.Cary@usace.army.mil[Steven.V.Cary@usace.army.mil]; jfarrell@arctic.gov[jfarrell@arctic.gov]; Andrew.J.Bruzewicz@usace.army.mil[Andrew.J.Bruzewicz@usace.army.mil]; Elena.Melchert@hq.doe.gov[Elena.Melchert@hq.doe.gov]; Lori.Medley@bsee.gov[Lori.Medley@bsee.gov]; kevin.easley@hq.doe.gov[kevin.easley@hq.doe.gov]; debbie.payton@noaa.gov[debbie.payton@noaa.gov]; Jeff.Ji@boem.gov[Jeff.Ji@boem.gov]; Walter.Johnson@boem.gov[Walter.Johnson@boem.gov]; jason.boehm@nist.gov[jason.boehm@nist.gov]; john.kucklick@nist.gov[john.kucklick@nist.gov]; john.kucklick@noaa.gov[john.kucklick@noaa.gov]; robb.hyde@navy.mil[robb.hyde@navy.mil]; steven.pearson@bsee.gov[steven.pearson@bsee.gov]; Abe.nachabe@navy.mil[Abe.nachabe@navy.mil]; dave.westerholm@noaa.gov[dave.westerholm@noaa.gov]; Weaver, James (USCG)[James.D.Weaver@uscg.mil]; Erica.Folio@Hq.Doe.Gov[Erica.Folio@Hq.Doe.Gov]; barry_Forsythe@fws.gov[barry_Forsythe@fws.gov]; David.Lehman@dot.gov[David.Lehman@dot.gov]; frank.stone@navy.mil[frank.stone@navy.mil]; rachel.hardey.ctr@navy.mil[rachel.hardey.ctr@navy.mil]; Crecy, Stacey L LCDR[Stacey.L.Crecy@uscg.mil]; Carnegie, Tammie R LT[Tammie.R.Carnegie@uscg.mil]; Turner, Arden C CIV[Arden.C.Turner@uscg.mil]; mark.g.vanhaverbeke@uscg.mil[mark.g.vanhaverbeke@uscg.mil]; Balsley, Alexander CIV[Alexander.Balsley@uscg.mil]; Fletcher, James E CIV[James.E.Fletcher@uscg.mil]; mfocazio@usgs.gov[mfocazio@usgs.gov]; DiRenzo, Joseph CIV[Joseph.DiRenzo@uscg.mil]; Hall, Gregory CDR (EDU)[Gregory.Hall@USCGA.EDU]
From: Vocke, William CIV
Sent: Tue 5/26/2015 6:57:53 PM
Subject: Reminders - Comments due on R&T Plan Ch 7-9 and Meeting minutes
Ch 7&8 Member Draft 2015-05-13.docx
Ch 9 - Member Early review 2015MAY13.docx
Draft Minutes ICCOPR FY15-2nd Quarter Meeting - member review.docx
Draft Minutes - 2015 ICCOPR-PWSRCAC meeting.docx

All,

Thank you to those who have provided comments on the meeting minutes and R&T Plan draft chapters that I sent earlier this month.

As a reminder, comments are due COB today (May 26, 2015) for the ICCOPR FY15 Quarter 2 meeting minutes and the PWSRCAC meeting minutes. (Files attached) I will take comments through COB tomorrow (May 27), after that the minutes will be considered final after incorporation of member comments.

A second reminder: Comments are due tomorrow COB for the early review drafts of Chapters 7, 8, an 9 (files attached) of the ICCOPR R&T Plan. Please review these chapters and provide me with any comments/corrections.

The Introduction and Chapter 1 are undergoing Working Group review and you should be receiving them for review late this week. Please give that final chapter of the plan you attention so we can make changes and get a complete copy of the plan compiled for member review. As it stands now, the R&T Plan has

about 180 pages.

Bill
(202) 372-2019

To: Loring, Joseph B CAPT[Joseph.B.Loring@uscg.mil]; david.moore@bsee.gov[david.moore@bsee.gov]; kurt.a.hansen@uscg.mil[kurt.a.hansen@uscg.mil]; Jenkins, Shannon R CIV[Shannon.R.Jenkins@uscg.mil]; Lundgren, Scott[Scott.R.Lundgren@uscg.mil]; Vocke, William CIV[William.T.Vocke@uscg.mil]; Platt, Jeffrey R LT[Jeffrey.R.Platt@uscg.mil]; Conmy, Robyn[Conmy.Robyn@epa.gov]; Wilson, Gregory[Wilson.Gregory@epa.gov]; Principe, Vanessa[Principe.Vanessa@epa.gov]; wayne.yoder@dhs.gov[wayne.yoder@dhs.gov]; holly_herod@fws.gov[holly_herod@fws.gov]; christina_kravitz@fws.gov[christina_kravitz@fws.gov]; daniel.yuska@dot.gov[daniel.yuska@dot.gov]; michael.carter@dot.gov[michael.carter@dot.gov]; michael.j.green-1@nasa.gov[michael.j.green-1@nasa.gov]; Kemp.skudin@navy.mil[Kemp.skudin@navy.mil]; Stephanie A. Brown[stephanie.a.brown@navy.mil]; steve.lehmann@noaa.gov[steve.lehmann@noaa.gov]; robert.w.smith@dot.gov[robert.w.smith@dot.gov]; Steven.V.Cary@usace.army.mil[Steven.V.Cary@usace.army.mil]; jfarrell@arctic.gov[jfarrell@arctic.gov]; Andrew.J.Bruzewicz@usace.army.mil[Andrew.J.Bruzewicz@usace.army.mil]; Elena.Melchert@hq.doe.gov[Elena.Melchert@hq.doe.gov]; Lori.Medley@bsee.gov[Lori.Medley@bsee.gov]; kevin.easley@hq.doe.gov[kevin.easley@hq.doe.gov]; debbie.payton@noaa.gov[debbie.payton@noaa.gov]; Jeff.Ji@boem.gov[Jeff.Ji@boem.gov]; Walter.Johnson@boem.gov[Walter.Johnson@boem.gov]; jason.boehm@nist.gov[jason.boehm@nist.gov]; john.kucklick@nist.gov[john.kucklick@nist.gov]; john.kucklick@noaa.gov[john.kucklick@noaa.gov]; robb.hyde@navy.mil[robb.hyde@navy.mil]; steven.pearson@bsee.gov[steven.pearson@bsee.gov]; Abe.nachabe@navy.mil[Abe.nachabe@navy.mil]; dave.westerholm@noaa.gov[dave.westerholm@noaa.gov]; Weaver, James (USCG)[James.D.Weaver@uscg.mil]; Erica.Folio@Hq.Doe.Gov[Erica.Folio@Hq.Doe.Gov]; barry_Forsythe@fws.gov[barry_Forsythe@fws.gov]; David.Lehman@dot.gov[David.Lehman@dot.gov]; frank.stone@navy.mil[frank.stone@navy.mil]; rachel.hardey.ctr@navy.mil[rachel.hardey.ctr@navy.mil]; Crecy, Stacey L LCDR[Stacey.L.Crecy@uscg.mil]; Carnegie, Tammie R LT[Tammie.R.Carnegie@uscg.mil]; Turner, Arden C CIV[Arden.C.Turner@uscg.mil]; mark.g.vanhaverbeke@uscg.mil[mark.g.vanhaverbeke@uscg.mil]; Balsley, Alexander CIV[Alexander.Balsley@uscg.mil]; Fletcher, James E CIV[James.E.Fletcher@uscg.mil]; mfocazio@usgs.gov[mfocazio@usgs.gov]; DiRenzo, Joseph CIV[Joseph.DiRenzo@uscg.mil]; Hall, Gregory CDR (EDU)[Gregory.Hall@USCGA.EDU]
From: Vocke, William CIV
Sent: Tue 5/26/2015 4:54:34 PM
Subject: ICCOPR FY15 Qtr 1 Meeting - Final Minutes
Final Minutes & Encl FY15Q1 ICCOPR mtg signed.pdf

ICCOPR members,

Attached for your records are the final minutes of the ICCOPR FY2015 First Quarterly Meeting conducted on January 22-23, 2015.

William T. Vocke
ICCOPR Executive Director
U.S. Coast Guard
Office of Marine Environmental Response
2703 Martin Luther King Jr. Ave. SE
Washington, DC 20593
(202) 372-2019

To: Brooks, Rebecca J LT[Rebecca.J.Brooks@uscg.mil]; Loring, Joseph B CAPT[Joseph.B.Loring@uscg.mil]; Weaver, James (USCG)[James.D.Weaver@uscg.mil]; Scott.A.Stoermer@uscg.mil[Scott.A.Stoermer@uscg.mil]; Ottenwaelder, Thomas A CDR[Thomas.A.Ottenwaelder@uscg.mil]; Sligh, Kevin M CIV[Kevin.M.Sligh@uscg.mil]; Carnegie, Tammie R LT[Tammie.R.Carnegie@uscg.mil]; Crecy, Stacey L LCDR[Stacey.L.Crecy@uscg.mil]; Platt, Jeffrey R LCDR[Jeffrey.R.Platt@uscg.mil]; Maghini, Monica K CIV[Monica.K.Maghini@uscg.mil]; Hall, Gregory CDR (EDU)[Gregory.Hall@USCGA.EDU]; Fletcher, James E CIV[James.E.Fletcher@uscg.mil]; kurt.a.hansen@uscg.mil[kurt.a.hansen@uscg.mil]; Balsley, Alexander CIV[Alexander.Balsley@uscg.mil]; DiRenzo, Joseph CIV[Joseph.DiRenzo@uscg.mil]; mark.g.vanhaverbeke@uscg.mil[mark.g.vanhaverbeke@uscg.mil]; Catanach, Curtis P CIV[Curtis.P.Catanach@uscg.mil]; Chaves, Wendy[Wendy.G.Chaves@uscg.mil]; Jenkins, Shannon R CIV[Shannon.R.Jenkins@uscg.mil]; dave.westerholm@noaa.gov[dave.westerholm@noaa.gov]; scott.lundgren@noaa.gov[scott.lundgren@noaa.gov]; steve.lehmann@noaa.gov[steve.lehmann@noaa.gov]; john.kucklick@nist.gov[john.kucklick@nist.gov]; jason.boehm@nist.gov[jason.boehm@nist.gov]; Elena.Melchert@hq.doe.gov[Elena.Melchert@hq.doe.gov]; Erica.Folio@Hq.Doe.Gov[Erica.Folio@Hq.Doe.Gov]; kevin.easley@hq.doe.gov[kevin.easley@hq.doe.gov]; david.moore@bsee.gov[david.moore@bsee.gov]; Lori.Medley@bsee.gov[Lori.Medley@bsee.gov]; william.vocke@bsee.gov[william.vocke@bsee.gov]; joseph.levine@bsee.gov[joseph.levine@bsee.gov]; Walter.Johnson@boem.gov[Walter.Johnson@boem.gov]; brian.zelenke@boem.gov[brian.zelenke@boem.gov]; Jeff.Ji@boem.gov[Jeff.Ji@boem.gov]; barry_Forsythe@fws.gov[barry_Forsythe@fws.gov]; holly_herod@fws.gov[holly_herod@fws.gov]; christina_kravitz@fws.gov[christina_kravitz@fws.gov]; michael.carter@dot.gov[michael.carter@dot.gov]; tom.thompson@dot.gov[tom.thompson@dot.gov]; robert.w.smith@dot.gov[robert.w.smith@dot.gov]; james.merritt@dot.gov[james.merritt@dot.gov]; David.Lehman@dot.gov[David.Lehman@dot.gov]; Steven.V.Cary@usace.army.mil[Steven.V.Cary@usace.army.mil]; Andrew.J.Bruzewicz@usace.army.mil[Andrew.J.Bruzewicz@usace.army.mil]; Nathan.J.Lamie@usace.army.mil[Nathan.J.Lamie@usace.army.mil]; Kemp.skudin@navy.mil[Kemp.skudin@navy.mil]; frank.stone@navy.mil[frank.stone@navy.mil]; abe.nachabe@navy.mil[abe.nachabe@navy.mil]; michael.s.dean@navy.mil[michael.s.dean@navy.mil]; Stephanie A. Brown[stephanie.a.brown@navy.mil]; Conmy, Robyn[Conmy.Robyn@epa.gov]; Principe, Vanessa[Principe.Vanessa@epa.gov]; Wilson, Gregory[Wilson.Gregory@epa.gov]; michael.j.green-1@nasa.gov[michael.j.green-1@nasa.gov]; wayne.yoder@dhs.gov[wayne.yoder@dhs.gov]; jfarrell@arctic.gov[jfarrell@arctic.gov]; Sarah.Helinek@csra.com[Sarah.Helinek@csra.com]; Rebecca.Weissman@csra.com[Rebecca.Weissman@csra.com]
From: Brooks, Rebecca J LT
Sent: Fri 5/13/2016 4:14:00 PM
Subject: RE: 2nd Quarter Meeting Minutes -- Final
3_DiPinto ICCOPR NRDA Science final.pdf
4_RCP Biodegradation of Dispersed oil ICCOPR - some pics.pdf
1_Dilbit BriefingICCOPR TF.pdf
2_ICCOPR-RadarBasedSlickCharacterization-CEJones-March2016.pdf
5_ICCOPR march 2016 EPA updates.pdf
7_BSEE_ICCOPR March 2016.pdf
8_BOEM_ICCOPR_March_2016.pdf
10_Meeting AnnouncementQ2FY16.pdf
9_Draft IR Workgroup Charter 12-30-15.pdf

ICCOPR,

I'm attaching the Enclosures separately. Thanks!

Very respectfully,

LT Becca Brooks

U.S. Coast Guard Headquarters STOP 7516
Office of Marine Environmental Response Policy (CG-MER-3)
2703 Martin Luther King Jr. Ave SE
Washington, DC 20593-7516
Phone: 202-372-2259

-----Original Message-----
From: Brooks, Rebecca J LT
Sent: Friday, May 13, 2016 12:06 PM
To: Loring, Joseph B CAPT; Weaver, James D CDR; Stoermer, Scott A CDR; Ottenwaelder, Thomas A CDR; Sligh, Kevin M CIV; Carnegie, Tammie R LT; Crecy, Stacey L LCDR; Platt, Jeffrey R LCDR; Brooks, Rebecca J LT; Maghini, Monica K CIV; Hall, Gregory CDR (EDU); Fletcher, James E CIV; Hansen, Kurt A CIV; Balsley, Alexander CIV; DiRenzo, Joseph CIV; VanHaverbeke, Mark G CIV; Catanach, Curtis P CIV; Chaves, Wendy; Jenkins, Shannon R CIV; 'dave.westerholm@noaa.gov'; 'scott.lundgren@noaa.gov'; 'Steve.Lehmann@noaa.gov'; 'john.kucklick@nist.gov'; 'jason.boehm@nist.gov'; 'Elena.Melchert@hq.doe.gov'; 'Erica.Folio@Hq.Doe.Gov'; 'kevin.easley@hq.doe.gov'; 'david.moore@bsee.gov'; 'Lori.Medley@bsee.gov'; 'william.vocke@bsee.gov'; 'joseph.levine@bsee.gov'; 'Walter.Johnson@boem.gov'; 'brian.zelenke@boem.gov'; 'Jeff.Ji@boem.gov'; 'barry_Forsythe@fws.gov'; 'holly_herod@fws.gov'; 'christina_kravitz@fws.gov'; 'michael.carter@dot.gov'; 'tom.thompson@dot.gov'; 'robert.w.smith@dot.gov'; 'james.merritt@dot.gov'; 'David.Lehman@dot.gov'; 'Steven.V.Cary@usace.army.mil'; 'Andrew.J.Bruzewicz@usace.army.mil'; 'Nathan.J.Lamie@usace.army.mil'; 'Kemp.skudin@navy.mil'; 'frank.stone@navy.mil'; 'abe.nachabe@navy.mil'; 'michael.s.dean@navy.mil'; 'stephanie.a.brown@navy.mil'; 'Conmy.Robyn@epamail.epa.gov'; 'principe.vanessa@epa.gov'; 'Wilson.Gregory@epamail.epa.gov'; 'michael.j.green-1@nasa.gov'; 'wayne.yoder@dhs.gov'; 'jfarrell@arctic.gov'; 'Sarah.Helinek@csra.com'; 'Rebecca.Weissman@csra.com'
Subject: 2nd Quarter Meeting Minutes -- Final

Good morning ICCOPR,

Attached, please find the minutes from our 2nd Qtr meeting. Thanks and have a great weekend!

Very respectfully,

LT Becca Brooks
U.S. Coast Guard Headquarters STOP 7516
Office of Marine Environmental Response Policy (CG-MER-3)
2703 Martin Luther King Jr. Ave SE
Washington, DC 20593-7516
Phone: 202-372-2259

U.S. Department of Homeland Security
United States Coast Guard

Commandant
United States Coast Guard

2703 Martin Luther King Jr. Ave. S.E.
Washington, DC 20593-7516
Staff Symbol: CG-MER-3
Phone: (202) 372-2247
Email: james.d.weaver@uscg.mil

3900
10 FEB 2016

MEMORANDUM

From: J.D. Weaver, CDR
Executive Director, Interagency Coordinating Committee on Oil Pollution Research (ICCOPR)

Reply to: 202-372-2259
Attn of: LT Rebecca Brooks

To: ICCOPR Membership

Subj: FY 2016 SECOND QUARTER MEETING INVITATION AND AGENDA

1. This memorandum provides information on the next quarterly ICCOPR meeting, which will be held on Wednesday, March 09, 2016. The meeting time and location are provided below and enclosure (1) gives further travel/logistical details:

Time:	9:00 a.m. – 3:30 p.m.
Location:	SRA International 3434 Washington Boulevard Arlington, VA
Conference Call Line:	1-(800) 747-5150 PIN: 9590509
Webex Connection:	See Enclosure (1)
POC:	Becca Brooks, 202-372-2259, rebecca.j.brooks@uscg.mil

2. The meeting agenda is provided in enclosure (2). This meeting has a full agenda, which includes updates on Deepwater Horizon NRDA process, the role of dispersants in stimulating the biodegradation of spilled oil, a NAS study on spills of diluted bitumen from pipelines, and the use of radar to characterize oil spills.

3. The agenda includes time for member R&D updates. Please provide LT Brooks with any written updates you wish to pass along and I will distribute the updates to the members and include them in the minutes.

4. Please contact LT Brooks (202-372-2259 / rebecca.j.brooks@uscg.mil) by COB on March 4, 2016 to let me know who will be attending from your organization – this will aid in our conference room setup as well as security notifications at the location.

#

Enclosures: (1) Directions and logistics
(2) Meeting agenda

Directions to SRA International - Arlington Center Office

3434 Washington Boulevard
Arlington, VA 22201
+1 (703) 284-5000

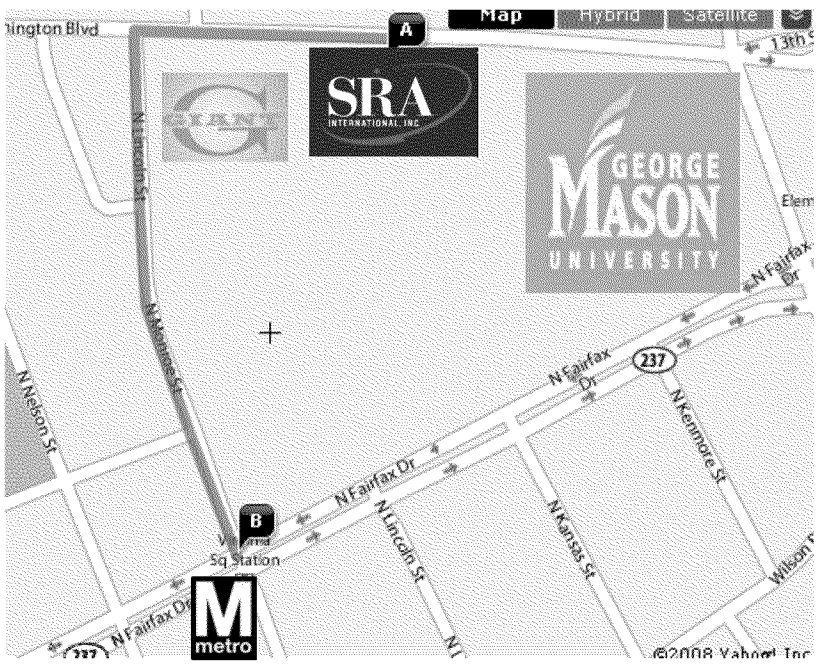
Visitors must check in with the receptionist located on the third floor upon arrival.

Visitors, please note: There are a limited number of SRA visitor spaces in the B3 and B4 levels in the Arlington Center parking garage – please ensure that you park in the spaces marked SRA or you will be ticketed.

Also, please note that metered parking is available on the streets surrounding the building. Garage parking is available less than one mile away at Founders Hall, 3330 Washington Blvd.; Ballston Mall garage, 4238 Wilson Blvd., adjacent to the Ballston metro stop; and at the Clarendon Interpark Market Commons garage, 2800 Clarendon Blvd., adjacent to the Clarendon metro stop.

Taking the Metro

- Orange Line to Virginia Square/GMU station
- Exit the station. Behind you will be intersection of Fairfax Drive and Monroe Street.
- Cross Fairfax Drive and continue up Monroe Street (1 block).
- Monroe Street becomes Lincoln Street in front of the Giant Food. Continue along Lincoln Street (1 block).
- Turn right onto Washington Blvd.
- Walk ½ block and SRA is on your right.



Enclosure (1)

Driving Directions

From Maryland:

Take I-495 South over the American Legion Bridge into Virginia. Take exit 45B (I-66 East – Washington). Stay on I-66 East for 6 miles, then take exit 71 (Glebe Road and Fairfax Drive). Off the exit ramp, at the second traffic light, take a left on to North Glebe Road. At the second traffic light, take a right on to Washington Boulevard. Stay on Washington Boulevard for approximately .8 miles. The Arlington Center building is just past the Giant Food store on the right (marked "3434"). Just past the building, turn right into the small alley for the entrance to the parking garage. Once in the garage, take the elevator to the third floor and check in with the receptionist in the lobby.

66 East inside I-495 (Capital Beltway) is restricted to high occupancy vehicle 2 passengers Monday – Friday, 5:30 a.m. – 9:30 a.m.

From Points West:

Take I-66 East Washington. Take exit 71 (Glebe Road and Fairfax Drive). Off the exit ramp, at the second traffic light, take a left on to North Glebe Road. At the second traffic light, take a right on to Washington Boulevard. Stay on Washington Boulevard for approximately .8 miles. The Arlington Center building is just past the Giant Food store on the right (marked "3434"). Just past the building, turn right into the small alley for the entrance to the parking garage. Once in the garage, take the elevator to the third floor and check in with the receptionist in the lobby.

66 East inside I-495 (Capital Beltway) is restricted to high occupancy vehicle 2 passengers Monday – Friday, 5:30 a.m. – 9:30 a.m.

From Points South:

Take I–395 North – Washington. Merge on to Washington Boulevard via exit 8A toward Virginia route 244 (Columbia Pike). Stay on Washington Boulevard for 2.8 miles, then take a slight left on to 13th Street. Bear right on to Washington Boulevard. The SRA Arlington Center building is located at 3434 Washington Boulevard. Facing the building, the parking garage is accessible via an alley on the left–hand side of the building. Once in the garage, take the elevator to the third floor level and check in with the receptionist in the lobby.

From Washington, D.C.:

Follow Constitution Avenue or the E Street Expressway to I-66 West. Bear right on to I-66 West. Take US-50 West to Arlington Boulevard. Bear right on to VA-237 West for approximately 1.5 miles, and bear a slight right on to Washington Boulevard. Travel for 0.2 miles. The SRA Arlington Center building is on the left, located at 3434 Washington Boulevard. Facing the building, the parking garage is accessible via an alley on the left-hand side of the building. Once in the garage, take the elevator to the third floor and check in with the receptionist in the lobby.

Enclosure (1)

CALL-IN AND WEB-EX INFO:

Conference Line: 800-747-5150
Pin: 9590509

Web-ex:

1. Go to:
https://srameeting.webex.com/mw0401lsp13/mywebex/default.do?service=1&siteurl=srameeting&nomenu=true&main_url=%2Fmc0901lsp13%2Fe.do%3Fsiteurl%3Dsrameeting%26AT%3DMI%26EventID%3D408214302%26UID%3D0%26Host%3DQUhTSwAAAAJiDKQQIyVAp6os8sh-MkgoXI0PMNZo5eT3WktpEQtaKixAgb_I7-tuJGCnX6FBQgpr_8CGnk2ss8yyLLU3RHrZ0%26FrameSet%3D2%26MTID%3Dm33a3043e8e870448f421061208cef8e5
2. Enter your name and email address.
3. Enter the meeting password: ICCOPR
4. Click "Join Now".

Enclosure (1)

Interagency Coordinating Committee on Oil Pollution Research (ICCOPR)
FY16 Second Quarter Meeting

Wednesday March 9, 2016 (9:00 AM – 3:30 PM)
SRA International
3434 Washington Boulevard, Arlington, VA
Conference Line: # (800) 747-5150 Access Code: 9590509

AGENDA

9:00 – 9:15 AM	Welcome and Introductions Opening Remarks	CAPT Joe Loring Robyn Conmy
9:15 – 9:20 AM	General Updates/Announcements • Biennial Report to Congress Status • Departures and Arrivals	CDR James Weaver
9:20 – 9:50 AM	Spills of Diluted Bitumen from Pipelines: A Comparative Study of Environmental Fate, Effects, and Response	Dr. Douglas Friedman
9:50 – 10:30 AM	Using RADAR to Characterize Oil Slicks	Cathleen Jones
10:30 – 11:15 AM	DWH NRDA Process	Lisa DiPinto
11:15 – 11:45 AM	Intentional Release Permitting Subcommittee Discussion	CDR James Weaver
11:45 AM – 1:00 PM	LUNCH	
1:00 – 1:30 PM	The Role of Dispersants in Stimulating the Biodegradation of Spilled Oil	Roger Prince
1:30 – 3:10 PM	Member R&D Updates	Members
3:10 – 3:20 PM	New Business	Members
3:20 – 3:30 PM	Closing comments and adjourn	CAPT Loring Robyn Conmy

Enclosure (2)

To: peter.egan@total.com[peter.egan@total.com]
Cc: Wilson, Gregory[Wilson.Gregory@epa.gov]; Principe, Vanessa[Principe.Vanessa@epa.gov]
From: Conmy, Robyn
Sent: Mon 4/18/2016 2:47:20 PM
Subject: purchase of Finasol OSR52

Mr. Egan,

This follows up our telephone conversation of April 11.

As discussed, EPA is seeking to acquire a number of dispersant products listed on the NCP Subpart J Product Schedule for the purposes of both toxicity and efficacy testing. The product testing is intended to further inform currently proposed regulatory actions under Subpart J of the National Contingency Plan. The products will in addition be used to support our general research in the area of oil spill response.

Your product Finasol OSR52 has been identified as one of interest, as it is commonly stockpiled in the U.S. Not only could the product be encountered when presented with a response situation, but including this dispersant product in toxicity and efficacy testing studies will also allow for comparison and consistency with other existing and ongoing studies by EPA and other federal agencies. EPA's Office of Research and Development (ORD) will be conducting the dispersant studies.

At this time we are seeking 2 U.S. gallons of the product.

We appreciate your time and attention to this request.

Respectfully,

Robyn Conmy

<>/<>/<>/<>/<>/<>/<>/<>/<>/<>/<>/<>/<>/<>/<>/<>

Robyn N. Conmy, Ph.D.

Research Ecologist

USEPA/NRMRL/LRPCD

26 West MLK Drive

Cincinnati, Ohio 45268

513-569-7090 (office)

513-431-1970 (EPA mobile)

727-692-5333 (Personal mobile)

conmy.robyn@epa.gov

Cc: Diane Wagenbrenner[dianesue3@att.net]
To: Principe, Vanessa[Principe.Vanessa@epa.gov]
From: Diane Wagenbrenner
Sent: Thur 4/23/2015 2:37:54 AM
Subject: From LAEO: Your Comment Submitted on Regulations.gov (ID: EPA-HQ-OPA-2006-0090-0409)
LAEO Public CommentFF.pdf
ATT00001.htm

Hello Vanessa,
I have tried to attach LAEO's public comment pdf doc in the .gov site three times. It keeps replacing it with a 'sample letter' document. In order to ensure there is a record that I did submit our comment (15 pages of a pdf document) by the deadline cut off, I am attaching it herewith. Thank you for providing this opportunity. Please see below:

LINK:
http://protectmarinelifenow.org/wp-content/uploads/delightful-downloads/2015/04/LAEO-Public-CommentFF1.pdf

I would appreciate it if you confirmed receipt.

Thanks Much,
Diane

Begin forwarded message:

From: "Regulations.gov" <no-reply@regulations.gov>
Subject: Your Comment Submitted on Regulations.gov (ID: EPA-HQ-OPA-2006-0090-0409)
Date: April 22, 2015 at 10:24:44 PM EDT
To: dianesue3@att.net

Please do not reply to this message. This email is from a notification only address that cannot accept incoming email.

Your comment was submitted successfully!

Comment Tracking Number: 1jz-8ig2-yl5y

Your comment may be viewable on Regulations.gov once the agency has reviewed it. This process is dependent on agency public submission policies/procedures and processing times. Use your tracking number to find out the status of your comment.

Agency: Environmental Protection Agency (EPA)
Document Type: Rulemaking
Title: Comment submitted by The Lawrence Anthony Earth Organization (LAEO)
Document ID: EPA-HQ-OPA-2006-0090-0409

Comment:
Dear EPA: This is Diane Wagenbrenner, VP Operations, Lawrence Anthony Earth Organization. I have submitted our public comment twice consisting of attaching a 15 page document. The system is not receiving this document under my comment, therefore, I am resubmitting it a 3rd time as a LINK here to ensure it does in fact get received.

Here it is: [URL REMOVED]

Thank you.

Uploaded File(s):
No files uploaded

For further information about the Regulations.gov commenting process, please visit http://www.regulations.gov/#!faqs.

*** For security purposes, URLs were removed from this receipt but not from your comment on Regulations.gov.**

Diane Wagenbrenner
VP Operations & Public Information
Lawrence Anthony Earth Organization
diane@theearthorganization.org
Ph: 858-531-6200

We would love for you to become a Member!
∞
Because None Survive Alone

www.theearthorganization.org

Campaign Coordinator: www.ProtectMarineLifeNow.org
Change Oil Spill Response Global Alliance Member

Helping members of our planetary ecosystems who cannot speak for themselves

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To: Matthiessen, Craig[Matthiessen.Craig@epa.gov]; Wilson, Gregory[Wilson.Gregory@epa.gov]; Principe, Vanessa[Principe.Vanessa@epa.gov]
Cc: Raymond Bradley[bradleyr@api.org]
From: Emily Hague
Sent: Wed 4/22/2015 10:07:59 PM
Subject: API and NOIA Comments on EPA Subpart J Proposed Rule
removed.txt
API and NOIA Comments on EPA Subpart J Proposed Rule with PNG Attachment 04.22.15.pdf

Hello Craig, Greg and Vanessa –

API and NOIA submitted the attached comments on the EPA Subpart J Proposed Rule this afternoon through Regulations.gov. Attached is our letter for your reference. We also plan to provide this letter by mail to Mathy Stanislaus.

Thank you for this opportunity to comment,

Emily

Emily Kennedy Hague

Senior Policy Advisor, Upstream & Industry Operations

American Petroleum Institute

1220 L Street, NW

Washington, DC 20005

Ph: 202-682-8260

Fx: 202-682-8426

hague@api.org

This transmission contains information that is privileged and confidential and is intended solely for use of the individual(s) listed above. If you received the communication in error, please notify me immediately. Any dissemination or copying of this communication by anyone other than the individual(s) listed above is prohibited.

April 22, 2015

U.S. Environmental Protection Agency
EPA Docket Center (EPA/DC)
Docket ID No. EPA–HQ–OPA–2006–0090
1200 Pennsylvania Avenue NW 20460

Submitted via electronic submission to http://www.regulations.gov **and by mail**

Dear Dr. Gregory Wilson,

On January 22, 2015, the U.S. Environmental Protection Agency (EPA or the Agency) issued a Proposed Rule to amend Subpart J of the National Oil and Hazardous Substances Contingency Plan that governs the use of dispersants, other chemical and biological agents, and other spill mitigating substances when responding to oil discharges into the waters of the United States. 80 Fed. Reg. 3380 (January 22, 2015). Comments are due by April 22, 2015. The following comments to the docket are provided by the American Petroleum Institute (API) and the National Ocean Industries Association (NOIA) (collectively, "we") on behalf of our member companies based on review of the above-cited Proposed Rule.

API is a national trade association that represents over 625 members involved in all aspects of the oil and natural gas industry, including the exploration and production of both onshore and offshore Federal resources. The U.S. oil and natural gas industry supports 9.8 million U.S. jobs and 8 percent of the U.S. economy, delivering tens of millions per day in revenue to our government. API members provide most of the nation's energy and are backed by a growing grassroots movement of more than 25 million Americans.

NOIA, founded in 1972, represents more than 270 companies among all segments of the offshore industry with an interest in the exploration and production of both traditional and renewable energy resources on the nation's outer continental shelf (OCS). NOIA's mission is to secure reliable access and a fair regulatory and economic environment for the companies that develop the nation's valuable offshore energy resources in an environmentally responsible manner.

API, NOIA, and our respective members recognize the important mission of the EPA in protecting human health and the environment and share in this mission. More than most industries, the oil and natural gas industry understands the nature of risk and places at the center of its concern comprehensive planning for and effective management of risks in order to safeguard human well-being and protect environmental resources. To this end, woven into every operational endeavor are release prevention measures, preparedness methods and plans for rapid, effective response should an incident resulting in a release occur. Developed alongside regulatory agencies, operators submit to and follow a distinct set of response principles which protect shared values. The framework by which these principles are employed and tradeoffs are made in order to protect these shared values is called Net Environmental Benefit Analysis (NEBA). NEBA is a process used by the response community for making the best choices to minimize impacts of oil releases on people and the environment. NEBA aids in protecting people and the environment, and is the matrix through which every decision is made in a response event. In the offshore context, oil dispersing agents are a primary tool in the NEBA process and the response toolkit, as they

are a principal tool used for protecting human health and defending environmentally sensitive areas. When a release occurs, judgment and response speed are critical. In an offshore setting, dispersants are essential in creating a safe environment and are a key ingredient in marshaling an effective, swift response.

API, NOIA, and our respective members understand that through this Proposed Rule, EPA's goal is to develop a regulation which protects people and preserves natural resources. We too wish to accomplish the same goal, based upon sound scientific research and grounded in real-world, outside-the-laboratory scenarios and taking into account incident-specific risk. While the original intent of the dispersant rule was simply to provide for a schedule of dispersants and other chemicals that may be used in carrying out the National Contingency Plan (NCP), the Proposed Rule would essentially expand its purpose to an operational rulemaking which would significantly alter operational procedures.

In summary, the Proposed Rule, if implemented, would be substantially problematic for all stakeholders, including the response community, which is required to carry out an effective spill response. The Proposed Rule would also be problematic for the Federal and state ag ency community interests, as well as the public with regard to increasing environmental and community impacts. Although the Agency indicates that it seeks to "*encourage the development of safer and more effective spill mitigating products, and would bette r target the use of these products to reduce the risks to human health and the environment*" and "*ensure that On-Scene Coordinators (OSCs), Regional Response Teams (RRTs), and Area Committees have sufficient information to support agent preauthorization or authorization of use decisions*," API, NOIA, and our respective members submit that the Proposed Rule falls short of these objectives and in many cases would have the opposite effect . For example, and at the center of our concern, is the proposed dispersed oil toxicity test and its threshold which could result in the elimination of many dispersants and potential future dispersant s. E ven if the dispersants themselves were completely non-toxic, the proposed dispersed oil toxicity test and associated pass/fail threshold could prevent all dispersants from being listed and available for use in a spill response . The Proposed Rule covers activities broader than mere scheduling criteria for dispersants. The added complexity resulting from the Proposed Rule in auth orization, monitoring and product listing, in addition to unfounded and overly corrective assumptions about dispersant effects described in the Proposed Rule, will not assist the Unified Command during an oil spill . Instead, it will likely complicate and limit its ability to respond in the most effective manner to ensure the health and safety of people and minimize environmental and community impacts. Also, prohibiting the application of dispersants during an oil spill response or delaying their use will significantly increase the economic and environmental damage of oil spills.

API and NOIA encourage the Agency to review the comments contained herein , incorporate the corresponding recommendations in a supplemental proposed rule, and provide the public and other Federal government and state stakeholder agencies with an opportunity to provide another round of comments be fore implementing a final rule. We also recommend that EPA initiat e a Negotiated Rulemaking under the Negotiated Rulemaking Act of 1990 to establish a negotiating committee under the Federal Advisory Committee Act to develop draft regulatory text on a consensus basis for adoption and implementation as a proposed supplemental proposed rule by EPA. A balanced negotiating committee made up of response experts – from the Federal Agencies who oversee oil spill response and from industry and relevant third-party experts – would add value to further Proposed Rule revisions and ensure that Subpart J is aligned with the latest scientific consensus on, and avoid an artificial bias against, the use of dispersants. As an example, Negotiated Rulemaking was successfully used to implement vessel and facility response planning requirements under the Oil Pollution Act of 1990. At a minimum, we believe that E PA should facilitate a discussion between the response experts before finalizing the Proposed Rule.

We first provide general comments followed by detailed comments on a section -by-section basis for EPA's consideration below.

GENERAL COMMENTS

Industry Shares EPA's Goal Of Establishing Sound Dispersants Policy Grounded In Science and Executable in Real-World Spill Scenarios

In every operation, the goal of industry is to never have an oil spill, and it invests extensive time and effort to prevent spills from occurring. Industry and government have a shared interest in a unified, coordinated, and proactive approach that allows us to protect our common values. These values include the health and safety of our citizens, sensitive ecosystems, the local business community and economy, and the vitality and sustainability of tourism and other key community industries, such as fishing.

To achieve a well-managed response and the protection of our common values, the primary guiding principle is to stop the source of a spill as quickly as possible with the goals of ensuring the health and safety of people and minimizing environmental and community impacts. In many spill circumstances, dispersants play a critical role in achieving these goals, perhaps most importantly by reducing risks associated with Volatile Organic Compounds (VOCs) in the immediate vicinity of the spill that could be both a human health and safety issue, and should continue to be a response option promptly available to the Unified Command. The Proposed Rule could jeopardize the protection of the common values by potentially precluding even completely non-toxic dispersants from being listed due to the proposed dispersed oil toxicity tests and associated pass/fail thresholds. Scientific studies have shown that approximately 97.5% of the TPH constituents in dispersed oil toxicity tests come from the oil (not the dispersant), so the proposed laboratory tests will measure the toxicity of oil (not the dispersant).[1] If the standardized oils (i.e., ANS and IFO-120) required to be used in the proposed test have toxicity values (LC50) in water accommodated fractions (WAF) less than 10 ppm, then no dispersant, no matter its individual toxicity, will meet the threshold values for listing.

Moreover, the creation of arbitrary thresholds for passing such tests, especially when EPA has shown that modern dispersants are of low toxicity, is not supportable and it is not clear whether any dispersant will be approved for the NCP Product Schedule when both toxicity and effectiveness tests are required. Specifically, setting an acute toxicity threshold of dispersants plus oil at an LC50 of 10 ppm has a high probability of eliminating an effective dispersant from the list, i.e., any dispersant that passes the baffled flask effectiveness test. We know from previous testing by industry that many (or even most) crude oils by themselves have LC50's below 10 ppm. Of more relevance is the use of toxicity results to assist in a NEBA-based discussion of the relative merit of using a particular dispersant in favor of another. Similarly, the attempt to link lab test results to decisions relating to pre-authorization and use is misplaced since laboratory tests are useful in understanding differences between products, not their real world performance.

The Proposed Rule indicates that the Agency " *does not state or imply* " that one response option is endorsed over another which is a practice shared by industry. However, the preponderance of additional requirements for dispersant u se will likely have the unintended consequence of prohibiting, or delaying the approval of, dispersant use in a timely manner regardless of whether they may be the best, or only, response option. Further, the language contained in the preamble suggests that the Agency considers dispersants as a last priority, rather than giving them equal consideration with all other appropriate response options. Additionally, API and NOIA are concerned that the Proposed Rule may cause chemical

[1] Scientific reasoning that the dispersant only contributes ~2.5% of the TPH toxicity is based on the following. In a 1:20 disp ersant-to-oil ratio (DOR), the dispersant proportion is 5%. The solvent component of modern day dispersants is roughly half, which mean s the overall TPH contribution from the dispersant is ~2.5%. As a result, the toxicity is dominated by the oil constituents.

manufacturers to either disco ntinue the production of effective, commercially -available products or discontinue research into the development of the next generation of dispersants.

A Net Environmental Benefit Analysis Process Ensures Response Choices that Minimize the Impacts of Oil Spills on People and the Environment

Any changes to the rule must take into account the Net Environmental Benefit Analysis (NEBA)[2] process. When a spill occurs, the OSC must make time-critical choices about which response options to implement immediately and effectively to manage the potential impacts of the spill. The NEBA process helps the OSC select choices that minimize the impacts of the spill on people and the environment. NEBA is a consensus-based planning tool that is used to bring natural resource trustees, regulators and stakeholders together to address resource-management decision-making needs for an oil spill response. It provides a structured, scientific method to evaluate the likely net reduction, or possible increase, in environmental and socio-economic impacts resulting from the implementation candidate response options as compared to the natural recovery or "do nothing" alternative. An assessment of the trade-offs associated with each option is then conducted taking into consideration the potential impacts to sensitive environmental resources and local community values. The NEBA process determines which response option or combination of options can best reduce the overall impact of spilled oil to common values and promote the fastest overall ecosystem recovery. Of particular note, the NEBA process considers the potential effects to a wide range of concerns, ranging from likely environmental effects (i.e., deep marine to terrestrial, etc.) to possible economic consequences. When initially considering the potential outcomes, no individual area receives a greater priority over another. Instead, all are weighed from an equal footing and only after evaluating all the likely effects is a determination made regarding the response option that offers that greatest environmental benefit. In so doing, decision-makers ensure that an unbiased process is used, with input from relevant stakeholders, to determine the best course of action. This process has been adopted all over the world to identify response methods that will yield the greatest benefit with the least impact.[3]

The NEBA process can be used in both oil spill preparedness planning and response. In the United States, a formal NEBA process is conducted during the planning phase at the Area Committee and Regional Response Team (RRT) levels with input from state and Federal participants to determine the benefits and limitations from using each response technology within their individual areas of responsibility. In most offshore regions of the U.S., this is accomplished in the form of the Consensus-Based Ecological Risk Assessments (CERA) process (NEBA equivalent) used by the U.S. Coast Guard (USCG)[4] and supported by the National Oceanic and Atmospheric Administration (NOAA), EPA, other Federal and state agencies, and academia. More than twenty workshops were held in various locations around the continental U.S., Caribbean, and Alaska from 1995 to 2011 to compare the benefits and risks of various response options when considering resource trade-off decisions. All of the workshops resulted in final publications (available from USCG) that were delivered to the Area Committees and RRTs to assist with response planning. One example of how this CERA/NEBA process was used to inform dispersant use decision-making is summarized in several papers authored by regulators in the state of California.[5] The applicability of the CERA/NEBA process as a tool for facilitating dispersant decision-making during spill response and planning was also evaluated by NOAA and published in a 2008 paper.[6]

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[2] NEBA is similar to the Consensus Ecological Risk Assessment (CERA) process developed by the U.S. Coast Guard in the mid -1990s.

[3] See, *Incident management system for the oil and gas industry: good practice guidelines for incident management and emergency response personnel*, IPIECA, August 2014, http://www.ipieca.org/publication/incident-management-system-oil-and-gas-industry-good-practice-guidelines-incident-manage.

[4] Aurand, D., Walko, L., & Pond, R. (2000). *Developing consensus ecological risk assessments: Environmental protection in oil spill response planning*. Washington, D.C.: U.S. Coast Guard.

[5] Addassi, Y. N., & Faurot-Daniels, E. (2005). California oil spill dispersant plan -Achievement through cooperation. *Proceedings of the 2005 International Oil Spill Conference, 2005* (1), 433 -437. doi:10.7901/2169 -3358-2005-1-433; Addassi, Y. N., Sowby, M.,

In 2014, the practice of incorporating a NEBA review during Source Control drills in the Gulf of Mexico was implemented by RRT VI during several large scale spill response exercises,[7] which has fostered good cooperation between the agencies to focus on the goal of minimizing shoreline community and ecosystem impacts by selecting response options that can maximize the effective treatment of oil offshore. NEBA discussions during both of these recent spill drills resulted in the concurrence of the RRT to authorize dispersants (both aerially and subsea) to treat the offshore oil slick.

Government decision-makers and/or the Responsible Party can conduct a rapid NEBA during actual spill responses to compare and rank the strengths and weaknesses of different response options for the incident-specific conditions. Lessons learned following a spill are incorporated into future policies and plans. Ecological recovery studies of the 1996 *Sea Empress* spill in the UK demonstrate the benefit of dispersant application along the coastline to prevent persistent oil from stranding in shoreline habits.[8] A more recent publication examined the recovery rates for a tropical ecosystem during a controlled study of dispersed versus untreated shoreline oil slicks and concluded that better recovery occurred in the areas where dispersant was used.[9]

Regrettably, the Proposed Rule lacks a NEBA perspective. It incorrectly focuses on intrinsic, hazard-based criteria for substance listing and ignores the more appropriate risk-based trade-off decision process responders must consider during an oil spill response. It does not recognize that dispersants are only applied when regulators and response decision-makers deem them necessary to prevent more significant and harmful consequences. The Proposed Rule favors protecting pelagic and benthic species while putting critical habitats, such as the ocean's surface and near-surface zones, as well as sensitive shorelines, at greater risk to environmental damage. Modeling results presented at the 2005 International Oil Spill Conference concluded that:

> *"…the results of the modeling support the contention that there are more opportunities to save wildlife, shorelines, and sensitive habitats along the shore with dispersant use than there are risks of impacting water column biota. If the areas that would be impacted by surface oil are those where wildlife are concentrated, as they typically are near shore, and the water column impacts resulting from dispersant use would be offshore where water column biota are lower in abundance, the trade-off is much more heavily weighted toward dispersant use before oil comes near the shoreline. In fact, for medium or smaller spills, or even larger spills where sensitive species and life stages are not present, the impact of dispersant use on water column biota could be negligible."*[10]

Parker-Hall, H., & Robberson, B. (2005). Establishment of dispersant use zones in the state of California: A consensus approach for marine waters 3 –200 nautical miles from shore. Proceedings of the 2005 International Oil Spill Conference, 2005(1), 187 -191. doi:10.7901/2169-3358-2005-1-187.

[6] Mearns, A., & Evans, M. (2008). Evaluating the consensus ecological risk assessment workshop as a tool for facilitating decision - making during spill response and planning. *Proceedings of the 2008 International Oil Spill Conference Proceedi ngs, 2008*(1), 739-741. doi:10.7901/2169-3358-2008-1-739

[7] Freeport McMoran Source Control drill (April 30-May 1, 2014) and BP Source Control drill (Nov 5-6, 2014)

[8] Lunel, T., Rusin, J., Bailey, N., Halliwell, C., & Davies, L. (1997). The net environmental benefit of a successful dispersant operation at the Sea Empress incident. *Proceedings of the 1997 International Oil Spill Conference, 1997* (1), 185 -194. doi:10.7901/2169-3358-1997-1-185

[9] Baca, B., Rosch, E., DeMicco, E. D., & Schuler, P. A. (2014). TROPIC S: 30 -year follow -up and analysis of mangroves, invertebrates, and hydrocarbons. *Proceedings of the 2014 International Oil Spill Conference, 2014* (1), 1734 -1748. doi:10.7901/2169-3358-2014.1.1734

[10] French McCay, et al., Modeling Fates and Impacts of Hypothetical Oil Spills in Delaware, Florida, Texas, California, and Alaska Waters, Varying Response Options Including Use of Dispersants. International Oil Spill Conference Proceedings: May 2005, Vol. 2005, No. 1 pp. 735-740. Also available at http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2005-1-735.

For oil spills where dispersant use is contemplated, a typical NEBA will predict the potential impacts to aquatic organisms from an increased exposure to dispersed oil droplets. Dispersant use is typically restricted to water depths greater than 10 to 20 meters so that dilution will minimize exposure or impacts to the benthic community. Studies have shown the dispersed oil concentrations are rapidly diluted within the large volume of receiving water from a high of a few hundred parts per million to a few parts per million within a few hours. Consequently, exposure to the toxic effects of the dispersed oil will be of short duration and limited to those aquatic organisms that inhabit near surface waters. The NEBA will also estimate the reduction of impacts to waterfowl, shoreline ecosystems and coastal communities resulting from the reduction in, or elimination of, the quantity of floating oil. The trade-offs of a short term increase in exposure of selected aquatic organisms to dispersed oil versus an increase in oil impacting coastal environments and communities must be evaluated and take into account local community values to determine if dispersant use is warranted.

Given the challenges of implementing other response options, a decision not to have dispersants available to responders could result in oil stranding on shorelines where it may persist for an extended time. Effectively dispersed oil will biodegrade rapidly so that the majority of the oil will persist for a much shorter period of time. Reducing the persistence of the oil in the environment is critical to reducing the overall impacts.[11] This is not to say that water column organisms are less intrinsically important than surface or shoreline species but using NEBA can and does provide a critical framework for deciding what is best for the overall ecosystem. Important considerations to understand in assessing this tradeoff include:[12]

- The impacts to the water column are mitigated by dilution – that is the potentially toxic levels of dispersed oil are limited in duration and physical coverage/extent and effected populations (e.g., plankton) tend to be ones that recover quickly.
- Oil effectively dispersed in the water column will generally biodegrade after a few days or weeks while oil stranded in near shore and shoreline areas can persist for years.
- Near shore and shoreline areas are the nursery grounds for many species, even those that live offshore as adults, so protecting the near shore areas also protects organism that live as adults offshore.
- The bio density of near shore areas (swamps and marshes) is far greater than the bio density in pelagic waters offshore.
- Dispersants also protect surface dwelling organisms offshore, i.e., marine mammals, birds, and turtles, through removal of floating oil.
- Slicks on the water surface are far more likely to impact fish eggs and larva that tend to float at or near the water surface than quickly removing oil from the surface with dispersants.
- In certain geographies, slicks can impact mangroves and other shoreline vegetation that can subsequently die off and result in shoreline erosion that increases sediments in the near shore water column and potentially affects corals and other species.

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[11] Hazen, et al., Deep-Sea Oil Plume Enriches Indigenous Oil-Degrading Bacteria, Science, 330 (2010), pp. 204-208.

[12] (a) French McCay, D., and Graham, E. Quantifying Tradeoffs – Net Environmental Benefits of Dispersant Use. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 762-775.
(b) McManus, M.A., Woodson, C.B. Plankton Distribution and Ocean Dispersal. The Journal of Experimental Biology, 215 (2012), pp. 1008-1016.
(c) DeMicco et al., Net Environmental Benefit Analysis (NEBA) of Dispersed Oil on Nearshore Tropical Ecosystems: TROPICS – The 25th Year Research Visit, International Oil Spill Conference Proceedings, May 2011, Vol. 2011-282.
(d) Varela et al., The Effect of the "Prestige" Oil Spill on the Plankton of the N -NW Spanish Coast. Marine Pollution Bulletin 53 (2006), pp. 272-296.
(e) Addassi, et al., Establishment of Dispersant Use Zones in the State of California: A Consensus Approach for Marine Waters 3-200 Nautical Miles from Shore. International Oil Spill Conference Proceedings: May 2005, Vol. 2015, No. 1, pp. 187-191.

The Agency should consider the NEBA process and how and why dispersants are used before making changes to the Subpart J Regulations.

The Proposed Rule has the Practical Effect of Treating Dispersants as Toxic and either Prohibiting or Discouraging the Use of this Critical Response Tool

Dispersants are an essential tool in the responder's toolkit. They are products used in oil spill response to dilute the oil in the water column to enhance natural microbial degradation, a process where microorganisms remove oil from the environment.[13] All marine environments contain naturally occurring microbes that feed on and break down crude oil. Dispersants aid the microbial degradation by forming tiny oil droplets, typically less than the size of a period on this page (<100 microns), thus increasing the oil's surface area and making it more available for the petroleum-degrading microorganisms to consume.[14]

All oil spill response options have their place in the response toolkit because of the extreme variability of spill conditions. Dispersants become a critical response tool for larger spills far from shore; spills more distant from stockpiles of recovery and containment equipment; when weather and ocean conditions preclude the use of other options; or when weather conditions are predicted to become more severe because they can be rapidly applied by aircraft or subsea (at a high encounter rate) when wind and wave conditions prevent other vessel-based recovery options.

The Proposed Rule focuses on the potential risks of dispersants without recognizing the benefits and core purpose of dispersants, which is to rapidly dilute the spilled oil and enhance removal of the oil from the environment through microbial degradation, resulting in reduced VOCs and shoreline impacts. Ultimately, the purpose of dispersants is to reduce the overall toxicity and persistence of oil in the environment.

We believe that research showing that dispersants do not enhance the biodegradation of oil from the environmental is based on studies that used unrealistically high concentrations of dispersed oil. Prince and Butler only recently developed a biodegradation test method that compares dispersed oil biodegradation to biodegradation of a surface slick at representatively low concentrations (i.e., 2.5 ppm).[15] This research unambiguously shows the enhanced biodegradation of dispersed oil over allowing an oil slick to remain on the surface. Most prior dispersed oil biodegradation studies used oil concentrations that were two or more orders of magnitude too high.[16]

Dispersants have proven to be an effective way to respond to an oil spill, most notably in those situations that prohibit, or otherwise limit, the effectiveness of other response measures. We submit that all response options should be contemplated based on their individual, or combined, ability to respond to

[13] American Society for Microbiology (ASM). (2011). *FAQ: Microbes & oil spills.* Retrieved from http://academy.asm.org/images/stories/documents/Microbes_and_Oil_Spills.pdf; Personna, Y., Boufadel, M., & Zhang, S. (2014). Biodegradation of dispersed Endicott oil in controlled experiments. Proceedings of the 2014 International Oil Spill Conference, 2014(1), 1126-1140. doi:10.7901/2169-3358-2014.1.1126; McFarlin, K., Leigh, M., & Perkins, R. (2014). Biodegradation of oil and dispersed oil by arctic marine microorganisms. Proceedings of the 2014 International Oil Spill Conference, 2014(1), 300-317. doi:10.7901/2169-3358-2014-1-300317.1.

[14] Hazen, T. C., Dubinsky, E. A., DeSantis, T. Z., Andersen, G. L., Piceno, Y. M., Singh, N., Jansson, J. K., Probst, A., Borglin, S. E., Fortney, J. L., Stringfellow, W. T., Bill, M., Conrad, M. E., Tom, L. M., Chavarria, K. L., Alusi, T. R., Lamendella, R., Joyner, D. C., Spier, C., Baelum, J., Auer, M., Zemla, M. L., Chakraborty, R., Sonnenthal, E. L., D'haeseleer, P., Holman, H. N., Osman, S., Lu, Z., Van Nostrand, J. D., Deng, Y., Zhou, J., & Mason, O. U. (2010). Deep-sea oil plume enriches indigenous oil-degrading bacteria. *Science*, *330*, 204-208. doi:10.1126/science.1195979

[15] Prince, R.C. and Butler, J.D. A protocol for assessing the effectiveness of oil spill dispersants in stimulating the biodegradation of oil. Environ Sci Pollut Res Int. 2014 Aug;21(16):9506-10. doi: 10.1007/s11356-013-2053-7. Epub 2013 Aug 13.

[16] Lee, K., Nedwed T., Prince R.C., Palandro D., Lab tests on the biodegradation of chemically dispersed oil should consider the rapid dilution that occurs at sea. Mar Pollut Bull. 2013 Aug 15;73(1):314-8. doi: 10.1016/j.marpolbul.2013.06.005. Epub 2013 Jun 27.

discharged oil, either on or below the water's surface, in a manner that causes the lowest negative effect on the environment and promotes the most rapid recovery of the affected ecosystem.

Laboratory Dispersant Efficacy Tests do not Predict How Well Dispersants Will Work in the Wide Range of Real World Spill Conditions

Although laboratory dispersant effectiveness testing can be used as a comparative screening tool for different dispersants under laboratory conditions, the Proposed Rule appears to suggest these results will be representative of actual effectiveness when applied to oil spills on open water. However, these results do not translate to the wide range of field conditions, oil types and weathering degrees in real world oil spills. Specifically, the static conditions in a lab, where researchers conduct experiments with known quantities of oil and dispersant, cannot be replicated at sea. Although the amount of dispersant that is to be applied is calculated based on a desired initial dispersant-to-oil ratio, the quantity and characteristics of oil during a real spill is an estimate, making any definitive, quantitative effectiveness estimation problematic. Localized determinations of the relative effect of surface dispersant application may be evaluated qualitatively using visual cues or semi-quantitatively using ultraviolet fluorometry, which is sufficient for operational effectiveness assessments. Additionally, much of the detailed spill monitoring specified by the Agency in the Proposed Rule has no bearing on dispersant effectiveness monitoring and cannot be conducted in a time-frame that will support day-to-day, near real-time operational decision-making.

We suggest the language in the Proposed Rule be modified to clarify the laboratory efficacy testing is for comparative purposes only and that the pass/fail criteria be established at a level that will only eliminate the least effective dispersants from being listed. Some dispersants that only exhibit average effectiveness in the laboratory tests may be very effective in certain situations in the field and the Response Community needs to maintain as many options as possible to select the most appropriate response option for a given set of conditions and circumstances.

Dispersant Toxicity Tests do not Accurately Simulate Real World Exposures.

API and NOIA acknowledge that there may be benefits to a so-called "gate-keeper" toxicity test with dispersant alone to ensure that any dispersants that might contain highly toxic components would not be accepted for listing on the Product Schedule. However, it is unclear what rationale was used for the dispersed oil toxicity tests stated in the Proposed Rule.

The relevant factors in dispersed oil toxicity include the concentration of dispersed oil, or oil compounds, in the water and the duration of exposure. The fundamental basis of aquatic toxicity testing is to create a set of concentrations and expose the animals for a duration where observable effects can be measured. As a result, laboratory exposures are useful for data collection and generating toxicity curves; however these conditions are not representative of the real world where the natural processes of rapid dilution and biodegradation act on the dispersed oil to dramatically reduce the exposure conditions [17]. Using acute 48- or 96-hour LC_{50} toxicity tests with dispersed oil mixtures (to calculate LC_{50} values) is considerably different from the likely exposure regime experienced by marine organisms in the open sea following an oil spill. For this reason, the Chemical Response to Oil Spills: Ecological Effects Research Forum (CROSERF)[18] was assembled to develop new dispersed oil toxicity testing protocols that account for rapid dilution. Academia, regulators and industry funded a ten year program through CROSERF to

[17] Lee, K., Nedwed, T., & Prince, R. (2011). Lab tests on the biodegradation rates of chemically dispersed oil must consider natural dilution. *Proceedings of the 2011 International Oil Spill Conference, 2011* (1), 245. doi:10.7901/2169-3358-2011-1-245
[18] Aurand, D., & Coelho, G. (2005). *Cooperative aquatic toxicity testing of dispersed oil and the chemical response to oil spills: Ecological effects research forum (CROSERF)*. Ecosystem Management & Associates, Inc., Technical Report 07-03. Lusby, MD.

develop new testing methods that are more aligned with real -world field c onditions. This data is now available via the NOAA Dtox database.[19]

Results from dispersed oil monitoring during the Deepwater Horizon (DWH) spill is clear evidence of the rapid dilution occurring after surface dispersant application [20] and subsea dispersant injection .[21] Further evidence of the rapid dilution of dispersed oil in the field is found in the analytical results from several field trials conducted in the North Sea to characterize the fate and transport of dispersants applied to an open ocean oil slick. These field experiments and the subsequent chemical characterization condu cted in 1994,[22] 1995,[23] and 1996[24] showed a rapid (within one hour) dilution of dispersed oil concentrations following dispersant application. This same effect was observed during the DWH response following surface dispersant application.[25] Since the proposed EPA dispersed oil testing does not take into account dilution, it is more likely that reported toxicity values at a rtificially high laboratory concentrations, not representative of real -world dilution exposures, will lead to misinterpretation of these tes t results and possibly preclude the use of dispersants altogether.

We strongly suggest that the laboratory toxicity test be limited to dispersants only to screen out the more toxic products and that toxicity testing for dispersed oil be explicitly elimin ated from the Rule. It is very likely that all dispersants will be unable to pass the dispersed oil toxicity test as existing oil toxicity data indicates the test oils alone will be unable to pass the test.

In the context of NEBA (and its forebear, th e Consensus Ecological Risk Assessment, or CERA), scientists understand and accept that marine organisms may experience localized, transient toxic effects from exposure to dispersed oil, but these local effects are offset by the benefit of dispersant use i n preventing or minimizing oil drifting ashore and causing severe and long -term harm to more sensitive coastal resources and communities . While knowledge of the potential for toxic effects to marine organisms is useful for conducting a NEBA, it cannot be t he sole indicator that dictates the use of dispersants. All resources -at-risk as well as coastal communities must be considered in the response option decision-making process, with the emphasis on coordinating a response that will result in the least overall impacts while promoting the most rapid overall recovery of the affected ecosystem.

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[19] Bejarano, A., Chu, V., Dahlin, J., & Farr, J. (2 014). Development and application of dtox: A quantitative database of the toxicity of dispersants and chemically dispersed oil. *Proceedings of the 2014 International Oil Spill Conference* , *2014*(1), 733 -746. doi:10.7901/2169-3358-2014.1.733

[20] Operational Science Advisory Team (OSAT 1). (2010). *Summary report for sub-sea and sub-surface oil and dispersant detection: Sampling and monitoring. Unified Area Command, New Orleans*. Retrieved from: http://www.dep.state.fl.us/deepwaterhorizon/files2/osat_report_17dec.pdf .

[21] Coelho, G., Aurand, D., Essex, L., Parkin, A., & Robinson, L. (2012). *Monitoring subsurface dispersant injection during the MC252 incident, volume 1*. Lusby, MD, USA: Ecosystem Management & Associates, Inc.

[22] AEA Technology. (1994). *International calibration of laboratory dispersant test methods against sea trials* . Oxfordshire, UK: AEA Technology.

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[25] Huber, C. A., Steen, A., & Parscal, B. (2014). Does wave height matter for effective surface dispersant application? *Proceedings of the 2014 International Oil Spill Conference, 2014* (1), 747-761. doi: 10.7901/2169-3358-2014.1.747

During an Oil Spill, Operational Monitoring Should Focus on How the Selected Response Options Mitigate the Effects of the Oil on the Environment

Following an oil spill, the primary emphasis of operational response monitoring should be directed toward the response effort and the effect that those efforts have on reducing the net negative environmental consequences. The Agency proposes the requirement to "*monitor agent use in the environment*." API and NOIA submit that operational monitoring should not be focused on monitoring the agent (i.e., dispersant) use, but rather on monitoring the overall changes to the characteristics, transport, and fate of the oil within the ecosystem. We also submit the Agency should acknowledge that the primary issue in a spill scenario is oil in the environment (not dispersants in the environment) and that operational monitoring efforts should concentrate on evaluating how well the response option (or options) mitigates the negative effects of the oil on sensitive environmental resources.

EPA proposes monitoring that will provide a comprehensive assessment of the environment. However, the monitoring actions required in the Proposed Rule go beyond those required to inform operational decision-making and cross into the realm of Natural Resource Damage Assessment (NRDA) monitoring. One reason for this is that NRDA monitoring requires days to years before opinions on damages are made. Operational decisions require real or near-real time data. Damage assessment monitoring should not fall under the purview of spill response decision-making, and any monitoring of response options should be done solely to ensure the effectiveness of that response technique.

The Proposed Rule includes additional surface dispersant effectiveness monitoring requirements beyond those established in current practices, with no justification of how this additional monitoring burden will enhance operational response decision-making. Further, the additional requirements do not differentiate between surface and subsurface use of dispersants. As a result, the Proposed Rule would apply an unnecessary set of requirements in the event of surface dispersant usage in lieu of those monitoring techniques outlined in the USCG *et al., Special Monitoring of Applied Response Technologies* (SMART) protocols.[26] Additionally, the monitoring regime outlined in the Proposed Rule deviates substantially from that recommended by the National Response Team (NRT) in its *Environmental Monitoring for Atypical Dispersant Operations: Including Guidance for Subsea Application and Prolonged Surface Application,*[27] which also advocates the adaptation of the SMART monitoring regimen. These additional monitoring requirements, if adopted, may divert valuable resources away from the response effort, potentially prolonging the spill event. They may also preclude the use of dispersants in many cases if required to be in place as a condition of authorization, as it can take many days to assemble the equipment, vessels, and scientific experts.

During a subsea dispersant application, the Agency proposes an exhaustive set of environmental monitoring parameters that include *in situ* oil droplet size distribution analysis, *in situ* fluorometry, fluorescence signatures, dissolved oxygen, total petroleum hydrocarbons, carbon dioxide, methane, heavy metals, turbidity, water temperature, pH, and conductivity. As stated previously, we concurs with monitoring that supports effective, operational decision-making, but argues that most of these parameters will not provide any information on the effectiveness of the subsea dispersant application, will unnecessarily require additional scientific resources and will delay the reporting of key operational monitoring parameters. Spill response effectiveness monitoring should be based on simple, rapid assessments that can provide near real-time information on the progress of the response. For this reason, we believe that any mandated operational monitoring should be both incident-specific and designed to integrate into the other operational activities taking place. As such, the Responsible Party

[26] These protocols were jointly developed by the U.S. Coast Guard, National Oceanic and Atmospheric Administration, U.S. Environmental Protection Agency, Centers for Disease Control and Prevention, and Minerals Management Service.
[27] See http://www.nrt.org/production/nrt/nrtweb.nsf/AllAttachmentsByTitle/SA-1086NRT_Atypical_Dispersant_Guidance_Final_5-30-2013.pdf/$File/NRT_Atypical_Dispersant_Guidance_Final_5-30-2013.pdf?OpenElement

shares in the responsibility with the OSC in determining what monitoring needs to be done in ac cordance with the region -specific pre -approval and planning process. Comprehensive, detailed environmental monitoring is not an appropriate topic for this Proposed Rule.

The Agency's Economic Review Fails to Recognize Significant Costs of the Proposed Rule.

The Regulatory Impact Analysis (RIA) conducted by the Agency does not estimate all of the potential policy scenarios, and the economic impacts of those policies, that are issued in the Proposed Rule. Therefore, the RIA neglects to provide the public with a full description of the proposal's impact. Additionally, EPA did not provide any quantified social benefits that could result from implementation of any part of the Proposed Rule. An independent assessment [28] of the proposal (see Attachment A) has found that including the impacts of the requirements neglected by the Agency in the RIA would increase the cost of the proposal three times. In addition to underestimating compliance costs and administration costs for both industry and the federal governmen t, the RIA supporting the proposal fails to calculate the costs associated with the immediate market imbalances that could occur if products are removed from the market, either temporarily or permanently.

Beyond the market imbalance, removal of dispersants from the toolbox could result in additional clean-up costs that are not considered in the RIA. As noted in Attachment A, "To the degree this rulemaking reduces chemical and biological agent availability and innovation, the nation will have less tools av ailable to fight oil spill damage." A possible outcome of this limitation "is that future oil spill damages would be more severe than they would be if the rule did not occur." EPA did not quantify the costs associated with the possibility that the rule w ould limit the ability of the Response Community to keep oil from reaching shorelines or damaging ecosystems to a greater extent than if dispersants were readily available. We believe additional costs could extend to costs associated with environmental cla ims, increased response costs due to the need for shoreline cleanup, and other costs of environmental damages to sensitive shorelines, birds, and lost economic and recreational opportunities. In fact, EPA confuses the social benefits of avoiding an oil spill or having an appropriate response to a spill with the social costs of a spill, such as lost tourism revenue and other environmental damages. Furthermore, the Agency underestimated the costs to small businesses, which resulted in the false conclusion t hat small businesses would not be materially affected by the proposed ruling. Using realistic estimates, the attached third-party report finds that 43 percent of the firms identified by the Agency would face compliance costs in excess of three percent of a nnual sales and risk of closure. The Agency should amend the methodology and deficiencies found in the RIA, as discussed here and in the attached report.

We explicitly incorporate the comments and recommendations addressing the RIA provided by the independent assessment (see Attachment A).

The Proposed Rule Conflicts with Current Facility and Vessel Oil Spill Response Plans

Effective September 30, 2009, facility and tank vessel plan holders were required to update their response plans to include planning for responding to discharges using dispersants under a USCG rulemaking. Specifically, dispersant equipment is required in areas where it has been pre-determined that dispersants would be a viable oil spill mitigation technique and pre-authorizations have been established. Previously, with regard to dispersants for facilities located in areas with pre-authorization, a mechanical recovery equipment credit for up to 25% could be obtained for certain persistent oils.

[28] The independent assessment was prepared by the Policy Navigation Group (PNG), which consists of a diverse team of senior policy analysts with experience at Office of Management and Budget in the White House, managers, economists, engineers, lawyers and skilled researchers, with particular expertise in both private and public sector environmental management strategies including benefit-cost analysis and life-cycle assessments. See http://www.policynavigation.com/index.php?page=bios for more information about PNG.

However, since 2009 facilities handling certain persistent oils in areas with pre-authorization must ensure, through contract or other approved means, the availability of dispersant response resources and the commencement of dispersant-application operations within 7 hours of the decision by the OSC to use dispersants. Dispersant response resources must include: (1) sufficient volumes of dispersants to meet specified regulatory requirements, (2) dispersant application platforms and systems sufficient to meet planning standards, and (3) trained personnel.

Similarly, vessels transporting certain persistent oils in areas where dispersants are pre-authorized have been since 2009 required, through contract or other approved means, to have dispersant-related response resources meeting dispersant planning standards, including appropriately trained dispersant-application personnel. The dispersant resources must include the identification of each primary dispersant staging site used by each dispersant-application platform and the corresponding distance to the associated stockpile. Similar requirements were adopted for non-tank vessels in 2013.

There are also aerial tracking requirements under the current response plan requirements, and there are now pre-authorization zones for the use of dispersants outlined in the applicable Area Contingency Plan throughout the nation for every state except for Alaska and Connecticut whereby the OSC has the authority to expedite the authorization for the use of dispersants. Although there are no specific dispersants requirements under Bureau of Safety and Environmental Enforcement's (BSEE) response plan requirements for offshore facilities, it is clear based on experience with the *Deepwater Horizon* that dispersants are a key response tool that must be available on an expedited basis to respond both to a spill on the surface of the water and subsea in case of a blowout.

The Proposed Rule, however, appears to directly conflict with Coast Guard response plan requirements and raises a host of questions related to the continued validity of facility and vessel response plans. It is unlikely that any dispersants will pass both the efficacy and toxicity tests required by the Proposed Rule as a precursor to being listed on the NCP Product Schedule. For example, the EPA proposal may have the practical effect of virtually eliminating the entire stockpile of available dispersants nationwide that will be able to be listed on the NCP Product Schedule following full implementation of the Proposed Rule. In addition, it could have the practical effect of eliminating the usefulness of preauthorization zones. This could result in invalidating response plans.

Furthermore, the Proposed Rule, if implemented , would require significant additional requirements for information needed an d monitoring required before dispersants use approval is granted , which may prevent a plan holder from being able to deploy dispersants in the desired/required amount of time. For some spills it may mean that dispersants cannot be used at all due to limit ed window of opportunity. Thus, the Proposed Rule raises significant issues related to USCG and BSEE facility and vessel oil spill response plan compliance and could result in unnecessary and increased environmental damage and corresponding spill claims a s a result of increased damages. In this regard, we note that although the President delegated to EPA the responsibility for the amendment of the NCP, the Proposed Rule may extend beyond the limits of EPA's authority under that delegation or the applicabl e law. Furthermore, amendments to the NCP must be coordinated with members of the NRT , including the USCG and other relevant agencies, prior to publication for notice and comment. 40 C.F.R. § 300.2. It appears this coordination may not have been accompl ished sufficiently to avoid the conflicts discussed above. Accordingly, we recommend that EPA further coordinate with the USCG and BSEE to ensure that the Proposed Rule does not adversely affect USCG and BSEE response planning procedures and requirements.

<u>Agency Review of Public Comments</u>

Due to the significance of this rulemaking to the industry and to other Federal government agency stakeholders involved with spill response, it is critical the Agency provide adequate time for these other

agencies to review and provide feedback on comments submitted by the public for EPA's benefit and consideration. Accordingly, we strongly urge the Agency to seek and consider comments from the other relevant Federal government agencies on the public's comments befor e it decides on how to handle all input received in response to the Proposed Rule.

Availability of EPA Testing Data

It has come to the attention of API and NOIA that the Agency may have testing data related to dispersants that may not have been released to the public. If that is the case then the Agency should make that data publicly available as soon as possible in some form of a supplemental notice to this Proposed Rule. Supplemental comments should then be requested to ensure that the public has an opportunity to provide additional informed comments for EPA's consideration before finalizing the Proposed Rule.

DETAILED COMMENTS ON THE PROPOSED AMENDMENTS TO 40 CFR PARTS 110 AND 300

Our specific section -by-section comments on the Proposed Rule are presented as follows . These comments conform to the organization of the Proposed Rule on a section-by-section basis.

I. § Section 300.5 Definitions

A. *The definition of burning agents should not include ignition devices*.

Burning Agents. The proposed defi nition reads: " *Burning agents are additives that improve the combustibility of the materials to which they are applied through physical or chemical means* ." In the preamble (80 Fed. Reg. 3385) an example is given of a helitorch system, stating that the mate rials in the helitorch would be considered burning agents. Additionally, the Agency is seeking comment on whether it should add ignition devices to the definition of burning agent.

The proposed defin ition seems to combine burning agents (materials that actually change the combustibility of the material they are added to) and ignition agents (materials used to start combustion, as is the case with the helitorch). This confuses the question around including ignition devices within the definition of burning agents which, if happens, could lead to administrative pauses in requesting a test burn, or any burn during an emergency phase of a response.

Igniters are used to initially heat a small portion of the oil to release vapors that can be ignited. The initi al process of ignition is not the same as improving overall combustibility of an oil. For example, when starting a campfire, a match does not change the combustibility of the wood; it simply provides the energy to start the combustion process. Similarly, a n in-situ burn ignition system provides energy to heat and vaporize some of the oil so that it can start to combust. For this reason, we submit that ignition devices (both ignition liquids and equipment) should not be included in the definition of a burning agent.

We recommend the Agency adopt the following definitions:

> *Burning agents are additives that change the combustibility of the materials to which they are applied through physical or chemical means prior to ignition.*
>
> *Ignition agents are additives that ignite, or initiate combustion of the materials to which they are applied.*

B. *EPA's definition of dispersants does not fully define dispersants.*

Dispersants. The EPA proposed definition of dispersants in 300.5 should be expanded to include an explanation of why the production of smaller droplets is important. The following language should be added to the end of the proposed definition: *"The formation of small droplets is intended to allow the oil to be rapidly diluted in open ocean environments t o non -harmful concentrations and to promote rapid biodegradation of the oil by naturally occurring microbes."*

C. *Oil-mineral aggregate ("OMAs") are not sorbents*

Sorbents. API and NOIA offer several comments on the definition of sorbents in 300.5, as follows:

- We support the addition of clay as an example of an inorganic/mineral compound, especial ly since commercial products made from clay are currently on the market.
- The Agency expresses concern that sorbents made from particulate matter may be used as sinking agents. Many inorganic/mineral compounds that are quite dense are commonly used on terrestrial spills on roads, pavements and other hard surfaces. The rule should not limit their use for these situations.
- Very fine clays (like those used in OMAs), wh ile still nominally denser than water, will still suspend in the water column because the particle sizes are very small. The rule needs to acknowledge that OMA's are not sinking agents. If the Agency is concerned that inorganic/mineral sorbents are being u sed as sinking agents, then their use should be explicitly prohibited for use as a sinking agent. Uses for other purposes should be allowed.
- EPA should not limit how sorbents in particulate form are used. The use of OMA technologies is not to sorb oil but to promote dispersion and biodegradation. The purpose of the technique is not the same as for sorbents and should not be regulated as such. OMA technologies should be excluded in the definition of sorbents and should have separate testing/authorization requirements.
- While most sorbents are collected and recovered from the environment, some natural organic sorbents are spread over oil on habitats where the oil cannot be easily removed. The sorbent ties up the oil to reduce further migration and to limit the exposure to flora and fauna. The Agency should not discourage this application as it is sometimes considered a "best practice" for certain oiled habitats. As such, the Agency should either remove the phrase, "generally collected and recovered…" or add lang uage to indicate that loose, organic sorbents used in wetlands may not be recovered.

D. *Saltwater should be defined in the Proposed Rule*

Saltwater. In column 2, 80 Fed. Reg. 3389, of the preamble and subsequent sections the term "saltwater" is used. It is recommended that saltwater be defined in the definitions in 300.5 since the Proposed Rule states that dispersants are only allowed in saltwater environments. There is no definition of saltwater offered in the proposal. Dispersants have been shown to work a t salinity much lower than the typical 35 ppt ocean concentrations and effectiveness at salinity as low as 14 ppt has been reported. A definition where dispersants can be used needs to be provided, taking into consideration the data on dispersant performance in brackish or estuarine environments.

II. <u>Section § 300.910 Authorization for Agent Use</u>

A. *The Unified Command (UC) determines the best use of response assets on a daily basis.*

EPA should not establish a policy or rule that mechanical recovery is always the priority choice of countermeasures to use in a response. In the preamble for this section (column 1, 80 Fed. Reg. 3387), the Agency makes the following statement:

> *"During the DWH response, a priority countermeasures scheme was established to first use mechanical recovery via skimming/booming or in-situ burning followed by subsea dispersant and lastly surface dispersant use."*

This may have been the conceptual prioritization from the perspective of EPA, but in reality dispersants played a much larger role and it was the responsibility of the UC to determine the best use of response assets on a daily basis to account for weather conditions, VOC suppression, oil slick locations, response equipment availability, etc. Every spill is different and specific references to a single spill event can indirectly and inappropriately be perceived as a recommended practice and should be avoided. In any spill scenario, all response tools must be used to their maximum effect. The Agency's unprecedented use of "Directives" during the DWH incident severely limited the use of dispersants and circumvented the NEBA decision-making process allowing significantly more oil reaching the water's surface and, subsequently, the shoreline. This resulted in additional environmental impacts with no documented benefits to the marine ecosystem.

The Agency should reconsider this statement and prioritization as it puts unneeded complexity into the response decision-making process and inappropriately prioritizes mechanical recovery over other response options. The effectiveness of mechanical recovery can be limited in large, offshore spills as a result of typical environmental conditions, such as wave action/height or wind conditions as well as the extensive surface area that must be covered. Further, the Agency's artificial prioritization of this technique over other viable response options is contrary to the NEBA concept to determine the best blend of response options (with no pre-determined or pre-existing bias) to achieve the best overall protection and recovery for the ecosystem.

B. *Decision-making plans are also important to response decision-making.*

Later in the same paragraph referenced above, the Agency makes the following statement:

> *"The Agency believes that preauthorization or expedited decision making plans are critical elements of contingency planning activities."*

We strongly agree that preauthorization and expedited decision-making are important.

C. *Proposed changes involving preauthorization planning will increase the workload of all Regional Response Teams (RRTs) and Area Committees (AC) and restrict their flexibility.*

EPA should not restrict RRT or OSC activities related to preauthorization plans in areas where preauthorization is desirable and applicable. At the end of the same paragraph (column 2, 80 Fed. Reg. 3387), the Agency makes the following statement:

> *"The Agency believes these proposed revisions to the authorization of use provisions will assist OSCs, RRTs, and ACs in their advanced planning activities as they consider response methods that result in the greatest environmental protection."*

We agree with the intent to assist the OSCs and RRTs. However, the added complexity resulting from the Proposed Rule in authorization, monitoring and product listing, in addition to the overly conservative assumptions about dispersant effects described in the Proposed Rule, will not assist these entities.

Instead, it complicates and limits their ability to respond. The Agency must provide specific examples to show how this rule ass ists responders, particularly in relation to the OSC duties of making timely operational decisions, especially those decisions based on using the concept of NEBA to guide a response.

The existing rule states that the RRTs and Area Committees should evaluate the desirability of using various agents as part of their planning processes and state that "*RCPs and ACPs shall, as appropriate, include applicable preauthorization plans....* " Under the current rule, most RRTs did, in fact , create preauthorization plans, and those plans did include appropriate oceanographic and geographic limits . In practice, only Region VI used those plans to mitigate oil spills, and the Region VI OSCs, RRTs, and Area Committees became very familiar with their use . Policies and practic es for the use of the RRT VI preauthorization plan were created by the appropriate member agencies without regulatory requirements and evolved to account for changes in information technology.

The proposed language states, "*RRTs and Area Committees shall address in a preauthorization plan…*" This becomes a mandate for all RRTs and Area Committees, including those areas that may have little interest or need for such plans. In fact, some RRTs and Area Committees do not even have water bodies where dispersants could be used. Most of the factors that are required to be considered by the Proposed Rule are already addressed in preauthorization plans (e.g., water depth, distance from shorelines). Some factors, however, such as the requirement that " *preauthorization plans must specify limits for the quantities and the duration of use*," for agents are new and have the effect of limiting the application and effectiveness of the pre authorization plans. This requirement wo uld suggest that RRTs must know in advance the si ze of the potential releases, the resources at risk and what strategies are available to protect them, the dispersability of the oil, and the optimum dispersant -to-oil application rate. The OSC's flexibility and the effecti veness of the response method are limited and not assisted by such requirements, and EPA has not justified that the proposed requirement is necessary in relation to existing requirements.

The existing rule also states that " *preauthorization plans may address factors such as* ..." However, the Proposed Rule states " *Preauthorization plans should document…* " and adds requirements for consideration of factors such as "inventory" and "manufacturing capability of available agents." Again, this requires additional effort on the part of RRTs and Area Committees, where such work is already typically being done by industry as part of their planning processes.

The net effect of most of the changes involving preauthorization planning is an increase in the workload of all RRTs and Area Committees while r estricting their flexibility in areas where preauthorization is desirable and applicable.

III. Section § 300.910(a) Use of Agents Identified on the Schedule on Oil Discharges Addressed by a Preauthorization Plan

A. *Adding more entities complicates the planning process.*

Section § 300.910(a) states that the RRTs and Area Committees shall address preauthorization plans. API and NOIA do not see any valid reason to add more entities to the planning process. In the preamble to this section, the Agency makes the following statement (column 1, 80 Fed. Reg. 3388):

> *"Therefore, the Agency is proposing to include RRTs as another planning entity with responsibility for developing preauthorization plans, and is requesting comment on this change, and on the advantages or dis advantages of keeping the development of these plans at the AC level."*

We believes that while the RRTs may provide more practical experience to the planning effort, the potential benefit would be overshadowed by the added complexity and bureaucracy. Unle ss the Agency can provide a sound rationale, we recommend against including the RRTs in the development of preauthorization plans.

B. *Area Committees should identify shoreline habitats that can benefit from the appropriate use of dispersants.*

In this same section of the preamble (column 3, 80 Fed. Reg. 3388), the Agency makes the following statement:

> *"The RRT's and ACs should identify the affected biological resources and their habitats likely to be negatively impacted, as well as those that are expected to benefit."*

API and NOIA support the requirement that A rea Committees should identify shoreline habitats that can benefit from the appropriate use of dispersants or other response methods. This will advance the use of the NEBA concept. Note that many of these resources are already identified in Area Contingency Plans.

C. *Preauthorization plans should provide the OSC sufficient authority to use chemical or biological response agents.*

In this same section of the preamble (column 1, 80 Fed. Reg. 3389), the Age ncy makes the following statement:

> *"The Agency is clarifying that if the preauthorization plan is approved in advance for chemical or biological agent use under specified discharge circumstances, then the OSC may authorize the use of the agents on the Sc hedule for their intended purpose without the incident specific concurrences and consultations described in paragraphs (b) of this section unless otherwise directed by the Administrator in accordance with current concurrence authority."*

We believe that the preauthorization plan should provide the OSC sufficient authority to use chemical or biological response agents. Since the Agency will have already been involved in the preauthorization plan approval, additional Administrator concurrence is unnecessary and would unduly complicate the response.

D. *RRTs and A rea Committees should be required to address and document their review and conclusions on whether or not the use of chemical or biological agents is appropriate.*

The Proposed Rule reads that:

> *"RRTs and Area Committees shall address in a preauthorization plan, as part of their planning activities, whether the use of chemical and biological agents listed on the Schedule on certain oil discharges is appropriate."*

This appears to compel RRTs and A rea Committees to document when and why such agents are appropriate, but does not require documentation or the rationale if they are not deemed appropriate, leaving the option open for RRTs and A rea Committees to simply not address prea uthorization for use of such agents. RRTs and A rea Committees should be required to address and document their review and conclusions on whether or not the use of chemical or biological agents is appropriate. API and NOIA suggest modifying the proposed language to read:

RRTs and A rea Committees shall address in a preauthorization plan, as part of their planning activities, whether or not the use of chemical and biological agents listed on the Schedule on certain oil discharges is appropriate and document the rationale for whether or not the use of an agent is considered appropriate.

IV. Section § 300.910(a)(1) Preauthorization Plan Development

A. *Dispersant use should not be limited by the preauthorization plan.*

EPA should not unnecessarily limit the use of dispersants through new req uirements in developing preauthorization plans. In this section (column 3 , 80 Fed. Reg. 3422), the Agency makes the following statement:

> *"For discharge situations identified where such agents may be used, the preauthorization plan must specify limits for the quantities and the duration of use* (Ed. emphasis added), *and use parameters for water depth, distance to shoreline, and proximity to populated areas."*

We assume that this provision in the Proposed Rule is a direct response to recommendation C5 on pag e 270 of the January 2011 report *Deep Water: the Gulf Oil Disaster and the Future of Offshore Drilling* by the National Commission on the BP *Deepwater Horizon* Oil Spill and Offshore Drilling. However, in the four years since the publication of this report, there have been numerous scientific, peer -reviewed environmental and health publications that have examined the dispersant use during DWH.[29] Subsequent laboratory toxicological studies of dispersed oil in the water column after dispersant application showed that there was no detectable harm to the species tested. Key findings from this research program included the following:

- Following surface dispersant applications, the dispersed oil c oncentrations in the water column return within 3 hours to background l evels due to vertical and horizontal dilution into surrounding ocean waters;

[29] Atlas, R. M., & Hazen, T. C. (2011). Oil biodegradation and bioremediation: A tale of the two wo rst spill in U.S. history. *Environmental Science & Technology, 45* (16), 6709-6715. doi:10.1021/es2013227; Chakraborty, R., Borglin, S. E., Dubinsky, E. A., Anderson, G. L., & Hazen, T. C. (2012). Microbial response to the MC -252 oil and Corexit 9500 in the Gulf of Mexico. Frontiers in Microbiology, Ecotoxicology and Bioremediation, 3, 357 -367. doi:10.3389/fmicb.2012.00357; Lubchenco, J. (2010, December 29). Oil spill clarifies road map for sea turtle recovery. The Miami Herald. Retrieved from http://www.nmfs.noaa.gov/mediacenter/docs/2011/mar/oil_spill_clarifies_road_map_for_sea_turtle_recovery.pdf ; Louisiana Department of Wildlife and F isheries. (2010, July). Oyster stock assessment report of the public oyster areas in Louisiana. Oyster Data Report Series No. 16. Retrieved from https://www.wlf.louisiana.gov/sites/default/files/pdf/page_fishing/32695 -Oyster%20Program/2010-oyster-stock-assessment-report.pdf; Operational Science Advisory Team. (2010). Summary report for sub-sea and sub -surface oil and dispersant detection: Sampling and monitoring. Retrieved from http://www.restorethegulf.gov/sites/default/files/documents/pdf/OSAT_Report_FINAL_1 7DEC.pdf; Operational Science Advisory Team. (2011). Summary report for sub -sea and sub -surface oil and dispersant detection: ecotoxicity addendum. Retrieved from http://www.restorethegulf.gov/sites/default/files/u306/FINAL%20OSAT%20Ecotox%20Addendum.pdf ; Shea, D. (2014, August 15). In re oil spill by the oil rig "Deepwater Horizon" in the Gulf of Mexico, on April 20, 2010. Expert report of Dr. Damia n Shea. New Orleans, LA: United States District Court, Eastern District of Louisiana. Retrieved from http://mdl2179trialdocs.com/releases/release20150120070000/TREX -013444.pdf; Soniat, T. M., King, S. M., Tarr, M. A., & Thorne, M. A. (2011). Chemical and physiological measures of oysters (Crassostrea virginica) from oil -exposed sites in Louisiana. Journal of Shellfish Research, 30(3), 713 -717. doi:10.2983/035.030.03 11; and U.S. Food and Drug Administration. (2010, October 29). NOAA and FDA announce chemical test for dispersant in Gulf seafood. Retrieved from http://www.fda.gov/NewsEvents/Newsroom/PressAnnouncements/2010/ucm231653.htm.

- The surface dispersants were applied over an operating area of 18,000 sq. mi., as a result, surface dispersant application rarely occurred in the exact same location, which further enhanced dilution of dispersed oil in the Gulf; and
- The mixing of relatively small volumes of dispersed oil into the very large, well -mixed Gulf of Mexico resulted in very short exposure durations of animals

These studies, conducted during and after the DWH aerial dispersant operations, indicate that there is no need to specify limits for the quantities and the duration of use of dispersants in a preauthorization plan. We believe the Section 300.910(a)(1) proposed requirement that specifies limits for the quantities and duration of use should be deleted from the Proposed Rule.

If the Agency wants to determine whether and how to limit dispersant use, we propose a joint EPA/industry study of existing research results to provide scientific credibility to any limitations that are established. Without scientific justification, artificially -set limitations on dispersant use would threaten the intent of using NEBA to support response decision -making and would limit the OSC's ability to make the best overall decision concerning the actual scenario and the environment.

To be clear, API and NOIA believe the amount of dispersant used should be based on the outflow of oil and the dispersant-to-oil ratio (DOR) that is effective in dispersing the plume. It is under stood that after a specified time period (e.g., 48 hours), the OSC will request RRT concurrence for continued dispersant use (except when there is a threat to human life and health) wherein concerns over quantities and duration can be evaluated.

We believe that the proposed preauthorization requirement to provide distance to shoreline and proximity to populated areas is not justified as the RRTs/Area Committees have already set these requirements in existing preauthorization plans as appropriate . Each RRT has developed preauthorization maps which clearly depict minimum distances from shore and minimum water depths. In addition to these already established distance and depth limitations, during an actual response, dispersant responders work with the RRT, OSC, and Responsible Party to set standard requirements and operating procedures for aerial spray safety setbacks of 1,000 ft. or more from vessels, platforms, response personnel, and sensitive marine life. Because these practices are already in place, there is no need to specifically regulate new parameters. For these reasons, API and NOIA believe the parameters for distance to shoreline and proximity to populated areas should be deleted.

We suggest that the Agency confer with other Federal agencies involv ed in oil spill planning and response and revise the language in the Proposed Rule to specify that preauthorization should rely on the concepts of CERA/NEBA as the foundation for pl ans and response decisions, not on artificially set limits on dispersant volumes. The USCG has conducted more than a dozen CERAs to help inform the decision-making process, but the Proposed Rule appears to contradict the CERA/NEBA tenets that were previously used to define preauthorization zones.

B. *EPA should work with other agenc ies to implement changes to preauthorization plans.*

Finally, since the Proposed Rule suggests that the Agency is adjusting the natural resource trustee concurrence requiremen t for preauthorization plans, we believe strongly that the Agency must demonstrate how it will work with other agencies to implement these proposed changes into the existing RRT preauthorization process and should specify a time interval for the relevant agencies to complete this integration (e.g., 1-year).

C. *The USCG and Bureau of Sa fety and Environmental Enforcement (BSEE) already regulate logistical aspects of dispersant use.*

There is no reason for the Agency to regulate logistical matters related to dispersant usage because they are already regulated by other agencies. In Section § 300.910(a)(1), the Agency makes the following statement:

> *"...and logistical factors including inventory, storage locations and manufacturing capability of available agents, availability of equipment needed for agent use, availability of adequately trained operators, and means to monitor agent use in the environment."*

There have been many advances in regulations and spill response planning in the past decad e. The regulations should acknowledge that there are now requirements in 33 CFR Parts 154 and 155 that have established a surface dispersant capability throughout the U.S. to apply up to 55,000 gallons (daily) of dispersant out to 50 nm offshore. These new regulations resulted in the development of 44 strategically located dispersant stockpile bases. Fur ther, these regulations require training and exercising of equipment and personnel. Given existing compliance with 33 CFR Parts 154 and 155, preauthorization plans do not have to restate all of these assets but should be able to refer to this regulated cap ability. With current U.S. stockpiles containing close to 1 million gallons of dispersant and international stockpiles containing over 1.5 million gallons (as established via the Global Dispersant Stockpile), the requirement to assess dispersant manufacturing capability during the initial response is unnecessary.

We recommend that the Agency revise this section of the regulation to not require specific information on stockpiles, spray equipment, personnel, training or manufacturing and acknowledge that the USCG and the BSEE are regulating these aspects of spill response.

V. <u>Section § 300.910(a)(2) – Preauthorization Plan Approval</u>

A. *The proposed language for w hen a withdrawal of concurrence invalidates a Preauthorization Plan is unclear.*

EPA needs to clarify when withdrawal of concurrence invalidates a preauthorization plan. In the preamble to this section (column 2, 80 Fed. Reg. 3389), the Agency states:

> *"The Agency is proposing specific procedures for concurrence withdrawals, allowing agencies to do so if they believe the preauthorization plan no longer addressed or reflects existing situations if it were to be implemented. While an agency with concurrence authority may not decide to withdraw concurrence from an approved preauthorization plan, there are curr ently no set procedures to promptly address those situations. The proposal would require the RRT and the ACs to address the withdrawal of approval of the preauthorization plan within 30 days of the withdrawal, allowing an opportunity to address the concerns."*

However, the Proposed Rule language is not clear regarding how the withdrawal process operates. While the proposed 30-day period for the RRT to address withdrawal is a positive step as it provides structure and guidance to the process, it is unclear w hen withdrawal of conc urrence would render the preauthorization plan invalid. API and NOIA believe this only makes sense if there is no active or ongoing response. Agencies should not withdraw their concurrence from an existing plan during a response as this could make responding in a timely fashion difficult, if not impossible. This could potentially allow an agency to invalidate a plan at the time of a s pill forcing a delay in the use of dispersants at the most critical time of the response. Note that the States of Alaska and Florida have withdrawn their approval for

preauthorization in state waters, which was done effectively without any additional regul atory requirements.

Clarifying the language to allow for preauthorization plans to remain in place dur ing the 30-day period in which RRTs and A rea Committees address the withdrawal would prevent disruption to response activities. This would maintain the validity and usefulness of preplanning and preauthorization, while allowing for agencies to withdraw con currence based on changing conditions, reducing the possibility of the withdrawal based on political or media influence. This 30 -day review period should also be subject to public comment.

We also note that currently Subpart J does not include the USCG representative to the RRT as a government agency required to approve preauthorization plans. It is important to inc lude one of the key stakeholders, the USCG, in the approval of preauthorization plans.

Accordingly, API and NOIA suggest modifying the proposed language as follows:

> *(2) Preauthorization Plan Approval. The EPA representative to the RRT, USCG RRT representative for the coastal a nd ocean zones where the USCG OSC would have primary authority and responsibility for operational decisions, the Department of Commerce and the Department of the Interior natural resource trustees and, as appropriate, the state RRT representatives shall review and either approve, approve with modification, or disapprove the preauthorization plans developed by the RRT and/or the Area Committees. Withdrawal of concurrence means the preauthorization plan becomes invalid and the authorization of use for chemical or biological agents must be performed according to paragraph (b) of this section. For an agency to withdraw concurren ce, the agency must first notify the RRTs and Area Committees. The RRTs and Area Committees shall review and address the withdrawal within 30 days of the date of notification, during which time the notification of withdrawal will be subject to public comment. The Preauthorization Plan will remain in effect while the RRTs and Area Committees review the withdrawal. If the agency withdrawing its concurrence remains unsatisfied after the 30 -day review period, then the Preauthorization Plan becomes invalid at th e conclusion of the 30 -day review period, and the authorization of use for chemical or biological agents must be performed according to paragraph (b) of this section.*

VI. Section § 300.910(a)(3) – Preauthorization Plans Reviews

A. *The re-approval process for pr eauthorization plans is too frequent and the timing and process for review and revision is unclear.*

Currently there are no requirements for the review of preauthorization plans. Revised Section 300.918(a)(3) requires preauthorization plan review, and revision as needed at the following times:

> *at least every 5 years; after a major discharge or a Spill of National Significance (SONS); to address revisions of the Schedule; to reflect new listings of threatened and/or endangered species; and to address any o ther change that may impact the conditions under which the use of chemical and biological agents is preauthorized.*

The preamble explains that "other changes" may include a new or revised worst case discharge estimate, and that this review requirement is "intended to ensure that preauthorization plans are actively maintained and updated to reflect revisions to the Schedule." (80 Fed. Reg. 3389). If the Agency decides to move forward with a re view requirement, API and NOIA recommend that the Agency clarify (1) what defines a

"major discharge"; (2) what process should be followed for re-approval; and (3) what effect a change in the preauthorization would have on existing FRPs and VRPs, which are also updated on a 5 -year cycle. We believe the review of preauthorization plans every 10 years or, at the discretion of the RRT/ Area Committee after a SONS (per [a] and [b] in the statement) , is sufficient and that the "major discharge" language should be removed . The Agency should also strike the requirement for review upon new threatened and/or endangered species listings and "to address any other change" since this type of planning on a "less than five year basis" overly -burdens the RRTs. Also, the Agency should clarify what the re-approval process would entail and establish a framework for how long review and approval should take. In addition, the USCG representative to the applicable RRT should also be included in this process. This, along with the remaining review triggers, would still allow for robust, current preauthorization plans, while maintaining stability of existing, potentially affected FRPs and VRPs.

We suggest modifying the proposed language as follows:

> *(3) Preauthorization Plans Reviews. The RRT and/or the Area Committees must review, and revise as needed, pursuant to paragraph (a)(1) of this section, preauthorization plans at least every 10 years; or at the discretion of the RRT and/or Area Committee after a Spill of National Significance (SONS); to address revisions of the Schedule; to reflect new listings of threatened and/or endangered species; and to address any other change that may impact the conditions under which the use of chemical and biological agents is preauthorized. The designated EPA RRT representative, the USCG RRT representative for the coastal and oceans zones where the USCG OSC would have primary authority and responsibility for operational decisions, the Department of Commerce and the Department of the Interior natural resource trustees, and the RRT representative from the state(s) with jurisdiction over the waters of the area to which a preauthorization plan applies shall review and either approve, approve with modification, or disapprove any revisions to the preauthorization plans.*

VII. Section § 300.910(b) Use of Agents Identified on the Schedule on Oil Discharges Not Addressed by a Preauthorization Plan

A. *A reasonable consultation time of 48 hours should be established for natural resource trustees if the Agency concludes that the current "if Practicable" standards should be changed*

In this section in the Proposed Rule (column 1 , 80 Fed. Reg. 3423), the Agency has removed the words *"when practicable"* with respect to consultation with the Department of Commerce (DOC) and the Department of the Interior (DOI) natural resource trustees for the following reasons discussed in the preamble:

> *"The requirement for consultation with the DOC and DOI natural resource trustees is also maintained. However, the language is amended by removing 'when practicable' with respect to consultation with the DOC and DOI natural resource trustees. The Agency believes that the case-by-case decision making should include consultations with natural resource trustees since these discharge situations may present unique challenges when selecting a response option that involves chemical or biological agents. While the Agency recognizes the time -critical nature of decision making during a response, advances in communication technology with increased capabilities to communicate quickly."*

(column 1, 80 Fed. Reg. 3390) API and NOIA believe that while technical advances in communication (e.g., cell phones) have improved since the last Subpart J revision, it does not guarantee an immediate or timely response by the required individuals. And the current system has worked well for years. Thus,

continued flexibility in the approval process (i.e., "when practicable") is still warranted to ensure the timeliest and best possible response . If the Agency concludes that the current " when practicable" language needs tightening up it could establish a reasonable consultation time of 36 hours. Spill response decision-making requires timely decision-making. Natural resource trustees already have an independent process to assess possible damages outside of the response effort (via Natur al Resources Damage Assessments [NRDA]). The phrase could be revised to state, "*...when practicable within a 36-hour timeframe*".

B. *The change in th e term "navigable waters threatened " will set up additional barriers to dispersant use and unduly limit actions by the OSC.*

In the same paragraph (column 1, 80 Fed. Reg. 3390), the Agency makes the following statement:

> *"The Agency is also proposing to revise the term 'navigable waters threatened' to 'waters and adjoining shorelines threatened' to be consistent with the provisions in paragraph (a) of this section."*

We are concerned that this change will set up additional barriers to dispersant use and unduly limit actions by the OSC.

C. *Early dispersant use decision-making should focus on documenting that a NEBA justification exists to support dispersant application.*

The Proposed Rule would unnecessarily establish new requirements f or an OSC to document the parameters used to authorize dispersants. This is discussed in the same section (column 2, 80 Fed. Reg. 3423), as follows:

> *"...the OSC must consider and document the parameters for the use of agents including the quantities to be used, the duration of use, the depth of water, the distance to shoreline and proximity to populated areas, and should address factors suc h as environmentally sensitive resources or restricted areas that might be impacted, agent inventory and storage locations, agent manufacturing capability, availability of equipment needed for agent use, availability of adequately trained operators and appropriate means to monitor agent use in the environment."*

Because dispersants have a limited window of opportunity to be used on spills, it is important to decide quickly on their use. Decisions by the OSC should not be delayed to complete information that is not needed. Many of the proposed items for the OSC to document (e.g., stockpiles, personnel, spray assets) are already specified and required in the applicable response plan requirements of 33 CFR Parts 154 and 155. Given the current stockpile availability in the U.S. and in the Global Dispersant Stockpile, dispersant availability will not be a concern for weeks or months. As suc h, we believe that the immediate actions by the OSC should include a review of the pre -authorization plan(s) and a rapid , incident-specific NEBA to support the selection of response options that may include dispersant application as a means to lessen or eliminate impacts to sensitive shoreline resources or to pr otect worker health and safety. In addition, we recommend that the Pr oposed Rule require referencing the USCG -classified dispersant OSRO or other OSRO for many of the items requested.

VIII. <u>Section § 300.910(c) Burning Agents</u>

A. *Ignition devices for in-situ burning are not burning agents.*

Under the current rule an OSC may author ize use of a burning agent on a case -by-case basis after concurrence of the EPA representative to the RRT, the state RRT representative and in consultation with the DOC and DOI natural resource trustees, when practicable. The Agency proposes to authorize the OSC to approve the use of a burning agent without the approval or consultation with other agencies to facilitate expedited use in recognition of their increasing importance in response to spills and that small quantities of burning agents are used and are quickly consumed by the resulting fire. API and NOIA agree and commend the Agency for this proposal. Further, we agree that ignition devices should be excluded from the definition of burning agents.

We believe that chemical herder agents are includ ed within the scope of the term burning agents. In the preamble to this section (column 3, 80 Fed. Reg. 3390), the Agency makes the following statement:

> *"Further, because of the nature of burning agents and the proposed revisions to the authorization of use for these products, the Agency continues to believe it is not necessary to require product submissions for burning agents."*

We believe this statement also applies to chemical herder agents. Please clarify if this is correct.

IX. Section § 300.910(d) Exception

A. *EPA needs to clarify the phrases "protection of human life" and "near inhabited areas."*

In this section in the Proposed Rule (column 2 , 80 Fed. Reg. 3423), the Agency makes reference to "the protection of human life ." We believe it is unclear whet her "*protection of human life* " is inclusive of the protection of worker health and safety. The Agency should amend this section to clearly include the protection of oil spill response worker safety within this concept. This same section also references spi lls "*near inhabited areas.* " This language is confusing since spills where dispersant use serves an environmental benefit will rarely (if ever) be near inhabited areas.

B. *A time limit on protecting human health is inappropriate.*

We believe the establishmen t of a 48 h our limit to the OSC's use of authority to use agents to protect human health is inappropriate. There should never be a limit to the OSC's ability to make decisions that are aimed at protec ting human health or human life, and the exception shoul d be permissible until the threat to human health has subsided. The current rule adequately allows for the OSC to approve use of dispersants in such cases and EPA has not justified that the proposed requirement is necessary or provides any benefit to existing requirements.

X. Section § 300.910(e) Prohibited Agents

A. *Banning nonylphenol (NP) and nonylphenol ethoxylates (NPE) is not necessary for dispersants.*

API and NOIA submit that NP and NPE components should not be banne d. In the preamble to this section (column 2, 80 Fed. Reg. 3391), the Agency makes the following statement:

> *"The Agency is also proposing to add a prohibition from listing on the Schedule and from authorizing use of any chemical or biological agents that contain n onylphenol (NP) or nonylphenol ethoxylates (NPEs) as components."*

While we appreciate the Agency's concern about NP and NPE components, an outright prohibition seems inconsistent with the practice of allowing NP and NPE ingredients in a variety of widely-used cleaning products in the U.S. After use, these products are routinely flushed and transported into wastewater discharges on a daily basis. Spill response dispersant use is extremely infrequent and only occurs when a significant threat to shoreline or near shore resources is present. Banning these components in oil spill dispersants while allowing their wide spread use in other commercial products seems contradictory and prejudicial. API and NOIA requests that the Agency explain why NP/NPE is banned in dispersant products, but not in many more commonly manufactured products.

B. *Endocrine disruption testing has little relevance and is not necessary.*

We submit that endocrine disruption testing should not be added. In the same section (column 1, 80 Fed. Reg. 3392), the Agency states:

> *"Because validated testing methods are still being developed the agency is not proposing any test requirements with respect to endocrine disruption for products to be listed on the Schedule."*

We believe that adding any such testing provides little relevance in the context of oil spill response decisions and that testing efforts are better directed at the use of standardized toxicity tests with aquatic organisms using endpoints of population relevance (i.e., mysid and *Menidia* tests proposed).

C. *Mechanical response clean-up methods have greater limitations in offshore conditions than dispersants.*

Mechanical response clean-up methods have many limitations. In the same section (column 2, 80 Fed. Reg. 3392), the Agency makes the following statement:

> *"There are chemical and biological agent alternatives to sinking agents and to agents containing NP or NPE; <u>as well as mechanical methods</u>* (Ed. emphasis added) *for responding to oil discharges, including those situations that pose extreme threats or are time critical."*

We believe the Agency must realize the limitations that mechanical response methods have in offshore conditions. Weather conditions will preclude booming and skimming operations in sea states above six feet wave height, and even in ideal sea state conditions, responding to offshore spills historically has resulted in 5-10% of spilled oil recovered by mechanical recovery methods. For this reason, it is critical that responders have reasonable access to chemical response methods, because of the substantially higher encounter rates (80% or more) that can be achieved by treating the spilled oil with dispersants.

XI. <u>Section § 300.910(f) Storage and Use of Agents</u>

A. *No additional requirements should be put in place for product shelf life.*

Currently, the manufacturer is required to provide information on recommended conditions of storage and use for each product at the time an application for listing a product under Subpart J is submitted to the Agency. With regard to shelf life, the Agency is requesting comments on whether more information should be submitted on issues related to shelf life. Specifically, in the preamble to this section (column 1, 80 Fed. Reg. 3393), the Agency makes the following statement:

> *"To alleviate concerns that applications are submitted that establish an extended or indefinite shelf life for a product, the Agency is requesting comments on whether any*

> *additional data or information requirements should be included for the product listing determinations specific to a product's shelf li fe, or whether alternative approaches, such as limiting the shelf life for product categories to a given timeframe, should be considered."*

API and NOIA believe that no additional requirements should be put in place for product shelf life and thus it shoul d not change the current practice of having the manufacturer provide information on recommended conditions of storage and use for each product. Ensuring product efficacy (regardless of age) is the only relevant end-point. For example, research has shown that properly maintained stockpiles of Corexit 9500 have remained effective for 25 years. Given that periodic effectiveness testing is proposed, there is no justification for also mandating a shelf life that could potentially result in costly replacement of stockpiles that remain viable and effective.

If the Rule dictates a dispersant shelf -life, this could caus e an undue financial burden. We believe that suppliers may set low shelf-lives to protect themselves from liability or to promote future recurring s ales, even though there are well-documented studies indicating that properly stored dispersant stockpiles have maintained their effectiveness for decades. A 2008 study by Clark, *et al.*,[30] evaluated U.S. stockpiles of Corexit 9527 and concluded that batches of this dispersant have remained viable for spill response for over 30 years. Establishing shelf -lives for products makes sense if periodic testing is not specified. However, since the Proposed Rule specifies re -testing of the dispersant stockpiles, there is no justification for also requiring a shelf -life. We submit that the requirement for a shelf -life should be removed from the Proposed Rule and that the Agency should instead provide more clarity on product re - testing for efficacy. Specifically, the requ irement to conduct periodic 5 -year tests of effectiveness and toxicity is unclear. The sampling requirement has not been delineated in the Proposed Rule, which could be interpreted, in the extreme case, that every single dispersant container would have to be re-sampled and tested to remain in an "approved" status.

The Rule should clearly state that representative samples of batches/lots are tested for efficacy and that the testing interval take into account the aforementioned studies that demonstrated tha t dispersant stockpiles maintain effectiveness for decades. Further, we submit that there is no scientific justification for re-testing toxicity.

B. *Central dispersant stockpiles are typically maintained by OSROs, not by Responsible Parties or product manufacturers.*

Under the Proposed Rule the OSC would only be able to authorize use if the Responsible Party certifies that the products have been stored under the conditions provided by the submitter. In this section in the Proposed Rule (column 2-3, 80 Fed. Reg. 3423), the Agency makes the following statement:

> *"The OSC may authorize for use only products that are certified by the Responsible Party to have been stored under the conditions provided by the submitter under 300.915(a)(6) and whose date of use does not exceed the expiration date listed on the container's label at the time of the incident. The Responsible Party must provide the OSC product documentation, developed in consultation with the submitter of the product to the Schedule, prior to OSC authori zation of product use affirming it has maintained its integrity, including no changes in its composition, efficacy, and toxicity."*

[30] Clark, J., Becker, K., & Lessard, R. (2008). Maintaining dispersant stockpiles and assessing their quality. *Proceedings of the 2008 International Oil Spill Conference, 2008*(1), 695-698. doi:10.7901/2169-3358-2008-1-695

The Agency needs to recognize that central dispersant stockpiles are typically maintained by OSROs and are stored mainly in 200 to 300 gallon totes so that they can be transported by truck or air to the site of a spill. In most spill situations, the dispersant stockpile will not be in the control of the Responsible Party or the submitter of the product (i.e., the original manufacturer) at the onset of a spill. As a result, there is no way for these two entities to make a certification for a product that was not in its direct control just prior to the spill. API and NOIA suggest modifying the language to clarify that Responsible Parties must only demonstrate compliance with Section 300.915(a)(6) for inventory/product they control.

C. *Certification of storage conditions should not be required for authorization of use.*

Section § 300.910(f) states that the OSC may authorize for use only products that have been stored under the conditions specified by the manufacturer including the maximum, minimum and optimum temperatures as well as humidity and other relevant conditions. This proposed regulation could require dispersants to be stored in climate controlled buildings with continuous temperature and humidity monitoring. We do not support this proposed requirement.

D. *API and NOIA opposes any re-testing requirements during a spill response.*

The intent of this section is difficult to discern but it appears that the certification requirement appears to essentially requires complete retesting of the product (at the time of the spill) for the Responsible Party to certify such a statement. It appears that the Agency has included this language with the specific intent to delay the dispersant authorization process by requiring complete re-testing at the time of a spill incident. We strongly oppose any re-testing requirements during a spill response. Any product testing should be conducted at a specified, planned interval, not during an emergency response. During a response, the Responsible Party should not have to certify the dispersants that will be applied, since that is the purpose of the NCP Product List. The only requirement should be for the Responsible Party to show the OSC, if requested, the original manufacturer's verification (Certification of Analysis) that the product meets specifications for dispersants with an age of less than the period for retesting recommended by the manufacturer. For older dispersants the Responsible Party should, if requested, show the efficacy re-test data for the stockpile. The test required should only be for effectiveness as it is a reliable indicator that the composition has remained the same. We propose that this language is changed to read: *"The OSC, to authorize the use of dispersants, may request that the Responsible Party provide test data of the dispersant stockpile showing it is effective."* We also suggest modifying the language so that it applies only for product manufactured or produced after the date of final rule publication.

E. *Re-testing requirements must permit flexibility in test results over time.*

This same section specifies re-testing and re-labelling requirements. This section does not specify the criteria for re-testing results and needs to specify permissible levels of deviation from past testing results. We point out that efficacy and toxicity testing have inherent variability. Two testing runs of the same product, in the same laboratory, in the same week can yield varied results, so any re-testing requirements must permit flexibility in test results over time. We suggest an allowable 10% variance in effectiveness test results, based on manufacturer and scientific experts' opinion on effectiveness testing. As previously stated, we do not believe there is any scientific justification to re-test for toxicity since efficacy results will confirm if the composition of the dispersant has changed. We suggest clarifying language so that it is clear product testing is only required if it is not stored under requirements provided by submitter, or it has expired.

F. *The assignment of an arbitrary 5-year life to products is biased and creates unwarranted expense due to recurrent testing.*

Finally, the assignment of an arbitrary 5-year life to products without regard to prior research on product viability over time, or on manufacturer input on product re-testing, is biased and creates unwarranted expense due to recurrent testing. Proposing 'no change' in composition, efficacy, and toxicity seems unreasonable and could result in significant costs of replacing usable dispersant stockpiles. Additionally, dispersant manufacturers typically advise that container seals not be broken and the material not be exposed to air, which would be necessary to test existing stocks, which may or may not have an expiration date printed on the label under current regulation.

Studies exist that show Corexit products maintain effectiveness for 25 years. We believe that any re-certification term should be based on existing scientific and manufacturer data. There should also be an allowance for some change/degradation of product over time, aligned to international practice. For example, the United Kingdom Marine Management Organisation allows a loss of efficacy to 75% of the original minimum level. Further, there is no scientific rationale to require any form of toxicity re-testing of a dispersant that was previously tested. Manufacturers will have the best insight regarding when product recertification should be needed. In addition, the Responsible Party should never be required to re-label products they did not produce, with the possible exception of adding a re-test date for product efficacy.

XII. Section § 300.910(g) Supplemental Testing, Monitoring, and Information

A. *API believes the standard efficacy and toxicity tests already required are more than adequate for regional use.*

We do not believe there is a need for additional testing than is currently required under the NCP. In the preamble to this section (column 2, 80 Fed. Reg. 3393), the Agency makes the following statement:

> *"The proposal removes 'in addition to the test methods specified in 300.915 and described in appendix C to part 300.' While RRT's may want to use the efficacy and toxicity testing protocols specified in Appendix C of the NCP for comparative purposes, the proposed revisions clearly establish the RRT's authority to require tests using parameters beyond those specified in Appendix C. Furthermore, there may be supplementary toxicity and efficacy testing information based on recognized standard testing methods already available that RRTs may want to consider when addressing site, area, or ecosystem specific concerns."*

We believe the standard efficacy and toxicity tests already required are more than adequate for regional use. We suggest the Agency consult the NOAA Dtox database. A review of that database suggests that the sensitivities of all tested species are in the known range and that additional tests simply reinforce the existing species sensitivity distribution curves. Regional data are unlikely to fundamentally change overall NEBA considerations for dispersant use. Any regionally required laboratory efficacy tests during a response will not be as relevant as a pilot test in the field and will only delay the dispersant authorization process approval beyond the window during which dispersants could be applied (thereby precluding their use in some situations where they may have provided a net environmental benefit). This proposal allows RRTs to request a broad range of additional data on a product, a situation that creates the potential for confusing and costly testing and is unlikely to add further information of value to oil spill response decision-making.

B. *Additional monitoring during a response is unreasonable.*

Section § 300.910(g) provides the RRT with the authority to request that the OSC require the Responsible Party to conduct additional monitoring associated with use of a product. We submit it is unreasonable to require additional monitoring during a response except in exceptional circumstances. In the preamble (column 2, 80 Fed. Reg. 3393), the Agency makes the following statement:

> *"For example, the RRT may want to monitor the exposure of marine mammals to oil constituents, including the dispersed oil, or to monitor toxicity in the water column using biological assays."*

We believe such monitoring during a response is unreasonable and should only be undertaken if (a) there is some critical question associated with the spill response that has not been answered with the testing already in place; and (b) there is sufficient time to arrange for proper and scientifically defensible protocols to be established. Given that tests associated with such monitoring are likely to be complex and require considerable time to prepare, implement, and interpret, it appears that the tests would not inform operational decision-making during the response, but rather would develop data for NRDA. As previously stated, operational monitoring and NRDA are two different things and this Proposed Rule should not specify NRDA monitoring. Additionally, the "biological assays" that are referenced in the Proposed Rule are impractical given the nature of offshore spills where dilution is significant, water movement is constant, and synoptic sampling of small quantities of organisms from dynamic water masses is not representative of any chronic or resident conditions.

API and NOIA suggest revising the language as follows:

> *(g) Supplemental Testing, Monitoring and Information. The RRT may require supplementary toxicity and efficacy testing, or available data or information that addresses site, area, or ecosystem specific concerns relative to the use of a product for both planning and authorization of use. During a discharge incident, the RRT may request that the OSC require a Responsible Party to conduct additional monitoring associated with the use of a product to the extent necessary for conducting response operations. Such additional monitoring data may include supplemental sampling and testing to ensure safety of response personnel, to assess acute environmental impacts or otherwise aid the OSC and/or the RRT in operational decisions.*

XIII. Section § 300.910(h) Recovery of Agents from the Environment

A. *The OSC has the authority to use the NEBA process to make decisions on recovery of agents from the environment.*

In the preamble to this section, the Agency is requesting comments on new language that would require the Responsible Party, under OSC oversight, to remove specified products/agents from the environment after use. While the Proposed Rule hints at NEBA, it does not reference it specifically when suggesting that some situations (e.g., safety of personnel or greater harm to the environment) might preclude the removal of these agents. That would seem to contradict the main change in this section (h) while not providing any framework (e.g., NEBA) in which to make a determination for precluding the removal. The language is also potentially redundant as the OSC is already obligated to consider safety and additional adverse environmental impacts (i.e., via NEBA) as part of the normal decision-making process. Essentially, it is already an underlying tenet of the response process. Additionally, in some cases recovering 100 percent of these agents after application is not practical or even feasible regardless of the diligence of the Responsible Party

We suggest revising the proposed language to make it clear that the OSC has the authority to use the NEBA process to make these decisions:

> *(h) Recovery of Agents from the Environment. Depending on factors such as the safety of response personnel and harm to the environment (including consideration of Net Environmental Benefit Analysis [NEBA]), and as directed by the OSC, the Responsible*

Party shall, following application, endeavor to adequately contain, collect, store and dispose of the agents that are intended to be recovered from the environment.

XIV. Section § 300.910(i) Reporting of Agent Use

A. *The Agency should not adopt a prescriptive time period for reporting of agent use.*

The Agency is requesting comments on the appropriateness of requiring the OSC to provide the RRT additional reporting information " *within 30 days of completion of agent use* ." This runs counter to the adaptive decision-making that might be required during a discharge event where such agents are used.

Based on the pre authorization testing that is being proposed and, more importantly, the variability of discharge situations, we recommend that the Agency not adopt a prescriptive time period and rather provide the relevant RRT(s) discretion to determine the appropriate time period for reporting agent use. A strong justification for this approach is that during prolonged discharges, a fixed 30 -day reporting period might constrain the response personnel and interfere with higher priority resource allocations. Furthermore, the OSC would typically request this information as part of the daily briefing.

API and NOIA suggest removing the 30-day window for reporting and modifying the proposed language as follows.

> *(i) Reporting of Agent Use. Unless already included in the OSC report required under § 300.165 of this part, the authorizing OSC shall provide the RRT the following information on chemical and biological agents used in response to an oil discharge: product name, quantity and concentration used, duration of use, and locations.*

XV. Section § 300.913 Monitoring the Use of Dispersants

A. *The appropriate use of spill mitigating products will reduce t he overall impact of the spill and protect the health and safety of response personnel.*

The Agency makes the following two related statements to explain the goal of the NCP Product Schedule (column 3, 80 Fed. Reg. 3393; column 3, 80 Fed. Reg. 3402; respectively):

> "*The goal of establishing a Schedule under the NCP is to protect the environment from possible damage related to spill mitigating products used in response to oil discharges.*"
>
> *"Emergency response personnel need to know whether a dispersant or an y other type of chemical or biological agent on the Schedule could have negative environmental impacts relative to the oil before decisions are made about its use in a particular oil discharge situation. Consequently, it is essential to consider comparativ e information about the efficacy and the toxicity of these products.*"

Possible damage related to spill mitigating products used in response to oil discharges is considered, but not the possible damage that could be caused by the oil itself without the us e of spill mitigating products. The main threat to response personnel, communities, and the ecosystem comes from the oil, not from the spill mitigating products. The concept of CERA/NEBA accepts that some effects might be caused by the response (including the use of spill mitigating products), but also recognizes the greater benefit of reducing the overall impact of the spill that can be achieved by using them. The Agency needs to acknowledge the importance of NEBA in justifying the use of dispersants.

We believe that the focus on the potential for negative environmental impacts that could be caused by a dispersant ignores the essential point that dispersants are used to mitigate (minimize) the negative human health and environmental impacts that could be caused by the oil. The main threat to the ecosystem comes from the oil itself, not from the dispersant. T he wording of the preamble to a final rule needs to:

- reflect the ultimate aim of dispersant use;
- clarify that the toxicity of dispersed oil comes from the oil (not the dispersant); and
- acknowledge and emphasize the importance of using a NEBA process in dispersant use decision-making.

We request that the Agency consider including the following two paragraphs (or equivalent language) in the preamble to the final rule to briefly explain dispersant use and the importance of NEBA in making dispersant use decisions.

> *"Dispersant Use and Net Environmental Benefit Analysis (NEBA)*
> *The aim of dispersant use is to protect response personnel from VOC exposure and to prevent oil from drifting ashore and potentially causing severe and long -term damage to coastal resources and communities, by dispersing the oil into the water column where it will be diluted rapidly to very low concentrations and the majority of the o il will subsequently be biodegraded. This common aim of dispersant use is the same, whether it is applied to oil on the sea surface or directly at the outflow source in the case of a subsea release. The potential risk of dispersant use is that, by dispersi ng the oil into the water column, there is an increased potential for toxic effects to be caused to marine organisms. The severity of the toxic effects that could be caused is related to the exposure of the marine organisms to the dispersed oil (or the par tly water-soluble oil compounds) and exposure is a function of concentration of the oil in the water and the duration for which such exposure persists.*
>
> *The issue of the environmental trade-offs caused by dispersant use is addressed by Net Environmental Benefit Analysis (NEBA). NEBA is a process used to make choices about oil spill response techniques to be used to minimize the potential impacts of the oil on people and the environment. NEBA takes into account the likely effectiveness and feasibility of co nducting alternative response techniques under the prevailing conditions. The main principle of NEBA is that an oil spill response technique (or combination of techniques) that is used should be that which minimizes potential impacts of the oil on the environment to the greatest extent and promotes the most rapid recovery and restoration of the affected area. In many cases of dispersant use, the potential risks to the offshore marine ecosystem are very low because dispersed oil concentrations are low and pe rsist only briefly. There is benefit in using dispersants in offshore environments to prevent damage to coastal communities and sensitive near -shore resources where persistent stranded oil can cause longer-term environmental problems."*

The Proposed Rule also appears to focus more on the environmental effects during the response rather than the health and safety of response personnel. The Agency should make it clear that one of the primary objectives of characterizing the efficacy and understanding transpor t is to protect the health and safety of response personnel. That critical aspect is not mentioned in this section.

B. *The OSC should determine where, when, and how monitoring resources should be deployed.*

EPA should clarify the meaning of the phrase *"upon initiation and for the duration of subsurface dispersant use."* Later in this section of the preamble (column 2, 80 Fed. Reg. 3394), the Agency states the following:

> *"The proposal requires the responsible party to implement monitoring for any subsurface dispersant use in response to an oil discharge upon initiation and for the duration of subsurface dispersant use."*

The phrase *"upon initiation and for the duration of subsurface dispersant use"* can be misconstrued to mean that all monitoring required by the Proposed Rule must be performed at all times, when in fact the monitoring timing and operational parameters should be established by the OSC. Every response is unique, and it should be left to the OSC to determine where, when and how monitoring resources should be deployed to provide the best near real-time operational monitoring on the progress of the response.

C. *The Proposed Rule should be restructured to separate surface dispersant application monitoring from subsea dispersant injection monitoring.*

EPA should distinguish between surface and subsea dispersant application monitoring. In the first paragraph of this section in the Proposed Rule (column 1, 80 Fed. Reg. 3424), the Agency states:

> *"As directed by the OSC, the Responsible Party must monitor any subsurface use of dispersant in response to an oil discharge, surface use of a dispersant in response to oil discharges of more than 100,000 US gallons occurring within 24 hours, and surface use of dispersant for more than 96 hours in response to an oil discharge, and submit a Quality Assurance Project Plan for approval to the OSC covering the collection of all environmental data".*

We believe it is significant that monitoring is to be required *"as directed by the OSC."* It should be made clear that the OSC has discretion to authorize initial use of dispersants during a time-limited efficacy testing phase while evaluating the need for and extent of additional adaptive monitoring actions. The OSC is in the best position to determine when and what operational spill response monitoring is to occur. Experience has shown that the use of phased monitoring approaches, consistent with the USCG *et al.*'s *Special Monitoring of Applied Response Technologies* (SMART) protocols, is appropriate, and they are most responsive to changes in site-specific conditions and information requirements. While the requirement for the Quality Assurance Project Plan (QAPP) is constructive in helping to maintain effective data integrity and management, the rule should provide the OSC with discretion in how detailed the document needs to be to meet this requirement. This would provide the relevant incident decision-makers with practical information that can be consistently acquired, analyzed, and understood.

The Proposed Rule seems to inappropriately replace the currently used 3-tier SMART protocols for monitoring surface dispersant use with the more exhaustive monitoring approach proposed for subsea dispersant use. The USCG Strike Teams already have the responsibility for monitoring surface dispersant operations and possess the trained personnel and equipment to conduct these activities. Many RRTs require the immediate activation of USCG Strike Team monitoring for all dispersant operations, regardless of size or location. We believe it is beneficial to have the government perform the surface monitoring to enhance credibility with the public that the operations are being conducted correctly and are working as intended. If this practice is going to change, the Agency should explain why it is circumventing an established, well-vetted process performed by the USCG Strike Teams. The information in the Proposed Rule creates confusion between existing responsibilities of the USCG Strike Teams and those of the Responsible Party. We request that this confusion be reconciled between the Agency and the USCG, as the Responsible Party should not be required to provide duplicate monitoring for surface dispersant operations.

For these reason s, we believe this section of the Proposed Rule should be restru ctured to separate surface dispersant application monitoring from subsea dispersant injection monitoring. API and NOIA offer the following relevant points:

- The section on surface dispersant application monitoring should specify that it will be implemented with existing SMART protocols using USCG resources.
- The section describing subsea dispersant injection monitoring should specify it will be performed by the Responsible Party.
- In both cases, the Proposed Rule should clearly state that the mobilization o f monitoring capabilities will not delay initial dispersant applications. Monitoring requirements should not impede the use of chemical agents during a response and should be implemented as appropriate resources become available during the response.
- The c riteria of greater than 100,000 gallons or duration of 96 hours for the spill should be replaced with a single criterion that " *any enhanced monitoring beyond SMART shall commence within seven days.* " Our rationale for a deployment schedule of seven days for any enhanced monitoring (whether subsea or surface dispersant monitoring) ensures that scientifically - defensible monitoring can be performed, by ensuring:
  - The best scientific experts can be assembled and mobilized to the spill;
  - Once on scene, the science team can design a monitoring plan that can be integrated safely into ongoing response operations, and be worked into the Simultaneous Operations (SIMOPs) schedule;
  - The team can tailor a general monitoring strategy into a specific mission plan for the monitoring vessel that is available (there is no way to know what research vessel may be available, and each vessel will have unique characteristics for equipment deployment);
  - Available monitoring vessel(s) can be identified, mobilized to port, and properly out fitted with the scientific equipment needed to implement the mission plan;
  - An appropriate sampling strategy can be developed and approved for the specific incident, taking into account ongoing response activities that may impede access to sampling sites; and,
  - Appropriate safety considerations for the monitoring vessel, dispersant application or injection platforms, and rapidly-assembled teams can be properly reviewed.

D. *Effectiveness determination is not currently scientifically feasible.*

The language in this section of the Proposed Rule appears to indicate the Agency believes that comprehensive monitoring will permit the dispersant effectiveness at sea to be quantitatively determined. This requirement for effectiveness determination is not currently scien tifically feasible. Also, use of the word "*comprehensive*" should be avoided as it is subjective. Instead, it should be replaced with "*adaptive*" which indicates that a decision could be revisited as the d ischarge situation changes. We recommend replacing all instances of the word " *comprehensive monitoring*" with "*adaptive monitoring*" throughout the proposed section. The following language could be used:

> *The agency believes that an adaptive monitoring program which includes objective science and ocean transp ort modeling in certain discharge situations is necessary to determine the overall effectiveness of the dispersants and should transcend the initial dispersant application to include the extent, character, and transport of the dispersant and dispersed oil in the water column.*

With respect to <u>surface dispersant use monitoring</u>, we offer the following comments:

- Experience at the DWH and other incidents has shown that no currently available remote sensing technique, including airborne visible/infrared spectro meter (AVIRIS) and other multi- and hyper-spectral equipment, is capable of accurately quantifying the total amount of oil on the sea surface. It is also not possible to accurately determine the total amount of dispersed oil in the water column at any time because water sampling or ultra violet fluorometry (UVF) transects cannot be made at sufficient resolution in space (i.e., distance and depth) and cannot be made at sufficient resolution in time (i.e., simultaneously at all points in the water under an oi l slick). Localized measurements by UVF made before and after dispersant spraying can reveal the relative effect of dispersant use, but is not quantitative . A sharp increase in dispersed oil concentrations in the water, after dispersant use, is a good indi cation that the dispersant is working, but such measurements cannot produce an aggregate estimate of disper sant effectiveness. As such, we believe that the Agency should remove any requirement for quantitative reporting of efficacy, since it is not technically possible.
- A QAPP should not be required for surface dispersant operations. QAPP for approval by the OSC covers the collection of all environmental data to ensure and maximize its quality, objectivity, utility, and integrity. All these requirements wil l result in the need to generate a very large document that needs to be reviewed, verified and approved by OSC. This will lead to delays in dispersants decision-making, while adding little value to the goals of the response. A more useful approach may incl ude a daily Quality Control review of the SMART data to determine if the surface dispersant applications were effective that day, to support decisions for possible dispersant use the next day. A Quality Control form was developed during DWH for this purpos e. we believe the QAPP requirement should be deleted for surface dispersant operations and replaced with a simplified Quality Control form for SMART data.

With respect to <u>subsea dispersant injection monitoring</u>, we provide the following comments:

- The Age ncy does not address methods for visual determination of subsea dispersant effectiveness. During DWH, visual monitoring of the subsea dispersant injection was conducted in two ways to provide valuable, near real -time information to help inform response dec isions. These included:
  - Aerial observations of surfacing oil quantity and appearance (provided from observation aircraft overflights); and
  - Subsea observations of changes in plume appearance at the injection site (provided from ROV imagery).

  This form of monitoring for subsea dispersant injection should be recognized as an important step for initially evaluating the operation while more "enhanced scientific monitoring capabilities" are being assembled.
- API has developed subsea monitoring guidance (API Techn ical Report 1152 , *Industry Recommended Subsea Dispersant Monitoring Plan – Version 1.0*) and recommends the Agency consider this as the basis for their approach for operational monitoring. This guidance is publicly available at http://www.oilspillprevention.org/~/media/oil-spill-prevention/spillprevention/r-and-d/dispersants/api-1152-industry-recommended-subsea-dis.pdf.

XVI. Section § 300.913(a) Documenting and Monitoring the Oil Discharged and Dispersants Used Requirements

A. *The Responsible Party should not be required to document information at the beginning of a response that has already been determin ed in planning and preparedness activities.*

The current regulations found in 33 CFR Parts 154 and 155 require OSROs that use dispersants to maintain a certain level of spray assets, dispersant stockpile quantities, and logistical capabilities to

deliver stockpiles to staging bases, and to provide information on the application dosages they can apply. Since this is regulated elsewhere, reporting of these elements should not be required in the Proposed Rule and should therefore be deleted.

The Responsible Party should not be required to provide the *"rationale for dispersant product choice(s) including the results of any efficacy and toxicity tests specific to area or site conditions."* If the dispersant product is on the Product Schedule (which means that eff icacy and toxicity data have already been provided to the government), then it is, by definition, a viable option for the response.

Providing *"hourly application rates"* does not apply to aerial and vessel application since dosages are prepared in gallons per acre application and are based on the spray assets' application speed an d spray system swath width. We suggest that this statement be modified to read: *"hourly application rates (in the case of subsea dispersant injection)."*

The phrase " *recommended di spersant-to-oil ratio (DOR)* " should be modified to " *recommended <u>initial</u> dispersant-to-oil ratio (DOR).* " Every spill is different, and the DOR should be adjusted as additional monitoring, analytical data results, and/or oil release rate information becomes available. Additionally, the DOR may need to change as the oil weathers or other conditions change. The Agency should consider providing a clarifying sentence recognizing that oil characteristics and effective DORs may vary and thus dispersant application rates/volumes cannot be fixed to pre-determined values as this practice may affect negatively the response.

The Agency should refrain from requiring estimates of dispersant volumes needed to effectively respond to the spill at the onset of the response. In the case of a subsea oil release, it is impossible to know how much oil will be released and , therefore, impossible to estimate what volume of dispersants might be necessary. Further, as oil weathers, DORs for surface application will need to be adjust ed, and these changing weathering conditions cannot be fully known in advance. Given current dispersant stockpiles in the U.S. and in the Global Dispersant Stockpile, it should be assumed that sufficient dispersants will be available if their use is warranted by NEBA.

B. *Identifying and reporting associated volatile petroleum hydrocarbons will be impossible with changing environmental conditions, and is unnecessary for response decision-making.*

The requirement to *"...document any associated volatile petroleum hydrocarbons..."* would be very difficult to achieve, given that volatiles will fluctuate with sun exposure and changing wind conditions. The reason for this requirement is not explained; therefore, the Agency should specify what is intended by this requirement or delete it.

C. *The Agency should accept best available industry practice for dispersant monitoring.*

There is no need to restate the requirement for documenting the results of toxicity testing. In general, the list of characteristics is practical and do es not create an undue burden ; however, there is a significant assumption in the requirements (i.e., that the condition of the discharge point is such that it will enable the acquisition of these data at any given time). A reference to a best available industry practice, or any of the existing guidance on dispersant sampling/monitoring (e.g., API guidelines on subsurface dispersant monitoring, API TR 1152) would be more effective for gathering the information requested by the agency without imposing undue b urden on response personnel. Additionally, there is no technical reason to differentiate subsurface discharges from the rest of this paragraph. We suggest removing this differentiation and suggests modifying the proposed language as follows:

As directed b y the OSC, the Responsible Party must monitor any subsurface use of dispersant in response to an oil discharge, surface use of dispersant in response to oil discharges of more than 100,000 U.S. gallons occurring within 24 hours, and surface use of dispersa nt for more than 96 hours in response to an oil discharge, and submit a Quality Assurance Project Plan for approval to the OSC covering the collection of operational monitoring data. When these dispersant use conditions are met, and for the duration of dispersant operations, the Responsible Party shall:

(a) Document the characteristics of the source oil; best estimate of the oil discharge flow rate, periodically reevaluated as conditions dictate, including a description of the method, associated uncertainti es, and materials; dispersant(s) product used, rationale for dispersant product choice(s), recommended dispersant-to-oil ratio (DOR); and the application method and procedures, including a description of the equipment to be used, hourly application rates, capacities, and total amount of dispersant needed.

XVII. Section § 300.913(b) Sampling Requirements

A. *Daily water sampling and testing is burdensome.*

The requirement to conduct these required tests on water samples daily may prove overly burdensome and not necessary after the initial efficacy tests. We suggest modifying the Proposed Rule to ensure that the OSC has discretion in h ow frequently the samples must be acquired after the initial efficacy tests are conducted. Sampling on a daily basis, once efficacy is determined and agreed, is arbitrary and does not fit the timeline required to provide in-depth analysis of samples.

The collection of water column samples where the dispersed oil plume is located is not necessary and in many cases is not possible for aer ial dispersant application. For spills of up to 100,000 gallons, aerial dispersant assets can be activated and apply dispersants to the entire spill area during Day 1, before a monitoring team can arrive on-site to conduct water sampling. It was shown during the DWH event that to collect water samples, special operations had to be developed and coordinated so that the vessel monitoring team had sufficient time to obtain the water samples of the dispersed oil. This was due to the fact that most of the area u nder the aerial dispersant application returned to normal background levels within one hour following the application. It should also be understood that water samples will only determine the amount of oil in the sample, not the effectiveness of the dispers ant, as there is no way of determining the amount of oil that was treated. As stated previously, these sampling requirements do not provide information on dispersant effectiveness and can therefore not inform the operational response. Water sampling requir ements are more appropriate to NRDA and should be directed under NOAA jurisdiction.

B. *The oil droplet size distribution measurement, as described, is not technically feasible.*

The requirement in 300.913(b)(1) to conduct *"in situ oil droplet size distribut ion, including the mass or volume mean diameters between droplet sizes ranging from 2.5 to 2000 µm* " is not possible for three reasons:

- The General Information section suggests that this measurement can be done via a Laser In Situ Scattering and Transmissometry (LISST) instrument, but the LISST detection limit is roughly 500 microns;
- Commercial droplet size measurement equipment suitable for deep water monitoring that ranges up to 2000 microns does not exist; and

- Even if such instrumentation became availab le in the future, there would be no way to safely deploy it in the resulting dispersed oil plume by either ROV or research vessel without interfering with other critical, oil spill response operations.

With respect to droplet size determination, the Agenc y should focus on the most important aspect of subsea dispersant injection, which is to significantly reduce the initial droplet size to slow and change the surface expression of oil release as well as "thin out" the surface slick for better dispersion on the surface. Work by API and sponsored by BSEE suggest that HD high speed photography or sonar are the most promising methods of studying changes in droplet size during a full scale applic ation of subsea dispersants. We propose that alternative methods (i. e., high definition, high speed photography; sonar; etc.), as they mature and become available, should be allowed. Additionally, there should be flexibility to use other, improved scientific methods as they become available.

C. *Fluorometry is only useful as a screening tool.*

Indirect measures, such as fluorometry, are useful only as a screening tool to help refine monitoring locations and not as direct evidence of oil or specific oil concentrations in the subsurface as suggested.

In 300.913(b)(2), in addition to *in-situ* fluorometry, the Proposed Rule also requires the Responsible Party to conduct a fluorescence intensity analysis on collected water samples to determine fluorescence signatures of the dispersed oil for use as a relatively simple and rapid mea ns to assess dispersion effectiveness. Fluorescence intensity in this context is redundant and not as meaningful a measure as particle size analysis. An alternative would be to simply suggest this as a potential measure that could be used as the situation demands. Moreover, dispersant effectiveness assessments using SMART Tier 1 visual monitoring is a relatively simple, rapid way to evaluate this and is a well-accepted practice, as is the use of simple fluorometry from the SMART Tier II protocol for surface dispersant application. The Agency should substantiate the need to replace the tiered monitoring approach of the SMART protocols and, rather than listing all possible tests that can be conducted, specify how they add value to response decision-making and offer improvements over other, existing approaches.

D. *Detailed chemical analysis is unnecessary and many of the tests are too di fficult to perform in the field.*

In 300.913(b)(4), the Agency should recognize that more real-time operational monitoring information can be obtained by "quick screening" some samples for total petroleum hydrocarbons (TPH) by means of a hand-held gas chromatograph flame ionization detector (GC -FID). Detailed chemical analysis will not inform the response decision-making process and should instead fall under the purview of NRDA.

The requirement in 300.913(b)(5) for carbon dioxide measurements is unclear. While pH and dissolved oxygen monitoring seem logical, carbon dioxide (CO_2) measurements are not routinely made in deep water. It is not clear from the Proposed Rule what benefit carbon dioxide monitoring would bring that dissolved oxygen does not already provide. Similarly, the proposed requirement to measure methane is also unnecessary as it is also linked to potential oxygen deple tion, and the measure of DO is a reliable and sufficient method. There is a limited amount of sensors and water sampling devices that can be deployed from a research vessel at one time and inclusion of CO_2 detection complicates other elements for the deployment of the instrument array.

Regarding the DO measurements, we suggest simply requiring the *in situ* measurement of DO using best available technology (which would currently be automated sensors) to measure dissolved oxygen at depth and not expose it to surface pressures and temperatures before or during analysis. Verification can be achieved through the use of consistent sensor cleaning procedures, calibration tests, and redundant sensors which can be compared. Winkler titration, as discussed in the Proposed Rule, is an outdated

analytical method that is impractical for use on unstable offshore vessels, is prone to the introduction of human errors, and would slow the information flow within the response. If periodic bench tests are required to verify the integrity of the *in situ* DO sensor measurements, there are more consistent and reliable techniques than Winkler titration. We also recommend that only a fraction of the water samples be used to verify the *in situ* DO measurements as opposed to every sample , which will slow the process and information flow.

With respect to TPH analysis, the recommendation would be to provide these data for a fraction of the water column samples as opposed to every water sample (as currently proposed).

The requirement in 300.913(b)(7) for analyzing heavy metals has no bearing on dispersed oil monitoring. There is no operational reason for collecting these data. This should fall under the purview of NRDA. The source samples of oil are much better sources for determining the proportion of individual constituents. The carbon dioxide, methane, and heavy metals analysis requirements do little to inform response decisions, add unnecessary time and cost to the response activities, and would have a high degree of uncertainty in the absence of understanding the natural variations that might occur in the water column or in the case that a compounding discharge event (e.g., major flood) occurs during the response.

The focus of the Proposed Rule is almost exclusively on empirical data a nd should include some elements of 3-D and 4-D modelling to broaden the overall understanding of subsurface conditions.

We suggest revising the proposed language as follows:

> *(b) In areas not affected by the discharge of oil, collect a representative set of background water column samples following standard operating and quality assurance procedures, at the closest safe distance from the discharge as determined by the OSC and in any direction of likely transport considering surface and subsurface currents and oil properties for the variables listed below. Adherence to API TR1152 meets the requirements of this subsection. In the dispersed oil plume, at an interval designated by the OSC, collect water column samples following standard operating and quality assurance procedures, at such depths and locations where dispersed oil is likely to be present to analyze for the following:*
>
> > *(1) In-situ oil droplet size distribution, including mass or volume mean diameter for droplet sizes, with the majority of data coll ected between the 2.5 and 100 µm size;*
> > *(2) In -situ fluorometry signatures targeted to the type of oil discharged and referenced against the source oil;*
> > *(3) Dissolved oxygen (DO);*
> > *(4) Total petroleum hydrocarbons (based on an extracted water sample), individual resolvable constituents including volatile organic compounds, aliphatic hydrocarbons, monocyclic, polycyclic, and other aromatic hydrocarbons including alkylated homologs, and hopane and sterane biomarker compounds;*
> > *(5) 3-D and/or 4-D modeling when/where practical*
> > *(6) Turbidity;*
> > *(7) Water temperature;*
> > *(8) pH; and*
> > *(9) Conductivity.*
>
> *The purpose of analyzing these components is to map the extent and location of subsurface oil ; to characterize the condition of that oil ; and to help inform transport models that are also a key part of the decision-making process by helping to characterize the overall movement of subsurface oil.*

XVIII. Section § 300.913(c) Dispersant Effectiveness and Oil Distribution Characterization

A. *The Proposed Rule needs to be clearer on what is required for surface monitoring and what is required for subsea monitoring.*

Section § 300.913 provides monitoring requirements collectively for "subsurface use of dispersant in response to an oil discharge, surface use of dispersant in response to oil discharges of more than 100,000 U.S. gallons occurring within 24 hours, and surface use of dispersant for more than 96 hours in response to an oil discharge…" However, the preamble is often unclear as to whether every requirement within this section applies to surface or subsea dispersant applications or both. To facilitate a better evaluation of the proposed changes, each subsection should be divided into those aspects that apply to subsea applications and those to surface applications and those that apply to both. Elements within this section are already addressed in other sections of this Proposed Rule, particularly water column monitoring. The sections ought to be combined. The concept of an informed monitoring program (one that includes fixed and adaptive sampling locations and modeling) is already well understood and acknowledged in the spill response community.

In 300.913(c), requiring best available technologies may result in equipment not suitable for field conditions. Consideration should be given to changing "*available*" to "*practicable*."

In 300.913(c), the best available technology requirement should acknowledge aerial photography as a tool to measure effectiveness. This was a key method of effectiveness assessment during DWH and is not mentioned in the Proposed Rule. It is much more practical than the concepts put forward in the present proposal.

The relative effectiveness of the surface application should be determined by using the SMART protocols. For surface application, it is impossible to determine a numerical effectiveness as the amount of oil on the surface that is being sprayed is not known. Note that the analysis equipment often cannot return to the spray site in time to capture the information requested as the dispersant plume quickly dilutes or cannot be found.

XIX. Section § 300.913(d) Ecological Receptor Characterization

A. *Monitoring required to determine possible environmental effects is too time consuming to support dispersant operations decisions.*

Industry agrees that environmental monitoring should be performed to support operational decision-making. Monitoring required to determine environmental effects, however, is likely to be too time consuming to support dispersant operations decisions and should remain a NRDA activity.

This section of the Proposed Rule requires the Responsible Party to characterize the ecological receptors and to consult with the OSC to determine an acute toxicity level of concern for the dispersed oil using available dose/response information relevant to potentially exposed species. Conducting the required ecological characterization of the spill site may not be possible in the available response time-frame. If the untreated oil is likely to drift ashore and impact a sensitive coastal resource within a day or two unless it is dispersed, there will be a very finite period of time for such considerations suggested in the Proposed Rule.

With respect to the proposed ecological thresholds, although it is constructive to have known benchmarks, it is not clear what decision would be forthcoming if a threshold were exceeded and would certainly be misplaced to derive new thresholds during a response. The documented toxicity of dispersed oil to individual laboratory organisms is by no means a measure of the overall population of that

organism, nor of the ecosystem as a whole, to recover from oil exposure. During a spill, dispersants operations might be stopped because of the threshold of an individual species even though there may be the potential for higher environmental damages beyond that species. During a spill, dispersants operations might be stopped based on a threshold for an individual species . The suggestion of using species sensitivity distributions (SSD) during an active response is a misuse of the method (which requires long periods of time to assess) and is counter to establishing frameworks that are relevant in the dynamic ocean setting.

Rather than requiring the Responsible Party to make this real-time assessment, a CERA/NEBA process (conducted as part of contingency planning) should serve as the basis to make operational decisions on whether dispersants and/or other agents should be used during a response. A CERA/NEBA is the only mechanism that allows a full environmental trade-offs analysis of all response options to be conducted.

XX. Section § 300.913(e) Immediate Reporting Requirements

A. *Reporting requirements should be more flexible.*

The Proposed Rule does not include any indication of what happens if such a requirement to immediately report the information is not met for any reason. From a functional standpoint, the idea of reporting is sound, but the OSC should have the discretion to determine the frequency of reporting.

The Agency is also requesting comments on whether similar requirements should be applied to surface dispersant application. There are already practical and agreed reporting requirements for surface dispersant use and the natural weathering and dispersion that takes place at the surface is fundamentally different than what might occur in the subsurface.

XXI. Section § 300.913(e)(1) Daily Sampling and Data Analyses Reporting

A. *The Agency should not develop requirements for daily authorizations of dispersant quantities.*

This section requires reporting of a deviation of more than 10 percent from the mean hourly volume of dispersant authorized for "*24 hours use*." The Proposed Rule does not require authorization of dispersant use in 24 hour increments. Such restrictive authorization requirements tremendously complicate dispersant operations while providing little environmental benefit. The Agency should not develop requirements for daily authorizations of dispersant quantities, as this decision should be based on the ongoing spill scenario and should be left to the OSC. Dispersant application rates may need to vary to account for dynamic spill conditions, environmental conditions, and other ongoing response operations. Placing daily limits on volumes of dispersants that may be used prevents trained response personnel from utilizing appropriate dispersant application rates. Furthermore, it circumvents the NEBA process that evaluates the best response options that protect the environment as a whole.

We suggest modifying the proposed language as follows:

> *(e) Report to the OSC as soon as practicable or at an interval determined by the OSC:*
> *(1) Deviation of more than 10 percent from the mean hourly dispersant use rate for subsurface application, based on the dispersant volume authorized for 24 hours use, and the reason for the deviation; and*
> *(2) Any threatened or endangered species, or other priority ecological receptors formally identified by the OSC in consultation with the Environmental Unit, that may be exposed, based on dispersed plume trajectory modeling and level of concern information.*

XXII. Section § 300.913(e)(2) Immediate Reporting of Ecological Receptors

A. *Real-time ecological receptor analysis is unrealistic and should be part of a CERA/NEBA process.*

The requirement in this section for real -time ecological receptor analysis is unrealistic. Such efforts need time and broad stakeholder participation to be meaningful. This information should be part of a NEBA process to document the resources at risk of the potentially affected ecosystem. Only through this detailed NEBA process can an adequate understating of overall ecosystem recovery be developed and assessed. Further, the process of overall environmental trade -offs is independent of individual species impacts and should be based at the ecosystem level.

XXIII. Section § 300.913(f) Daily Sampling and Data Analyses Reporting

A. *Daily reporting of water sampling data should only apply to subsea dispersant injection and is not useful for dispersant decision-making.*

This section should be amended to clarify that daily reporting of water sampling data only applies to subsea dispersant injection. Further, the requirement in Section 300.913(f)(3) for a 5-day turnaround time for analysis is unrealistic, given that it could take several days for the sample to be transported to shore and additional time for it to reach a qua lified laboratory and put in the queue for analysis. During DWH, the sheer quantity of samples overwhelmed both the regional and the nation's labs processing abilities. In many cases, the backlog of samples lasted 30 days or longer. A blanket requirement o f five days is unrealistic and should be replaced with a negotiated time that is staggered on the basis of sample data priority for operational decision-making. The data may be useful for NRDA, but not for dispersants decision-making because other monitori ng techniques can better inform decision-making. These water samples will provide information about concentrations in water from 5 or more days previously, but will be irrelevant for operational questions that require near real-time feedback.

We recommend combining this section with the proposed "*Immediate Reporting*" section into one section that notes the importance of reporting in supporting the coordination of response actions. Suggest modifying proposed language as follows:

(e) Reporting

(1) Report to the OSC as soon as practicable or at an interval determined by the OSC any:

(i) Deviation of more than 10 percent from the mean hourly dispersant use rate for subsurface application, based on the dispersant volume authorized for 24 hours use, and the reason for the deviation; and

(ii) Ecological receptors, including any threatened or endangered species that may be exposed based on dispersed plume trajectory modeling and level of concern information.

(2) Report to the OSC at an interval determined by the OSC, water sampling and data analyses collected in § 300.913(b) and include:

(i) Specific hourly dispersant application rate and the total amount of dispersant used for the previous reporting period established by the OSC with concurrence from the EPA representative to the RRT;

(ii) All collected data and analyses of those data within a timeframe necessary to make operational decisions, including documented observations, photographs, video, and any other information related to

dispersant use, based on a reasonable and appropriate timeframe authorized by the OSC;
(iii) Estimates of the transport of dispersed and non-dispersed oil and associated volatile petroleum hydrocarbons, and dispersants, using the best available trajectory modeling.

XXIV. Section § 300.915(a) General Information for any Product Category

A. *The proposed information requirements to be submitted by dispersant manufacturers may reduce the number of dispersant suppliers.*

The proposed requirements for information to be submitted, most likely by dispersant manufacturers, as described in 300.915 (a)(1)-(21), are extensive. API and NOIA are concerned that dispersant manufacturers may not have a sufficient business case to meet all proposed data requirements. The Agency therefore needs to demonstrate that this Proposed Rule will not collapse the market for dispersants and drive away all viable producers from supplying products to meet the need. Further, the Agency should consider developing a total re-listing cost analysis.

XXV. Section § 300.915(a)(5) Safety Data Sheet

A. *A Safety Data Sheet for each component in a product is unnecessary.*

The proposed requirement includes *"A Safety Data Sheet ('SDS') for the product."* We believe this is a reasonable request. However, in the preamble, the Agency solicited comments on the value of requiring an SDS for each individual component. We believe that requiring more than just an SDS for the whole product will add unnecessary burden to the submitter that will not add any protection. The information needed to protect responders will be provided in the SDS for the product as a whole.

XXVI. Section § 300.915(a)(11) Environmental Fate Information

A. *Vendors should not be required to generate new environmental fate information for their products.*

The proposed language in this section should be modified to clearly state that this data should be reported *only* if it is already available. As currently written it is unclear if the vendors are being asked to collect new data for their products to cover these parameters.

XXVII. Section § 300.915(a)(13) Identity and Concentration of Product Components

A. *Vendors should not be required to provide the identity and concentration of product components.*

Some vendors may refuse to submit this detailed data as it may threaten a proprietary advantage. This may result in less favorable/effective product being listed in the Product Schedule. We recommend that reporting should be restricted to naming the ingredients, but should not require that the percentage of each ingredient is disclosed. Although Proposed Rule Section 300.950(b) allows this information to be claimed as confidential business information, the requirement under 300.915(a)(13) still presents challenges because there is no guarantee that the claim of confidentiality will be accepted. This may discourage manufacturers from supplying dispersant products.

XXVIII. Section § 300.915(a)(15) Certification

A. *The requirement that product not contain levels exceeding the National Water Quality Standards is unnecessary.*

The agency is proposing certification, including data, methodology, and supporting documentation, indicating that the product does not contain levels that exceed the National Water Quality Standards lowest aquatic life acute value for the following contaminants: metals reasonably expected to be in the product including arsenic, cadmium, chromium, copper, lead, mercury, nickel, vanadium, zinc; cyanide; chlorinated hydrocarbons; pesticides; polychlorinated biphenyls (PCBs); and polynuclear aromatic hydrocarbons (PAHs).

The National Water Quality Standard Contaminants are defined as concentrations in the water column. Water quality criteria are applicable to receiving waters, not formulated products, and this proposal assumes the appropriate exposure is to full-strength (100%) product rather than a reasonable environmental-realistic exposure concentration.

This requirement is not reasonable because of the enormous dilution that occurs when any product is used in an oil spill situation, and it is not required for other chemicals released into the environment. We believe that the existing requirements to communicate hazardous impurities on product SDSs should be sufficient and suggests removing the requirement.

XXIX. Section § 300.915(a)(19) Annual Product Production Volume

A. *The requirement for vendor production capability is not realistic of the market for dispersants.*

Most dispersants are blends of components and are only manufactured upon request. Capacity is not fixed and varies with available blending tankage, existing business demands, other product orders, and component supplies/shipping constraints. While such data are very useful in a large spill where existing stockpiles could be depleted, the information provided in such a request at the time of the application would not be relevant to a future time when product manufacturing could be required during a response. Further, the development of both U.S. stockpiles and international Dispersant Global Stockpiles were designed to ensure that sufficient, effective dispersants will be available when needed. We believe this requirement should be removed. If not removed altogether, the Agency should consider modifying the language to require dispersant or agent producers to be able to provide such information within 24 hours should the OSC need it and make it a condition of product authorization. If the Agency is concerned about the availability of sufficient volume of dispersants required for operations, it should ensure that the main dispersants products that are used around the world and are extensively studied are included on the National Product Schedule and are available for response in the U.S.

XXX. Section § 300.915(a)(20) Recognition

A. *Design for Environment recognition is unnecessary.*

The Agency asks for recognition from EPA's Design for the Environment (DfE) if applicable. DfE recognition should not be included in the Proposed Rule because it is not required, and the Agency has other ways to advance voluntary programs.

XXXI. Section § 300.915(b)(1) Dispersant Efficacy

A. *The new efficacy test cannot predict field dispersant effectiveness.*

API and NOIA support the Agency's proposed change in efficacy testing from the Swirling Flask Test (SFT) to the Baffled Flask Test (BFT) method. The SFT was a very low energy test and required the use of low viscosity test oil s to achieve significant levels of measured dispersant effectiveness. The BFT is a much more energetic test method thus permitting the use of higher viscosity test oils to achieve higher levels of measured effectiveness with the same dispersant. It is impo rtant to recognize that such laboratory tests can evaluate relative effectiveness between different dispersants, but cannot be used to predict the effectiveness of dispersants in the field on specific oils under specific conditions , such as differences in wave height, possible application in high turbulence subsea or using prop wash in ice - covered waters.

B. *The new test oils may not provide comparable results if new test samples are obtained.*

We also support the Agency's proposed changes in test oils from South Louisiana Crude (SLC) and Prudhoe Bay Crude (PBC) to Alaska North Slope (ANS) and Intermediate Fuel Oil (IFO–120), since these new test oils provide a wider range of properties in the oils to be tested. The agency should note that ANS is a blend of c rude oils produced on the North Slope of Alaska, and the composition and properties have varied through the years as the crude oils produced on the Alaska North Slope have changed . Also, IFO-120 composition is entirely dependent on the crude run at the supplying refinery and their blending needs. However, IFO-120 is a blend of residual fuel components including vacuum resid uum cut with a lighter product to achieve a specified viscosity (i.e. , 120 cSt at 100F in this case), but will vary dramatically in composition between lots at a given refinery and between refineries. It is probable that the varying composition of IFO-120 will result in inconsistent DE results over time. This means that a single batch of IFO-120 will have to be preserved for all future pro duct testing to ensure comparability. The Agency should conduct stability tests of ANS and IFO -120 stocks to ensure they can maintain viable samples over time. The Agency could consider substituting a heavy crude oil rather than this heavy refined product or store a large single batch of IFO -120 with data provided on shelf stability or a provision to account for changes over time.

C. *Testing dispersant efficacy at different temperatures will not provide information that will predict dispersant effectiveness in real world conditions.*

We oppose introducing testing at different temperatures. This new approach implies that laboratory tests represent field conditions in some way which is not the case. The Agency proposes that dispersants should only be approved for the type of oil they worked in the lab and temperatures tested in the lab. This is incorrect as:

- different oils will be treated than the two tested in the laboratory;
- even the same oil will weather with potential effects to dispersant efficacy;
- turbulence in environment will surely be different;
- subsea injection even into the same oil in the Arctic is different because of oil temperature and turbulence level subsea; and
- dispersing oil in ice is also different from lab tests because of the mixing provided by vessel propellers.

In the preamble to this same section, the Agency appears to suggest that the Proposed Rule changes are intended to indicate the likely effectiveness of operational dispersant use on oil spilled in the Arctic or Gulf of Mexico (column 3, 80 Fed. Reg. 3403; both locales are specified). Relatively simple efficacy tests such as the BFT are incapable of simulating the range of parameters and processes that will be encountered and influence real -world dispersant effectiveness. The Rule sho uld clearly state that laboratory efficacy testing is a comparative screening tool for different dispersants under laboratory conditions and should recognize that a ctual dispersant effectiveness on oil treated at sea can vary a great deal from

effectiveness data collected in a laboratory. A dispersant/oil combination that produces an effectiveness result in the BFT laboratory method of 70% might result in >95% dispersion at sea (e.g., in a moderate sea state), and less dispersion in other circumstances (e.g., calmer sea state). Therefore as part of dispersant use authorization, divorced from the product approval process, the availability of suitable mixing energy becomes an operational consideration, coupled with the dilution potential for the dispersed oil. We suggest that reference to specific regions should be deleted from this section.

D. *Dispersant efficacy thresholds listed in the Proposed Rule are too high.*

In the preamble to this section (column 2, 80 Fed. Reg. 3403), the Agency's justification for dispersant efficacy thresholds (DE values) includes:

> "*Three of the eight dispersants tested clearly differentiated themselves from the other five dispersants for having the best DE_{LCL95} efficacy results… This natural break in the results provided the Agency with the basis for the proposed threshold criteria.*"

We believe the proposed thresholds of efficacy for listing on the Schedule are high. The supporting documentation in the docket shows that only six (not eight) dispersants were tested and two of these six dispersants were only tested with one oil. The rationale for selecting the proposed efficacy thresholds for listing on the Schedule is not convincing on the basis of the limited data presented. Data from another EPA study[31] shows significant variability in the results obtained with the BFT. Variability in test results is troubling and this variation could lead to confusing data sets where the same dispersant sometimes "passes" and sometimes "fails" because of the high threshold limit that has been set. While the Agency states it tested the dispersants currently listed and found three of them to be sufficiently effective, the EPA study on the BFT funded by BSEE and published in 2011 suggests otherwise. As shown in Table 3 of this BFT study, Corexit 9500 may not be listed based on published Dispersant Effectiveness (expressed as the LCL95) of 69% and 61% on ANS Fresh and IFO-120, respectively, at room temperature (15° C). This suggests that the recommended thresholds are potentially too restrictive and do not sufficiently take into account the variability of the BFT.

The Agency should reconsider the proposed efficacy thresholds for listing on the Schedule. We suggest that these thresholds could be lowered without any significant impairment to the effectiveness of operational dispersant use at a response. In addition, reporting only the DELCL95 reduces the amount of information available on a product. We recommend that the test average and standard deviation should be provided, which would provide additional information on the precision of the testing.

The Agency makes the following statement in the preamble (column 1, 80 Fed. Reg. 3404):

> "*As a result of this increased mixing energy, better dispersion is realized under conditions more realistic of wave action in the sea*"

We believe that this statement would be more accurate if it were re-phrased as follows:

> "*As a result of this increased mixing energy, higher dispersant effectiveness results are obtained.*"

Since the recent subsea dispersant injection development does not have major implications for the rationale behind the current tests for dispersant product approval, it might be important to recognize that the laboratory test data are sufficient to identify whether a product has appropriate effectiveness,

[31] Venosa and Holder, 2011, Laboratory-Scale Testing of Dispersant Effectiveness of 20 Oils Using the Baffled Flask Test

irrespective of whether the product may be considered for use in surface applica tion or subsea injection (SSDI) scenarios. Additional testing for SSDI approval is not necessary.

XXXII. Section § 300.915(b)(2) Dispersant Toxicity tests and listing criteria

We offer the following comments on the proposed revisions to the toxicity testing and has ordered the comments by specific test.

A. *Standard static acute toxicity testing should be used only for the dispersant alone.*

The Agency proposes that a dispersant shou ld be tested using a modified standard static acute toxicity test for the dispersant with *Americamysis bahia* and *Menidia beryllina* using the 48 hour and 96 hour duration LC_{50} procedure. We agree there is a need for toxicity testing of dispersants to preven t highly toxic (LC50 <1ppm) dispersants from being listed on the Schedule. The proposed toxicity test method, although designed for effluent testing and having no relevance to real -world exposures of marine organisms to dispersants during dispersant use on oil releases, is a convenient way to screen individual dispersants. We agree with this proposal for dispersant-only toxicity tests.

The Agency also specifies a threshold for a dispersant to be listed on the Schedule, *"the LC_{50} being that at the lower 95% confidence interval for all acute toxicity tests must be greater than 10 ppm."* We believe this is a reasonable threshold for the "dispersant only" toxicity test.

B. *Standard static acute toxicity testing of dispersant/oil mixtures does not represent real world exposures.*

The purpose of the proposed toxicity testing of dispersant/oil mixtures is not clear. If the objective of the toxicity testing is to ensure that any dispersant that is to be listed has less than a specified level of toxicity measured in the test, then a dispersant alone toxicity test is sufficient.

We oppose the proposed dispersant/oil acute toxicity testing as a requirement for a dispersant to be listed on the Schedule, for the following reasons:

- It is now widely accepted by scientists that any concerns about the potential for toxic effects on marine orga nisms resulting from the use of modern dispersants should consider the potential effects of dispersed oil, not the dispersant itself. This is logical because dispersant is used at low concentrations, compared to the dispersed oil concentrations produced by their use , and they have much lower toxicity than oil . The potential severity of toxic effects that could be caused to marine organisms by exposure to dispersed oil will be a function of exposure: the concentration of dispersed oil (or oil components) in the water, the duration of that exposure , and oil type and receiving organisms . The Agency proposed dispersant/oil mixture tests will not provide any information about real-world exposure.
- More sophisticated dispersant/oil mixture toxicity testing procedu res, using more relevant exposure regimes, can produce information about the potential for toxic effects on marine organisms by oil dispersed (or oil compounds released in to the water) as the result of dispersant use. Such toxicity studies may be relevant to deciding where and when dispersant use may be authorized, but not to dispersants being listed on the Schedule.
- Toxicity testing of dispersant/oil mixtures (i.e., dispersed oil) usi ng the proposed standard static acute LC_{50} procedures will inevitably discriminate against more effective dispersants which disperse more oil into the water, thereby increasing exposure to aquatic organisms. Such testing does not give any indication of the potential for toxic effects to be caused by dispersant use on spilled oil on the sea surface.

- Previous work on dispersant/oil mixture toxicity testing conducted by the Agency in 2010 (Comparative Toxicity of Louisiana Sweet Crude Oil [LSC] and Chemically Dispersed LSC to Two Gulf of Mexico Aquatic Test Species [published by Hemmer, Barron and Greene]) shows that the proposed 10 ppm threshold (determined with LSC oil, not ANS or IFO -120) with *Americamysis bahia* would not be met by any of the eight dispersa nts tested at that time. Only one dispersant would have met the 10 ppm threshold with *Menidia beryllina*.

In general, the Agency should clearly distinguish between the requirements of (i) the toxicity testing required to assess which dispersants should be listed on the Schedule, and (ii) toxicological studies with appropriate oils, test organisms and exposure conditions that will inform discussions about how the listed dispersants might cause impacts in U.S. waters under the specific circumstances of an oil spill or release. The two toxicity test approaches required are incompatible. Attempting to use the same standard, static acute LC_{50} procedures to provide information or guidance on both aspects will not achieve these goals. Since the proposed dispersant/oil mixture toxicity testing requirements in this section do not address item (ii) above, the Agency needs to clarify the objective and rationale of the proposed acute exposure toxicity testing of dispersant/oil mixtures and should explain how this relate s to the listing of a product on the Schedule.

C. *Testing of dispersants using the developmental assay for the purple sea urchin is not relevant.*

The Agency proposes a requirement for an EPA test protocol involving sea urchin embryos, routinely used in eff luent testing, to be used to assess the potential for a dispersant product to cause adverse effects on the developmental process. The relevance of this test, which was developed for the assessment of wastewater effluents, to dispersant use is highly questi onable. Again, trying to estimate potential real world consequences to dispersed oil exposure should be part of a NEBA decision -based process. The environmental trade-offs of using dispersants in offshore environments to protect sensitive shoreline habitats from oil exposure is being circumvented. Given that the purple sea urchin is found in shallow coastal waters, there is no relevance of applying purple sea urchin data given that dispersant operations are unlikely to occur in these environments. In additi on, the proposed threshold that the LC_{50} must be greater than 10 ppm is not a relevant indicator to inform any potential real -world effects of dispersant use in the environment. Additionally, if the agency applies their proposed toxicity thresholds to the sub-chronic sea urchin toxicity tests, it is likely that many (maybe all) current and approved dispersants in the U .S. will fail the threshold . Some of them could also fail with the sub -chronic *M. beryllina* tests.

We oppose the proposed developmental ass ay and do not believe it should be a requirement for a dispersant to be listed on the Schedule. API and NOIA are also concerned that little experience is available in application of this assay to dispersants, and it is unclear about the intra -lab precision associated with this proposed requirement and the practical challenges that may arise in interpretation of test results.

D. *Sub-chronic 7 -day static toxicity tests for dispersant are not relevant and are unnecessary.*

The Agency states (300.915(b) (2), 80 Fe d. Reg. 3405) that it " *has limited information concerning the possible sub -lethal effects of dispersants currently listed on the Product Schedule* " and that " *This information would also be of value as guidance to regional responders and OSC's on possible ad verse effects on survival and growth of larval fish and invertebrates caused by longer -term exposure to dispersants.*"

Chronic exposure to dispersant alone is not a relevant indicator of risks posed when dispersant is used to mitigate the effects of an oil release. As stated previously, this test was developed and validated for wastewater effluents and is not relevant to the use of dispersants in offshore spill response. Rather than proposing sub-chronic toxicity testing requirements for any dispersant to be listed on the Schedule, the Agency could undertake studies to establish whether this is a valid concern, or whether it could provide useful information under the likely conditions of dispersant use on offshore oil releases.

The Agency's proposal of a No Observed Effect Concentration (NOEC) equal to or greater than 1 ppm listing threshold level for sub-chronic effects is arbitrary. Although this threshold level provides a ten-fold safety factor over the proposed 10 ppm acute toxicity threshold values, it could also be questioned on the same basis; static toxicity tests over 48 to 96 hours do not represent relevant exposure scenarios in the marine ecosystem following offshore applications of dispersant.

We oppose the proposed sub-chronic toxicity testing and does not believe it should be a requirement for a dispersant to be listed on the Schedule. Sub-lethal/sub-chronic studies are not necessary (acute toxicity endpoints are considered relevant) since the global commercial dispersant products are confirmed as biodegradable so that the surfactants and solvent constituents of the dispersant formulation do not persist in the marine environment causing adverse effects. The French dispersant product approval regulator requires a biodegradability test of the dispersant as part of its product approval process. Commercial dispersants commonly stockpiled around the world are therefore readily biodegradable and pass the French test. If a dispersant is approved in France, it must have passed the biodegradation test (AFNOR standard NF T90-346). It is recommended that ready biodegradability of a dispersant be required for approval in the U.S. as well. Therefore any candidate dispersant product would need to be tested for biodegradability, or the dispersant manufacturer could be required to state that the formulation constituents are biodegradable and provide supporting evidence.

E. *Dispersant testing should only be used for screening individual dispersant products.*

If the objective of the toxicity tests are to select less toxic dispersants (based on an aquatic toxicity threshold), then dispersant alone toxicity tests are sufficient and the maximum toxicity threshold of a candidate dispersant should be set if the dispersant is significantly less toxic than the reference oils. The dispersed oil toxicity testing (CEWAF) should not be considered for dispersant use authorization as it discriminates against the effective dispersant products which disperse more oil into the water thereby increasing exposure to the aquatic test organisms. It is also important to note that CEWAF toxicity testing does not simulate actual dispersant use on spilled oil in the marine environment. Additionally, static toxicity tests over 48 to 96 hours do not represent relevant exposure scenarios in the environment following surface application of dispersants.

In summary, the Agency's suggested toxicity testing changes in the Proposed Rule do not take into account the essential role of NEBA in considering the potential benefits and risks of dispersant use as a response option for an offshore oil release. The Product Schedule should focus on the basic testing to compare the efficacy and toxicity of the dispersants against each other with the sole purpose of screening good products that should be listed. The Proposed Rule should not attempt to translate any laboratory data into possible real-world implications. This process should instead be defined by full stakeholder NEBA discussions specific to a given spill scenario.

XXXIII. Section 300.915(c)(1) Surface Washing Agent Efficacy

A. *Surface Washing Agent (SWA) efficacy testing should not be required until the Agency develops its own test protocol.*

In the preamble the Agency has requested comments on available methodologies and whether the rule should identify the specific methodologies to be used until the Agency develops and adopts a new testing protocol for SWA efficacy testing (column 1, 80 Fed. Reg. 3407). The Agency lists two tests by ASTM and Environment Canada as possible interim tests while the Agency develops its own test. There is no evaluation of how the ASTM test compares to the Environment Canada test. As a result, expecting similar results by both tests is unrealistic. The average efficacy in the published data reported using the Environment Canada test may indeed be approximately 30%, but the variation is high and the tests were performed on a Canadian oil using only one test. We believe the Agency should delay requiring SWA efficacy testing until it develops its own test protocol that utilizes a U.S. oil.

XXXIV. Section § 300.915(d) Bioremediation Agent Testing and Listing Requirements

A. *An additional protocol specific to products containing enzymes only would be appropriate.*

The Agency is requesting comments on whether an additional protocol specific to products containing enzymes only would be appropriate. This would consist only of exposure water, weathered oil and the enzymatic product in the concentrations specified by the manufacturer. A new protocol would be useful because effectiveness data from the testing would help determine whether this technology would be beneficial during a response. Many claims may be made about "safer" products to treat oil and thus more credible scientific information is warranted on products approved on the Schedule.

XXXV. Section § 300.915(e) Solidifier Testing and Listing Requirements

A. *Solidifier toxicity testing would be useful.*

The Agency is requesting comments on the need for acute toxicity tests conducted with solidifiers - reference oil mixtures. Toxicity tests with oil may be beneficial as they will help to evaluate efficiency of solidifiers in retaining water soluble hydrocarbons and preventing them from leaching into water. Simple efficiency tests may not provide such data.

XXXVI. Section § 300.915(g) Sorbent Requirements

A. *The proposed Sorbent Product List should not exclude natural sorbent materials.*

The Agency proposes to make available a Sorbent Product List that includes certain publically available non-proprietary sorbent materials. We believe this should be a generic list and should not exclude natural sorbent materials (e.g., hay) that could be obtained locally at a spill site.

XXXVII. Section § 300.950 Submission of Confidential Business Information (CBI)

A. *Full public disclosure of product information may reduce the number of products being made available in the U.S.*

In 300.950 (column 3, 80 Fed. Reg. 3426), the Agency requires everything in the product listing be made public except the actual concentrations of product ingredients. While the Agency may need full disclosure of product formulae, we do not believe the Agency needs to make them public and can accept products with both the ingredients and the concentrations as CBI. Any disclosure of information on product formulae (either ingredients or % concentrations) could put a manufacturer at a competitive disadvantage. This may discourage some manufacturers from listing their product at all and could result in effective dispersant products not being available in the United States.

XXXVIII. Section § 300.955 Addition of a Product to the Schedule

A. *The transition period for currently listed products is too short.*

In 300.955(f), the Agency specifies a 24 -month transition period for currently listed products. This is a very short timeframe given the variety of products listed and depth of technical work (e.g., toxicology studies) required to be contracted, conduc ted, analyzed, and reported. We believe the Agency should extend the transition period to the lesser of five years, the current product expiration date, or after suitable replacement products are listed and commercially available.

We also believe that this section should include a discussion of how currently owned stockpiles purchased in 2010 and 2011 (more than one million gallons of Corexit, in the U .S.) will be tested to comply with the proposed existing stockpile testing requirements of being tested every five years. It is recommended the Agency state that currently held stockpiles will have five years to be re-tested after that dispersant product is listed on the new Product Schedule.

XXXIX. Appendix C to Part 300 Requirements for Product Testing Protocols and Summary Test Data

A. *The dispersant-to-oil ratio (DOR) ratio used in the BFT should be 1:20.*

In Appendix C, Section 2.1 (column 3, 80 Fed. Reg. 3428), the BFT mandates a DOR of 1:25. A DOR of 1:20 has commonly been accepted for use in the U.S. and abroad. Further, the 1:25 DOR may not even be within the manufacturer's recommended use ratio. The Agency needs to ju stify this test requirement. We believe that the DOR for the BFT should be changed to 1:20 to align with the regulatory requirements in 33 CFR 154 and 155 for calculating aerial and vessel dispersant capabilities and to align with standard dispersant spray system calibration. A DOR of 1:20 leads to a 5 gallon per acre dosag e for surface spray systems and is the minimum amount of dispersant to oil slicks that can be visually identified as having sufficient thickness to warrant dispersant application. Having the testing procedure completed for the same DOR would provide more reliance that, when applied, the dispersant will be effective.

B. *The Agency should explain how it will address changes in the refe rence oils as they age and as new samples are acquired for the future.*

In Appendix C, Section 2.3.2, the Agency requires the u se of ANS and IFO -120 as standard reference oils. The Agency is supplying these materials to labs but no data is presented showing shelf stability over time for either and whether stable equivalent materials can be provided in the future. No provision is provided for addressing changes in dispersant efficacy due to changes in composition of ANS (e.g., field production changes, new fields in pipeline blend, etc.).

Also, IFO -120 composition is entirely dependent on the crude run at the supplying refinery an d their blending needs. It is a blend of residual fuel components including vacuum residue cut with a lighter product to achieve a specified viscosity (i.e., 120 cSt at 100 degrees F in this case), but it will vary dramatically in composition between lots at a given refinery and between refineries. If multiple IFO -120 samples were provided from different refineries to a toxicity laboratory, there would be varying results because IFO-120 composition changes from day to day and between refineries. This means that a single batch of IFO -120 will have to be preserved for all future product testing to ensure comparability. The Agency should conduct stability tests of ANS and IFO -120 stocks to ensure they can maintain viable samples over time.

CONCLUSIONS

In conclusion, as evidenced by the extensive substantive comments provided herein, it is clear that much work needs to be done before the Agency should finalize a rule in this key area of spill response, including to make sure that the final rule does not have the unintended consequence of eliminating all or most commercially available and future dispersants for use in spill response. We believe the Proposed Rule will likely result in dispersants being eliminated as a response technique, for the following reasons:

- The Proposed Rule does not recognize that response option decisions must be based on NEBA and that dispersing oil in offshore environments , where it may dilute and biodegrade, is often preferred over the long -term environmental damages that will occur when untreated oil strands and persists in shoreline environments;
- The Proposed Rule focuses on potential risks of dispersants without recognizing the primary purpose of dispersants, which is to rapidly dilute the spilled oil and enhance removal of the o il from the environment through microbial degradation, resulting in reduced VOCs (personnel safety), and a reduction in persistent, stranded oil in shoreline ecosystems (leading to faster ecosystem recovery);
- The Proposed Rule's dispersed oil toxicity tes ting thresholds could eliminate all dispersants that are on the current NCP list and could preclude the listing of future dispersants that are currently in development. Furthermore, the proposed dispersed oil toxicity testing thresholds favor ineffective dispersants over effective products and will mistakenly measure the toxicity of the standard test oils, not of the dispersant product;
- The Proposed Rule adversely constrains the ability of the OSC to make the necessary operational decisions to ensure for an expeditious, efficient, and effective response to mitigate the impacts of a spill to the greatest extent possible;
- The Proposed Rule raises significant issues related to USCG and BSEE facility and vessel oil spill response plan compliance and could resul t in unnecessary and increased environmental impacts and corresponding spill claims as a result of increased damages;
- The Proposed Rule's stockpile re-testing procedures have not taken into account manufacturer recommendations, nor considered scientific publications on the demonstrated, lengthy shelf-life of dispersant products; and
- The Proposed Rule's dispersant monitoring requirements are not focused on collecting data that can provide useful information regarding an ongoing dispersant operation. Instead, these requirements have the potential to delay dispersant use resulting in unnecessary environmental damage.

In addition, the RIA conducted by EPA is substantially flawed. The RIA falls woefully short of EPA's regulatory requirements. EPA fails to provide any quantification of the potential social benefits of the Rule; in fact, the RIA lists benefits associated with avoiding and limiting the impacts of oil spills as potential benefits of this Rule, even though the Proposed Rule has the potential to ag gravate the impacts of an oil spill by limiting response options. As a result, the RIA significantly underestimates the potential costs of the Proposed Rule , while also underestimating the direct costs that the Rule would impose on small businesses, government, and the greater industry.

Accordingly, API and NOIA strongly urge the Agency to consider these comments and suggested revisions to the Proposed Rule to ensure that the best dispersants and dispersant-use practices are available for offshore oil spill response. We recommend that there be further discussions between the Federal agencies and industry scientific and operational experts to add value to further revisions of the Proposed Rule to ensure that the proposed changes to Subpart J align with the latest scientific practices and do not artificially bias against the use of certain response options, such as dispersants.

Furthermore, API and NOIA recommend EPA initiate a Negotiated Rulemaking which has proven to be effective in controversial rulemakings such as this one. At a minimum, we urge the Agency to publish a Supplemental Proposed Rule in the Federal Register for additional public comments before publishing a final rule to ultimately make sure that responders, both from the government and industry, are able to use dispersants in the most effective and expeditious manner, taking into consideration necessary environmental and safety factors, to provide for the best response possible depending on the circumstances of a particular spill event. Given the time it will take to initiate and complete a new rulemaking after the final rule is published it is imperative for the general public and all stakeholders that we get it right the first time.

Thank you for your time and attention to these comments on the Proposed Rule. API, NOIA and our member companies share EPA's goal of establishing sound Dispersants Use Policy and are committed to working with the Agency and the other Federal Agencies involved in oil spill response to ensure the health and safety of people and minimize environmental and community impacts during an oil spill. Please do not hesitate to contact Emily Hague (202-682-8260, Hague@api.org) or Nicolette Nye (202-465-8463, nnye@noia.org) if you have any questions.

Sincerely,

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American Petroleum Institute

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Attachment A

Analysis of EPA's Regulatory Impact Analysis for the Proposed Revisions to the National Oil and Hazardous Substances Pollution Contingency Plan in 40 CFR 300 Subpart J

Submitted by:

Policy Navigation Group

April 2015

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EXECUTIVE SUMMARY

Policy Navigation Group (PNG) was asked by the American Petroleum Institute to review the Regulatory Impact Analysis (RIA) for U.S. Environmental Protection Agency's (EPA) proposed rule entitled *National Oil and Hazardous Substances Pollution Contingency Plan.*[1] We were asked to evaluate whether the RIA for the proposed rule is consistent with the analytical standards set forward in OMB Circular A-4 and EPA's Guidelines for Preparing Economic Analyses and to perform an independent cost analysis.[2] In our analysis, the proposed RIA has the following principal deficiencies:

- The proposed rule's RIA does not have a consistent baseline that allows the public and policy officials to compare the incremental social costs and the incremental social benefits of EPA's proposed regulation and the individual policy options within the proposal.
- The RIA fails to estimate many policy scenarios and requirements issued in the proposed rulemaking. The RIA thus fails to provide the public a full description of the proposal's impact and undermines the public's opportunity to provide meaningful comment on the proposed rule.
- Further, for the provisions that it does give quantified social cost estimates, the RIA often underestimates compliance costs. The RIA thus underestimates the full social cost to comply and to administer the changes for both private firms and government agencies.
- The RIA does not provide any quantified social benefit estimates either for the proposal as a whole or for its individual options. Moreover, its qualitative description of social benefits is inaccurate and at times actually describes social costs of the proposal. Without estimates of the incremental social benefits of the rulemaking and the proposal's regulatory options, the public cannot provide meaningful comments on the merits of EPA's proposal.
- The RIA's methodology is designed to underestimate the small business impact. EPA's economic impact analysis is inconsistent with EPA's economic analysis guidelines and EPA's requirements under the Regulatory Flexibility Act (RFA).[3] In this analysis, we address some of the RIA's deficiencies and find that the rulemaking could have a significant impact on a substantial number of small businesses subject to the rulemaking.

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[1] 80 FR 3380. Also, U.S. Environmental Protection Agency, *Regulatory Impact Analysis for Proposed Revisions to the National Oil and Hazardous Substances Pollution Contingency Plan Regulations*, December 3, 2014.

[2] U.S. Environmental Protection Agency, *Guidelines for Preparing Economic Analyses*, 2014.

[3] 5 U.S.C. 601-612

- These principal issues are among many aspects of the analysis that are inconsistent with Executive orders on regulatory review, OMB guidance, and EPA's own guidance for economic analysis.[4]

In the RIA, EPA estimates that the total incremental net present value (at 7 percent) social cost of the rule is $7.8 million, or approximately an annualized cost of $0.7 million over 20 years. In our analysis, we find that the estimated social costs are at least three times higher than EPA's estimate. The cost of the major provisions are given below:

Table ES-1. Estimated Social Costs of the Proposal

	NPV at 7% ($)	Annualized Cost over 20 years at 7% ($)
Product Loss Costs	4,000,000-7,300,000	380,000-720,000
Product Testing Costs	5,300,000	500,000
Stranded Capital/Stockpile Value Loss	1,000,000-1,250,000	90,000-120,000
Label	180,000	20,000
Recovery Costs	1,700,000	160,000
Monitoring Costs	11,000,000	1,000,000
Preauthorization Costs	200,000	20,000
EPA Costs	800,000	80,000
Totals[5]	24,000,000-27,000,000	2,300,000-2,600,000

These costs disproportionately burden small businesses. Most producers in this market are small businesses. The RIA did not find a significant effect on a substantial number of these small businesses. However, when we adjust for the more significant costs in Table ES-1 for the provisions the RIA omits and for real cost of capital, 43 percent of small businesses that the RIA analyzed have compliance costs greater than three percent of their 2011 revenues. As shown in Table ES-2, many small businesses face severe impacts. EPA should evaluate whether it must comply with the procedural and other analytic requirements of the Small Business Regulatory Enforcement Fairness Act (SBREFA).

[4] Executive Order 12866 Regulatory Review, September 30, 1993.

[5] Throughout this report, totals and summaries may be different due to rounding. Reflecting the likely precision of these estimates, figures are presented to two significant digits or less.

Table ES-2. Economic Impact of the Proposal on Small Businesses

Pct of 2011 Revenue	Number of Product Types	Percent of Companies
<3%	17	57%
3%-5%	5	17%
>5%	8	27%

We recommend that EPA correct these deficiencies including undertaking a comprehensive benefit analysis to determine if the rule is in the national interest. Once EPA conducts its analysis of the incremental net social benefits of each proposed provision, it should select the regulatory options that maximize net social benefits. As EPA's economic analysis guidelines states:

> Preparing high -quality economic analysis can greatly enhance the effectiveness of environmental policy decisions by providing policy makers with the ability to systematically assess the consequences of various actions. An economic analysis can describe the implications of policy alternatives not just in terms of economic efficiency, but also in terms of the magnitude and distribution of an array of impacts.[6]

This report discusses the major issues with the RIA in more detail, provides alternative estimates for the proposal's social costs, and recommends how EPA should correct these flaws before reissuing a proposed rule.

[6] U.S. EPA, *Guidelines*, pg. 1-2.

SECTION 1. INCONSISTENCY BETWEEN BASELINE AND POST-REGULATION MARKET SCENARIOS

1.1. BASELINE IS INCOMPLETE AND INCONSISTENT WITH OMB GUIDANCE

The RIA's description of the analytic baseline is incomplete and inconsistent with OMB guidance.[7] There are several problems with the RIA's regulatory baseline:

- The RIA does not establish baseline conditions for many proposed requirements. As discussed in Section 2 below, the RIA does not fully estimate the social benefits and costs of all of the provisions of the proposal. As it corrects the serious deficiency of omitting cost estimates for proposed provisions, EPA must apply a consistent framework for both baseline and post-proposal market conditions in any final rulemaking.

- The RIA assumes a regulatory baseline where all existing manufacturers must pay to test their products. Even in absence of a rule, manufacturers may choose to conduct additional toxicity testing to demonstrate the inherent low hazard of their product and thus to differentiate their products in the market. Oil spill response organizations and responsible parties may also insist on further toxicity testing from producers due to liability concerns. Other jurisdictions also require testing of oil response products. For example, the corresponding European Union (EU) authority, the European Maritime Safety Agency, lists the dispersant testing requirements as of 2014 in the EU member states.[8] Eight EU members require testing of dispersant products. For all these reasons, producers may have some or all of the proposed testing data already available.

Recommendation. EPA should gather additional information on available data not only to prepare a more accurate economic analysis, but also to properly estimate the incremental social costs of this rule. If additional data already exists, EPA could tailor the final rule's requirements to this data and only mandate additional testing where meaningful data gaps exist.

1.2. PROPOSAL DOES NOT HAVE CONSISTENT SCENARIO FOR THE SOCIAL BENEFITS AND SOCIAL COST ESTIMATES

The RIA assumes all existing products comply with the new testing requirements and remain on the market.[9] The RIA also assumes new products are approved by EPA at the same

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[7] U.S. Office of Management and Budget, Circular A-4 Regulatory Analysis, September 2003.

[8] European Maritime Safety Agency, *Inventory of National Policies Regarding the Use of Oil Spill Dispersants in the EU Member States*, 2014

[9] U.S. Environmental Protection Agency, *Regulatory Impact Analysis for Proposed Revisions to the National Oil and Hazardous Substances Pollution Contingency Plan Regulations*, December 3, 2014.

pace as in the past. In other words, society gains the same benefits from products with the same capabilities and efficacy with or without the rule.

If this post-regulatory scenario is true, the rule has few, if any, social benefits.[10] For example, EPA cites reduced product toxicity on marine life as a potential social benefit. However, any potential ecological harm could only possibly be reduced if some existing (and future) products are withdrawn, not used, or disallowed due to the new toxicity testing requirement and due to the new EPA approval process.

However, the RIA's scenario is not the most plausible post-regulation scenario. It is more likely that some existing products will not remain on the approved list after the rulemaking. This outcome is more likely than the RIA scenario for two reasons. First, EPA may decide not to approve some of the existing products. It seems unlikely that EPA would use its scarce resources to promulgate increased toxicity testing standards if it did not have concerns with the toxicity of some existing products.

Second, given the uncertain sales volume, producers may not make a competitive expected rate of return with the additional testing and application expense and the greater risk of disapproval. In this case, they can be expected not to remain on the schedule after the rule is effective.

There is ample evidence that existing producers face a non-zero risk of product disapproval:

- Interest groups and media alleged significant concerns with oil spill product safety during the 2010 SONS.[11,12] Media attention and interest group attention to the issue does not mean that products are toxic per se; however, the threat of media scrutiny dampens producers' interest in bringing products to market. Increased attention is likely to lengthen EPA's approval process and the costs for the producer to respond to media inquiries. For producers, these response costs decrease the rate of return for oil spill products and potentially raise the costs for other company products.[13]

- Many producers are small businesses and need certain rates of return to compensate for their cost of capital and for the opportunity cost to innovate in

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[10] There is the argument that there is an information externality - the producers of the agents have a more concentrated interest and easier access to the potential toxicity information than the purchasers. However, since the producers are mostly small businesses and the purchasers are typically government agencies or large businesses, the purchasers can be expected to have sufficient resources and potential legal liability to overcome any potential information externality.

[11] See for example, http://www.biologicaldiversity.org/programs/public_lands/energy/dirty_energy_development/oil_and_gas/gulf_oil_spill/dispersants.html.

[12] E. Rothsenthal, *In Gulf of Mexico, Chemicals under Scrutiny*, The New York Times, May 5, 2010.

[13] For example, the parent company, and not individual product, may face public criticism.

other markets. Their internal rate of return requirements may preclude further investments once the costs and the risk increase.

In addition to the effect on existing products, the rulemaking is likely to affect the number of future products. By requiring additional testing and approval, the rulemaking increases market barriers. Some new products may not reach the market in the future due to the costs and risks that new products will not pass the new testing requirements.

1.2.1. Social Cost Estimate

To overcome these limitations, we conduct an alternative estimate to illustrate the importance of considering how the rule will raise market barriers. In Section 6 below, we demonstrate that many smaller producers could face a significant economic impact from the rule, i.e., greater than three percent of their annual revenue. As EPA and Small Business Administration guidance suggests, we assume those firms fail or leave the market due to the regulatory costs.[14]

The social cost is the lost value added to society from these products that leave the market. Value added is the remaining revenue after the costs of the inputs (e.g., labor, materials, and energy) are subtracted. Since value added is often proprietary information and varies from firm to firm, we use a recent value added metric for the chemical industry as a whole. From 2013 Bureau of Economic Analysis data, the average valued added in chemical manufacturing is 44 percent of revenue.[15] We assume that each company in the oil spill product market has a value added of 44 percent of revenue.

Once existing firms leave the market, society loses the value added of their products for Subpart J responses. However, in a competitive marketplace, other firms will enter and offer their own products. Since the regulation is not changing the demand for oil spill response products or acting to reduce the likelihood of spills, post-regulatory supply will rise to meet this unchanged demand. Society, therefore, only temporarily loses the availability of some oil response capabilities once existing producers leave the market in response to regulation.

We assume the value added is lost for three years. While three years is an assumption, it is a reasonable one given the proposed rule's timing. Since existing firms have two years to provide EPA with the new test data, if they decide not to reapply, they will likely try to stay on the market for the full two years. Once EPA removes them from the schedule, competitors will then see a market opening. We assume these competitors offer alternatives and submit their applications to EPA one year later.

We recognize other outcomes are possible. Instead of replacing existing products with new products at a 1:1 ratio, fewer new products could enter the marketplace, leaving the

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[14] U.S. Small Business Administration, *Guide for Government Agencies How to Comply with the Regulatory Flexibility Act*, May 2012. See U.S. EPA, *Final Guidance for EPA Rule writers: Regulatory Flexibility Act as amended by the Small Business Regulatory Enforcement Fairness Act*, November 2006.

[15] U.S. Department of Commerce, Bureau of Economic Analysis, *Value Added by Industry*, November 2014

approved products with a greater market share. In this case, compliance costs would be lower than this estimate; however, an additional social cost would be the loss of resiliency to responds to market disruptions. In addition to small firms, large firms may also not submit the new information due to the expense. On an individual product basis, larger firms may not find it profitable to continue.

Recognizing these limitations, based on these assumptions and the revenue information the RIA provides in Exhibit 7-1, Table 1-1 shows our estimate of the social cost of market disruption/transition due to the proposed rule.

Table 1-1. Social Costs from Market Transition

Annual Revenue	Product Type	Assumed Value Added	Social Cost	Discounted Social Cost (7 percent)
$ 62,000	Solidifiers	$ 27,000.00	$ 81,000.00	$ 74,000.00
$ 160,000	Surface Washing Agent	$ 71,000.00	$ 213,000.00	$ 195,000.00
$ 120,000	Solidifiers	$ 53,000.00	$ 159,000.00	$ 146,000.00
$ 200,000	Solidifiers	$ 88,000.00	$ 264,000.00	$ 242,000.00
$ 30,000	Solidifiers	$ 13,000.00	$ 39,000.00	$ 36,000.00
$ 120,000	Surface Washing Agent	$ 53,000.00	$ 159,000.00	$ 146,000.00
$ 150,000	Surface Washing Agent	$ 66,000.00	$ 198,000.00	$ 181,000.00
$ 1,000,000	Dispersant(2) & Surface Washing Agent	$ 441,000.00	$ 1,323,000.00	$ 1,211,000.00
$ 187,000	Surface Washing Agent	$ 82,000.00	$ 246,000.00	$ 225,000.00
$ 290,000	Bioremediation Agent	$ 128,000.00	$ 384,000.00	$ 352,000.00
$ 280,000	Surface Washing Agent	$ 123,000.00	$ 369,000.00	$ 338,000.00
$ 559,000	Bioremediation Agent	$ 246,000.00	$ 738,000.00	$ 676,000.00
$ 120,000	Bioremediation Agent	$ 53,000.00	$ 159,000.00	$ 146,000.00
Total (rounded)				$ 4,000,000.00

Summary	NPV at 7%	Annualized Cost over 20 years at 7%
Product Loss Costs	$4,000,000	$380,000

The social costs for existing products are estimated to be $4 million. If it takes longer for alternative products to enter the market, these costs would be higher. These social costs do not include the loss of efficacy and resiliency to respond to oil spills during this transition period. In Section 2.3 below, we expand this estimate to add the potential product loss social costs from the proposed ban on products containing NP and NPE.

As discussed previously, the regulation will not only discourage existing producers from re-qualifying, but also discourage new entrants by raising the costs and the risks of market

entry. The RIA assumes new entrants arrive after the rule at the same pace as in the baseline, or 10 per year. This assumption is not supported by economic theory. As discussed below in Section 3.4, we predict that application costs would rise by 40-50 percent for surface washing and stabilizer products, 260 percent for bioremediation products, and 120 percent for dispersants compared to current requirements. While we did not find estimates of the supply elasticity in these markets, such significant increases in prices will affect supply. We assume new product applications decrease by 30 percent from 10 to seven per year in response. The cost implications of this change are further discussed in Section 5.

1.2.2. **Recommendation**

Setting the baseline and policy alternative scenario is one of the key foundations of a regulatory analysis. As EPA's Guidelines for Economic Analysis states: "Because the level of detail presented in the baseline specification is an important determinant of the kinds of analysis that can be conducted on proposed regulatory options, careful thought in specifying the baseline is crucial."[16] The RIA has not shown this careful thought. For the final rule, EPA should understand the available toxicity and efficacy data available from producers. EPA should select, at a minimum, alternative market outcomes from the regulation in which some existing products do not return to the approved list. EPA must estimate the incremental social benefits and social costs from more accurate baselines.

[16] U.S. EPA, *Guidelines*, pg. 5-1.

SECTION 2. SOCIAL COSTS NOT INCLUDED IN THE RIA

2.1. STRANDED PRODUCTION CAPITAL AND PRODUCTS

EPA has not estimated the full social costs from a decision not to approve a product or from a producer's decision not to reapply. For the reasons listed in the previous section, it is plausible that some existing products will not be listed in the future due to the new regulatory requirements. In Section 1.2.1, we estimate the temporary lost value to society. The full social costs include the net change in value of the oil spill response product and the stranded human and physical capital used to produce the product. In addition, existing stockpiles of the dis-approved product can be expected to suddenly have lower value due to the disapproval. While on scene coordinators (OSC) could still allow their use during a spill response, the likelihood is lower once the product is no longer approved.

These costs are potentially significant. Stockpiling response products is an essential strategy to minimize oil spills' consequences. Response products must be deployed within hours of an oil spill; there is not time to ramp up production once a spill happens. Stockpiles are substantial and deployed across the globe. For example, a 2014 EU report lists nearly 3,500 metric tons of more than 40 different compounds in EU member state stockpiles.[17]

EPA has recognized this social cost category in other rulemakings. EPA has banned or phased-out products in other environmental programs. For example, EPA regulates the phase-out of ozone-depleting substances (ODS) under the Clean Air Act (CAA). EPA has conducted several major RIAs for the multiple phase-out decisions for ODS use under Title VI of the CAA. For example, in its Section 604 and Section 606 rulemakings, EPA considered the stranded capital and product costs for the ODS subject to the phase-out. EPA also attempted to estimate the social costs of the reduced efficacy of the substitutes.[18]

2.1.1. Social Cost Estimate

We consider the stranded capital and product costs separately. For the stranded capital, there are several considerations in estimating the social cost. First, the regulation does not destroy the labor and physical capital, but blocks its highest valued use. Workers and entrepreneurs can use their knowledge and machinery to make other products and/or the same product. Second, there is a distinct loss as suppliers move their capital from this highest valued use before the regulation to a lower valued use after the regulation. They also have costs as they retrain and retool their equipment for this shift.

This information guides our estimate. At one extreme, if the regulation completely destroyed the economic value of the enterprise, the loss could be estimated as the enterprise values of the firms. Using a standard financial estimation of small business enterprise value, the loss would be three to five times the firm's intrinsic value (i.e., value added). In this

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[17] European Maritime Safety Agency, *Inventory of National Policies Regarding the Use of Oil Spill Dispersants in the EU Member States*, 2014

[18] For a good summary, see Appendix G of *The Benefits and Costs of the Clean Air Act, 1990 to 2010*, U.S. EPA, 1999.

case, the maximum social cost would be $6 million to $8 million. At the other extreme, in a dynamic economy, excess capital and labor is rapidly moved from one use to another, with almost zero transition cost. Since the regulation fundamentally does not change demand, we assume that the stranded human and physical capital costs will be closer to the low end and assume a loss of $1 million.

For the stranded product costs, knowledge of which existing products will not return to the schedule and the amounts of those products are stockpiled is important information. The RIA gives information about the product types that are likely to leave the market due to regulation (see Section 6 below), but not the specific products.

For current amounts in stockpiles, in support of its 2009 vessel response plan (VRP) rulemaking, the Coast Guard complied data on US stockpiles of products listed on Subpart J.[19] Although this data is comprehensive, it is from 1998. The VRP rulemaking required responsible parties to have contracts with oil spill removal organizations (OSRO) or organic capacity to respond to categorical spills.[20] The rulemaking required owners and operators to have response resources capable of applying dispersants. This rulemaking, and subsequent ones, increased the amount of dispersants stockpiled in the United States.

From public information given by OSROs, most advertised dispersant capacity is for Corexit® formulations. While it is very likely that these organizations also stockpile stabilizers, surface washing agents, and potentially bioremediation agents, we did not find a current, comprehensive list of stockpiled substances.

We therefore constructed our estimate under two scenarios: (1) if EPA does not approve Corexit® formulations; and, (2) If EPA does not approve other agents. For the latter, we include these costs in Section 2.4. A potential ban on Corexit® is discussed in this section.

We gathered available data on current and relatively recent reports of Corexit® formulation stockpiles in the United States and globally. Since the chemical is not approved for use in Europe, we found that global stockpiles are located primarily in the United States and Brazil.[21] Table 2-1 gives the organization and the reported stockpile amount.

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[19] U.S. Coast Guard, "Caps" Review of Oil Spill Response Plan Equipment Capability, at https://homeport.uscg.mil/cgibin/st/portal/uscg_docs/MyCG/Editorial/20080725/combined%20document.pdf?id=213ab594d05ab39ffd49d74a2e188eb8246d23ed&user_id=7ee08b44562829c5918c18d08ac87c29.

[20] 74 FR 45004

[21] http://www.oilspillresponse.com/files/OSRL_GDS_Equipment_20Nov2014.pdf

Table 2-1. Estimated Stockpiles of Corexit® Formulations

Organization	Units	gal/unit	Total
MSRC[22]	1	104,000	104,000
Clean Seas Cooperative[23]	1	20,750	20,750
Oil Spill Response[24]	500	264	132,000
Alyeska Pipeline[25]	1	60,000	60,000
Clean Islands[26]	1	37,260	37,260
LOOP[27]	1	33,600	33,600
Clean Gulf Associates[28]	1	34,650	34,650
CISPRI[29]	1	20,570	20,570
Nalco[30]	1	12,000	12,000

Total (rounded)	450,000
Estimated Value	$ 250,000

[22] https://www-msrc-org-documents.s3.amazonaws.com/major-equipment-list/MSRC_Major_Equipment_List.pdf?AWSAccessKeyId=AKIAIGH7YZWA2HRSZUFA&Expires=1427976589&Signature=lYm5WdnIB7M4XV%2BR1foyl5kUg70%3D

[23] http://www.cleanseas.com/equipment.htm#ABSORBENTS/DISPERSANTS/SPRAY

[24] http://www.oilspillresponse.com/files/OSRL_GDS_Equipment_20Nov2014.pdf

[25] Minerals Management Service, *Assessment of the Use of Dispersants on Oil Spills in California Marine Waters*, S.L. Ross Environmental Research Ltd, June 2002.

[26] http://www.cleanislands.com/

[27] Minerals Management Service, *Assessment of the Use of Dispersants on Oil Spills in California Marine Waters*, S.L. Ross Environmental Research Ltd, June 2002.

[28] http://www.cleangulfassoc.com/equipment.

[29] Minerals Management Service, *Assessment of the Use of Dispersants on Oil Spills in California Marine Waters*, S.L. Ross Environmental Research Ltd, June 2002.

[30] http://www.rrt9.org/external/content/document/2763/904415/1/Nalco%20Dispersant%20Mfgr%20Capability.pdf

Table 2-1 may overestimate the amount stockpiled since different organizations may have overlapping agreements to use the same stockpile. The estimates may also be underestimates since we could not find publicly available data on the stockpiles of some of the larger OSROs such as NRC.[31] Based on a recently reported retail price from an OSRO of $0.55/gallon, the reported stockpiles in Table 2-1 are worth $0.25 million. Since the product is not approved for use in other jurisdictions, if EPA did not approve its continued use, it is likely that current stockpiles will have little residual value.

In summary, the stranded capital/stockpile value loss is the sum of the loss of enterprise value (assumed to be $1 million) and the potential loss of in value of Corexit® formulations. Since the loss in Corexit® formulations is speculative, we present our estimate for this rulemaking outcome as a range.

Summary	NPV at 7%	Annualized Cost over 20 years at 7%
Stranded Capital/Stockpile Value Loss	$ 1,000,000-$1,250,000	$90,000-$120,000

2.1.2. Recommendation

Once EPA establishes a more plausible baseline and post-regulation market conditions, it must account for all social costs that flow from an EPA decision not to approve products currently on the list. These costs include the stranded physical and human production capital, the loss in value of stockpiled products, and any loss in oil spill response efficacy from these decisions. EPA has access to data on oil response product stockpiles that it should use to better estimate the social costs of this rulemaking. EPA's analysis for the final rule should at least be as comprehensive as EPA's approaches in other comparable EPA rulemakings.

2.2. Periodic Revisions of Preauthorization plans

In the proposal, EPA requires Regional Response Teams (RRTs) to review and to update their preauthorization plans for chemical and biological response agents after major oil spills or at least once every five years. The RIA does not estimate the social costs of this proposed requirement.[32]

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[31] http://nrcc.com/our-services/response-services/response-equipment-rental-packages/

[32] On page 37 of the RIA, under the section entitled "Authorization of Agent Use (part 300.910)," the RIA notes that RRTs and Area Committees are required to provide a preauthorization plan and to follow other requirements. The RIA states: "The incremental burden for members of the RRT and Area Committees requires labor hours to participate in the development of preauthorization plans and to add them to RCPS and ACPs." However, it is not clear whether the extremely low burden the RIA uses (2 hours) is to update the 11 or more preauthorization plans or the title of section,

There is evidence that this provision would have meaningful costs if finalized. Recently, EPA's Inspector General (IG) issued a report finding defects in emergency management planning and contingency planning for oil spills.[33] In response, EPA stated:

> Thus, although we generally agree with the recommendations in this report, and they parallel our efforts, two key obstacles (i.e., limited involvement by other agencies and stakeholders and resources) must be overcome for their successful implementation.[34]

The EPA program response to the IG suggests that resources, not interest, is the barrier to updating preauthorization plans. If local governments and other RRT team members are constrained by a lack of resources, then it is not clear how a regulation will alter this reality. The social costs then must reflect this scarcity. The social costs are not limited to the full compensation costs and capital costs necessary to maintain that employee. Unlike private markets, the supply of government officials' time does not increase with greater demand. For this reason, the social costs are the opportunity costs of that official's time - i.e., the social benefits society would gain if the government official spends the time on the next most valuable use of that person's time--enforcement, policy setting, permit approvals, or other public matters. The opportunity cost of this resource - a government agency official's work time - is how EPA's Guidelines for Economic Analysis defines social cost.[35]

2.2.1. **Estimated Social Costs**

Based on the IG's analysis, we estimate the social costs as the resources required to update preauthorization plans more frequently than is current practice. We assume in the baseline that plans are currently revised once every seven years; the proposal requires them every five years or after major oil spills. Based on the IG report finding that some plans had not been updated since the 1990s, a seven year update frequency in the baseline may underestimate social cost. For the post-rule scenario, we use a five year frequency since the other trigger, major spills, are rare and may be expected to lead to preauthorization plan reviews even in the absence of this rulemaking.

The resources required are the time spent revising each plan and the review of each plan by the member organizations. From the agenda of recent RRT meetings, we count the number of distinct Federal and state agencies. In a recent Region 6 RRT meeting, 13 Federal agencies sent staff.[36] We assume that 13 Federal agencies are part of each RRT. States,

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authorization of agent use. In either case, the RIA's estimate is far too low to comply with the proposed requirement.

[33] U.S. Environmental Protection Agency, Office of the Inspector General, *EPA Could Improve Contingency Planning for Oil and Hazardous Substance Response*, February 15, 2013.

[34] Ibid, pg. 19.

[35] "Social cost represents the total burden that a regulation will impose on the economy. It is defined as the sum of all opportunity costs incurred as a result of a regulation where an opportunity cost is the value lost to society of any goods and services that will not be produced and consumed as a result of a regulation," *Guidelines*, p.8-1.

[36] http://www.rrt6.org/Uploads/Files/rrt_semi_annual_meeting_summary_2014_November.pdf

territories, and Tribes also serve on the RRTs. Among the 11 RRTs (one for each EPA region and one for Alaska), we assume 56 States, Tribes, and territories send representatives and participants.

We make some assumptions on the effort needed to revise each preauthorization plan. We assume 20 percent of the RRT's member organizations assign one staff person to serve on an RRT subgroup to revise the plan. Each assigned staff person spends 40 total hours in this revision process. Then, each Federal, State, Tribe, and territory agency reviews the draft revised plan in their organization. Three people in each organization are a part of the review to account for the agency's management and likely legal review. Each person reviewing the draft plan spends six hours reading and discussing the revised plan.

For the costs of government staff time, we use median and mean wages for Federal employees and State employees, respectively.[37] To these wages, we apply recent Federal government values for benefits and overhead to the Federal and State hourly wage values.[38] For the reasons discussed above, this estimate of the opportunity cost of this resource likely underestimates its true social value and thus the social cost of this proposed requirement.

We then compare the social costs for the baseline and proposed requirements - the costs of revising the plans on a seven versus five year frequency. We discount the baseline and proposal time stream of costs at a discount rate of seven percent and take the difference between those time streams as the social cost. The net present value of the additional social cost at a discount rate of seven percent is $0.18 million.

Summary	NPV at 7%	Annualized cost over 20 years at 7%
Preauthorization costs	$180,000	$20,000

2.2.2. Recommendation

The RIA must fully include the social costs and social benefits of this provision and calculate the social costs as the opportunity cost of government agency staff time.

2.3. Prohibition on Chemicals and Proposal to Ban EDCs

The RIA does not estimate the social benefits or the social costs for the proposed option to prohibit approving products containing nonylphenol (NP) and nonylphenol ethoxylates (NPE). More significantly, the RIA did not estimate the social benefits and costs of a regulatory option discussed in the preamble, a ban on endocrine disrupting compounds in approved products.

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[37] U.S. Bureau of Labor Statistics, May 2014 State Occupational Employment and Wage Estimates, http://www.bls.gov/oes/current/oes_ms.htm#11-0000.

[38] See for example, U.S. Office of Personnel Management, Federal Investigative Services Division, *White Paper: Support Services Contract Cost Benefit Analysis.*

Banning any compounds will have social costs and potentially social benefits. As discussed elsewhere in these comments, EPA has acknowledged in other rulemakings the loss of income and loss of productive capital from product bans. These costs must be included in the economic analysis of this option.

One notable option EPA lists is to prohibit materials containing endocrine disrupting compounds from the approved list. More broadly, EPA's proposed prohibition - without any stated criteria for the ban - raises significant market uncertainty. Without transparency into EPA's rationale for the prohibition, producers may decide not to pay for testing costs and risk disapproval, reducing the overall efficacy and variety of products available.

However, the social costs are more significant than the loss of net value in the oil spill response market. Bans by a government agency will cast a cloud over the public's perception of the health and safety of a chemical compound. States and companies maintain lists of "toxic" chemicals and have policies that discourage purchasing and use of chemicals on these lists.[39] By banning a substance in oil spill response products, it is more likely that the market for NP and NPE compounds will shrink throughout the overall economy.

Moreover, the incremental social benefits of the proposed NP and NPE ban are uncertain. The RIA did not quantify these benefits. There is reason to believe that any such social benefits will be small. EPA's own test data provides evidence that the proposed bans would have minimal, if any, social benefits. EPA conducted tests of eight dispersant compound-oil mixtures, some of which contained NPE, for their endocrine activity.[40] EPA found:

> None of the eight dispersants tested displayed biologically significant endocrine disrupting activity, with the exception of a weak response for two of the dispersants (Nokomis 3-F4 and ZI- 400) in one of the tests. This estrogenic result is likely not of biological significance. Cell death (degree the dispersant is toxic to living cells) was observed in some tests at concentrations above 10 parts per million. The endocrine and the cytotoxicity screening were conducted at dispersant concentrations from 0.001 parts per million up to 10,000 parts per million. None of the dispersants triggered cell death at the likely concentrations of dispersants expected in the Gulf.[41]

Therefore, although EPA's study had a small sample set, EPA's test data provides no evidence that these oil spill response compounds with NP and NPE pose any inherent hazard that would justify the social costs of a precautionary ban. The preamble does not provide quantified social benefit estimates to support a ban over other policy alternatives.

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[39] See, for example, Maine's "Chemicals of High Concern," at http://www.maine.gov/dep/safechem/highconcern/.

[40] Judson, R. S., Martin, M. T., Reif, D. M., Houck, K. A., Knudsen, T. B., Rotroff, D. M., Dix, D. J. (2010). *Analysis of Eight Oil Spill Dispersants Using Rapid, In Vitro Tests for Endocrine and Other Biological Activity.* Environmental Science & Technology, 44(15), 5979-5985. doi:10.1021/es102150z

[41] http://www.epa.gov/bpspill/dispersants-qanda.html#toxtest8. See also U.S. Environmental Protection Agency, *Toxicity of Louisiana Sweet Crude Oil (LSC) and chemical dispersed LSC to two Gulf of Mexico aquatic test species,* August 2010.

EPA failed to consider and to evaluate policy alternatives to its proposed ban. Under the Executive orders, EPA must evaluate available policy alternatives and select the ones in which the benefits justify the costs.[42] There are several policy alternatives EPA could choose and could evaluate besides a ban on NP and NPE compounds, such as imposing lesser restrictions or requirements. Such options could tailor the social costs more directly to any potential hazard than a product ban. Only through objective, transparent policy analysis of these alternatives can senior officials and the public weigh the options to decide upon the best policy.

2.3.1. **Estimated Social Costs**

We searched PubMED for published, peer-reviewed articles that found evidence of NP and NPE-containing oil spill response agents. The only study that specifically listed these compounds was EPA's 2010 work in response to the SONS.[43] It identified NP and NPE compounds in two listed dispersants, Nokomis 3-F4 and ZI-400. For the purpose of this estimate, we assume these products are subject to the proposal's ban.

Based on our evaluation, the manufacturers of these products are likely small businesses. To estimate the impact of the ban, we use a similar approach as in Section 1.2.1. The social costs are not permanent; the social value of the banned products is eventually replaced by substitutes or through greater sales of other dispersants. In EPA's testing, the most widely-used dispersant did not contain NP and NPE. The social costs, therefore, are limited to the immediate disruption in the market.

Since we do not know the actual sales of these dispersant products, we average the annual revenue from the three small business manufacturers of dispersant products given in the RIA. As done is Section 1.2.1, we use the value added of the chemical industry to estimate the added value from these products. The social cost of the ban is the lost value from these two products for a three year period.

There are several reasons this approach underestimates the likely social cost. First, medium and large companies may have their products banned also. While these companies may have resources to reformulate their products, there still will be social costs to switch to substitutes. Second, our estimate of two banned products comes from our search of the public, peer-reviewed literature. Given the controversy over dispersants during the SONS and EPA's proposed rule, companies have an incentive not to disclose voluntarily NP and NPE ingredients. Third, it is possible that NP and NPE compounds are used in other product types such as surface washing agents. Fourth, the manufacturers of the two dispersants that EPA identified as containing NP and NPE have similar products on the schedule. If these products also contain NP and NPE, they would also face bans under the proposal.

Finally, we do not estimate the social costs of a more sweeping ban on all EDC compounds. EPA's proposal is too vague for the public to understand its implications. First,

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[42] U.S. Office of Management and Budget, Circular A-4 Regulatory Analysis, September 2003, pg. 16.

[43] Judson RS, Martin MT, Reif DM, et al. Analysis of Eight Oil Spill Dispersants Using Rapid, In Vitro Tests for Endocrine and Other Biological Activity. *Environmental science & technology.* 2010; 44(15):5979-5985. doi:10.1021/es102150z.

EPA does not define what it means to be an EDC. Second, EPA does not state whether all compounded named as an EDC are banned as ingredients or whether *de minimis* amounts are permitted.

Since some of these same products may drop out of the market due to the new testing requirement, we structure our NP product ban cost estimate so as not to double count the product loss estimates already presented. In Section 1.2.1, one product is a dispersant. Our range is simply whether this product's loss is included in the $4 million product loss calculated in Section 1.2.1 or is an additional social cost.

Summary	NPV at 7%	Annualized Cost over 20 years at 7%
Product Loss Costs	$4,000,000-$7,300,000	$380,000-$720,000

2.3.2. Recommendation

The RIA must fully estimate the social costs and the social benefits of the proposal to ban NP and NPE compounds in listed products and the alternative to ban EDCs. To comply with the Executive orders and OMB guidance, EPA must also evaluate policy alternatives to banning compounds and select the one with the greatest net social benefits.

2.4. Expired Product Testing and/or Replacement Costs

EPA proposes that stockpiled products must be tested in order to be used after their expiration date. The RIA does not estimate the social costs of this requirement.

This provision has social costs and potentially social benefits. There are two costs: increased product testing costs and potentially the cost of more frequent product shipments to stockpile locations. The social benefits are potentially more effective products due to this requirement.

2.4.1. Estimated Social Costs

Over time organizations that stockpile oil response products will attempt to minimize the cost of this requirement through inventory management. They can change their ordering procedures to better match inventory to use. More significantly, they can shift sales of products past their official expiration date to other markets. Numerous oil spills and cleanups occur that do not involve Federal OSCs. Since many expiration dates are minimal (e.g., "at least two years"), buyers may be willing to accept response products with older shelf lives for a discount or because their spill response need is less. Vendors/organizations that stockpile will, over time, manage their inventories so that products with young shelf lives are reserved for any Subpart J needs and then, rather than retest to verify their continued use, are migrated to other markets.

This strategy can only work if the major stockpiled products have sufficiently long shelf lives. In the Attachment, the recommended shelf lives for each existing product are listed. We assign a shelf life of 20 years to products reporting unlimited shelf life.

Bioremediation products have the shortest average shelf life of less than three years. Dispersants have the longest average shelf life, with the most widely stockpiled dispersant having an unlimited shelf life. While products vary significantly, there are numerous products in each category with relatively long shelf lives to allow inventory management. To the degree there are effects, management of existing bioremediation products could be most vulnerable to the requirement for additional testing.

For these reasons, we model the social cost as a one-time event to shift management of existing inventories. We assume future purchases and sales will direct products with older shelf lives to cleanups outside National Contingency Plan jurisdiction. We also assume that some operators of existing stockpiles and inventories will decide it is more cost-effective to test rather than replace their existing inventory.[44] They may have quantities of the surface washing products with shorter shelf lives than the average nine year life-span of these products. Different stockpiles will have different products; therefore, the testing decision is based on the number of stockpile-product combinations. We assume that operators find 20 stockpile-product combinations where testing is more cost-effective than selling into other markets or discarding and replacing the product. Since dispersants have a much longer shelf live on average, we only assume four stockpile-product decisions to test. Table 2.2 presents the results based on these assumptions. This provision could have social costs of $1.7 million.

Table 2-2 Estimated Costs of Testing Expired Products

Product	Testing Cost	Number of Stockpiles-Products	Total Cost
Bioremediation Agent	$31,800	20	$1,270,000
Dispersant	$13,050	4	$52,200
Surface Washing Agent	$10,300	20	$206,000
Solidifier	$10,300	20	$206,000
Total			**$1,740,000**

In Section 2.1.1, we consider the social cost of managing stockpiles of existing products that are not approved in the post-regulatory scenario. We assume that OSRO and others manage their inventories of surface washing agents, sorbents, and other products to market them to non-NCP spill responses. In Section 5 we combine all of the provisions that require testing into one estimate so that the analysis makes consistent predictions of market dynamics after the rulemaking.

2.4.2. **Recommendation**

EPA must estimate the social benefits and social costs of this provision if it is included in the final rule. EPA should use current data on stockpile amounts and their expiration dates.

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[44] Or they will replace products in response to the rule up to the expected value of testing them to prove their efficacy. We use the testing cost as the upper limit of the cost to replace existing inventories.

2.5. RECOVERY OF AGENTS FROM ENVIRONMENT

In the proposal, EPA adds a regulatory requirement that responsible parties are obligated to recover certain oil spill response products from the environment. When stabilizers, surface washing agents, and sorbents are used, responsible parties must recover them when it is safe to do so. The RIA does not estimate any social benefits or social costs from this provision.

This requirement has social costs and potentially social benefits. For major spills, it is likely the regulation formalizes the likely site-specific orders by the OSC. By making it a regulatory requirement, the major change is that it subjects the responsible party to the full enforcement authorities under the Clean Water Act. The proposal reduces the government's administrative effort to levy fines and penalties.

The marginal increase in the threat of fines and penalties may change responsible party behavior. Responsible parties may put greater effort into recovery operations and respond to reports of agents in the environment after the spill for a longer period of time. More effort at recovery may then yield some environmental benefits on the margin. However, greater human activity - boats, motors, skimmers - in environmentally-sensitive areas may cause damage while recovering response products. The current framework - to take actions which have the greatest net environmental benefits - is more flexible and allows site-specific balancing of ecological, human safety, and response product use.

2.5.1. Estimated Social Costs

As a practical matter, this provision may not have any additional social costs for major Tier I, Tier II, or Tier III oil spills. On scene coordinators effectively order product recovery for these major spills. For larger spills, the greater level of government oversight in both the baseline and the post-regulation may be expected to lead to similar levels of responsible party activity. For smaller spills, the proposed regulatory requirement could increase social costs by diverting resources into product recovery, especially after the immediate spill response. It is difficult to estimate the additional costs in these site-specific decisions.

Since 2000, there have been on average 13 spills per year of between 5,000-10,000 gallons of oil products into U.S. navigable waters.[45] We assume that these spills are large enough that responsible parties use significant amounts of response products, but not so large that they trigger substantial government oversight.

We assume that the regulatory provision triggers an additional $10,000 in response costs per spill of this medium-to-large spill size. Since daily penalties under the Clean Water Act are up to $37,500 per day per violation, a responsible party may be willing to respond to reports of sorbents and other products in the environment after a spill rather than risk a penalty. They may be willing to spend much more than $10,000 per incident to avoid the fines. However, assuming an average per incident additional cost of $10,000, the net present value (at seven percent) social cost of this requirement is $1.7 million.

[45] United States Coast Guard, *Polluting Incidents In and Around U.S. Waters: A Spill/Release Compendium: 1969 – 2011*, December 2012.

2.5.2. **Recommendation**

EPA should articulate in any final rule the specific social benefits and social costs it believes will occur as a result of this provision. Specifically, EPA should explain the value of this requirement as a regulation as opposed to a site-specific/incident-specific decision that maximizes net environmental benefits.

SECTION 3. UNDERESTIMATED COSTS

3.1. MONITORING COSTS

The proposal requires responsible parties to carry out extensive monitoring of dispersant use, oil concentrations, and ecological effects in the event of a major oil spill where dispersants are used. The RIA estimates the cost of these monitoring requirements to be $500,000 per year for an average of one applicable major, off-shore oil spill per year.

The justification for the cost estimate in the RIA is two studies. However, these studies do not replicate the specific proposed requirements and therefore do not provide adequate justification for the RIA's estimate.

3.1.1. Estimated Social Costs

We build a bottom-up estimate of the social costs to monitor and to report the information listed in the proposed rule. We first make some assumptions concerning the duration of the spill. We assume the responsible party conducts active monitoring of the oil plume and dispersant use for 14 days, followed by 21 days of monitoring of the dissolved oil/dispersant mixture in the water column. Modeling of the oil movement in the water is carried out for 14 days; fluorescence monitoring occurs for the entire 35-day period.

Since dispersants are used, the oil spill is assumed to occur off shore, meaning boats are needed to obtain the water samples and to gather data for the modeling. Background samples are assumed to be gathered at four points upwind and downwind of the plume. In-plume measurements are assumed to be gathered at five points, with three different sampling points in the water column at each point. After the 14 day period, monitoring requirements for the next 21 days fall from five locations in the plume to four areas in the affected area. Background samples are still collected.

Field and test blanks are assumed to be analyzed for each background and plume collection point. The proposal also requires the responsible party to submit a quality assurance plan for the sampling and analysis.

Given the need for rapid decisions, the ecological characterization and risk assessment requirements are divided into two phases. For immediate decisions during the 14 day active response, experts gather available information from already-published studies and regional ecological evaluations. This study also sets the acute toxicity level from available data. Once the response moves to the 21-day monitoring of the ultimate dispersion, a more complete, written ecological characterization report is compiled.

The responsible party assigns 10 managerial and technical staff to manage, carry out, and to report compliance with the monitoring requirements during the 35-day event.

Based on this scenario, we gathered publicly-available price data from OSROs and commercial laboratories to build a social cost estimate. The Oil Spill Response Limited

organization has a global price list and cost data for their Florida-based response location.[46] Table 3-1 gives the principal data used in this cost estimate:

Table 3-1. Prices for Oil Spill Dispersant Use Modeling

Fluorescence Tracking[47]	659	GBP/day
Boat Rental[48]	400	GBP/day
Oil Modeling[49]	2,300	GBP/day
Heavy Metal Analysis[50]	350	$/sample
Volatile Organic Compounds and Benzene, Toluene, Ethylbenzene, and Xylenes[51]	250	$/sample
Total Petroleum Hydrocarbons[52]	150	$/sample
Other Parameters[53]	150	$/sample

Based on this scenario, the estimated monitoring costs are approximately $850,000 per spill. This value is substantially greater than the RIA estimate. This estimate does not include insurance costs, contingency costs, surcharges for rapid delivery, sample shipping costs, travel costs, or other logistical needs. Including these costs would increase the social costs of this provision.

Given the frequency of one spill per year, the net present value and annualized value of these social costs are given below.

Summary	NPV at 7%	Annualized Cost over 20 years at 7%
Monitoring Costs	$11,000,000	$1,000,000

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[46] http://www.oilspillresponse.com/

[47] http://www.oilspillresponse.com/files/ScaleOfFees2015.pdf.

[48] Ibid

[49] http://www.oilspillresponse.com/files/ScaleOfFees2015.pdf.

[50] See for example, Price List from Water Testing Labs at http://www.wtlmd.com/wastewater-testing-pricing-maryland-md-va-dc-de.php.

[51] Ibid

[52] Ibid

[53] Ibid

3.1.2. Recommendation

EPA should use the available data from OSRO equipment price lists and laboratory sampling costs to build up a more complete cost estimate for all of the required parameters for dispersant modeling in the proposed rule. With a frequency of dispersant use of approximately once per year, there is sufficient existing data and markets to use market prices to estimate the social cost. EPA should also characterize plume size and expected monitoring requirements from past spill responses. Gathering this data will provide more support for a social cost estimate.

3.2. EPA Costs to Administer the Rule

The RIA underestimates the total resource cost for EPA to administer the rule because it fails to include the total compensation and overhead costs to employ Federal agency staff and it omits the time necessary for EPA to administer the new requirements. The RIA's approach does not comply with EPA's obligations under the Paperwork Reduction Act's implementing regulations (PRA).[54]

The RIA use BLS data from 2011 as estimates of the opportunity cost of government employees. There are several problems with this data:

- It is out of date. The BLS has compensation data available through September 2014.[55] Moreover, the General Services schedule of Federal wages for 2014 is also available as it determines EPA employees' paychecks.

- It underestimates total compensation. It is unclear whether the data the RIA uses is for salary and wages only or for total compensation. It appears that the RIA uses a labor cost of approximately $54 per hour for EPA employees.[56] The

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[54] See 5 CFR 1320.3(a)(1):

(1) *Burden* means the total time, effort, or financial resources expended by persons to generate, maintain, retain, or disclose or provide information to or for a Federal agency, including:

(i) Reviewing instructions;

(ii) Developing, acquiring, installing, and utilizing technology and systems for the purpose of collecting, validating, and verifying information;

(iii) Developing, acquiring, installing, and utilizing technology and systems for the purpose of processing and maintaining information;

(iv) Developing, acquiring, installing, and utilizing technology and systems for the purpose of disclosing and providing information;

(v) Adjusting the existing ways to comply with any previously applicable instructions and requirements;

(vi) Training personnel to be able to respond to a collection of information;

(vii) Searching data sources;

(viii) Completing and reviewing the collection of information; and

(ix) Transmitting, or otherwise disclosing the information.

[55] See the Employment Compensation Survey, http://www.bls.gov/ncs/tables.htm.

[56] Calculated from data in RIA, pg. 36.

RIA should use total compensation measures to account for Federal employee benefits such as pension, health care, disability insurance, and personal leave. This information is readily available in EPA budget documents, in OMB budget memoranda, and from the Office of Personnel and Management.

- The total resource costs for government services is more than the total compensation cost of labor. Government workers do not work in the open air. They need buildings, electricity, computers, telephones, water, and many other overhead costs. Estimating the overhead costs for government employment is a routine practice in Federal budgeting, in program evaluation, and for compliance with the Paperwork Reduction Act.[57]

Further, the RIA does not include the costs for EPA to administer certain provisions of the rule. In addition to the costs to participate in the RRT and AC meetings included in Section 2.2.1, the RIA fails to include the EPA resources necessary to remove a product from the listing schedule.

3.2.1. Estimated Social Costs

We estimate the social costs of EPA resources to oversee the proposed requirements. Although it is likely an underestimate, we retain the RIA's estimate of 26.5 hours for EPA staff to review each product application. Interestingly, the RIA estimates producers of existing products spend only 7.7 to 27.7 hours to submit the required testing data to EPA. Thus, by the RIA, EPA's review time is longer - up to three times longer - than the time needed to prepare the information. If this ratio is correct, EPA's review process could take over 100 hours. We also agree with the RIA's estimate that the same number of hours is needed when a manufacturer submits new testing data after a product has been reformulated.

However, the RIA assumes EPA spends only 2.5 hours reviewing resubmissions of data from applicants. Since EPA has only 90 days to review an application, it is likely to extend its review by asking applicants for additional information. It seems implausible that EPA would need less than 10 percent of its estimated total review time to review resubmitted data. We use an estimate of 20 hours. We also double the amount of time the RIA estimates to review an appeal of a product disapproval. We believe other divisions of EPA, including the Office of General Counsel, will support the Administrator's review of an appeal and a final Agency decision.

For the opportunity cost of EPA personnel time, we use the fully-loaded employment costs. In FY13, the median EPA employee salary was nearly $108,000, or nearly $55 per hour.[58] We apply OPM's benefit and overhead percentages to calculate a fully-loaded rate of

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[57] 5 CFR 1320.3(a)(1).

[58] U.S. Office of Personnel Management, *Salary Information for the Executive Branch Fiscal Year 2013*, April 2014.

$81.50 per hour.[59] This estimate is a slight underestimate of the likely median wage due to general schedule increases since FY13.

Using the post-regulation rate of existing product submissions and new product submissions, we calculate a net present value (at seven percent) of $0.81 million in social costs for EPA to administer the testing requirements.

3.2.2. Recommendation

The RIA should include costs of EPA to carry out all the proposal in its entirety. EPA should include the total compensation cost for government personnel and the overhead costs necessary to house and to equip these employees so that they can perform their new tasks under this proposed regulation. EPA must include these costs and the resources to oversee all of the provisions of the rule in subsequent analyses.

3.3. Testing and Product Listing Costs

The RIA underestimates the costs an organization expends to understand and to comply with this regulation. The RIA assumes essentially that one or two individuals are solitary actors that read, plan, and implement a regulation for a company. In reality, many employees and managers in an organization will be involved in a product's application.

In addition to underestimating the costs for producers, the RIA underestimates the costs to understand, to comply, and to submit product applications. For example, the RIA does not include these costs:

- Laboratory Personnel Understanding the Rule. The RIA does not include the cost for laboratory personnel either within the manufacturer or at a commercial lab to understand the new testing requirements.
- Legal Personnel Time. It seems implausible that a company would file an important submission to EPA without it undergoing legal review. The submission could determine the entire market for a product.
- Response Costs. Often EPA staff will seek clarifications from respondents on their data submissions to the agency. Seeking clarifications in lieu of outright denials/approvals conserves resources for both EPA and respondents. Oddly, the RIA includes EPA's cost to review these re-submissions, but not those of the respondents to prepare them.[60]

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[59] See for example, U.S. Office of Personnel Management, Federal Investigative Services Division, *White Paper: Support Services Contract Cost Benefit Analysis.*

[60] Even if the RIA estimates the full resource cost for the respondent to submit a "perfect" application that does not require clarification, the respondent is not in control of EPA staff comprehension of the submission and their ability to ask questions, triggering respondent costs.

3.3.1. Estimated Social Costs

In Table 3-2 below, we present alternative labor estimates for producers to comply with the rule that addresses the RIA's limitations. We include hours for all the provisions required of producers, including ones the RIA omits like the product label redesign.

Table 3-2. Estimated Skilled Labor Resources Producers Require to Comply with Proposal's Testing Requirements

(Hours)

	Labor Hours Needed		
	Managerial	Technical	Clerical
Hourly Compensation	$ 55.56	$ 55.56	$23.57
Understand Rule	4	8	2
Contract for Tests	2	16	4
Manage Tests	0	8	8
Prepare Documentation	4	40	16
Design Label	0.5	8	8
Legal Review	4	0	2
Revise Documentation	2	4	45
Respond/Follow up	4	16	8
Total (Hours)	20.5	100	93
Total ($) including overhead rate of 17 percent			$10,400

We include hours for essential tasks to prepare the required information. First, the producer must find and contract with an independent certified laboratory for the efficacy and toxicity testing. They must manage the outside laboratory's performance and review the results. In addition, the producer must prepare the written submission to EPA and follow up with any EPA questions.

For labor rates, we use the BLS Employer Cost for Employment Survey data for December 2014.[61] We use the same overhead rate as the RIA, 17 percent, and use the RIA's relative proportion of the application costs among dispersants, solidifiers, surface washing agents, and bioremediation agents. We use these labor costs for product testing in the multiple provisions in the proposal that require product testing.

[61] http://www.bls.gov/ncs/ect/sp/ececqrtn.pdf.

3.3.2. Recommendation

EPA should include all the costs to understand, to explain, and to incorporate the proposed rule into their organizations' operations. EPA is required to perform this analysis under the PRA regulations. In addition, from past applications, EPA should review whether, and if so, the scope of additional information requests it gave to applicants and include these costs in the any final rule. These costs must be assigned to the regulation.

3.4. Limitation To Tested Waters and Efficacy and Toxicity Testing Costs

In the proposal, EPA limits use of a product to the water characteristics of its toxicity and efficacy testing. Product data with just freshwater test data are limited to freshwater uses, for example. The proposed rule expands the number of efficacy tests for bioremediation agents and alters the efficacy test for dispersants. The proposed rule adds new toxicity tests for dispersants and freshwater/saltwater tests for bioremediation, solidifiers, surface washing agents, and other products.

The RIA makes a global assumption that producers chose just one testing environment, salt water or freshwater, and bear the costs for only one test protocol. Rather than chase market demand and maximize net profits, producers instead make their marketing decisions based on the testing cost. The RIA's assumption violates basic economic theory and thus underestimates social costs.

EPA's own data demonstrates this point. Producers list which of the current required toxicity and efficacy testing they have conducted. This information is available on the Subpart J schedule. Except for the bioremediation products, all other products list test data in both the reference saltwater and freshwater species. For bioremediation products, 27 products do not list any information; 21 report test data in both species. In other words, producers currently want to sell in both markets due to the demand for oil spill remediation in both waters. The rulemaking does not change this market demand.

3.4.1. Estimated Social Costs

Since producers currently market to oil spill response demands in both freshwater and saltwater environments, we assume existing and new product manufacturers will pay for the new efficacy and toxicity tests required for both environments. Using the RIA's testing costs, the total laboratory testing cost per product is listed in Table 3-3.

Table 3-3. Testing Costs by Product Type

Dispersants	$13,050
Bioremediation	$31,800
Solidifiers,	$10,300
Surface Washing	$10,300

We use these testing costs to estimate the application cost and the economic impact of the proposed rule. The labor and laboratory testing costs are combined and presented in Section 6.

3.4.2. Recommendation

Consumer demand will drive producers' decisions on marketing, not the testing requirements of the rule. EPA should align its economic analysis to observed producer decisions and thus expect increased testing costs rather than the estimates found in the RIA.

3.5. Retesting Whenever Chemical Composition Changes

In the proposal, producers would be required to retest its products and submit the results to EPA whenever they change the chemical compounds or their concentrations in an approved product. The proposal calls for comment on an option for allowing *de minimis* changes in concentrations or formulations, but proposes retesting for any change. The RIA assigns the same amount of cost to this requirement as it does for a new product application. For the reasons discussed in Section 3.3 above, the RIA underestimates social costs.

3.5.1. Estimated Social Costs

For a cost estimate, we assume that on average one product each year undergoes a change that triggers the requirement to retest. With more than 100 products and product lines on the Subpart J list, the RIA's assumption seems reasonable that approximately one product would undergo a change each year to trigger retesting.

Since we do not know which product type will undergo change, we take an average of the estimated testing costs for the four product types. Therefore, if one product triggers the retesting requirement per year, the net present value (at seven percent) of this proposed provision is $1.7 million/year.

3.5.2. Recommendation

EPA should articulate in any final rule the specific social benefits and social costs it believes will occur as a result of this provision. Specifically, EPA should explain the value of this requirement as opposed to a performance standard that makes manufacturers responsible to demonstrate that formulation changes do not affect toxicity or efficacy.

3.6. Product Label Redesign

In the proposed rule, applicants must submit a sample product label that includes the manufacture and expiration date, the storage conditions, and the mandatory disclaimer language. Producers must not only change the description on the label on the physical product, but also the description on any promotional material, websites, and other presentation forms. The RIA includes the social cost of submitting the sample label in its overall producer cost estimates.

EPA has estimated the social costs of mandatory labeling and labeling changes in multiple rulemakings.[62] The social costs include the one-time labor and capital costs to craft the new label design, any on-going incremental costs to produce the new label, and costs to digitize the information for electronic media.

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[62] See, for example, U.S. Environmental Protection Agency, *Final Technical Support Document, Fuel Economy Labeling of Motor Vehicles: Revisions to Improve Calculation of Fuel Economy Estimates*, EPA420-R-06-017, December 2006.

3.6.1. Estimated Social Costs

We include additional labor hours to account for the changes to a producer's website and marketing materials. Table 3-4 shows the labor costs for this requirement. We add $500 for each producer in capital and material costs to create the new label.

3.6.2. Recommendation

In any final rulemaking RIA, EPA should draw upon other EPA analyses to estimate the labor hours and capital cost requirements to redesign labels and marketing materials.

3.7. Accredited Laboratory Requirement

The proposed rule requires test data be generated from an accredited laboratory. In the baseline, companies could use any laboratory or generate the information in their own laboratories. While the RIA states that it gathered costs from laboratories to conduct the tests, it is unclear whether this cost information is from accredited labs.

3.7.1. Estimated Social Costs

If the RIA data is from accredited labs, then the costs of this requirement is included in the test costs used in the RIA. If it is not, then the RIA's costs for each test is likely underestimated.

3.7.2. Recommendation

In any final rule, the accompanying RIA should disclose the sources of its information so that policy officials and the public can evaluate the incremental social benefits and social costs of this provision as required by the Executive orders on regulatory review.

SECTION 4. THE RIA'S SOCIAL BENEFIT DESCRIPTION IS INACCURATE AND DOES NOT COMPLY WITH EPA'S REGULATORY ANALYSIS REQUIREMENTS

Fundamentally, the RIA fails to comply with the Executive orders on regulatory review because it does not quantify the potential social benefits either in dollars or in any other metric.[63]

Even more troubling, the RIA lists social benefits that are irrelevant to this rule and, if applicable at all, are actually social costs. The RIA lists qualitative benefits from avoiding oil spills such as lost tourism revenue and enjoyment. However, this rulemaking has the potential for aggravating the potential damages from oil spills. To the degree this rulemaking reduces chemical and biological agent availability and innovation, the nation will have less tools available to fight oil spill damage. A possible, but hopefully remote, outcome of this rule is that future oil spill damages would be more severe than they would be if the rule did not occur. Therefore, the potential social costs from oil spills should be considered, if at all, as a social cost of this rulemaking, not a benefit.

The RIA also does not quantify the marginal social benefits from each provision and each regulatory option. Under Circular A-4, agencies are required to estimate the marginal social costs and benefits for each regulatory provision.[64] Since this rulemaking proposes multiple changes to Subpart J, the public and policy officials cannot determine which provisions have net social benefits and which provision provides the most social benefits.

As discussed in Section 1, the other fundamental problem is that the RIA does not have a consistent baseline and post-regulatory alternative to allow a consistent measurement of social benefits. We present our recommended post-regulatory scenario in Section 5.

Recommendation. The RIA does not comply with the basic requirements of a social benefit estimate. First, it must define clearly what the social benefits are from this rulemaking and describe the real social goods that increase from the baseline to the post-regulation scenario. Second, an RIA for any final rulemaking must attempt to quantify the incremental amount of these social goods that can be attributed to this rulemaking and to the specific provisions of the rulemaking that will generate these social goods. Finally, EPA must use the established literature to value the gains, if any, in ecological services from the rulemaking.

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[63] OMB, Circular A-4, pg. 27.

[64] OMB, Circular A-4, pg. 7.

SECTION 5. TOTAL SOCIAL COSTS

5.1. POST-MARKET CONDITIONS

As discussed in Section 1, EPA's economic analysis guidelines emphasize the need for a clear and consistent market baseline and description of post-regulation market conditions. This guidance is especially relevant for this rulemaking because of the interaction of the requirements, the effect on regulated parties' behavior, and the ultimate social cost of the rulemaking.

This section describes a potential sequence of actions flowing from EPA's promulgation of the final rule. The social cost of these actions, and the time they occur, is the structure of our social cost estimates:

- In year 1, EPA promulgates the final rule.
- In year 1 and 2, existing products remain on the market. At the end of year 2, 13 existing products do not submit testing data due to high costs. The value of 13 comes from the results of the economic impact analysis in Section 6. Therefore, the number of existing submitted application is 13 less than the baseline. It is likely that these 13 products include the products banned due to the NP and NPE formulation ban.[65]
- Starting in year 1 and continuing, the rate of new product applications falls from 10 per year to 7 due to increased costs and market barriers
- In year 3, 13 new product applications are submitted to fill the baseline market demand.
- In years 1-3, 64 expired product applications come as suppliers adjust their inventory. We assume 24 in year 1 and 20 each in years 2 and 3.
- One new application appears each year for product reformulation.

[65] In other words, the social costs of the product loss from the banned products are estimated. However, we assume that for the one or two potential products subject to the ban, only one new product is added in the future.

Table 5-1. Pace of Product Applications

	Year						
	1	2	3	4	5	6	7
Baseline							
Existing Products	109						
Annual New Products	10	10	10	10	10	10	10
New Estimate							
Existing Products	59	27					
Expired Products	24	20	20				
Annual New Products/New Formulations	7	8	8	21	8	8	8
Total	**90**	**55**	**28**	**21**	**8**	**8**	**8**

5.2. ADDITIONAL SOCIAL COSTS

5.2.1. Additional Social Costs from this Analysis

Based on the information in Table 5-1, we can integrate the social cost estimates for the different provisions of the rule. Table 5-2 gives the net present value and annualized social costs for the provisions with estimates in this analysis. As in Table 5-1, the social cost for testing includes the costs for expired products, for new products, for retesting of existing products, and for impact of existing products dropping out of the market.

Table 5-2. Additional Social Costs of the Proposal

	NPV at 7% ($)	Annualized Cost over 20 years at 7% ($)
Product Loss Costs	4,000,000-7,300,000	380,000-720,000
Product Testing Costs	5,300,000[66]	500,000
Stranded Capital/Stockpile Value Loss	1,000,000-1,250,000	90,000-120,000
Label	180,000	20,000

[66] This number is the net present value of the weighted annual testing cost multiplied by the number of products per year that is given in Table 5-1. The weighted annual testing cost is that year's mix of dispersant, solidifiers, surface washing, and bioremediation products that submit testing information. For existing products, the each yearly mix of different product types is proportional to the number of each type on Subpart J and the number of each type subtracted/added to the additional testing cost. As discussed in Table 2-2, different product types also have a different frequency of expired product testing. This proportion thus changes the number of each product type tested per year and thus the weighted annual testing cost.

Recovery Costs	1,700,000	160,000
Monitoring Costs	11,000,000	1,000,000
Preauthorization Costs	200,000	20,000
EPA Costs	800,000	80,000

Totals[67]	24,000,000-27,000,000	2,300,000 --2,600,000

5.2.2. Other Costs from the RIA

The RIA included social costs estimates for other proposed requirements that are not re-estimated in this analysis. The RIA estimates the costs for some sorbent manufacturers to submit technical data to be considered on a Sorbent Product List. The RIA estimates the annualized cost to be approximately $15,000. Adding this provision to the costs in Table 5-2 does not materially change the social cost estimate.

[67] Throughout this report, totals and summaries may be different due to rounding. Reflecting the likely precision of these estimates, figures are presented to two significant digits or less.

SECTION 6. THE RIA UNDERESTIMATES THE SMALL BUSINESS IMPACT

The RIA's methodology underestimates the rule's economic impact on small businesses. The proposed rulemaking may have a substantial effect on a significant number of small businesses in the oil spill response product market. EPA should evaluate whether it must comply the procedural and other analytic requirements of the Small Business Regulatory Enforcement Fairness Act (SBREFA).

EPA's methodology underestimates the economic impact in two principal ways. First, as discussed above, it underestimates the direct labor and capital costs to comply with the rule. Second, it underestimates the cost of capital in at least two ways: (1) by assuming owners can finance testing requirements over a longer time period than is likely; and, (2) by underestimating the cost of capital for small businesses. Each of these issues is discussed below.

First, firms producing existing listed products only have two years to reapply and to resubmit the newly-required information. Yet, the RIA annualizes a firm's costs over a 20 year period. It is highly unlikely that a small business could borrow funds over a 20 year period for a product that may only have a limited market for two years. Nor would rational business owners with high opportunity costs for capital tie up their capital for such a long time period. A more realistic financing period is two years.

Second, as EPA's economic guidelines state for economic impact analyses, EPA should use the private cost of capital for small businesses.[68] EPA uses the social cost of capital established by OMB. However, due to the increased loss risk, capital lending institutions or capital investors charge higher effective interest rates for loans to small businesses. The Federal Reserve conducts routine survey of small business lending conditions.[69] In recent months, they have found completed, Small Business Administration-backed small business loans at an interest rate of between 5.1 and 5.6 percent. However, the average effective borrowing rate across all small businesses is much higher. As firms report, if they do not qualify for commercial credit, they use instruments with higher interest rates such as credit cards, trade credit, or debt consolidation. The average effective borrowing rate across all small businesses and all credit needs is substantially greater than seven percent.

We present an alternative estimate of economic impact to small business as an illustration of how large the impacts are likely to be. Table 6-1 shows the testing and the labor costs for existing producers to comply with the proposed rule using different discount rates and annualization periods.

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[68] EPA, *Guidelines*, pg. 9-16.

[69] Federal Reserve Banks of New York, Atlanta, Cleveland and Philadelphia, *Joint Small Business Credit Survey Report, 2014*, February 2015.

Table 6-1. Annualized Compliance Costs for New Testing Requirements, RIA Estimate and Revised Estimate

	Testing Costs	Estimated Labor Costs	RIA's Total Costs	Estimated Total Costs	Annualized at 7% over 20 Years	Annualized at 7% over 5 Years	Annualized at 7% over 2 Years
Dispersants	$13,050	$10,398	$14,240	$23,448	$1,344	$3,473	$12,969
Bioremediation	$31,800	$7,728	$14,042	$39,528	$1,325	$3,425	$21,863
Solidifiers,	$10,300	$6,412	$5,986	$16,712	$565	$1,460	$9,243
Surface Washing	$10,300	$5,077	$5,880	$15,377	$555	$1,434	$8,505

Table 6-2 replicates Exhibit 7-1 of the RIA to present the testing and application costs as a percentage of the firm's annual sales. For economic impact analyses, if a regulation's cost to a firm is three percent of its revenue or more, the general conclusion is that the firm is at risk of closure.[70] The RIA reviewed 30 of the 35 small businesses and found that none exceeded the three percent significant impact threshold. However, using a more realistic financing period and more realistic estimates of costs, 43 percent (13/30) of the firms would face compliance costs greater than three percent of their annual 2011 sales. We recognize that Table 3 uses 2014 values for labor costs and 2011 data for revenue. In any final rule, EPA should update the revenue estimates and recalculate the economic impact using costs and financing options that reflect market conditions.

[70] U.S. Small Business Administration, *Guide for Government Agencies How to Comply with the Regulatory Flexibility Act*, May 2012. See U.S. EPA, *Final Guidance for EPA Rulewriters: Regulatory Flexibility Act as amended by the Small Business Regulatory Enforcement Fairness Act*, November 2006.

Table 6-2. Economic Impact on Small Businesses

Company	Number of Employees	Annual Revenue	Product Type	Annualized Cost	Pct of Revenue
1	1	$ 62,000	Solidifiers	$9,243	14.9%
2	1	$ 1,000,000	Surface Washing Agent	$8,505	0.9%
3	1	$ 160,000	Surface Washing Agent	$8,505	5.3%
4	2	$ 2,500,000	Bioremediation Agent	$21,863	0.9%
5	2	$ 120,000	Solidifiers	$9,243	7.7%
6	2	$ 200,000	Solidifiers	$9,243	4.6%
7	2	$ 30,000	Solidifiers	$9,243	30.8%
8	2	$ 10,000,000	Solidifiers	$9,243	0.1%
9	2	$ 120,000	Surface Washing Agent	$8,505	7.1%
10	3	$ 280,000	Surface Washing Agent	$8,505	3.0%
11	3	$ 1,300,000	Surface Washing Agent	$8,505	0.7%
12	3	$ 150,000	Surface Washing Agent	$8,505	5.7%
13	3	$ 5,000,000	Surface Washing Agent	$8,505	0.2%
14	4	$ 559,000	Bioremediation Agent	$21,863	3.9%
15	4	$ 1,000,000	Dispersant(2) & Surface Washing Agent	$34,442.26	3.4%
16	4	$ 730,000	Solidifiers	$9,243	1.3%
17	4	$ 500,000	Surface Washing Agent	$8,505	1.7%
18	4	$ 187,000	Surface Washing Agent	$8,505	4.5%
19	4	$ 350,000	Surface Washing Agent	$8,505	2.4%
20	5	$ 5,000,000	Bioremediation Agent	$21,863	0.4%
21	5	$ 290,000	Bioremediation Agent	$21,863	7.5%
22	6	$ 120,000	Bioremediation Agent	$21,863	18.2%
23	6	$ 15,000,000	Dispersant(1) & Surface Washing Agent	$21,473	0.1%
24	6	$ 500,000	Surface Washing Agent	$8,505	1.7%
25	6	$ 5,000,000	Surface Washing Agent	$8,505	0.2%
26	7	$ 660,000	Surface Washing Agent	$8,505	1.3%
27	8	$ 3,054,214	Bioremediation Agent	$21,863	0.7%
28	8	$ 2,500,000	Surface Washing Agent	$8,505	0.3%
29	8	$ 1,500,000	Surface Washing Agent	$8,505	0.6%
30	9	$ 2,500,000	Surface Washing Agent	$8,505	0.3%

ATTACHMENT: SHELF LIFE OF LISTED AGENTS[71]

Product	Type	Shelf Life	Assumed Shelf Life (years)
AGROREMED (see SPILLREMED (MARINE)®)	Bioremediation Agent	one year	1
BILGEREMED (see SPILLREMED (MARINE)®)	Bioremediation Agent	one year	1
HYDROREMED (see SPILLREMED (MARINE)®)	Bioremediation Agent	one year	1
INIPOL EAP 22	Bioremediation Agent	one year	1
MUNOX SR®	Bioremediation Agent	over one year when stored at temperatures from 35°F to 95°F	1
OILCLEAN w/ACTIVATOR (see PRO-ACT)	Bioremediation Agent	one year	1
PRISTINE SEA II	Bioremediation Agent	As a dry bacterial blend, the shelf life is 1 year, and as a liquid bacterial mixture, the shelf life is 6 months	1
PRO-ACT	Bioremediation Agent	One year	1
SPILLREMED (INDUSTRIAL)	Bioremediation Agent	one year	1
VAPORREMED (see SPILLREMED (MARINE)®)	Bioremediation Agent	one year	1
BILGE CLEAR (see S-200)	Bioremediation Agent	1½ years if kept in the unopened original container	1.5
NANOBITE (see S-200)	Bioremediation Agent	1½ years	1.5
OIL GONE EASY (see S-200)	Bioremediation Agent	1½ years if kept in the unopened original container	1.5
S-200	Bioremediation Agent	1½ years	1.5
S-200C (see S-200)	Bioremediation Agent	1½ years	1.5

[71] Information compiled from individual products listed on schedule as of March, 2015. http://www2.epa.gov/emergency-response/alphabetical-list-ncp-product-schedule-products-available-use-during-oil-spill.

S-200 OIL CLEAN (see S-200)	Bioremediation Agent	1½ years	1.5
S-200 OIL GONE (see S-200)	Bioremediation Agent	1½ years	1.5
SHEENCLEAN (see S-200)	Bioremediation Agent	1½ years	1.5
Z-11 (see S-200)	Bioremediation Agent	1½ years	1.5
BIO-REGEN HYDROCARBON (see SOIL RX)	Bioremediation Agent	Shelf life exceeds 2 years when properly stored in the unopened original container	2
BIOREM-2000 OIL DIGESTER™	Bioremediation Agent	Two years when stored within the storage temperature range in the original container	2
BIOREM-2000 SC (see BIOREM-2000 OIL DIGESTER™)	Bioremediation Agent	Two years when stored within the storage temperature range in the original container	2
JE1058BS	Bioremediation Agent	2 years if stored in a cool dry area	2
REMEDIADE™	Bioremediation Agent	unopened is 2 years	2
SOIL RX	Bioremediation Agent	two years	2
SP 7010 (see REMEDIADE™)	Bioremediation Agent	two years	2
SUMP SAFE BIO-RECLAIM	Bioremediation Agent	The material must be used within 24-48 hours of constitution of the powdered bacteria portion in water. The dry material must be kept at -20°C and is stable for two years at this temperature. Once sent to the field, the material may be stored on ice for up to two weeks prior to constitution	2
SYSTEM E.T. 20 (formerly MCW.B 20)	Bioremediation Agent	2 years if maintained at 4ºC (39ºF)	2
WASTE AWAY®	Bioremediation Agent	Two years	2
WMI-2000	Bioremediation Agent	2 years if stored at ambient temperatures	2
B&S INDUSTRIAL (see STEP ONE)	Bioremediation Agent	Over 3 years	3
BET BIOPETRO (formerly BET BIOPETRO HEAVY)	Bioremediation Agent	More than 3 years in unopened original shipping container, stored in cool dry area	3
BIOWORLD BIOREMEDIATION HYDROCARBON TREATMENT PRODUCTS	Bioremediation Agent	exceeds 3 years when stored properly in cool, dry place out of direct sun light	3
SHAMANTRA BIO (see SHAMANTRA GREEN)	Bioremediation Agent	3 years when stored in sealed silos, polydrums, poly bags or totes	3
SHAMANTRA GREEN	Bioremediation Agent	3 years when stored in sealed silos, polydrums, poly bags or totes	3
STEP ONE	Bioremediation Agent	Over 3 years	3

VB591™, VB997™, BINUTRIX®	Bioremediation Agent	three years	3
ACT TERRA FIRMA	Bioremediation Agent	If kept in a sealed container with desiccant bag the shelf life is 5 years	5
ACT-TF (see ACT TERRA FIRMA)	Bioremediation Agent	If kept in a sealed container with desiccant bag the shelf life is 5 years	5
DRYLET™ MB BIOREMEDIATION	Bioremediation Agent	Minimum 5 years, with proper storage, in original packaging. Freezingdoes not harm shelf life; however, extreme heat (over 180°F) for long periods of time can shorten shelf life	5
DUALZORB®	Bioremediation Agent	unopened product is 5 years if not exposed toweather or direct sunlight	5
ERGOFIT MICRO MIX AQUA	Bioremediation Agent	5 years	5
LAND AND SEA RESTORATION	Bioremediation Agent	More than 5 years in unopened original shipping container, store in a cool, dry place	5
MICROSORB SC (see OPPENHEIMER FORMULA)	Bioremediation Agent	5 years	5
OIL SPILL EATER II	Bioremediation Agent	5 years	5
OPPENHEIMER FORMULA	Bioremediation Agent	5 years	5
The OPPENHEIMER FORMULA I (see OPPENHEIMER FORMULA)	Bioremediation Agent	5 year	5
TRAILZORB (see DUALZORB®)	Bioremediation Agent	5 years if not exposed to weather or direct sunlight	5
WHITZORB (see DUALZORB®)	Bioremediation Agent	unopened product is 5 years if not exposed to weather ordirect sunlight	5
MICRO-BLAZE®	Bioremediation Agent	Minimum 10 years	10
SUPERSPERSE™ WAO2500	Dispersant	one year	1
MARINE D-BLUE CLEAN™	Dispersant	2 years, if unopened	2
NOKOMIS 3-AA	Dispersant	two years	2
FFT-SOLUTION™	Dispersant	5 years	5
NEOS AB3000	Dispersant	five years	5
MARE CLEAN 200 (formerly MARE CLEAN 505)	Dispersant	10 years when stored indoors	10
NOKOMIS 3-F4	Dispersant	15 years or more if stored correctly in plastic drums	15
ACCELL CLEAN® DWD	Dispersant	unopened drums of ACCELL CLEAN® DWD is unlimited	20

BIODISPERS (formerly PETROBIODISPERS)	Dispersant	unlimited	20
COREXIT® EC9500A (formerly COREXIT 9500)	Dispersant	The shelf life of unopened drums of COREXIT® EC9500A is unlimited	20
COREXIT® EC9500B	Dispersant	The shelf life of unopened drums of COREXIT® EC9500B is potentially unlimited when containers remain capped and sealed to prevent contamination and evaporation of solvents	20
COREXIT® EC9527A (formerly COREXIT 9527)	Dispersant	The shelf life of unopened drums of COREXIT® EC9580A is unlimited	20
DISPERSIT SPC 1000™	Dispersant	The shelf life of Dispersit SPC 1000™ is unlimited in unopened containers	20
FINASOL® OSR 52	Dispersant	unlimited when the containers remain capped and sealed	20
JD-109	Dispersant	unlimited	20
JD-2000™	Dispersant	unlimited	20
SAF-RON GOLD	Dispersant	unlimited in unopened containers	20
SEA BRAT #4	Dispersant	Indefinite when stored properly	20
SEACARE ECOSPERSE 52 (see FINASOL® OSR 52)	Dispersant	potentially unlimited when the containers remain capped and sealed to prevent contamination and evaporation of solvents, and are stored in a place with stable temperatures and are unexposed to direct sunlight	20
SEACARE E.P.A. (see DISPERSIT SPC 1000™)	Dispersant	unlimited in unopened containers	20
SF-GOLD DISPERSANT (see SAF-RON GOLD)	Dispersant	unlimited	20
ZI-400	Dispersant	Unlimited in sealed polydrums of totes	20
ZI-400 OIL SPILL DISPERSANT (see ZI-400)	Dispersant	Unlimited in sealed polydrums of totes	20
MARI-ZYME (see ZYME-FLOW)	Miscellaneous Oil Spill Control Agent – MOSCA	1 year minimum	1
UNITED 658 PETRO-ZYME (see ZYME-FLOW)	Miscellaneous Oil Spill Control Agent – MOSCA	1 year minimum	1
ZYME-FLOW	Miscellaneous Oil Spill Control Agent – MOSCA	1 year minimum	1
ZYME-TREAT (see ZYME-FLOW)	Miscellaneous Oil Spill Control Agent – MOSCA	1 year minimum	1
PX 700™	Miscellaneous Oil Spill Control Agent – MOSCA	Two years	2

NORSOREX® APX	Miscellaneous Oil Spill Control Agent – MOSCA	3 years from date of production	3
ALSOCUP	Miscellaneous Oil Spill Control Agent – MOSCA	five years	5
CIAGENT (formerly CI AGENT, CHEAP INSURANCE, and PETRO-CAPTURE)	Miscellaneous Oil Spill Control Agent – MOSCA	5 years, if stored in cool dry area, away from direct sunlight	5
ELASTOL	Miscellaneous Oil Spill Control Agent – MOSCA	5 years when stored at temperatures below 150ºF	5
LIQUID ELASTOL (see ELASTOL)	Miscellaneous Oil Spill Control Agent – MOSCA	5 years when stored at temperatures below 150ºF	5
OIL BOND®	Miscellaneous Oil Spill Control Agent – MOSCA	5 years	5
OPFLEX®	Miscellaneous Oil Spill Control Agent – MOSCA	5 years	5
SEPARATE (see ELASTOL)	Miscellaneous Oil Spill Control Agent – MOSCA	5 years	5
PES-51	Miscellaneous Oil Spill Control Agent – MOSCA	6 years (unopened drum), 1 year (opened drum)	6
GELCO 200	Miscellaneous Oil Spill Control Agent – MOSCA	10 years when stored in dry, cool area out of sunlight	10
AQUA N-CAP™ POLYMER (see OIL SOLUTIONS POWDER)	Miscellaneous Oil Spill Control Agent – MOSCA	Not Limited	20
OIL SOLUTIONS POWDER	Miscellaneous Oil Spill Control Agent – MOSCA	Not limited	20
RAPIDGRAB 2000™	Miscellaneous Oil Spill Control Agent – MOSCA	unlimited	20
WASTE-SET #3200®	Miscellaneous Oil Spill Control Agent – MOSCA	unlimited	20
WASTE-SET #3400®	Miscellaneous Oil Spill Control Agent – MOSCA	unlimited	20
SILTECH OP-40	Surface Collecting Agent	three years	3
THICKSLICK 6535	Surface Collecting Agent	three years	3
CLEAN SPLIT (see SPLIT DECISION SC)	Surface Washing Agent	one year	1

DUO-SPLIT (see SPLIT DECISION SC)	Surface Washing Agent	one year	1
GREEN TECHNOLOGIES SOLUTIONS-OIL RECOVERY (GTS-OR)	Surface Washing Agent	One year minimum when stored between 50°F and 100°F	1
SPLIT DECISION SC (formerly SPLIT DECISION)	Surface Washing Agent	one year	1
TXCHEM HE-1000™	Surface Washing Agent	One year in a sealed container	1
AQUACLEAN	Surface Washing Agent	18 months if stored between 50ºF and 104ºF, and away from acids	1.5
BIOGRASS® EXTRA	Surface Washing Agent	Two years minimum	2
CN-110	Surface Washing Agent	2 years	2
CORIBA 700 ER (see CORIBA 700 SR)	Surface Washing Agent	Two years unopened minimum	2
CORIBA 700 OS (see CORIBA 700 SR)	Surface Washing Agent	Two years unopened minimum	2
CORIBA 700 SR	Surface Washing Agent	Two years unopened minimum	2
CORIBA 713 ER (see CORIBA 713 SR)	Surface Washing Agent	Two years unopened minimum	2
CORIBA 713 OS (see CORIBA 713 SR)	Surface Washing Agent	Two years unopened minimum	2
CORIBA 713 SR	Surface Washing Agent	Two years unopened minimum	2
DE-SOLV-IT CLEAN AWAY APC SUPER CONCENTRATE	Surface Washing Agent	Two years in sealed drums or totes	2
DE-SOLV-IT INDUSTRIAL FORMULA	Surface Washing Agent	Two years in sealed polydrums or totes	2
DO-ALL #18	Surface Washing Agent	at least two years	2
ECOVOOM-MARINE (see JEP-MARINE CLEAN)	Surface Washing Agent	minimum 2 years	2
ETHOS CLEAN	Surface Washing Agent	2 years in a sealed (unopened) container (tote, drum, pail) as delivered. 1 year in an opened container).	2
JEP-MARINE CLEAN	Surface Washing Agent	minimum 2 years	2
MARINE GREEN CLEAN™	Surface Washing Agent	2 years	2
MARINE GREEN CLEAN PLUS™	Surface Washing Agent	2 years	2

NONTOX™	Surface Washing Agent	minimum of two years	2
OSR-10	Surface Washing Agent	2 years in a sealed (unopened) container (tote, drum, pail)	2
PROCLEANS	Surface Washing Agent	2 years at recommended temperatures if unopened	2
SOC 10	Surface Washing Agent	two years	2
SUPERALL #38 (see TOPSALL #30)	Surface Washing Agent	two years	2
TOPSALL #30	Surface Washing Agent	two years	2
TULXA	Surface Washing Agent	Two years if stored in dry, fresh environment	2
EO ALL PURPOSE SOAP-LAVENDER	Surface Washing Agent	Three years	3
FIREMAN'S BRAND SPILLCLEAN (see SPILLCLEAN)	Surface Washing Agent	3 years. Avoid extreme heat and store in a dry, cool area	3
SPILLCLEAN or SPILLCLEAN ["Concentrate"]	Surface Washing Agent	three years	3
CLEAN GREEN	Surface Washing Agent	5 years in sealed polydrums or totes	5
CLEANGREEN® PLANET WASH (see CLEAN GREEN)	Surface Washing Agent	5 years in sealed polydrums or totes	5
MICRO CLEAN (see NATURE'S WAY HS)	Surface Washing Agent	five years	5
NATURE'S WAY HS	Surface Washing Agent	five years	5
NATURE'S WAY PC (see NATURE'S WAY HS)	Surface Washing Agent	five years	5
POWERCLEAN (see NATURE'S WAY HS)	Surface Washing Agent	five years	5
PREMIER 99	Surface Washing Agent	5 years	5
SAFE KLEEN	Surface Washing Agent	Five years if stored in tightly closed containers under dry conditions within temperature range	5
SC-1000™	Surface Washing Agent	Minimum of 5 years	5
SIMPLE GREEN®2013 Reformulation	Surface Washing Agent	five years	5
G-CLEAN OSC-1809	Surface Washing Agent	Five to ten years in sealed polydrums or totes	7.5
OIL SPILL CLEANUP (see G-CLEAN OSC-1809)	Surface Washing Agent	Five to ten years in sealed polydrums or totes	7.5
DYNAMIC GREEN™	Surface Washing Agent	6-10 years in sealed poly drums or totes	8

BIOSOLVE® HYDROCARBON MITIGATION™ AGENT	Surface Washing Agent	10+ year shelf life if unopened	10
CYTOSOL	Surface Washing Agent	Closed container: 10 years in a dry environment. Open container: 1 year in a warm, humid environment. The product does not deteriorate appreciably over time, but wil grow bacteria if water condensation accumulates in the container.	10
F-500	Surface Washing Agent	15 years when stored between 35ºF - 130ºF in unopened containers	15
NOKOMIS 5-W	Surface Washing Agent	15 years or more if stored correctly in plastic drums	15
ACCELL CLEAN® SWA	Surface Washing Agent	unopened drums of ACCELL CLEAN® SWA is unlimited	20
ALL PURPOSE CLEANER & REMEDIATOR (see GREEN BEAST™ OIL SPILL & ODOR REMEDIATOR)	Surface Washing Agent	Unlimited in sealed polydrums or totes	20
AWAN PRA OIL FIELD SOLUTION™ (see EPA OIL FIELD SOLUTION™)	Surface Washing Agent	Unlimited in sealed polydrums or totes (as delivered). Avoid direct sunlight.	20
BG-CLEAN™ 401	Surface Washing Agent	unlimited	20
COREXIT® EC9580A (formerly COREXIT 9580 SHORELINE CLEANER)	Surface Washing Agent	unlimited	20
ENVIROCLEAN (formerly ENVIRO CLEAN 165)	Surface Washing Agent	Unlimited if unopened	20
ENVIRONMENTAL 1 CRUDE OIL CLEANER	Surface Washing Agent	Unlimited in sealed polydrums or totes	20
ENVIRONMENTAL 1 WASHING AGENT (see ENVIRONMENTAL 1 CRUDE OIL CLEANER)	Surface Washing Agent	Unlimited in sealed polydrums or totes	20
EPA OIL FIELD SOLUTION™	Surface Washing Agent	Unlimited in sealed polydrums or totes (as delivered). Avoid direct sunlight.	20
E-SAFE©	Surface Washing Agent	Unlimited if left in unopened containers stored at 40º - 110ºF and away from direct sunlight	20
GLOBAL ENVIRONMENTAL CLEANER™ (see EPA OIL FIELD SOLUTION™)	Surface Washing Agent	Unlimited in sealed polydrums or totes	20
GOLD CREW SW	Surface Washing Agent	20 years (unopened)	20

GREEN BEAST OIL SPILL & ODOR REMEDIATOR	Surface Washing Agent	Unlimited in sealed polydrums or totes	20
GREEN BEAST WASHING AGENT (see GREEN BEAST OIL SPILL & ODOR REMEDIATOR	Surface Washing Agent	Unlimited in sealed polydrums or totes	20
HYDRO-CLEAN™ (see EPA OIL FIELD SOLUTION™)	Surface Washing Agent	Unlimited in sealed polydrums or totes	20
NALE-IT	Surface Washing Agent	Indefinite	20
NATURAMA G3 A-5	Surface Washing Agent	unlimited	20
PETRO-CLEAN	Surface Washing Agent	Indefinite when stored properly	20
PETRO-GREEN ADP-7	Surface Washing Agent	indefinite	20
PETROMAX PSC 3	Surface Washing Agent	Unlimited when stored in unopened, sealed 5 gallon containers, 55 gallon drums, polydrums, and totes	20
PETROMAX SOIL CLEANING AND WASHING AGENT (see PETROMAX PSC 3)	Surface Washing Agent	Unlimited when stored in unopened, sealed 5 gallon containers, 55 gallon drums, polydrums, and totes	20
PETROTECH 25	Surface Washing Agent	unlimited shelf-life when maintained in the factory sealed containers and stored within the prescribed temperature limits	20
SANDKLENE 950	Surface Washing Agent	Unlimited in sealed drums or totes	20
SHEEN-MAGIC©	Surface Washing Agent	Unlimited if left in unopened containers stored at 40º - 110ºF and away from direct sunlight	20
SIMPLE GREEN®	Surface Washing Agent	unlimited	20
VERU-SOLVE™ MARINE 200 HP	Surface Washing Agent	Indefinite, product will not degrade over time	20

To: Principe, Vanessa[Principe.Vanessa@epa.gov]; Wilson, Gregory[Wilson.Gregory@epa.gov]
From: Conmy, Robyn
Sent: Thur 10/8/2015 5:56:51 PM
Subject: ICCOPR report to congress
Draft FY14-15 Report to Congress - 2015-09-24_conmy edits.docx

Attached are my edits and contributions to the report. I did not include a section on the oil screening project, but can if you would like to include it. Just let me know what changes or additions OEM would like to include. I will submit to Bill early next week.

Cheers,

Robyn

<>/<>/<>/<>/<>/<>/<>/<>/<>/<>/<>/<>/<>/<>/<>/<>

Robyn N. Conmy, Ph.D.

Research Ecologist

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To: Matthiessen, Craig[Matthiessen.Craig@epa.gov]; Wilson, Gregory[Wilson.Gregory@epa.gov]; Principe, Vanessa[Principe.Vanessa@epa.gov]
Cc: Raymond Bradley[bradleyr@api.org]
From: Emily Hague
Sent: Fri 5/29/2015 3:45:14 PM
Subject: API and NOIA Comments on EPA Subpart J Proposed Rule - Correction
removed.txt
API and NOIA Comments on EPA Subpart J Proposed Rule with Corrected PNG Attachment - Amended 05.29.15.pdf

Hello Craig, Greg and Vanessa –

API and NOIA submitted its comment letter on the EPA Subpart J Proposed Rule along with an independent economic assessment on April 22nd. It was subsequently discovered that, due to an error, the assessment undervalued existing stockpiles of dispersants in the U.S. inventory. We have corrected the error in the assessment and would like to resubmit our comment letter with the corrected version of the assessment. No changes have been made to the comment letter itself.

Please consider the attached submission as our comments on the Proposed Rule.

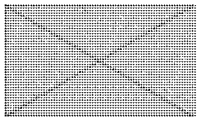
Thank you,

Emily

Emily Kennedy Hague

202-682-8260

hague@api.org



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From: Emily Hague
Sent: Wednesday, April 22, 2015 6:08 PM
To: 'Matthiessen, Craig'; Wilson, Gregory (Wilson.Gregory@epa.gov); Principe, Vanessa (Principe.Vanessa@epa.gov)
Cc: Raymond Bradley
Subject: API and NOIA Comments on EPA Subpart J Proposed Rule

Hello Craig, Greg and Vanessa –

API and NOIA submitted the attached comments on the EPA Subpart J Proposed Rule this afternoon through Regulations.gov. Attached is our letter for your reference. We also plan to provide this letter by mail to Mathy Stanislaus.

Thank you for this opportunity to comment,

Emily

Emily Kennedy Hague

Senior Policy Advisor, Upstream & Industry Operations

American Petroleum Institute

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Washington, DC 20005

Ph: 202-682-8260

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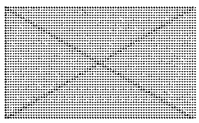
hague@api.org



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May 29, 2015

U.S. Environmental Protection Agency
EPA Docket Center (EPA/DC)
Docket ID No. EPA–HQ–OPA–2006–0090
1200 Pennsylvania Avenue NW 20460

Submitted via electronic submission to http://www.regulations.gov **and by mail**

Dear Dr. Gregory Wilson,

On April 22, 2015, the American Petroleum Institute and the National Ocean Industries Association (collectively, "we") submitted a letter providing our comments on the U.S. Environmental Protection Agency's Proposed Rule to amend Subpart J of the National Oil and Hazardous Substances Contingency Plan. 80 Fed. Reg. 3380 (Jan. 22, 2015).

As an attachment to our April 22 letter, we provided an independent economic assessment of the Proposed Rule. It was subsequently discovered that, due to an error, the assessment undervalued existing stockpiles of dispersants in the U.S. inventory. Accordingly, we are now re-submitting our comment letter, attached to which is a corrected version of the assessment. There are no changes to the letter itself.

Please consider the attached submission as our comments on the Proposed Rule. We again thank you for your time and attention to our comments. Please do not hesitate to contact Emily Hague (202-682-8260, Hague@api.org) or Nicolette Nye (202-465-8463, nnye@noia.org) if you have any questions.

Sincerely,

Erik Milito
Group Director, Upstream and
Industry Operations
American Petroleum Institute

Nicolette Nye
VP Communications & Industry Affairs
National Ocean Industries Association

ED_001324_00007236-00001

April 22, 2015

U.S. Environmental Protection Agency
EPA Docket Center (EPA/DC)
Docket ID No. EPA–HQ–OPA–2006–0090
1200 Pennsylvania Avenue NW 20460

Submitted via electronic submission to http://www.regulations.gov **and by mail**

Dear Dr. Gregory Wilson,

On January 22, 2015, the U.S. Environmental Protection Agency (EPA or the Agency) issued a Proposed Rule to amend Subpart J of the National Oil and Hazardous Substances Contingency Plan that governs the use of dispersants, other chemical and biological agents, and other spill mitigating substances when responding to oil discharges into the waters of the United States. 80 Fed. Reg. 3380 (January 22, 2015). Comments are due by April 22, 2015. The following comments to the docket are provided by the American Petroleum Institute (API) and the National Ocean Industries Association (NOIA) (collectively, "we") on behalf of our member companies based on review of the above-cited Proposed Rule.

API is a national trade association that represents over 625 members involved in all aspects of the oil and natural gas industry, including the exploration and production of both onshore and offshore Federal resources. The U.S. oil and natural gas industry supports 9.8 million U.S. jobs and 8 percent of the U.S. economy, delivering tens of millions per day in revenue to our government. API members provide most of the nation's energy and are backed by a growing grassroots movement of more than 25 million Americans.

NOIA, founded in 1972, represents more than 270 companies among all segments of the offshore industry with an interest in the exploration and production of both traditional and renewable energy resources on the nation's outer continental shelf (OCS). NOIA's mission is to secure reliable access and a fair regulatory and economic environment for the companies that develop the nation's valuable offshore energy resources in an environmentally responsible manner.

API, NOIA, and our respective members recognize the important mission of the EPA in protecting human health and the environment and share in this mission. More than most industries, the oil and natural gas industry understands the nature of risk and places at the center of its concern comprehensive planning for and effective management of risks in order to safeguard human well-being and protect environmental resources. To this end, woven into every operational endeavor are release prevention measures, preparedness methods and plans for rapid, effective response should an incident resulting in a release occur. Developed alongside regulatory agencies, operators submit to and follow a distinct set of response principles which protect shared values. The framework by which these principles are employed and tradeoffs are made in order to protect these shared values is called Net Environmental Benefit Analysis (NEBA). NEBA is a process used by the response community for making the best choices to minimize impacts of oil releases on people and the environment. NEBA aids in protecting people and the environment, and is the matrix through which every decision is made in a response event. In the offshore context, oil dispersing agents are a primary tool in the NEBA process and the response toolkit, as they

are a principal tool used for protecting human health and defending environmentally sensitive areas. When a release occurs, judgment and response speed are critical. In an offshore setting, dispersants are essential in creating a safe environment and are a key ingredient in marshaling an effective, swift response.

API, NOIA, and our respective members understand that through this Proposed Rule, EPA's goal is to develop a regulation which protects people and preserves natural resources. We too wish to accomplish the same goal, based upon sound scientific research and grounded in real-world, outside-the-laboratory scenarios and taking into account incident-specific risk. While the original intent of the dispersant rule was simply to provide for a schedule of dispersants and other chemicals that may be used in carrying out the National Contingency Plan (NCP), the Proposed Rule would essentially expand its purpose to an operational rulemaking which would significantly alter operational procedures.

In summary, the Proposed Rule, if implemented, would be substantially problematic for all stakeholders, including the response community, which is required to carry out an effective spill response. The Proposed Rule would also be problematic for the Federal and state ag ency community interests, as well as the public with regard to increasing environmental and community impacts. Although the Agency indicates that it seeks to "*encourage the development of safer and more effective spill mitigating products, and would bette r target the use of these products to reduce the risks to human health and the environment*" and "*ensure that On-Scene Coordinators (OSCs), Regional Response Teams (RRTs), and Area Committees have sufficient information to support agent preauthorization or authorization of use decisions*," API, NOIA, and our respective members submit that the Proposed Rule falls short of these objectives and in many cases would have the opposite effect . For example, and at the center of our concern, is the proposed dispersed oil toxicity test and its threshold which could result in the elimination of many dispersants and potential future dispersant s. E ven if the dispersants themselves were completely non-toxic, the proposed dispersed oil toxicity test and associated pass/fail threshold could prevent all dispersants from being listed and available for use in a spill response . The Proposed Rule covers activities broader than mere scheduling criteria for dispersants. The added complexity resulting from the Proposed Rule in auth orization, monitoring and product listing, in addition to unfounded and overly corrective assumptions about dispersant effects described in the Proposed Rule, will not assist the Unified Command during an oil spill . Instead, it will likely complicate and limit its ability to respond in the most effective manner to ensure the health and safety of people and minimize environmental and community impacts. Also, prohibiting the application of dispersants during an oil spill response or delaying their use will significantly increase the economic and environmental damage of oil spills.

API and NOIA encourage the Agency to review the comments contained herein , incorporate the corresponding recommendations in a supplemental proposed rule, and provide the public and other Federal government and state stakeholder agencies with an opportunity to provide another round of comments be fore implementing a final rule. We also recommend that EPA initiat e a Negotiated Rulemaking under the Negotiated Rulemaking Act of 1990 to establish a negotiating committee under the Federal Advisory Committee Act to develop draft regulatory text on a consensus basis for adoption and implementation as a proposed supplemental proposed rule by EPA. A balanced negotiating committee made up of response experts – from the Federal Agencies who oversee oil spill response and from industry and relevant third-party experts – would add value to further Proposed Rule revisions and ensure that Subpart J is aligned with the latest scientific consensus on, and avoid an artificial bias against, the use of dispersants. As an example, Negotiated Rulemaking was successfully used to implement vessel and facility response planning requirements under the Oil Pollution Act of 1990. At a minimum, we believe that E PA should facilitate a discussion between the response experts before finalizing the Proposed Rule.

We first provide general comments followed by detailed comments on a section -by-section basis for EPA's consideration below.

GENERAL COMMENTS

Industry Shares EPA's Goal Of Establishing Sound Dispersants Policy Grounded In Science and Executable in Real-World Spill Scenarios

In every operation, the goal of industry is to never have an oil spill, and it invests extensive time and effort to prevent spills from occurring. Industry and government have a shared interest in a unified, coordinated, and proactive approach that allows us to protect our common values. These values include the health and safety of our citizens, sensitive ecosystems, the local business community and economy, and the vitality and sustainability of tourism and other key community industries, such as fishing.

To achieve a well-managed response and the protection of our common values, the primary guiding principle is to stop the source of a spill as quickly as possible with the goals of ensuring the health and safety of people and minimizing environmental and community impacts. In many spill circumstances, dispersants play a critical role in achieving these goals, perhaps most importantly by reducing risks associated with Volatile Organic Compounds (VOCs) in the immediate vicinity of the spill that could be both a human health and safety issue, and should continue to be a response option promptly available to the Unified Command. The Proposed Rule could jeopardize the protection of the common values by potentially precluding even completely non-toxic dispersants from being listed due to the proposed dispersed oil toxicity tests and associated pass/fail thresholds. Scientific studies have shown that approximately 97.5% of the TPH constituents in dispersed oil toxicity tests come from the oil (not the dispersant), so the proposed laboratory tests will measure the toxicity of oil (not the dispersant).[1] If the standardized oils (i.e., ANS and IFO-120) required to be used in the proposed test have toxicity values (LC50) in water accommodated fractions (WAF) less than 10 ppm, then no dispersant, no matter its individual toxicity, will meet the threshold values for listing.

Moreover, the creation of arbitrary thresholds for passing such tests, especially when EPA has shown that modern dispersants are of low toxicity, is not supportable and it is not clear whether any dispersant will be approved for the NCP Product Schedule when both toxicity and effectiveness tests are required. Specifically, setting an acute toxicity threshold of dispersants plus oil at an LC50 of 10 ppm has a high probability of eliminating an effective dispersant from the list, i.e., any dispersant that passes the baffled flask effectiveness test. We know from previous testing by industry that many (or even most) crude oils by themselves have LC50's below 10 ppm. Of more relevance is the use of toxicity results to assist in a NEBA-based discussion of the relative merit of using a particular dispersant in favor of another. Similarly, the attempt to link lab test results to decisions relating to pre-authorization and use is misplaced since laboratory tests are useful in understanding differences between products, not their real world performance.

The Proposed Rule indicates that the Agency " *does not state or imply* " that one response option is endorsed over another which is a practice shared by industry. However, the preponderance of additional requirements for dispersant u se will likely have the unintended consequence of prohibiting, or delaying the approval of, dispersant use in a timely manner regardless of whether they may be the best, or only, response option. Further, the language contained in the preamble suggests that the Agency considers dispersants as a last priority, rather than giving them equal consideration with all other appropriate response options. Additionally, API and NOIA are concerned that the Proposed Rule may cause chemical

[1] Scientific reasoning that the dispersant only contributes ~2.5% of the TPH toxicity is based on the following. In a 1:20 disp ersant-to-oil ratio (DOR), the dispersant proportion is 5%. The solvent component of modern day dispersants is roughly half, which mean s the overall TPH contribution from the dispersant is ~2.5%. As a result, the toxicity is dominated by the oil constituents.

manufacturers to either disco ntinue the production of effective, commercially -available products or discontinue research into the development of the next generation of dispersants.

A Net Environmental Benefit Analysis Process Ensures Response Choices that Minimize the Impacts of Oil Spills on People and the Environment

Any changes to the rule must take into account the Net Environmental Benefit Analysis (NEBA)[2] process. When a spill occurs, the OSC must make time-critical choices about which response options to implement immediately and effectively to manage the potential impacts of the spill. The NEBA process helps the OSC select choices that minimize the impacts of the spill on people and the environment. NEBA is a consensus-based planning tool that is used to bring natural resource trustees, regulators and stakeholders together to address resource-management decision-making needs for an oil spill response. It provides a structured, scientific method to evaluate the likely net reduction, or possible increase, in environmental and socio-economic impacts resulting from the implementation candidate response options as compared to the natural recovery or "do nothing" alternative. An assessment of the trade-offs associated with each option is then conducted taking into consideration the potential impacts to sensitive environmental resources and local community values. The NEBA process determines which response option or combination of options can best reduce the overall impact of spilled oil to common values and promote the fastest overall ecosystem recovery. Of particular note, the NEBA process considers the potential effects to a wide range of concerns, ranging from likely environmental effects (i.e., deep marine to terrestrial, etc.) to possible economic consequences. When initially considering the potential outcomes, no individual area receives a greater priority over another. Instead, all are weighed from an equal footing and only after evaluating all the likely effects is a determination made regarding the response option that offers that greatest environmental benefit. In so doing, decision-makers ensure that an unbiased process is used, with input from relevant stakeholders, to determine the best course of action. This process has been adopted all over the world to identify response methods that will yield the greatest benefit with the least impact.[3]

The NEBA process can be used in both oil spill preparedness planning and response. In the United States, a formal NEBA process is conducted during the planning phase at the Area Committee and Regional Response Team (RRT) levels with input from state and Federal participants to determine the benefits and limitations from using each response technology within their individual areas of responsibility. In most offshore regions of the U.S., this is accomplished in the form of the Consensus-Based Ecological Risk Assessments (CERA) process (NEBA equivalent) used by the U.S. Coast Guard (USCG)[4] and supported by the National Oceanic and Atmospheric Administration (NOAA), EPA, other Federal and state agencies, and academia. More than twenty workshops were held in various locations around the continental U.S., Caribbean, and Alaska from 1995 to 2011 to compare the benefits and risks of various response options when considering resource trade-off decisions. All of the workshops resulted in final publications (available from USCG) that were delivered to the Area Committees and RRTs to assist with response planning. One example of how this CERA/NEBA process was used to inform dispersant use decision-making is summarized in several papers authored by regulators in the state of California.[5] The applicability of the CERA/NEBA process as a tool for facilitating dispersant decision-making during spill response and planning was also evaluated by NOAA and published in a 2008 paper.[6]

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[2] NEBA is similar to the Consensus Ecological Risk Assessment (CERA) process developed by the U.S. Coast Guard in the mid - 1990s.

[3] See, *Incident management system for the oil and gas industry: good practice guidelines for incident management and emergency response personnel*, IPIECA, August 2014, http://www.ipieca.org/publication/incident-management-system-oil-and-gas-industry-good-practice-guidelines-incident-manage.

[4] Aurand, D., Walko, L., & Pond, R. (2000). *Developing consensus ecological risk assessments: Environmental protection in oil spill response planning*. Washington, D.C.: U.S. Coast Guard.

[5] Addassi, Y. N., & Faurot-Daniels, E. (2005). California oil spill dispersant plan -Achievement through cooperation. *Proceedings of the 2005 International Oil Spill Conference, 2005* (1), 433 -437. doi:10.7901/2169 -3358-2005-1-433; Addassi, Y. N., Sowby, M.,

In 2014, the practice of incorporating a NEBA review during Source Control drills in the Gulf of Mexico was implemented by RRT VI during several large scale spill response exercises,[7] which has fostered good cooperation between the agencies to focus on the goal of minimizing shoreline community and ecosystem impacts by selecting response options that can maximize the effective treatment of oil offshore. NEBA discussions during both of these recent spill drills resulted in the concurrence of the RRT to authorize dispersants (both aerially and subsea) to treat the offshore oil slick.

Government decision-makers and/or the Responsible Party can conduct a rapid NEBA during actual spill responses to compare and rank the strengths and weaknesses of different response options for the incident-specific conditions. Lessons learned following a spill are incorporated into future policies and plans. Ecological recovery studies of the 1996 *Sea Empress* spill in the UK demonstrate the benefit of dispersant application along the coastline to prevent persistent oil from stranding in shoreline habits.[8] A more recent publication examined the recovery rates for a tropical ecosystem during a controlled study of dispersed versus untreated shoreline oil slicks and concluded that better recovery occurred in the areas where dispersant was used.[9]

Regrettably, the Proposed Rule lacks a NEBA perspective. It incorrectly focuses on intrinsic, hazard-based criteria for substance listing and ignores the more appropriate risk-based trade-off decision process responders must consider during an oil spill response. It does not recognize that dispersants are only applied when regulators and response decision-makers deem them necessary to prevent more significant and harmful consequences. The Proposed Rule favors protecting pelagic and benthic species while putting critical habitats, such as the ocean's surface and near-surface zones, as well as sensitive shorelines, at greater risk to environmental damage. Modeling results presented at the 2005 International Oil Spill Conference concluded that:

> *"…the results of the modeling support the contention that there are more opportunities to save wildlife, shorelines, and sensitive habitats along the shore with dispersant use than there are risks of impacting water column biota. If the areas that would be impacted by surface oil are those where wildlife are concentrated, as they typically are near shore, and the water column impacts resulting from dispersant use would be offshore where water column biota are lower in abundance, the trade-off is much more heavily weighted toward dispersant use before oil comes near the shoreline. In fact, for medium or smaller spills, or even larger spills where sensitive species and life stages are not present, the impact of dispersant use on water column biota could be negligible."*[10]

Parker-Hall, H., & Robberson, B. (2005). Establishment of dispersant use zones in the state of California: A consensus approach for marine waters 3 –200 nautical miles from shore. Proceedings of the 2005 International Oil Spill Conference, 2005(1), 187 -191. doi:10.7901/2169-3358-2005-1-187.

[6] Mearns, A., & Evans, M. (2008). Evaluating the consensus ecological risk assessment workshop as a tool for facilitating decision - making during spill response and planning. *Proceedings of the 2008 International Oil Spill Conference Proceedi ngs, 2008*(1), 739-741. doi:10.7901/2169-3358-2008-1-739

[7] Freeport McMoran Source Control drill (April 30-May 1, 2014) and BP Source Control drill (Nov 5-6, 2014)

[8] Lunel, T., Rusin, J., Bailey, N., Halliwell, C., & Davies, L. (1997). The net environmental benefit of a successful dispersant operation at the Sea Empress incident. *Proceedings of the 1997 International Oil Spill Conference, 1997* (1), 185 -194. doi:10.7901/2169-3358-1997-1-185

[9] Baca, B., Rosch, E., DeMicco, E. D., & Schuler, P. A. (2014). TROPIC S: 30 -year follow -up and analysis of mangroves, invertebrates, and hydrocarbons. *Proceedings of the 2014 International Oil Spill Conference, 2014* (1), 1734 -1748. doi:10.7901/2169-3358-2014.1.1734

[10] French McCay, et al., Modeling Fates and Impacts of Hypothetical Oil Spills in Delaware, Florida, Texas, California, and Alaska Waters, Varying Response Options Including Use of Dispersants. International Oil Spill Conference Proceedings: May 2005, Vol. 2005, No. 1 pp. 735-740. Also available at http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2005-1-735.

For oil spills where dispersant use is contemplated, a typical NEBA will predict the potential impacts to aquatic organisms from an increased exposure to dispersed oil droplets. Dispersant use is typically restricted to water depths greater than 10 to 20 meters so that dilution will minimize exposure or impacts to the benthic community. Studies have shown the dispersed oil concentrations are rapidly diluted within the large volume of receiving water from a high of a few hundred parts per million to a few parts per million within a few hours. Consequently, exposure to the toxic effects of the dispersed oil will be of short duration and limited to those aquatic organisms that inhabit near surface waters. The NEBA will also estimate the reduction of impacts to waterfowl, shoreline ecosystems and coastal communities resulting from the reduction in, or elimination of, the quantity of floating oil. The trade-offs of a short term increase in exposure of selected aquatic organisms to dispersed oil versus an increase in oil impacting coastal environments and communities must be evaluated and take into account local community values to determine if dispersant use is warranted.

Given the challenges of implementing other response options, a decision not to have dispersants available to responders could result in oil stranding on shorelines where it may persist for an extended time. Effectively dispersed oil will biodegrade rapidly so that the majority of the oil will persist for a much shorter period of time. Reducing the persistence of the oil in the environment is critical to reducing the overall impacts.[11] This is not to say that water column organisms are less intrinsically important than surface or shoreline species but using NEBA can and does provide a critical framework for deciding what is best for the overall ecosystem. Important considerations to understand in assessing this tradeoff include:[12]

- The impacts to the water column are mitigated by dilution – that is the potentially toxic levels of dispersed oil are limited in duration and physical coverage/extent and effected populations (e.g., plankton) tend to be ones that recover quickly.
- Oil effectively dispersed in the water column will generally biodegrade after a few days or weeks while oil stranded in near shore and shoreline areas can persist for years.
- Near shore and shoreline areas are the nursery grounds for many species, even those that live offshore as adults, so protecting the near shore areas also protects organism that live as adults offshore.
- The bio density of near shore areas (swamps and marshes) is far greater than the bio density in pelagic waters offshore.
- Dispersants also protect surface dwelling organisms offshore, i.e., marine mammals, birds, and turtles, through removal of floating oil.
- Slicks on the water surface are far more likely to impact fish eggs and larva that tend to float at or near the water surface than quickly removing oil from the surface with dispersants.
- In certain geographies, slicks can impact mangroves and other shoreline vegetation that can subsequently die off and result in shoreline erosion that increases sediments in the near shore water column and potentially affects corals and other species.

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[11] Hazen, et al., Deep-Sea Oil Plume Enriches Indigenous Oil-Degrading Bacteria, Science, 330 (2010), pp. 204-208.

[12] (a) French McCay, D., and Graham, E. Quantifying Tradeoffs – Net Environmental Benefits of Dispersant Use. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 762-775.
(b) McManus, M.A., Woodson, C.B. Plankton Distribution and Ocean Dispersal. The Journal of Experimental Biology, 215 (2012), pp. 1008-1016.
(c) DeMicco et al., Net Environmental Benefit Analysis (NEBA) of Dispersed Oil on Nearshore Tropical Ecosystems: TROPICS – The 25th Year Research Visit, International Oil Spill Conference Proceedings, May 2011, Vol. 2011-282.
(d) Varela et al., The Effect of the "Prestige" Oil Spill on the Plankton of the N -NW Spanish Coast. Marine Pollution Bulletin 53 (2006), pp. 272-296.
(e) Addassi, et al., Establishment of Dispersant Use Zones in the State of California: A Consensus Approach for Marine Waters 3-200 Nautical Miles from Shore. International Oil Spill Conference Proceedings: May 2005, Vol. 2015, No. 1, pp. 187-191.

The Agency should consider the NEBA process and how and why dispersants are used before making changes to the Subpart J Regulations.

The Proposed Rule has the Practical Effect of Treating Dispersants as Toxic and either Prohibiting or Discouraging the Use of this Critical Response Tool

Dispersants are an essential tool in the responder's toolkit. They are products used in oil spill response to dilute the oil in the water column to enhance natural microbial degradation, a process where microorganisms remove oil from the environment.[13] All marine environments contain naturally occurring microbes that feed on and break down crude oil. Dispersants aid the microbial degradation by forming tiny oil droplets, typically less than the size of a period on this page (<100 microns), thus increasing the oil's surface area and making it more available for the petroleum-degrading microorganisms to consume.[14]

All oil spill response options have their place in the response toolkit because of the extreme variability of spill conditions. Dispersants become a critical response tool for larger spills far from shore; spills more distant from stockpiles of recovery and containment equipment; when weather and ocean conditions preclude the use of other options; or when weather conditions are predicted to become more severe because they can be rapidly applied by aircraft or subsea (at a high encounter rate) when wind and wave conditions prevent other vessel-based recovery options.

The Proposed Rule focuses on the potential risks of dispersants without recognizing the benefits and core purpose of dispersants, which is to rapidly dilute the spilled oil and enhance removal of the oil from the environment through microbial degradation, resulting in reduced VOCs and shoreline impacts. Ultimately, the purpose of dispersants is to reduce the overall toxicity and persistence of oil in the environment.

We believe that research showing that dispersants do not enhance the biodegradation of oil from the environmental is based on studies that used unrealistically high concentrations of dispersed oil. Prince and Butler only recently developed a biodegradation test method that compares dispersed oil biodegradation to biodegradation of a surface slick at representatively low concentrations (i.e., 2.5 ppm).[15] This research unambiguously shows the enhanced biodegradation of dispersed oil over allowing an oil slick to remain on the surface. Most prior dispersed oil biodegradation studies used oil concentrations that were two or more orders of magnitude too high.[16]

Dispersants have proven to be an effective way to respond to an oil spill, most notably in those situations that prohibit, or otherwise limit, the effectiveness of other response measures. We submit that all response options should be contemplated based on their individual, or combined, ability to respond to

[13] American Society for Microbiology (ASM). (2011). *FAQ: Microbes & oil spills.* Retrieved from http://academy.asm.org/images/stories/documents/Microbes_and_Oil_Spills.pdf; Personna, Y., Boufadel, M., & Zhang, S. (2014). Biodegradation of dispersed Endicott oil in controlled experiments. Proceedings of the 2014 International Oil Spill Conference, 2014(1), 1126-1140. doi:10.7901/2169-3358-2014.1.1126; McFarlin, K., Leigh, M., & Perkins, R. (2014). Biodegradation of oil and dispersed oil by arctic marine microorganisms. Proceedings of the 2014 International Oil Spill Conference, 2014(1), 300-317. doi:10.7901/2169-3358-2014-1-300317.1.

[14] Hazen, T. C., Dubinsky, E. A., DeSantis, T. Z., Andersen, G. L., Piceno, Y. M., Singh, N., Jansson, J. K., Probst, A., Borglin, S. E., Fortney, J. L., Stringfellow, W. T., Bill, M., Conrad, M. E., Tom, L. M., Chavarria, K. L., Alusi, T. R., Lamendella, R., Joyner, D. C., Spier, C., Baelum, J., Auer, M., Zemla, M. L., Chakraborty, R., Sonnenthal, E. L., D'haeseleer, P., Holman, H. N., Osman, S., Lu, Z., Van Nostrand, J. D., Deng, Y., Zhou, J., & Mason, O. U. (2010). Deep-sea oil plume enriches indigenous oil-degrading bacteria. *Science*, *330*, 204-208. doi:10.1126/science.1195979

[15] Prince, R.C. and Butler, J.D. A protocol for assessing the effectiveness of oil spill dispersants in stimulating the biodegradation of oil. Environ Sci Pollut Res Int. 2014 Aug;21(16):9506-10. doi: 10.1007/s11356-013-2053-7. Epub 2013 Aug 13.

[16] Lee, K., Nedwed T., Prince R.C., Palandro D., Lab tests on the biodegradation of chemically dispersed oil should consider the rapid dilution that occurs at sea. Mar Pollut Bull. 2013 Aug 15;73(1):314-8. doi: 10.1016/j.marpolbul.2013.06.005. Epub 2013 Jun 27.

discharged oil, either on or below the water's surface, in a manner that causes the lowest negative effect on the environment and promotes the most rapid recovery of the affected ecosystem.

Laboratory Dispersant Efficacy Tests do not Predict How Well Dispersants Will Work in the Wide Range of Real World Spill Conditions

Although laboratory dispersant effectiveness testing can be used as a comparative screening tool for different dispersants under laboratory conditions, the Proposed Rule appears to suggest these results will be representative of actual effectiveness when applied to oil spills on open water. However, these results do not translate to the wide range of field conditions, oil types and weathering degrees in real world oil spills. Specifically, the static conditions in a lab, where researchers conduct experiments with known quantities of oil and dispersant, cannot be replicated at sea. Although the amount of dispersant that is to be applied is calculated based on a desired initial dispersant-to-oil ratio, the quantity and characteristics of oil during a real spill is an estimate, making any definitive, quantitative effectiveness estimation problematic. Localized determinations of the relative effect of surface dispersant application may be evaluated qualitatively using visual cues or semi-quantitatively using ultraviolet fluorometry, which is sufficient for operational effectiveness assessments. Additionally, much of the detailed spill monitoring specified by the Agency in the Proposed Rule has no bearing on dispersant effectiveness monitoring and cannot be conducted in a time-frame that will support day-to-day, near real-time operational decision-making.

We suggest the language in the Proposed Rule be modified to clarify the laboratory efficacy testing is for comparative purposes only and that the pass/fail criteria be established at a level that will only eliminate the least effective dispersants from being listed. Some dispersants that only exhibit average effectiveness in the laboratory tests may be very effective in certain situations in the field and the Response Community needs to maintain as many options as possible to select the most appropriate response option for a given set of conditions and circumstances.

Dispersant Toxicity Tests do not Accurately Simulate Real World Exposures.

API and NOIA acknowledge that there may be benefits to a so-called "gate-keeper" toxicity test with dispersant alone to ensure that any dispersants that might contain highly toxic components would not be accepted for listing on the Product Schedule. However, it is unclear what rationale was used for the dispersed oil toxicity tests stated in the Proposed Rule.

The relevant factors in dispersed oil toxicity include the concentration of dispersed oil, or oil compounds, in the water and the duration of exposure. The fundamental basis of aquatic toxicity testing is to create a set of concentrations and expose the animals for a duration where observable effects can be measured. As a result, laboratory exposures are useful for data collection and generating toxicity curves; however these conditions are not representative of the real world where the natural processes of rapid dilution and biodegradation act on the dispersed oil to dramatically reduce the exposure conditions [17]. Using acute 48- or 96-hour LC_{50} toxicity tests with dispersed oil mixtures (to calculate LC_{50} values) is considerably different from the likely exposure regime experienced by marine organisms in the open sea following an oil spill. For this reason, the Chemical Response to Oil Spills: Ecological Effects Research Forum (CROSERF)[18] was assembled to develop new dispersed oil toxicity testing protocols that account for rapid dilution. Academia, regulators and industry funded a ten year program through CROSERF to

[17] Lee, K., Nedwed, T., & Prince, R. (2011). Lab tests on the biodegradation rates of chemically dispersed oil must consider natural dilution. *Proceedings of the 2011 International Oil Spill Conference, 2011* (1), 245. doi:10.7901/2169-3358-2011-1-245
[18] Aurand, D., & Coelho, G. (2005). *Cooperative aquatic toxicity testing of dispersed oil and the chemical response to oil spills: Ecological effects research forum (CROSERF)*. Ecosystem Management & Associates, Inc., Technical Report 07-03. Lusby, MD.

develop new testing methods that are more aligned with real -world field c onditions. This data is now available via the NOAA Dtox database.[19]

Results from dispersed oil monitoring during the Deepwater Horizon (DWH) spill is clear evidence of the rapid dilution occurring after surface dispersant application [20] and subsea dispersant injection .[21] Further evidence of the rapid dilution of dispersed oil in the field is found in the analytical results from several field trials conducted in the North Sea to characterize the fate and transport of dispersants applied to an open ocean oil slick. These field experiments and the subsequent chemical characterization condu cted in 1994,[22] 1995,[23] and 1996[24] showed a rapid (within one hour) dilution of dispersed oil concentrations following dispersant application. This same effect was observed during the DWH response following surface dispersant application.[25] Since the proposed EPA dispersed oil testing does not take into account dilution, it is more likely that reported toxicity values at a rtificially high laboratory concentrations, not representative of real -world dilution exposures, will lead to misinterpretation of these tes t results and possibly preclude the use of dispersants altogether.

We strongly suggest that the laboratory toxicity test be limited to dispersants only to screen out the more toxic products and that toxicity testing for dispersed oil be explicitly elimin ated from the Rule. It is very likely that all dispersants will be unable to pass the dispersed oil toxicity test as existing oil toxicity data indicates the test oils alone will be unable to pass the test.

In the context of NEBA (and its forebear, th e Consensus Ecological Risk Assessment, or CERA), scientists understand and accept that marine organisms may experience localized, transient toxic effects from exposure to dispersed oil, but these local effects are offset by the benefit of dispersant use i n preventing or minimizing oil drifting ashore and causing severe and long -term harm to more sensitive coastal resources and communities . While knowledge of the potential for toxic effects to marine organisms is useful for conducting a NEBA, it cannot be t he sole indicator that dictates the use of dispersants. All resources -at-risk as well as coastal communities must be considered in the response option decision-making process, with the emphasis on coordinating a response that will result in the least overall impacts while promoting the most rapid overall recovery of the affected ecosystem.

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[19] Bejarano, A., Chu, V., Dahlin, J., & Farr, J. (2 014). Development and application of dtox: A quantitative database of the toxicity of dispersants and chemically dispersed oil. *Proceedings of the 2014 International Oil Spill Conference* , *2014*(1), 733 -746. doi:10.7901/2169-3358-2014.1.733

[20] Operational Science Advisory Team (OSAT 1). (2010). *Summary report for sub-sea and sub-surface oil and dispersant detection: Sampling and monitoring. Unified Area Command, New Orleans*. Retrieved from: http://www.dep.state.fl.us/deepwaterhorizon/files2/osat_report_17dec.pdf .

[21] Coelho, G., Aurand, D., Essex, L., Parkin, A., & Robinson, L. (2012). *Monitoring subsurface dispersant injection during the MC252 incident, volume 1*. Lusby, MD, USA: Ecosystem Management & Associates, Inc.

[22] AEA Technology. (1994). *International calibration of laboratory dispersant test methods against sea trials* . Oxfordshire, UK: AEA Technology.

[23] AEA Technology. (1995). *International calibration of laboratory di spersant test methods against sea trials. Field trial report. July 1995 sea trials*. Oxfordshire, UK: AEA Technology ; Jones, M., & Petch, S. (1995). A report on the analysis of hydrocarbons in sea waters and associated samples from trial oil spills off east ern England, July 1995. Newcastle upon Tyne, UK: University of Newcastle upon Tyne.

[24] Strøm-Kristiansen, T., Hokstad, J. N., Lewis, A., & Brandvik, P. J. (1997). *NOFO 1996 oil on water exercise – analysis of sample material. SINTEF Data report number STF66 A97050*. Trondheim, Norway: SINTEF ; Coelho, G. M., Aurand, D. V., Petch, G.S., & Jones, D.M. (1998). Toxicity bioassays on dispersed oil in the North Sea: June 1996 field trials. Ecosystem Management & Associates, Inc., Report 96-02. Purcellville, VA: Ecosystem Management & Associates, Inc.

[25] Huber, C. A., Steen, A., & Parscal, B. (2014). Does wave height matter for effective surface dispersant application? *Proceedings of the 2014 International Oil Spill Conference, 2014* (1), 747-761. doi: 10.7901/2169-3358-2014.1.747

During an Oil Spill, Operational Monitoring Should Focus on How the Selected Response Options Mitigate the Effects of the Oil on the Environment

Following an oil spill, the primary emphasis of operational response monitoring should be directed toward the response effort and the effect that those efforts have on reducing the net negative environmental consequences. The Agency proposes the requirement to "*monitor agent use in the environment*." API and NOIA submit that operational monitoring should not be focused on monitoring the agent (i.e., dispersant) use, but rather on monitoring the overall changes to the characteristics, transport, and fate of the oil within the ecosystem. We also submit the Agency should acknowledge that the primary issue in a spill scenario is oil in the environment (not dispersants in the environment) and that operational monitoring efforts should concentrate on evaluating how well the response option (or options) mitigates the negative effects of the oil on sensitive environmental resources.

EPA proposes monitoring that will provide a comprehensive assessment of the environment. However, the monitoring actions required in the Proposed Rule go beyond those required to inform operational decision-making and cross into the realm of Natural Resource Damage Assessment (NRDA) monitoring. One reason for this is that NRDA monitoring requires days to years before opinions on damages are made. Operational decisions require real or near-real time data. Damage assessment monitoring should not fall under the purview of spill response decision-making, and any monitoring of response options should be done solely to ensure the effectiveness of that response technique.

The Proposed Rule includes additional surface dispersant effectiveness monitoring requirements beyond those established in current practices, with no justification of how this additional monitoring burden will enhance operational response decision-making. Further, the additional requirements do not differentiate between surface and subsurface use of dispersants. As a result, the Proposed Rule would apply an unnecessary set of requirements in the event of surface dispersant usage in lieu of those monitoring techniques outlined in the USCG *et al., Special Monitoring of Applied Response Technologies* (SMART) protocols.[26] Additionally, the monitoring regime outlined in the Proposed Rule deviates substantially from that recommended by the National Response Team (NRT) in its *Environmental Monitoring for Atypical Dispersant Operations: Including Guidance for Subsea Application and Prolonged Surface Application,*[27] which also advocates the adaptation of the SMART monitoring regimen. These additional monitoring requirements, if adopted, may divert valuable resources away from the response effort, potentially prolonging the spill event. They may also preclude the use of dispersants in many cases if required to be in place as a condition of authorization, as it can take many days to assemble the equipment, vessels, and scientific experts.

During a subsea dispersant application, the Agency proposes an exhaustive set of environmental monitoring parameters that include *in situ* oil droplet size distribution analysis, *in situ* fluorometry, fluorescence signatures, dissolved oxygen, total petroleum hydrocarbons, carbon dioxide, methane, heavy metals, turbidity, water temperature, pH, and conductivity. As stated previously, we concurs with monitoring that supports effective, operational decision-making, but argues that most of these parameters will not provide any information on the effectiveness of the subsea dispersant application, will unnecessarily require additional scientific resources and will delay the reporting of key operational monitoring parameters. Spill response effectiveness monitoring should be based on simple, rapid assessments that can provide near real-time information on the progress of the response. For this reason, we believe that any mandated operational monitoring should be both incident-specific and designed to integrate into the other operational activities taking place. As such, the Responsible Party

[26] These protocols were jointly developed by the U.S. Coast Guard, National Oceanic and Atmospheric Administration, U.S. Environmental Protection Agency, Centers for Disease Control and Prevention, and Minerals Management Service.
[27] See http://www.nrt.org/production/nrt/nrtweb.nsf/AllAttachmentsByTitle/SA-1086NRT_Atypical_Dispersant_Guidance_Final_5-30-2013.pdf/$File/NRT_Atypical_Dispersant_Guidance_Final_5-30-2013.pdf?OpenElement

shares in the responsibility with the OSC in determining what monitoring needs to be done in ac cordance with the region -specific pre -approval and planning process. Comprehensive, detailed environmental monitoring is not an appropriate topic for this Proposed Rule.

The Agency's Economic Review Fails to Recognize Significant Costs of the Proposed Rule.

The Regulatory Impact Analysis (RIA) conducted by the Agency does not estimate all of the potential policy scenarios, and the economic impacts of those policies, that are issued in the Proposed Rule. Therefore, the RIA neglects to provide the public with a full description of the proposal's impact. Additionally, EPA did not provide any quantified social benefits that could result from implementation of any part of the Proposed Rule. An independent assessment [28] of the proposal (see Attachment A) has found that including the impacts of the requirements neglected by the Agency in the RIA would increase the cost of the proposal three times. In addition to underestimating compliance costs and administration costs for both industry and the federal governmen t, the RIA supporting the proposal fails to calculate the costs associated with the immediate market imbalances that could occur if products are removed from the market, either temporarily or permanently.

Beyond the market imbalance, removal of dispersants from the toolbox could result in additional clean-up costs that are not considered in the RIA. As noted in Attachment A, "To the degree this rulemaking reduces chemical and biological agent availability and innovation, the nation will have less tools av ailable to fight oil spill damage." A possible outcome of this limitation "is that future oil spill damages would be more severe than they would be if the rule did not occur." EPA did not quantify the costs associated with the possibility that the rule w ould limit the ability of the Response Community to keep oil from reaching shorelines or damaging ecosystems to a greater extent than if dispersants were readily available. We believe additional costs could extend to costs associated with environmental cla ims, increased response costs due to the need for shoreline cleanup, and other costs of environmental damages to sensitive shorelines, birds, and lost economic and recreational opportunities. In fact, EPA confuses the social benefits of avoiding an oil spill or having an appropriate response to a spill with the social costs of a spill, such as lost tourism revenue and other environmental damages. Furthermore, the Agency underestimated the costs to small businesses, which resulted in the false conclusion t hat small businesses would not be materially affected by the proposed ruling. Using realistic estimates, the attached third-party report finds that 43 percent of the firms identified by the Agency would face compliance costs in excess of three percent of a nnual sales and risk of closure. The Agency should amend the methodology and deficiencies found in the RIA, as discussed here and in the attached report.

We explicitly incorporate the comments and recommendations addressing the RIA provided by the independent assessment (see Attachment A).

The Proposed Rule Conflicts with Current Facility and Vessel Oil Spill Response Plans

Effective September 30, 2009, facility and tank vessel plan holders were required to update their response plans to include planning for responding to discharges using dispersants under a USCG rulemaking. Specifically, dispersant equipment is required in areas where it has been pre-determined that dispersants would be a viable oil spill mitigation technique and pre-authorizations have been established. Previously, with regard to dispersants for facilities located in areas with pre-authorization, a mechanical recovery equipment credit for up to 25% could be obtained for certain persistent oils.

[28] The independent assessment was prepared by the Policy Navigation Group (PNG), which consists of a diverse team of senior policy analysts with experience at Office of Management and Budget in the White House, managers, economists, engineers, lawyers and skilled researchers, with particular expertise in both private and public sector environmental management strategies including benefit-cost analysis and life-cycle assessments. See http://www.policynavigation.com/index.php?page=bios for more information about PNG.

However, since 2009 facilities handling certain persistent oils in areas with pre-authorization must ensure, through contract or other approved means, the availability of dispersant response resources and the commencement of dispersant-application operations within 7 hours of the decision by the OSC to use dispersants. Dispersant response resources must include: (1) sufficient volumes of dispersants to meet specified regulatory requirements, (2) dispersant application platforms and systems sufficient to meet planning standards, and (3) trained personnel.

Similarly, vessels transporting certain persistent oils in areas where dispersants are pre-authorized have been since 2009 required, through contract or other approved means, to have dispersant-related response resources meeting dispersant planning standards, including appropriately trained dispersant-application personnel. The dispersant resources must include the identification of each primary dispersant staging site used by each dispersant-application platform and the corresponding distance to the associated stockpile. Similar requirements were adopted for non-tank vessels in 2013.

There are also aerial tracking requirements under the current response plan requirements, and there are now pre-authorization zones for the use of dispersants outlined in the applicable Area Contingency Plan throughout the nation for every state except for Alaska and Connecticut whereby the OSC has the authority to expedite the authorization for the use of dispersants. Although there are no specific dispersants requirements under Bureau of Safety and Environmental Enforcement's (BSEE) response plan requirements for offshore facilities, it is clear based on experience with the *Deepwater Horizon* that dispersants are a key response tool that must be available on an expedited basis to respond both to a spill on the surface of the water and subsea in case of a blowout.

The Proposed Rule, however, appears to directly conflict with Coast Guard response plan requirements and raises a host of questions related to the continued validity of facility and vessel response plans. It is unlikely that any dispersants will pass both the efficacy and toxicity tests required by the Proposed Rule as a precursor to being listed on the NCP Product Schedule. For example, the EPA proposal may have the practical effect of virtually eliminating the entire stockpile of available dispersants nationwide that will be able to be listed on the NCP Product Schedule following full implementation of the Proposed Rule. In addition, it could have the practical effect of eliminating the usefulness of preauthorization zones. This could result in invalidating response plans.

Furthermore, the Proposed Rule, if implemented , would require significant additional requirements for information needed an d monitoring required before dispersants use approval is granted , which may prevent a plan holder from being able to deploy dispersants in the desired/required amount of time. For some spills it may mean that dispersants cannot be used at all due to limit ed window of opportunity. Thus, the Proposed Rule raises significant issues related to USCG and BSEE facility and vessel oil spill response plan compliance and could result in unnecessary and increased environmental damage and corresponding spill claims a s a result of increased damages. In this regard, we note that although the President delegated to EPA the responsibility for the amendment of the NCP, the Proposed Rule may extend beyond the limits of EPA's authority under that delegation or the applicabl e law. Furthermore, amendments to the NCP must be coordinated with members of the NRT , including the USCG and other relevant agencies, prior to publication for notice and comment. 40 C.F.R. § 300.2. It appears this coordination may not have been accompl ished sufficiently to avoid the conflicts discussed above. Accordingly, we recommend that EPA further coordinate with the USCG and BSEE to ensure that the Proposed Rule does not adversely affect USCG and BSEE response planning procedures and requirements.

<u>Agency Review of Public Comments</u>

Due to the significance of this rulemaking to the industry and to other Federal government agency stakeholders involved with spill response, it is critical the Agency provide adequate time for these other

agencies to review and provide feedback on comments submitted by the public for EPA's benefit and consideration. Accordingly, we strongly urge the Agency to seek and consider comments from the other relevant Federal government agencies on the public's comments befor e it decides on how to handle all input received in response to the Proposed Rule.

Availability of EPA Testing Data

It has come to the attention of API and NOIA that the Agency may have testing data related to dispersants that may not have been released to the public. If that is the case then the Agency should make that data publicly available as soon as possible in some form of a supplemental notice to this Proposed Rule. Supplemental comments should then be requested to ensure that the public has an opportunity to provide additional informed comments for EPA's consideration before finalizing the Proposed Rule.

DETAILED COMMENTS ON THE PROPOSED AMENDMENTS TO 40 CFR PARTS 110 AND 300

Our specific section -by-section comments on the Proposed Rule are presented as follows . These comments conform to the organization of the Proposed Rule on a section-by-section basis.

I. § Section 300.5 Definitions

A. *The definition of burning agents should not include ignition devices*.

Burning Agents. The proposed defi nition reads: " *Burning agents are additives that improve the combustibility of the materials to which they are applied through physical or chemical means* ." In the preamble (80 Fed. Reg. 3385) an example is given of a helitorch system, stating that the mate rials in the helitorch would be considered burning agents. Additionally, the Agency is seeking comment on whether it should add ignition devices to the definition of burning agent.

The proposed defin ition seems to combine burning agents (materials that actually change the combustibility of the material they are added to) and ignition agents (materials used to start combustion, as is the case with the helitorch). This confuses the question around including ignition devices within the definition of burning agents which, if happens, could lead to administrative pauses in requesting a test burn, or any burn during an emergency phase of a response.

Igniters are used to initially heat a small portion of the oil to release vapors that can be ignited. The initi al process of ignition is not the same as improving overall combustibility of an oil. For example, when starting a campfire, a match does not change the combustibility of the wood; it simply provides the energy to start the combustion process. Similarly, a n in-situ burn ignition system provides energy to heat and vaporize some of the oil so that it can start to combust. For this reason, we submit that ignition devices (both ignition liquids and equipment) should not be included in the definition of a burning agent.

We recommend the Agency adopt the following definitions:

> *Burning agents are additives that change the combustibility of the materials to which they are applied through physical or chemical means prior to ignition.*
>
> *Ignition agents are additives that ignite, or initiate combustion of the materials to which they are applied.*

B. *EPA's definition of dispersants does not fully define dispersants.*

Dispersants. The EPA proposed definition of dispersants in 300.5 should be expanded to include an explanation of why the production of smaller droplets is important. The following language should be added to the end of the proposed definition: *"The formation of small droplets is intended to allow the oil to be rapidly diluted in open ocean environments t o non -harmful concentrations and to promote rapid biodegradation of the oil by naturally occurring microbes."*

C. *Oil-mineral aggregate ("OMAs") are not sorbents*

Sorbents. API and NOIA offer several comments on the definition of sorbents in 300.5, as follows:

- We support the addition of clay as an example of an inorganic/mineral compound, especial ly since commercial products made from clay are currently on the market.
- The Agency expresses concern that sorbents made from particulate matter may be used as sinking agents. Many inorganic/mineral compounds that are quite dense are commonly used on terrestrial spills on roads, pavements and other hard surfaces. The rule should not limit their use for these situations.
- Very fine clays (like those used in OMAs), wh ile still nominally denser than water, will still suspend in the water column because the particle sizes are very small. The rule needs to acknowledge that OMA's are not sinking agents. If the Agency is concerned that inorganic/mineral sorbents are being u sed as sinking agents, then their use should be explicitly prohibited for use as a sinking agent. Uses for other purposes should be allowed.
- EPA should not limit how sorbents in particulate form are used. The use of OMA technologies is not to sorb oil but to promote dispersion and biodegradation. The purpose of the technique is not the same as for sorbents and should not be regulated as such. OMA technologies should be excluded in the definition of sorbents and should have separate testing/authorization requirements.
- While most sorbents are collected and recovered from the environment, some natural organic sorbents are spread over oil on habitats where the oil cannot be easily removed. The sorbent ties up the oil to reduce further migration and to limit the exposure to flora and fauna. The Agency should not discourage this application as it is sometimes considered a "best practice" for certain oiled habitats. As such, the Agency should either remove the phrase, "generally collected and recovered…" or add lang uage to indicate that loose, organic sorbents used in wetlands may not be recovered.

D. *Saltwater should be defined in the Proposed Rule*

Saltwater. In column 2, 80 Fed. Reg. 3389, of the preamble and subsequent sections the term "saltwater" is used. It is recommended that saltwater be defined in the definitions in 300.5 since the Proposed Rule states that dispersants are only allowed in saltwater environments. There is no definition of saltwater offered in the proposal. Dispersants have been shown to work a t salinity much lower than the typical 35 ppt ocean concentrations and effectiveness at salinity as low as 14 ppt has been reported. A definition where dispersants can be used needs to be provided, taking into consideration the data on dispersant performance in brackish or estuarine environments.

II. <u>Section § 300.910 Authorization for Agent Use</u>

A. *The Unified Command (UC) determines the best use of response assets on a daily basis.*

EPA should not establish a policy or rule that mechanical recovery is always the priority choice of countermeasures to use in a response. In the preamble for this section (column 1, 80 Fed. Reg. 3387), the Agency makes the following statement:

> *"During the DWH response, a priority countermeasures scheme was established to first use mechanical recovery via skimming/booming or in-situ burning followed by subsea dispersant and lastly surface dispersant use."*

This may have been the conceptual prioritization from the perspective of EPA, but in reality dispersants played a much larger role and it was the responsibility of the UC to determine the best use of response assets on a daily basis to account for weather conditions, VOC suppression, oil slick locations, response equipment availability, etc. Every spill is different and specific references to a single spill event can indirectly and inappropriately be perceived as a recommended practice and should be avoided. In any spill scenario, all response tools must be used to their maximum effect. The Agency's unprecedented use of "Directives" during the DWH incident severely limited the use of dispersants and circumvented the NEBA decision-making process allowing significantly more oil reaching the water's surface and, subsequently, the shoreline. This resulted in additional environmental impacts with no documented benefits to the marine ecosystem.

The Agency should reconsider this statement and prioritization as it puts unneeded complexity into the response decision-making process and inappropriately prioritizes mechanical recovery over other response options. The effectiveness of mechanical recovery can be limited in large, offshore spills as a result of typical environmental conditions, such as wave action/height or wind conditions as well as the extensive surface area that must be covered. Further, the Agency's artificial prioritization of this technique over other viable response options is contrary to the NEBA concept to determine the best blend of response options (with no pre-determined or pre-existing bias) to achieve the best overall protection and recovery for the ecosystem.

B. *Decision-making plans are also important to response decision-making.*

Later in the same paragraph referenced above, the Agency makes the following statement:

> *"The Agency believes that preauthorization or expedited decision making plans are critical elements of contingency planning activities."*

We strongly agree that preauthorization and expedited decision-making are important.

C. *Proposed changes involving preauthorization planning will increase the workload of all Regional Response Teams (RRTs) and Area Committees (AC) and restrict their flexibility.*

EPA should not restrict RRT or OSC activities related to preauthorization plans in areas where preauthorization is desirable and applicable. At the end of the same paragraph (column 2, 80 Fed. Reg. 3387), the Agency makes the following statement:

> *"The Agency believes these proposed revisions to the authorization of use provisions will assist OSCs, RRTs, and ACs in their advanced planning activities as they consider response methods that result in the greatest environmental protection."*

We agree with the intent to assist the OSCs and RRTs. However, the added complexity resulting from the Proposed Rule in authorization, monitoring and product listing, in addition to the overly conservative assumptions about dispersant effects described in the Proposed Rule, will not assist these entities.

Instead, it complicates and limits their ability to respond. The Agency must provide specific examples to show how this rule ass ists responders, particularly in relation to the OSC duties of making timely operational decisions, especially those decisions based on using the concept of NEBA to guide a response.

The existing rule states that the RRTs and Area Committees should evaluate the desirability of using various agents as part of their planning processes and state that "*RCPs and ACPs shall, as appropriate, include applicable preauthorization plans....* " Under the current rule, most RRTs did, in fact , create preauthorization plans, and those plans did include appropriate oceanographic and geographic limits . In practice, only Region VI used those plans to mitigate oil spills, and the Region VI OSCs, RRTs, and Area Committees became very familiar with their use . Policies and practic es for the use of the RRT VI preauthorization plan were created by the appropriate member agencies without regulatory requirements and evolved to account for changes in information technology.

The proposed language states, "*RRTs and Area Committees shall address in a preauthorization plan…*" This becomes a mandate for all RRTs and Area Committees, including those areas that may have little interest or need for such plans. In fact, some RRTs and Area Committees do not even have water bodies where dispersants could be used. Most of the factors that are required to be considered by the Proposed Rule are already addressed in preauthorization plans (e.g., water depth, distance from shorelines). Some factors, however, such as the requirement that " *preauthorization plans must specify limits for the quantities and the duration of use*," for agents are new and have the effect of limiting the application and effectiveness of the pre authorization plans. This requirement wo uld suggest that RRTs must know in advance the si ze of the potential releases, the resources at risk and what strategies are available to protect them, the dispersability of the oil, and the optimum dispersant -to-oil application rate. The OSC's flexibility and the effecti veness of the response method are limited and not assisted by such requirements, and EPA has not justified that the proposed requirement is necessary in relation to existing requirements.

The existing rule also states that " *preauthorization plans may address factors such as* ..." However, the Proposed Rule states " *Preauthorization plans should document…* " and adds requirements for consideration of factors such as "inventory" and "manufacturing capability of available agents." Again, this requires additional effort on the part of RRTs and Area Committees, where such work is already typically being done by industry as part of their planning processes.

The net effect of most of the changes involving preauthorization planning is an increase in the workload of all RRTs and Area Committees while r estricting their flexibility in areas where preauthorization is desirable and applicable.

III. Section § 300.910(a) Use of Agents Identified on the Schedule on Oil Discharges Addressed by a Preauthorization Plan

A. *Adding more entities complicates the planning process.*

Section § 300.910(a) states that the RRTs and Area Committees shall address preauthorization plans. API and NOIA do not see any valid reason to add more entities to the planning process. In the preamble to this section, the Agency makes the following statement (column 1, 80 Fed. Reg. 3388):

> *"Therefore, the Agency is proposing to include RRTs as another planning entity with responsibility for developing preauthorization plans, and is requesting comment on this change, and on the advantages or dis advantages of keeping the development of these plans at the AC level."*

We believes that while the RRTs may provide more practical experience to the planning effort, the potential benefit would be overshadowed by the added complexity and bureaucracy. Unle ss the Agency can provide a sound rationale, we recommend against including the RRTs in the development of preauthorization plans.

B. *Area Committees should identify shoreline habitats that can benefit from the appropriate use of dispersants.*

In this same section of the preamble (column 3, 80 Fed. Reg. 3388), the Agency makes the following statement:

> *"The RRT's and ACs should identify the affected biological resources and their habitats likely to be negatively impacted, as well as those that are expected to benefit."*

API and NOIA support the requirement that A rea Committees should identify shoreline habitats that can benefit from the appropriate use of dispersants or other response methods. This will advance the use of the NEBA concept. Note that many of these resources are already identified in Area Contingency Plans.

C. *Preauthorization plans should provide the OSC sufficient authority to use chemical or biological response agents.*

In this same section of the preamble (column 1, 80 Fed. Reg. 3389), the Age ncy makes the following statement:

> *"The Agency is clarifying that if the preauthorization plan is approved in advance for chemical or biological agent use under specified discharge circumstances, then the OSC may authorize the use of the agents on the Sc hedule for their intended purpose without the incident specific concurrences and consultations described in paragraphs (b) of this section unless otherwise directed by the Administrator in accordance with current concurrence authority."*

We believe that the preauthorization plan should provide the OSC sufficient authority to use chemical or biological response agents. Since the Agency will have already been involved in the preauthorization plan approval, additional Administrator concurrence is unnecessary and would unduly complicate the response.

D. *RRTs and A rea Committees should be required to address and document their review and conclusions on whether or not the use of chemical or biological agents is appropriate.*

The Proposed Rule reads that:

> *"RRTs and Area Committees shall address in a preauthorization plan, as part of their planning activities, whether the use of chemical and biological agents listed on the Schedule on certain oil discharges is appropriate."*

This appears to compel RRTs and A rea Committees to document when and why such agents are appropriate, but does not require documentation or the rationale if they are not deemed appropriate, leaving the option open for RRTs and A rea Committees to simply not address prea uthorization for use of such agents. RRTs and A rea Committees should be required to address and document their review and conclusions on whether or not the use of chemical or biological agents is appropriate. API and NOIA suggest modifying the proposed language to read:

RRTs and A rea Committees shall address in a preauthorization plan, as part of their planning activities, whether or not the use of chemical and biological agents listed on the Schedule on certain oil discharges is appropriate and document the rationale for whether or not the use of an agent is considered appropriate.

IV. Section § 300.910(a)(1) Preauthorization Plan Development

A. *Dispersant use should not be limited by the preauthorization plan.*

EPA should not unnecessarily limit the use of dispersants through new req uirements in developing preauthorization plans. In this section (column 3 , 80 Fed. Reg. 3422), the Agency makes the following statement:

> *"For discharge situations identified where such agents may be used, the preauthorization plan must specify limits for the quantities and the duration of use* (Ed. emphasis added), *and use parameters for water depth, distance to shoreline, and proximity to populated areas."*

We assume that this provision in the Proposed Rule is a direct response to recommendation C5 on pag e 270 of the January 2011 report *Deep Water: the Gulf Oil Disaster and the Future of Offshore Drilling* by the National Commission on the BP *Deepwater Horizon* Oil Spill and Offshore Drilling. However, in the four years since the publication of this report, there have been numerous scientific, peer -reviewed environmental and health publications that have examined the dispersant use during DWH.[29] Subsequent laboratory toxicological studies of dispersed oil in the water column after dispersant application showed that there was no detectable harm to the species tested. Key findings from this research program included the following:

- Following surface dispersant applications, the dispersed oil c oncentrations in the water column return within 3 hours to background l evels due to vertical and horizontal dilution into surrounding ocean waters;

[29] Atlas, R. M., & Hazen, T. C. (2011). Oil biodegradation and bioremediation: A tale of the two wo rst spill in U.S. history. *Environmental Science & Technology, 45* (16), 6709-6715. doi:10.1021/es2013227; Chakraborty, R., Borglin, S. E., Dubinsky, E. A., Anderson, G. L., & Hazen, T. C. (2012). Microbial response to the MC -252 oil and Corexit 9500 in the Gulf of Mexico. Frontiers in Microbiology, Ecotoxicology and Bioremediation, 3, 357 -367. doi:10.3389/fmicb.2012.00357; Lubchenco, J. (2010, December 29). Oil spill clarifies road map for sea turtle recovery. The Miami Herald. Retrieved from http://www.nmfs.noaa.gov/mediacenter/docs/2011/mar/oil_spill_clarifies_road_map_for_sea_turtle_recovery.pdf ; Louisiana Department of Wildlife and F isheries. (2010, July). Oyster stock assessment report of the public oyster areas in Louisiana. Oyster Data Report Series No. 16. Retrieved from https://www.wlf.louisiana.gov/sites/default/files/pdf/page_fishing/32695 -Oyster%20Program/2010-oyster-stock-assessment-report.pdf; Operational Science Advisory Team. (2010). Summary report for sub-sea and sub -surface oil and dispersant detection: Sampling and monitoring. Retrieved from http://www.restorethegulf.gov/sites/default/files/documents/pdf/OSAT_Report_FINAL_1 7DEC.pdf; Operational Science Advisory Team. (2011). Summary report for sub -sea and sub -surface oil and dispersant detection: ecotoxicity addendum. Retrieved from http://www.restorethegulf.gov/sites/default/files/u306/FINAL%20OSAT%20Ecotox%20Addendum.pdf ; Shea, D. (2014, August 15). In re oil spill by the oil rig "Deepwater Horizon" in the Gulf of Mexico, on April 20, 2010. Expert report of Dr. Damia n Shea. New Orleans, LA: United States District Court, Eastern District of Louisiana. Retrieved from http://mdl2179trialdocs.com/releases/release20150120070000/TREX -013444.pdf; Soniat, T. M., King, S. M., Tarr, M. A., & Thorne, M. A. (2011). Chemical and physiological measures of oysters (Crassostrea virginica) from oil -exposed sites in Louisiana. Journal of Shellfish Research, 30(3), 713 -717. doi:10.2983/035.030.03 11; and U.S. Food and Drug Administration. (2010, October 29). NOAA and FDA announce chemical test for dispersant in Gulf seafood. Retrieved from http://www.fda.gov/NewsEvents/Newsroom/PressAnnouncements/2010/ucm231653.htm.

- The surface dispersants were applied over an operating area of 18,000 sq. mi., as a result, surface dispersant application rarely occurred in the exact same location, which further enhanced dilution of dispersed oil in the Gulf; and
- The mixing of relatively small volumes of dispersed oil into the very large, well -mixed Gulf of Mexico resulted in very short exposure durations of animals

These studies, conducted during and after the DWH aerial dispersant operations, indicate that there is no need to specify limits for the quantities and the duration of use of dispersants in a preauthorization plan. We believe the Section 300.910(a)(1) proposed requirement that specifies limits for the quantities and duration of use should be deleted from the Proposed Rule.

If the Agency wants to determine whether and how to limit dispersant use, we propose a joint EPA/industry study of existing research results to provide scientific credibility to any limitations that are established. Without scientific justification, artificially -set limitations on dispersant use would threaten the intent of using NEBA to support response decision -making and would limit the OSC's ability to make the best overall decision concerning the actual scenario and the environment.

To be clear, API and NOIA believe the amount of dispersant used should be based on the outflow of oil and the dispersant-to-oil ratio (DOR) that is effective in dispersing the plume. It is under stood that after a specified time period (e.g., 48 hours), the OSC will request RRT concurrence for continued dispersant use (except when there is a threat to human life and health) wherein concerns over quantities and duration can be evaluated.

We believe that the proposed preauthorization requirement to provide distance to shoreline and proximity to populated areas is not justified as the RRTs/Area Committees have already set these requirements in existing preauthorization plans as appropriate . Each RRT has developed preauthorization maps which clearly depict minimum distances from shore and minimum water depths. In addition to these already established distance and depth limitations, during an actual response, dispersant responders work with the RRT, OSC, and Responsible Party to set standard requirements and operating procedures for aerial spray safety setbacks of 1,000 ft. or more from vessels, platforms, response personnel, and sensitive marine life. Because these practices are already in place, there is no need to specifically regulate new parameters. For these reasons, API and NOIA believe the parameters for distance to shoreline and proximity to populated areas should be deleted.

We suggest that the Agency confer with other Federal agencies involv ed in oil spill planning and response and revise the language in the Proposed Rule to specify that preauthorization should rely on the concepts of CERA/NEBA as the foundation for pl ans and response decisions, not on artificially set limits on dispersant volumes. The USCG has conducted more than a dozen CERAs to help inform the decision-making process, but the Proposed Rule appears to contradict the CERA/NEBA tenets that were previously used to define preauthorization zones.

B. *EPA should work with other agenc ies to implement changes to preauthorization plans.*

Finally, since the Proposed Rule suggests that the Agency is adjusting the natural resource trustee concurrence requiremen t for preauthorization plans, we believe strongly that the Agency must demonstrate how it will work with other agencies to implement these proposed changes into the existing RRT preauthorization process and should specify a time interval for the relevant agencies to complete this integration (e.g., 1-year).

C. *The USCG and Bureau of Sa fety and Environmental Enforcement (BSEE) already regulate logistical aspects of dispersant use.*

There is no reason for the Agency to regulate logistical matters related to dispersant usage because they are already regulated by other agencies. In Section § 300.910(a)(1), the Agency makes the following statement:

> *"...and logistical factors including inventory, storage locations and manufacturing capability of available agents, availability of equipment needed for agent use, availability of adequately trained operators, and means to monitor agent use in the environment."*

There have been many advances in regulations and spill response planning in the past decad e. The regulations should acknowledge that there are now requirements in 33 CFR Parts 154 and 155 that have established a surface dispersant capability throughout the U.S. to apply up to 55,000 gallons (daily) of dispersant out to 50 nm offshore. These new regulations resulted in the development of 44 strategically located dispersant stockpile bases. Fur ther, these regulations require training and exercising of equipment and personnel. Given existing compliance with 33 CFR Parts 154 and 155, preauthorization plans do not have to restate all of these assets but should be able to refer to this regulated cap ability. With current U.S. stockpiles containing close to 1 million gallons of dispersant and international stockpiles containing over 1.5 million gallons (as established via the Global Dispersant Stockpile), the requirement to assess dispersant manufacturing capability during the initial response is unnecessary.

We recommend that the Agency revise this section of the regulation to not require specific information on stockpiles, spray equipment, personnel, training or manufacturing and acknowledge that the USCG and the BSEE are regulating these aspects of spill response.

V. <u>Section § 300.910(a)(2) – Preauthorization Plan Approval</u>

A. *The proposed language for w hen a withdrawal of concurrence invalidates a Preauthorization Plan is unclear.*

EPA needs to clarify when withdrawal of concurrence invalidates a preauthorization plan. In the preamble to this section (column 2, 80 Fed. Reg. 3389), the Agency states:

> *"The Agency is proposing specific procedures for concurrence withdrawals, allowing agencies to do so if they believe the preauthorization plan no longer addressed or reflects existing situations if it were to be implemented. While an agency with concurrence authority may not decide to withdraw concurrence from an approved preauthorization plan, there are curr ently no set procedures to promptly address those situations. The proposal would require the RRT and the ACs to address the withdrawal of approval of the preauthorization plan within 30 days of the withdrawal, allowing an opportunity to address the concerns."*

However, the Proposed Rule language is not clear regarding how the withdrawal process operates. While the proposed 30-day period for the RRT to address withdrawal is a positive step as it provides structure and guidance to the process, it is unclear w hen withdrawal of conc urrence would render the preauthorization plan invalid. API and NOIA believe this only makes sense if there is no active or ongoing response. Agencies should not withdraw their concurrence from an existing plan during a response as this could make responding in a timely fashion difficult, if not impossible. This could potentially allow an agency to invalidate a plan at the time of a s pill forcing a delay in the use of dispersants at the most critical time of the response. Note that the States of Alaska and Florida have withdrawn their approval for

preauthorization in state waters, which was done effectively without any additional regul atory requirements.

Clarifying the language to allow for preauthorization plans to remain in place dur ing the 30-day period in which RRTs and A rea Committees address the withdrawal would prevent disruption to response activities. This would maintain the validity and usefulness of preplanning and preauthorization, while allowing for agencies to withdraw con currence based on changing conditions, reducing the possibility of the withdrawal based on political or media influence. This 30 -day review period should also be subject to public comment.

We also note that currently Subpart J does not include the USCG representative to the RRT as a government agency required to approve preauthorization plans. It is important to inc lude one of the key stakeholders, the USCG, in the approval of preauthorization plans.

Accordingly, API and NOIA suggest modifying the proposed language as follows:

> *(2) Preauthorization Plan Approval. The EPA representative to the RRT, USCG RRT representative for the coastal a nd ocean zones where the USCG OSC would have primary authority and responsibility for operational decisions, the Department of Commerce and the Department of the Interior natural resource trustees and, as appropriate, the state RRT representatives shall review and either approve, approve with modification, or disapprove the preauthorization plans developed by the RRT and/or the Area Committees. Withdrawal of concurrence means the preauthorization plan becomes invalid and the authorization of use for chemical or biological agents must be performed according to paragraph (b) of this section. For an agency to withdraw concurren ce, the agency must first notify the RRTs and Area Committees. The RRTs and Area Committees shall review and address the withdrawal within 30 days of the date of notification, during which time the notification of withdrawal will be subject to public comment. The Preauthorization Plan will remain in effect while the RRTs and Area Committees review the withdrawal. If the agency withdrawing its concurrence remains unsatisfied after the 30 -day review period, then the Preauthorization Plan becomes invalid at th e conclusion of the 30 -day review period, and the authorization of use for chemical or biological agents must be performed according to paragraph (b) of this section.*

VI. Section § 300.910(a)(3) – Preauthorization Plans Reviews

A. *The re-approval process for pr eauthorization plans is too frequent and the timing and process for review and revision is unclear.*

Currently there are no requirements for the review of preauthorization plans. Revised Section 300.918(a)(3) requires preauthorization plan review, and revision as needed at the following times:

> *at least every 5 years; after a major discharge or a Spill of National Significance (SONS); to address revisions of the Schedule; to reflect new listings of threatened and/or endangered species; and to address any o ther change that may impact the conditions under which the use of chemical and biological agents is preauthorized.*

The preamble explains that "other changes" may include a new or revised worst case discharge estimate, and that this review requirement is "intended to ensure that preauthorization plans are actively maintained and updated to reflect revisions to the Schedule." (80 Fed. Reg. 3389). If the Agency decides to move forward with a re view requirement, API and NOIA recommend that the Agency clarify (1) what defines a

"major discharge"; (2) what process should be followed for re-approval; and (3) what effect a change in the preauthorization would have on existing FRPs and VRPs, which are also updated on a 5 -year cycle. We believe the review of preauthorization plans every 10 years or, at the discretion of the RRT/ Area Committee after a SONS (per [a] and [b] in the statement) , is sufficient and that the "major discharge" language should be removed . The Agency should also strike the requirement for review upon new threatened and/or endangered species listings and "to address any other change" since this type of planning on a "less than five year basis" overly -burdens the RRTs. Also, the Agency should clarify what the re-approval process would entail and establish a framework for how long review and approval should take. In addition, the USCG representative to the applicable RRT should also be included in this process. This, along with the remaining review triggers, would still allow for robust, current preauthorization plans, while maintaining stability of existing, potentially affected FRPs and VRPs.

We suggest modifying the proposed language as follows:

> *(3) Preauthorization Plans Reviews. The RRT and/or the Area Committees must review, and revise as needed, pursuant to paragraph (a)(1) of this section, preauthorization plans at least every 10 years; or at the discretion of the RRT and/or Area Committee after a Spill of National Significance (SONS); to address revisions of the Schedule; to reflect new listings of threatened and/or endangered species; and to address any other change that may impact the conditions under which the use of chemical and biological agents is preauthorized. The designated EPA RRT representative, the USCG RRT representative for the coastal and oceans zones where the USCG OSC would have primary authority and responsibility for operational decisions, the Department of Commerce and the Department of the Interior natural resource trustees, and the RRT representative from the state(s) with jurisdiction over the waters of the area to which a preauthorization plan applies shall review and either approve, approve with modification, or disapprove any revisions to the preauthorization plans.*

VII. Section § 300.910(b) Use of Agents Identified on the Schedule on Oil Discharges Not Addressed by a Preauthorization Plan

A. *A reasonable consultation time of 48 hours should be established for natural resource trustees if the Agency concludes that the current "if Practicable" standards should be changed*

In this section in the Proposed Rule (column 1 , 80 Fed. Reg. 3423), the Agency has removed the words *"when practicable"* with respect to consultation with the Department of Commerce (DOC) and the Department of the Interior (DOI) natural resource trustees for the following reasons discussed in the preamble:

> *"The requirement for consultation with the DOC and DOI natural resource trustees is also maintained. However, the language is amended by removing 'when practicable' with respect to consultation with the DOC and DOI natural resource trustees. The Agency believes that the case-by-case decision making should include consultations with natural resource trustees since these discharge situations may present unique challenges when selecting a response option that involves chemical or biological agents. While the Agency recognizes the time -critical nature of decision making during a response, advances in communication technology with increased capabilities to communicate quickly."*

(column 1, 80 Fed. Reg. 3390) API and NOIA believe that while technical advances in communication (e.g., cell phones) have improved since the last Subpart J revision, it does not guarantee an immediate or timely response by the required individuals. And the current system has worked well for years. Thus,

continued flexibility in the approval process (i.e., "when practicable") is still warranted to ensure the timeliest and best possible response . If the Agency concludes that the current " when practicable" language needs tightening up it could establish a reasonable consultation time of 36 hours. Spill response decision-making requires timely decision-making. Natural resource trustees already have an independent process to assess possible damages outside of the response effort (via Natur al Resources Damage Assessments [NRDA]). The phrase could be revised to state, "*...when practicable within a 36-hour timeframe*".

B. *The change in th e term "navigable waters threatened " will set up additional barriers to dispersant use and unduly limit actions by the OSC.*

In the same paragraph (column 1, 80 Fed. Reg. 3390), the Agency makes the following statement:

> *"The Agency is also proposing to revise the term 'navigable waters threatened' to 'waters and adjoining shorelines threatened' to be consistent with the provisions in paragraph (a) of this section."*

We are concerned that this change will set up additional barriers to dispersant use and unduly limit actions by the OSC.

C. *Early dispersant use decision-making should focus on documenting that a NEBA justification exists to support dispersant application.*

The Proposed Rule would unnecessarily establish new requirements f or an OSC to document the parameters used to authorize dispersants. This is discussed in the same section (column 2, 80 Fed. Reg. 3423), as follows:

> *"...the OSC must consider and document the parameters for the use of agents including the quantities to be used, the duration of use, the depth of water, the distance to shoreline and proximity to populated areas, and should address factors suc h as environmentally sensitive resources or restricted areas that might be impacted, agent inventory and storage locations, agent manufacturing capability, availability of equipment needed for agent use, availability of adequately trained operators and appropriate means to monitor agent use in the environment."*

Because dispersants have a limited window of opportunity to be used on spills, it is important to decide quickly on their use. Decisions by the OSC should not be delayed to complete information that is not needed. Many of the proposed items for the OSC to document (e.g., stockpiles, personnel, spray assets) are already specified and required in the applicable response plan requirements of 33 CFR Parts 154 and 155. Given the current stockpile availability in the U.S. and in the Global Dispersant Stockpile, dispersant availability will not be a concern for weeks or months. As suc h, we believe that the immediate actions by the OSC should include a review of the pre -authorization plan(s) and a rapid , incident-specific NEBA to support the selection of response options that may include dispersant application as a means to lessen or eliminate impacts to sensitive shoreline resources or to pr otect worker health and safety. In addition, we recommend that the Pr oposed Rule require referencing the USCG -classified dispersant OSRO or other OSRO for many of the items requested.

VIII. <u>Section § 300.910(c) Burning Agents</u>

A. *Ignition devices for in-situ burning are not burning agents.*

Under the current rule an OSC may author ize use of a burning agent on a case -by-case basis after concurrence of the EPA representative to the RRT, the state RRT representative and in consultation with the DOC and DOI natural resource trustees, when practicable. The Agency proposes to authorize the OSC to approve the use of a burning agent without the approval or consultation with other agencies to facilitate expedited use in recognition of their increasing importance in response to spills and that small quantities of burning agents are used and are quickly consumed by the resulting fire. API and NOIA agree and commend the Agency for this proposal. Further, we agree that ignition devices should be excluded from the definition of burning agents.

We believe that chemical herder agents are includ ed within the scope of the term burning agents. In the preamble to this section (column 3, 80 Fed. Reg. 3390), the Agency makes the following statement:

> *"Further, because of the nature of burning agents and the proposed revisions to the authorization of use for these products, the Agency continues to believe it is not necessary to require product submissions for burning agents."*

We believe this statement also applies to chemical herder agents. Please clarify if this is correct.

IX. Section § 300.910(d) Exception

A. *EPA needs to clarify the phrases "protection of human life" and "near inhabited areas."*

In this section in the Proposed Rule (column 2 , 80 Fed. Reg. 3423), the Agency makes reference to "the protection of human life ." We believe it is unclear whet her "*protection of human life* " is inclusive of the protection of worker health and safety. The Agency should amend this section to clearly include the protection of oil spill response worker safety within this concept. This same section also references spi lls "*near inhabited areas.* " This language is confusing since spills where dispersant use serves an environmental benefit will rarely (if ever) be near inhabited areas.

B. *A time limit on protecting human health is inappropriate.*

We believe the establishmen t of a 48 h our limit to the OSC's use of authority to use agents to protect human health is inappropriate. There should never be a limit to the OSC's ability to make decisions that are aimed at protec ting human health or human life, and the exception shoul d be permissible until the threat to human health has subsided. The current rule adequately allows for the OSC to approve use of dispersants in such cases and EPA has not justified that the proposed requirement is necessary or provides any benefit to existing requirements.

X. Section § 300.910(e) Prohibited Agents

A. *Banning nonylphenol (NP) and nonylphenol ethoxylates (NPE) is not necessary for dispersants.*

API and NOIA submit that NP and NPE components should not be banne d. In the preamble to this section (column 2, 80 Fed. Reg. 3391), the Agency makes the following statement:

> *"The Agency is also proposing to add a prohibition from listing on the Schedule and from authorizing use of any chemical or biological agents that contain n onylphenol (NP) or nonylphenol ethoxylates (NPEs) as components."*

While we appreciate the Agency's concern about NP and NPE components, an outright prohibition seems inconsistent with the practice of allowing NP and NPE ingredients in a variety of widely-used cleaning products in the U.S. After use, these products are routinely flushed and transported into wastewater discharges on a daily basis. Spill response dispersant use is extremely infrequent and only occurs when a significant threat to shoreline or near shore resources is present. Banning these components in oil spill dispersants while allowing their wide spread use in other commercial products seems contradictory and prejudicial. API and NOIA requests that the Agency explain why NP/NPE is banned in dispersant products, but not in many more commonly manufactured products.

B. *Endocrine disruption testing has little relevance and is not necessary.*

We submit that endocrine disruption testing should not be added. In the same section (column 1, 80 Fed. Reg. 3392), the Agency states:

> *"Because validated testing methods are still being developed the agency is not proposing any test requirements with respect to endocrine disruption for products to be listed on the Schedule."*

We believe that adding any such testing provides little relevance in the context of oil spill response decisions and that testing efforts are better directed at the use of standardized toxicity tests with aquatic organisms using endpoints of population relevance (i.e., mysid and *Menidia* tests proposed).

C. *Mechanical response clean-up methods have greater limitations in offshore conditions than dispersants.*

Mechanical response clean-up methods have many limitations. In the same section (column 2, 80 Fed. Reg. 3392), the Agency makes the following statement:

> *"There are chemical and biological agent alternatives to sinking agents and to agents containing NP or NPE; <u>as well as mechanical methods</u>* (Ed. emphasis added) *for responding to oil discharges, including those situations that pose extreme threats or are time critical."*

We believe the Agency must realize the limitations that mechanical response methods have in offshore conditions. Weather conditions will preclude booming and skimming operations in sea states above six feet wave height, and even in ideal sea state conditions, responding to offshore spills historically has resulted in 5-10% of spilled oil recovered by mechanical recovery methods. For this reason, it is critical that responders have reasonable access to chemical response methods, because of the substantially higher encounter rates (80% or more) that can be achieved by treating the spilled oil with dispersants.

XI. <u>Section § 300.910(f) Storage and Use of Agents</u>

A. *No additional requirements should be put in place for product shelf life.*

Currently, the manufacturer is required to provide information on recommended conditions of storage and use for each product at the time an application for listing a product under Subpart J is submitted to the Agency. With regard to shelf life, the Agency is requesting comments on whether more information should be submitted on issues related to shelf life. Specifically, in the preamble to this section (column 1, 80 Fed. Reg. 3393), the Agency makes the following statement:

> *"To alleviate concerns that applications are submitted that establish an extended or indefinite shelf life for a product, the Agency is requesting comments on whether any*

> *additional data or information requirements should be included for the product listing determinations specific to a product's shelf li fe, or whether alternative approaches, such as limiting the shelf life for product categories to a given timeframe, should be considered."*

API and NOIA believe that no additional requirements should be put in place for product shelf life and thus it shoul d not change the current practice of having the manufacturer provide information on recommended conditions of storage and use for each product. Ensuring product efficacy (regardless of age) is the only relevant end-point. For example, research has shown that properly maintained stockpiles of Corexit 9500 have remained effective for 25 years. Given that periodic effectiveness testing is proposed, there is no justification for also mandating a shelf life that could potentially result in costly replacement of stockpiles that remain viable and effective.

If the Rule dictates a dispersant shelf -life, this could caus e an undue financial burden. We believe that suppliers may set low shelf-lives to protect themselves from liability or to promote future recurring s ales, even though there are well-documented studies indicating that properly stored dispersant stockpiles have maintained their effectiveness for decades. A 2008 study by Clark, *et al.*,[30] evaluated U.S. stockpiles of Corexit 9527 and concluded that batches of this dispersant have remained viable for spill response for over 30 years. Establishing shelf -lives for products makes sense if periodic testing is not specified. However, since the Proposed Rule specifies re -testing of the dispersant stockpiles, there is no justification for also requiring a shelf -life. We submit that the requirement for a shelf -life should be removed from the Proposed Rule and that the Agency should instead provide more clarity on product re - testing for efficacy. Specifically, the requ irement to conduct periodic 5 -year tests of effectiveness and toxicity is unclear. The sampling requirement has not been delineated in the Proposed Rule, which could be interpreted, in the extreme case, that every single dispersant container would have to be re-sampled and tested to remain in an "approved" status.

The Rule should clearly state that representative samples of batches/lots are tested for efficacy and that the testing interval take into account the aforementioned studies that demonstrated tha t dispersant stockpiles maintain effectiveness for decades. Further, we submit that there is no scientific justification for re-testing toxicity.

B. *Central dispersant stockpiles are typically maintained by OSROs, not by Responsible Parties or product manufacturers.*

Under the Proposed Rule the OSC would only be able to authorize use if the Responsible Party certifies that the products have been stored under the conditions provided by the submitter. In this section in the Proposed Rule (column 2-3, 80 Fed. Reg. 3423), the Agency makes the following statement:

> *"The OSC may authorize for use only products that are certified by the Responsible Party to have been stored under the conditions provided by the submitter under 300.915(a)(6) and whose date of use does not exceed the expiration date listed on the container's label at the time of the incident. The Responsible Party must provide the OSC product documentation, developed in consultation with the submitter of the product to the Schedule, prior to OSC authori zation of product use affirming it has maintained its integrity, including no changes in its composition, efficacy, and toxicity."*

[30] Clark, J., Becker, K., & Lessard, R. (2008). Maintaining dispersant stockpiles and assessing their quality. *Proceedings of the 2008 International Oil Spill Conference, 2008*(1), 695-698. doi:10.7901/2169-3358-2008-1-695

The Agency needs to recognize that central dispersant stockpiles are typically maintained by OSROs and are stored mainly in 200 to 300 gallon totes so that they can be transported by truck or air to the site of a spill. In most spill situations, the dispersant stockpile will not be in the control of the Responsible Party or the submitter of the product (i.e., the original manufacturer) at the onset of a spill. As a result, there is no way for these two entities to make a certification for a product that was not in its direct control just prior to the spill. API and NOIA suggest modifying the language to clarify that Responsible Parties must only demonstrate compliance with Section 300.915(a)(6) for inventory/product they control.

C. *Certification of storage conditions should not be required for authorization of use.*

Section § 300.910(f) states that the OSC may authorize for use only products that have been stored under the conditions specified by the manufacturer including the maximum, minimum and optimum temperatures as well as humidity and other relevant conditions. This proposed regulation could require dispersants to be stored in climate controlled buildings with continuous temperature and humidity monitoring. We do not support this proposed requirement.

D. *API and NOIA opposes any re-testing requirements during a spill response.*

The intent of this section is difficult to discern but it appears that the certification requirement appears to essentially requires complete retesting of the product (at the time of the spill) for the Responsible Party to certify such a statement. It appears that the Agency has included this language with the specific intent to delay the dispersant authorization process by requiring complete re-testing at the time of a spill incident. We strongly oppose any re-testing requirements during a spill response. Any product testing should be conducted at a specified, planned interval, not during an emergency response. During a response, the Responsible Party should not have to certify the dispersants that will be applied, since that is the purpose of the NCP Product List. The only requirement should be for the Responsible Party to show the OSC, if requested, the original manufacturer's verification (Certification of Analysis) that the product meets specifications for dispersants with an age of less than the period for retesting recommended by the manufacturer. For older dispersants the Responsible Party should, if requested, show the efficacy re-test data for the stockpile. The test required should only be for effectiveness as it is a reliable indicator that the composition has remained the same. We propose that this language is changed to read: *"The OSC, to authorize the use of dispersants, may request that the Responsible Party provide test data of the dispersant stockpile showing it is effective."* We also suggest modifying the language so that it applies only for product manufactured or produced after the date of final rule publication.

E. *Re-testing requirements must permit flexibility in test results over time.*

This same section specifies re-testing and re-labelling requirements. This section does not specify the criteria for re-testing results and needs to specify permissible levels of deviation from past testing results. We point out that efficacy and toxicity testing have inherent variability. Two testing runs of the same product, in the same laboratory, in the same week can yield varied results, so any re-testing requirements must permit flexibility in test results over time. We suggest an allowable 10% variance in effectiveness test results, based on manufacturer and scientific experts' opinion on effectiveness testing. As previously stated, we do not believe there is any scientific justification to re-test for toxicity since efficacy results will confirm if the composition of the dispersant has changed. We suggest clarifying language so that it is clear product testing is only required if it is not stored under requirements provided by submitter, or it has expired.

F. *The assignment of an arbitrary 5-year life to products is biased and creates unwarranted expense due to recurrent testing.*

Finally, the assignment of an arbitrary 5-year life to products without regard to prior research on product viability over time, or on manufacturer input on product re-testing, is biased and creates unwarranted expense due to recurrent testing. Proposing 'no change' in composition, efficacy, and toxicity seems unreasonable and could result in significant costs of replacing usable dispersant stockpiles. Additionally, dispersant manufacturers typically advise that container seals not be broken and the material not be exposed to air, which would be necessary to test existing stocks, which may or may not have an expiration date printed on the label under current regulation.

Studies exist that show Corexit products maintain effectiveness for 25 years. We believe that any re-certification term should be based on existing scientific and manufacturer data. There should also be an allowance for some change/degradation of product over time, aligned to international practice. For example, the United Kingdom Marine Management Organisation allows a loss of efficacy to 75% of the original minimum level. Further, there is no scientific rationale to require any form of toxicity re-testing of a dispersant that was previously tested. Manufacturers will have the best insight regarding when product recertification should be needed. In addition, the Responsible Party should never be required to re-label products they did not produce, with the possible exception of adding a re-test date for product efficacy.

XII. Section § 300.910(g) Supplemental Testing, Monitoring, and Information

A. *API believes the standard efficacy and toxicity tests already required are more than adequate for regional use.*

We do not believe there is a need for additional testing than is currently required under the NCP. In the preamble to this section (column 2, 80 Fed. Reg. 3393), the Agency makes the following statement:

> *"The proposal removes 'in addition to the test methods specified in 300.915 and described in appendix C to part 300.' While RRT's may want to use the efficacy and toxicity testing protocols specified in Appendix C of the NCP for comparative purposes, the proposed revisions clearly establish the RRT's authority to require tests using parameters beyond those specified in Appendix C. Furthermore, there may be supplementary toxicity and efficacy testing information based on recognized standard testing methods already available that RRTs may want to consider when addressing site, area, or ecosystem specific concerns."*

We believe the standard efficacy and toxicity tests already required are more than adequate for regional use. We suggest the Agency consult the NOAA Dtox database. A review of that database suggests that the sensitivities of all tested species are in the known range and that additional tests simply reinforce the existing species sensitivity distribution curves. Regional data are unlikely to fundamentally change overall NEBA considerations for dispersant use. Any regionally required laboratory efficacy tests during a response will not be as relevant as a pilot test in the field and will only delay the dispersant authorization process approval beyond the window during which dispersants could be applied (thereby precluding their use in some situations where they may have provided a net environmental benefit). This proposal allows RRTs to request a broad range of additional data on a product, a situation that creates the potential for confusing and costly testing and is unlikely to add further information of value to oil spill response decision-making.

B. *Additional monitoring during a response is unreasonable.*

Section § 300.910(g) provides the RRT with the authority to request that the OSC require the Responsible Party to conduct additional monitoring associated with use of a product. We submit it is unreasonable to require additional monitoring during a response except in exceptional circumstances. In the preamble (column 2, 80 Fed. Reg. 3393), the Agency makes the following statement:

> *"For example, the RRT may want to monitor the exposure of marine mammals to oil constituents, including the dispersed oil, or to monitor toxicity in the water column using biological assays."*

We believe such monitoring during a response is unreasonable and should only be undertaken if (a) there is some critical question associated with the spill response that has not been answered with the testing already in place; and (b) there is sufficient time to arrange for proper and scientifically defensible protocols to be established. Given that tests associated with such monitoring are likely to be complex and require considerable time to prepare, implement, and interpret, it appears that the tests would not inform operational decision-making during the response, but rather would develop data for NRDA. As previously stated, operational monitoring and NRDA are two different things and this Proposed Rule should not specify NRDA monitoring. Additionally, the "biological assays" that are referenced in the Proposed Rule are impractical given the nature of offshore spills where dilution is significant, water movement is constant, and synoptic sampling of small quantities of organisms from dynamic water masses is not representative of any chronic or resident conditions.

API and NOIA suggest revising the language as follows:

> *(g) Supplemental Testing, Monitoring and Information. The RRT may require supplementary toxicity and efficacy testing, or available data or information that addresses site, area, or ecosystem specific concerns relative to the use of a product for both planning and authorization of use. During a discharge incident, the RRT may request that the OSC require a Responsible Party to conduct additional monitoring associated with the use of a product to the extent necessary for conducting response operations. Such additional monitoring data may include supplemental sampling and testing to ensure safety of response personnel, to assess acute environmental impacts or otherwise aid the OSC and/or the RRT in operational decisions.*

XIII. Section § 300.910(h) Recovery of Agents from the Environment

A. *The OSC has the authority to use the NEBA process to make decisions on recovery of agents from the environment.*

In the preamble to this section, the Agency is requesting comments on new language that would require the Responsible Party, under OSC oversight, to remove specified products/agents from the environment after use. While the Proposed Rule hints at NEBA, it does not reference it specifically when suggesting that some situations (e.g., safety of personnel or greater harm to the environment) might preclude the removal of these agents. That would seem to contradict the main change in this section (h) while not providing any framework (e.g., NEBA) in which to make a determination for precluding the removal. The language is also potentially redundant as the OSC is already obligated to consider safety and additional adverse environmental impacts (i.e., via NEBA) as part of the normal decision-making process. Essentially, it is already an underlying tenet of the response process. Additionally, in some cases recovering 100 percent of these agents after application is not practical or even feasible regardless of the diligence of the Responsible Party

We suggest revising the proposed language to make it clear that the OSC has the authority to use the NEBA process to make these decisions:

> *(h) Recovery of Agents from the Environment. Depending on factors such as the safety of response personnel and harm to the environment (including consideration of Net Environmental Benefit Analysis [NEBA]), and as directed by the OSC, the Responsible*

Party shall, following application, endeavor to adequately contain, collect, store and dispose of the agents that are intended to be recovered from the environment.

XIV. Section § 300.910(i) Reporting of Agent Use

A. *The Agency should not adopt a prescriptive time period for reporting of agent use.*

The Agency is requesting comments on the appropriateness of requiring the OSC to provide the RRT additional reporting information " *within 30 days of completion of agent use* ." This runs counter to the adaptive decision-making that might be required during a discharge event where such agents are used.

Based on the pre authorization testing that is being proposed and, more importantly, the variability of discharge situations, we recommend that the Agency not adopt a prescriptive time period and rather provide the relevant RRT(s) discretion to determine the appropriate time period for reporting agent use. A strong justification for this approach is that during prolonged discharges, a fixed 30 -day reporting period might constrain the response personnel and interfere with higher priority resource allocations. Furthermore, the OSC would typically request this information as part of the daily briefing.

API and NOIA suggest removing the 30-day window for reporting and modifying the proposed language as follows.

> *(i) Reporting of Agent Use. Unless already included in the OSC report required under § 300.165 of this part, the authorizing OSC shall provide the RRT the following information on chemical and biological agents used in response to an oil discharge: product name, quantity and concentration used, duration of use, and locations.*

XV. Section § 300.913 Monitoring the Use of Dispersants

A. *The appropriate use of spill mitigating products will reduce the overall impact of the spill and protect the health and safety of response personnel.*

The Agency makes the following two related statements to explain the goal of the NCP Product Schedule (column 3, 80 Fed. Reg. 3393; column 3, 80 Fed. Reg. 3402; respectively):

> "*The goal of establishing a Schedule under the NCP is to protect the environment from possible damage related to spill mitigating products used in response to oil discharges.*"
>
> *"Emergency response personnel need to know whether a dispersant or any other type of chemical or biological agent on the Schedule could have negative environmental impacts relative to the oil before decisions are made about its use in a particular oil discharge situation. Consequently, it is essential to consider comparative information about the efficacy and the toxicity of these products.*"

Possible damage related to spill mitigating products used in response to oil discharges is considered, but not the possible damage that could be caused by the oil itself without the use of spill mitigating products. The main threat to response personnel, communities, and the ecosystem comes from the oil, not from the spill mitigating products. The concept of CERA/NEBA accepts that some effects might be caused by the response (including the use of spill mitigating products), but also recognizes the greater benefit of reducing the overall impact of the spill that can be achieved by using them. The Agency needs to acknowledge the importance of NEBA in justifying the use of dispersants.

We believe that the focus on the potential for negative environmental impacts that could be caused by a dispersant ignores the essential point that dispersants are used to mitigate (minimize) the negative human health and environmental impacts that could be caused by the oil. The main threat to the ecosystem comes from the oil itself, not from the dispersant. The wording of the preamble to a final rule needs to:

- reflect the ultimate aim of dispersant use;
- clarify that the toxicity of dispersed oil comes from the oil (not the dispersant); and
- acknowledge and emphasize the importance of using a NEBA process in dispersant use decision-making.

We request that the Agency consider including the following two paragraphs (or equivalent language) in the preamble to the final rule to briefly explain dispersant use and the importance of NEBA in making dispersant use decisions.

> *"Dispersant Use and Net Environmental Benefit Analysis (NEBA)*
> *The aim of dispersant use is to protect response personnel from VOC exposure and to prevent oil from drifting ashore and potentially causing severe and long-term damage to coastal resources and communities, by dispersing the oil into the water column where it will be diluted rapidly to very low concentrations and the majority of the oil will subsequently be biodegraded. This common aim of dispersant use is the same, whether it is applied to oil on the sea surface or directly at the outflow source in the case of a subsea release. The potential risk of dispersant use is that, by dispersing the oil into the water column, there is an increased potential for toxic effects to be caused to marine organisms. The severity of the toxic effects that could be caused is related to the exposure of the marine organisms to the dispersed oil (or the partly water-soluble oil compounds) and exposure is a function of concentration of the oil in the water and the duration for which such exposure persists.*
>
> *The issue of the environmental trade-offs caused by dispersant use is addressed by Net Environmental Benefit Analysis (NEBA). NEBA is a process used to make choices about oil spill response techniques to be used to minimize the potential impacts of the oil on people and the environment. NEBA takes into account the likely effectiveness and feasibility of conducting alternative response techniques under the prevailing conditions. The main principle of NEBA is that an oil spill response technique (or combination of techniques) that is used should be that which minimizes potential impacts of the oil on the environment to the greatest extent and promotes the most rapid recovery and restoration of the affected area. In many cases of dispersant use, the potential risks to the offshore marine ecosystem are very low because dispersed oil concentrations are low and persist only briefly. There is benefit in using dispersants in offshore environments to prevent damage to coastal communities and sensitive near-shore resources where persistent stranded oil can cause longer-term environmental problems."*

The Proposed Rule also appears to focus more on the environmental effects during the response rather than the health and safety of response personnel. The Agency should make it clear that one of the primary objectives of characterizing the efficacy and understanding transport is to protect the health and safety of response personnel. That critical aspect is not mentioned in this section.

B. *The OSC should determine where, when, and how monitoring resources should be deployed.*

EPA should clarify the meaning of the phrase *"upon initiation and for the duration of subsurface dispersant use."* Later in this section of the preamble (column 2, 80 Fed. Reg. 3394), the Agency states the following:

> *"The proposal requires the responsible party to implement monitoring for any subsurface dispersant use in response to an oil discharge upon initiation and for the duration of subsurface dispersant use."*

The phrase *"upon initiation and for the duration of subsurface dispersant use"* can be misconstrued to mean that all monitoring required by the Proposed Rule must be performed at all times, when in fact the monitoring timing and operational parameters should be established by the OSC. Every response is unique, and it should be left to the OSC to determine where, when and how monitoring resources should be deployed to provide the best near real-time operational monitoring on the progress of the response.

C. *The Proposed Rule should be restructured to separate surface dispersant application monitoring from subsea dispersant injection monitoring.*

EPA should distinguish between surface and subsea dispersant application monitoring. In the first paragraph of this section in the Proposed Rule (column 1, 80 Fed. Reg. 3424), the Agency states:

> *"As directed by the OSC, the Responsible Party must monitor any subsurface use of dispersant in response to an oil discharge, surface use of a dispersant in response to oil discharges of more than 100,000 US gallons occurring within 24 hours, and surface use of dispersant for more than 96 hours in response to an oil discharge, and submit a Quality Assurance Project Plan for approval to the OSC covering the collection of all environmental data".*

We believe it is significant that monitoring is to be required *"as directed by the OSC."* It should be made clear that the OSC has discretion to authorize initial use of dispersants during a time-limited efficacy testing phase while evaluating the need for and extent of additional adaptive monitoring actions. The OSC is in the best position to determine when and what operational spill response monitoring is to occur. Experience has shown that the use of phased monitoring approaches, consistent with the USCG *et al.*'s *Special Monitoring of Applied Response Technologies* (SMART) protocols, is appropriate, and they are most responsive to changes in site-specific conditions and information requirements. While the requirement for the Quality Assurance Project Plan (QAPP) is constructive in helping to maintain effective data integrity and management, the rule should provide the OSC with discretion in how detailed the document needs to be to meet this requirement. This would provide the relevant incident decision-makers with practical information that can be consistently acquired, analyzed, and understood.

The Proposed Rule seems to inappropriately replace the currently used 3-tier SMART protocols for monitoring surface dispersant use with the more exhaustive monitoring approach proposed for subsea dispersant use. The USCG Strike Teams already have the responsibility for monitoring surface dispersant operations and possess the trained personnel and equipment to conduct these activities. Many RRTs require the immediate activation of USCG Strike Team monitoring for all dispersant operations, regardless of size or location. We believe it is beneficial to have the government perform the surface monitoring to enhance credibility with the public that the operations are being conducted correctly and are working as intended. If this practice is going to change, the Agency should explain why it is circumventing an established, well-vetted process performed by the USCG Strike Teams. The information in the Proposed Rule creates confusion between existing responsibilities of the USCG Strike Teams and those of the Responsible Party. We request that this confusion be reconciled between the Agency and the USCG, as the Responsible Party should not be required to provide duplicate monitoring for surface dispersant operations.

For these reason s, we believe this section of the Proposed Rule should be restru ctured to separate surface dispersant application monitoring from subsea dispersant injection monitoring. API and NOIA offer the following relevant points:

- The section on surface dispersant application monitoring should specify that it will be implemented with existing SMART protocols using USCG resources.
- The section describing subsea dispersant injection monitoring should specify it will be performed by the Responsible Party.
- In both cases, the Proposed Rule should clearly state that the mobilization o f monitoring capabilities will not delay initial dispersant applications. Monitoring requirements should not impede the use of chemical agents during a response and should be implemented as appropriate resources become available during the response.
- The c riteria of greater than 100,000 gallons or duration of 96 hours for the spill should be replaced with a single criterion that " *any enhanced monitoring beyond SMART shall commence within seven days.* " Our rationale for a deployment schedule of seven days for any enhanced monitoring (whether subsea or surface dispersant monitoring) ensures that scientifically - defensible monitoring can be performed, by ensuring:
  - The best scientific experts can be assembled and mobilized to the spill;
  - Once on scene, the science team can design a monitoring plan that can be integrated safely into ongoing response operations, and be worked into the Simultaneous Operations (SIMOPs) schedule;
  - The team can tailor a general monitoring strategy into a specific mission plan for the monitoring vessel that is available (there is no way to know what research vessel may be available, and each vessel will have unique characteristics for equipment deployment);
  - Available monitoring vessel(s) can be identified, mobilized to port, and properly out fitted with the scientific equipment needed to implement the mission plan;
  - An appropriate sampling strategy can be developed and approved for the specific incident, taking into account ongoing response activities that may impede access to sampling sites; and,
  - Appropriate safety considerations for the monitoring vessel, dispersant application or injection platforms, and rapidly-assembled teams can be properly reviewed.

D. *Effectiveness determination is not currently scientifically feasible.*

The language in this section of the Proposed Rule appears to indicate the Agency believes that comprehensive monitoring will permit the dispersant effectiveness at sea to be quantitatively determined. This requirement for effectiveness determination is not currently scien tifically feasible. Also, use of the word "*comprehensive*" should be avoided as it is subjective. Instead, it should be replaced with "*adaptive*" which indicates that a decision could be revisited as the d ischarge situation changes. We recommend replacing all instances of the word " *comprehensive monitoring*" with "*adaptive monitoring*" throughout the proposed section. The following language could be used:

> *The agency believes that an adaptive monitoring program which includes objective science and ocean transp ort modeling in certain discharge situations is necessary to determine the overall effectiveness of the dispersants and should transcend the initial dispersant application to include the extent, character, and transport of the dispersant and dispersed oil in the water column.*

With respect to <u>surface dispersant use monitoring</u>, we offer the following comments:

- Experience at the DWH and other incidents has shown that no currently available remote sensing technique, including airborne visible/infrared spectro meter (AVIRIS) and other multi- and hyper-spectral equipment, is capable of accurately quantifying the total amount of oil on the sea surface. It is also not possible to accurately determine the total amount of dispersed oil in the water column at any time because water sampling or ultra violet fluorometry (UVF) transects cannot be made at sufficient resolution in space (i.e., distance and depth) and cannot be made at sufficient resolution in time (i.e., simultaneously at all points in the water under an oi l slick). Localized measurements by UVF made before and after dispersant spraying can reveal the relative effect of dispersant use, but is not quantitative . A sharp increase in dispersed oil concentrations in the water, after dispersant use, is a good indi cation that the dispersant is working, but such measurements cannot produce an aggregate estimate of disper sant effectiveness. As such, we believe that the Agency should remove any requirement for quantitative reporting of efficacy, since it is not technically possible.
- A QAPP should not be required for surface dispersant operations. QAPP for approval by the OSC covers the collection of all environmental data to ensure and maximize its quality, objectivity, utility, and integrity. All these requirements wil l result in the need to generate a very large document that needs to be reviewed, verified and approved by OSC. This will lead to delays in dispersants decision-making, while adding little value to the goals of the response. A more useful approach may incl ude a daily Quality Control review of the SMART data to determine if the surface dispersant applications were effective that day, to support decisions for possible dispersant use the next day. A Quality Control form was developed during DWH for this purpos e. we believe the QAPP requirement should be deleted for surface dispersant operations and replaced with a simplified Quality Control form for SMART data.

With respect to <u>subsea dispersant injection monitoring</u>, we provide the following comments:

- The Age ncy does not address methods for visual determination of subsea dispersant effectiveness. During DWH, visual monitoring of the subsea dispersant injection was conducted in two ways to provide valuable, near real -time information to help inform response dec isions. These included:
  - Aerial observations of surfacing oil quantity and appearance (provided from observation aircraft overflights); and
  - Subsea observations of changes in plume appearance at the injection site (provided from ROV imagery).

  This form of monitoring for subsea dispersant injection should be recognized as an important step for initially evaluating the operation while more "enhanced scientific monitoring capabilities" are being assembled.
- API has developed subsea monitoring guidance (API Techn ical Report 1152 , *Industry Recommended Subsea Dispersant Monitoring Plan – Version 1.0*) and recommends the Agency consider this as the basis for their approach for operational monitoring. This guidance is publicly available at http://www.oilspillprevention.org/~/media/oil-spill-prevention/spillprevention/r-and-d/dispersants/api-1152-industry-recommended-subsea-dis.pdf.

XVI. Section § 300.913(a) Documenting and Monitoring the Oil Discharged and Dispersants Used Requirements

A. *The Responsible Party should not be required to document information at the beginning of a response that has already been determin ed in planning and preparedness activities.*

The current regulations found in 33 CFR Parts 154 and 155 require OSROs that use dispersants to maintain a certain level of spray assets, dispersant stockpile quantities, and logistical capabilities to

deliver stockpiles to staging bases, and to provide information on the application dosages they can apply. Since this is regulated elsewhere, reporting of these elements should not be required in the Proposed Rule and should therefore be deleted.

The Responsible Party should not be required to provide the *"rationale for dispersant product choice(s) including the results of any efficacy and toxicity tests specific to area or site conditions."* If the dispersant product is on the Product Schedule (which means that eff icacy and toxicity data have already been provided to the government), then it is, by definition, a viable option for the response.

Providing *"hourly application rates"* does not apply to aerial and vessel application since dosages are prepared in gallons per acre application and are based on the spray assets' application speed an d spray system swath width. We suggest that this statement be modified to read: *"hourly application rates (in the case of subsea dispersant injection)."*

The phrase " *recommended di spersant-to-oil ratio (DOR)* " should be modified to " *recommended <u>initial</u> dispersant-to-oil ratio (DOR).* " Every spill is different, and the DOR should be adjusted as additional monitoring, analytical data results, and/or oil release rate information becomes available. Additionally, the DOR may need to change as the oil weathers or other conditions change. The Agency should consider providing a clarifying sentence recognizing that oil characteristics and effective DORs may vary and thus dispersant application rates/volumes cannot be fixed to pre-determined values as this practice may affect negatively the response.

The Agency should refrain from requiring estimates of dispersant volumes needed to effectively respond to the spill at the onset of the response. In the case of a subsea oil release, it is impossible to know how much oil will be released and , therefore, impossible to estimate what volume of dispersants might be necessary. Further, as oil weathers, DORs for surface application will need to be adjust ed, and these changing weathering conditions cannot be fully known in advance. Given current dispersant stockpiles in the U.S. and in the Global Dispersant Stockpile, it should be assumed that sufficient dispersants will be available if their use is warranted by NEBA.

B. *Identifying and reporting associated volatile petroleum hydrocarbons will be impossible with changing environmental conditions, and is unnecessary for response decision-making.*

The requirement to *"...document any associated volatile petroleum hydrocarbons..."* would be very difficult to achieve, given that volatiles will fluctuate with sun exposure and changing wind conditions. The reason for this requirement is not explained; therefore, the Agency should specify what is intended by this requirement or delete it.

C. *The Agency should accept best available industry practice for dispersant monitoring.*

There is no need to restate the requirement for documenting the results of toxicity testing. In general, the list of characteristics is practical and do es not create an undue burden ; however, there is a significant assumption in the requirements (i.e., that the condition of the discharge point is such that it will enable the acquisition of these data at any given time). A reference to a best available industry practice, or any of the existing guidance on dispersant sampling/monitoring (e.g., API guidelines on subsurface dispersant monitoring, API TR 1152) would be more effective for gathering the information requested by the agency without imposing undue b urden on response personnel. Additionally, there is no technical reason to differentiate subsurface discharges from the rest of this paragraph. We suggest removing this differentiation and suggests modifying the proposed language as follows:

As directed b y the OSC, the Responsible Party must monitor any subsurface use of dispersant in response to an oil discharge, surface use of dispersant in response to oil discharges of more than 100,000 U.S. gallons occurring within 24 hours, and surface use of dispersa nt for more than 96 hours in response to an oil discharge, and submit a Quality Assurance Project Plan for approval to the OSC covering the collection of operational monitoring data. When these dispersant use conditions are met, and for the duration of dispersant operations, the Responsible Party shall:

(a) Document the characteristics of the source oil; best estimate of the oil discharge flow rate, periodically reevaluated as conditions dictate, including a description of the method, associated uncertainti es, and materials; dispersant(s) product used, rationale for dispersant product choice(s), recommended dispersant-to-oil ratio (DOR); and the application method and procedures, including a description of the equipment to be used, hourly application rates, capacities, and total amount of dispersant needed.

XVII. Section § 300.913(b) Sampling Requirements

A. *Daily water sampling and testing is burdensome.*

The requirement to conduct these required tests on water samples daily may prove overly burdensome and not necessary after the initial efficacy tests. We suggest modifying the Proposed Rule to ensure that the OSC has discretion in h ow frequently the samples must be acquired after the initial efficacy tests are conducted. Sampling on a daily basis, once efficacy is determined and agreed, is arbitrary and does not fit the timeline required to provide in-depth analysis of samples.

The collection of water column samples where the dispersed oil plume is located is not necessary and in many cases is not possible for aer ial dispersant application. For spills of up to 100,000 gallons, aerial dispersant assets can be activated and apply dispersants to the entire spill area during Day 1, before a monitoring team can arrive on-site to conduct water sampling. It was shown during the DWH event that to collect water samples, special operations had to be developed and coordinated so that the vessel monitoring team had sufficient time to obtain the water samples of the dispersed oil. This was due to the fact that most of the area u nder the aerial dispersant application returned to normal background levels within one hour following the application. It should also be understood that water samples will only determine the amount of oil in the sample, not the effectiveness of the dispers ant, as there is no way of determining the amount of oil that was treated. As stated previously, these sampling requirements do not provide information on dispersant effectiveness and can therefore not inform the operational response. Water sampling requir ements are more appropriate to NRDA and should be directed under NOAA jurisdiction.

B. *The oil droplet size distribution measurement, as described, is not technically feasible.*

The requirement in 300.913(b)(1) to conduct *"in situ oil droplet size distribut ion, including the mass or volume mean diameters between droplet sizes ranging from 2.5 to 2000 µm* " is not possible for three reasons:

- The General Information section suggests that this measurement can be done via a Laser In Situ Scattering and Transmissometry (LISST) instrument, but the LISST detection limit is roughly 500 microns;
- Commercial droplet size measurement equipment suitable for deep water monitoring that ranges up to 2000 microns does not exist; and

- Even if such instrumentation became availab le in the future, there would be no way to safely deploy it in the resulting dispersed oil plume by either ROV or research vessel without interfering with other critical, oil spill response operations.

With respect to droplet size determination, the Agenc y should focus on the most important aspect of subsea dispersant injection, which is to significantly reduce the initial droplet size to slow and change the surface expression of oil release as well as "thin out" the surface slick for better dispersion on the surface. Work by API and sponsored by BSEE suggest that HD high speed photography or sonar are the most promising methods of studying changes in droplet size during a full scale applic ation of subsea dispersants. We propose that alternative methods (i. e., high definition, high speed photography; sonar; etc.), as they mature and become available, should be allowed. Additionally, there should be flexibility to use other, improved scientific methods as they become available.

C. *Fluorometry is only useful as a screening tool.*

Indirect measures, such as fluorometry, are useful only as a screening tool to help refine monitoring locations and not as direct evidence of oil or specific oil concentrations in the subsurface as suggested.

In 300.913(b)(2), in addition to *in-situ* fluorometry, the Proposed Rule also requires the Responsible Party to conduct a fluorescence intensity analysis on collected water samples to determine fluorescence signatures of the dispersed oil for use as a relatively simple and rapid mea ns to assess dispersion effectiveness. Fluorescence intensity in this context is redundant and not as meaningful a measure as particle size analysis. An alternative would be to simply suggest this as a potential measure that could be used as the situation demands. Moreover, dispersant effectiveness assessments using SMART Tier 1 visual monitoring is a relatively simple, rapid way to evaluate this and is a well-accepted practice, as is the use of simple fluorometry from the SMART Tier II protocol for surface dispersant application. The Agency should substantiate the need to replace the tiered monitoring approach of the SMART protocols and, rather than listing all possible tests that can be conducted, specify how they add value to response decision-making and offer improvements over other, existing approaches.

D. *Detailed chemical analysis is unnecessary and many of the tests are too di fficult to perform in the field.*

In 300.913(b)(4), the Agency should recognize that more real-time operational monitoring information can be obtained by "quick screening" some samples for total petroleum hydrocarbons (TPH) by means of a hand-held gas chromatograph flame ionization detector (GC -FID). Detailed chemical analysis will not inform the response decision-making process and should instead fall under the purview of NRDA.

The requirement in 300.913(b)(5) for carbon dioxide measurements is unclear. While pH and dissolved oxygen monitoring seem logical, carbon dioxide (CO_2) measurements are not routinely made in deep water. It is not clear from the Proposed Rule what benefit carbon dioxide monitoring would bring that dissolved oxygen does not already provide. Similarly, the proposed requirement to measure methane is also unnecessary as it is also linked to potential oxygen deple tion, and the measure of DO is a reliable and sufficient method. There is a limited amount of sensors and water sampling devices that can be deployed from a research vessel at one time and inclusion of CO_2 detection complicates other elements for the deployment of the instrument array.

Regarding the DO measurements, we suggest simply requiring the *in situ* measurement of DO using best available technology (which would currently be automated sensors) to measure dissolved oxygen at depth and not expose it to surface pressures and temperatures before or during analysis. Verification can be achieved through the use of consistent sensor cleaning procedures, calibration tests, and redundant sensors which can be compared. Winkler titration, as discussed in the Proposed Rule, is an outdated

analytical method that is impractical for use on unstable offshore vessels, is prone to the introduction of human errors, and would slow the information flow within the response. If periodic bench tests are required to verify the integrity of the *in situ* DO sensor measurements, there are more consistent and reliable techniques than Winkler titration. We also recommend that only a fraction of the water samples be used to verify the *in situ* DO measurements as opposed to every sample , which will slow the process and information flow.

With respect to TPH analysis, the recommendation would be to provide these data for a fraction of the water column samples as opposed to every water sample (as currently proposed).

The requirement in 300.913(b)(7) for analyzing heavy metals has no bearing on dispersed oil monitoring. There is no operational reason for collecting these data. This should fall under the purview of NRDA. The source samples of oil are much better sources for determining the proportion of individual constituents. The carbon dioxide, methane, and heavy metals analysis requirements do little to inform response decisions, add unnecessary time and cost to the response activities, and would have a high degree of uncertainty in the absence of understanding the natural variations that might occur in the water column or in the case that a compounding discharge event (e.g., major flood) occurs during the response.

The focus of the Proposed Rule is almost exclusively on empirical data a nd should include some elements of 3-D and 4-D modelling to broaden the overall understanding of subsurface conditions.

We suggest revising the proposed language as follows:

> *(b) In areas not affected by the discharge of oil, collect a representative set of background water column samples following standard operating and quality assurance procedures, at the closest safe distance from the discharge as determined by the OSC and in any direction of likely transport considering surface and subsurface currents and oil properties for the variables listed below. Adherence to API TR1152 meets the requirements of this subsection. In the dispersed oil plume, at an interval designated by the OSC, collect water column samples following standard operating and quality assurance procedures, at such depths and locations where dispersed oil is likely to be present to analyze for the following:*
>
> > *(1) In-situ oil droplet size distribution, including mass or volume mean diameter for droplet sizes, with the majority of data coll ected between the 2.5 and 100 µm size;*
> > *(2) In -situ fluorometry signatures targeted to the type of oil discharged and referenced against the source oil;*
> > *(3) Dissolved oxygen (DO);*
> > *(4) Total petroleum hydrocarbons (based on an extracted water sample), individual resolvable constituents including volatile organic compounds, aliphatic hydrocarbons, monocyclic, polycyclic, and other aromatic hydrocarbons including alkylated homologs, and hopane and sterane biomarker compounds;*
> > *(5) 3-D and/or 4-D modeling when/where practical*
> > *(6) Turbidity;*
> > *(7) Water temperature;*
> > *(8) pH; and*
> > *(9) Conductivity.*
>
> *The purpose of analyzing these components is to map the extent and location of subsurface oil ; to characterize the condition of that oil ; and to help inform transport models that are also a key part of the decision-making process by helping to characterize the overall movement of subsurface oil.*

XVIII. Section § 300.913(c) Dispersant Effectiveness and Oil Distribution Characterization

A. *The Proposed Rule needs to be clearer on what is required for surface monitoring and what is required for subsea monitoring.*

Section § 300.913 provides monitoring requirements collectively for "subsurface use of dispersant in response to an oil discharge, surface use of dispersant in response to oil discharges of more than 100,000 U.S. gallons occurring within 24 hours, and surface use of dispersant for more than 96 hours in response to an oil discharge…" However, the preamble is often unclear as to whether every requirement within this section applies to surface or subsea dispersant applications or both. To facilitate a better evaluation of the proposed changes, each subsection should be divided into those aspects that apply to subsea applications and those to surface applications and those that apply to both. Elements within this section are already addressed in other sections of this Proposed Rule, particularly water column monitoring. The sections ought to be combined. The concept of an informed monitoring program (one that includes fixed and adaptive sampling locations and modeling) is already well understood and acknowledged in the spill response community.

In 300.913(c), requiring best available technologies may result in equipment not suitable for field conditions. Consideration should be given to changing "*available*" to "*practicable*."

In 300.913(c), the best available technology requirement should acknowledge aerial photography as a tool to measure effectiveness. This was a key method of effectiveness assessment during DWH and is not mentioned in the Proposed Rule. It is much more practical than the concepts put forward in the present proposal.

The relative effectiveness of the surface application should be determined by using the SMART protocols. For surface application, it is impossible to determine a numerical effectiveness as the amount of oil on the surface that is being sprayed is not known. Note that the analysis equipment often cannot return to the spray site in time to capture the information requested as the dispersant plume quickly dilutes or cannot be found.

XIX. Section § 300.913(d) Ecological Receptor Characterization

A. *Monitoring required to determine possible environmental effects is too time consuming to support dispersant operations decisions.*

Industry agrees that environmental monitoring should be performed to support operational decision-making. Monitoring required to determine environmental effects, however, is likely to be too time consuming to support dispersant operations decisions and should remain a NRDA activity.

This section of the Proposed Rule requires the Responsible Party to characterize the ecological receptors and to consult with the OSC to determine an acute toxicity level of concern for the dispersed oil using available dose/response information relevant to potentially exposed species. Conducting the required ecological characterization of the spill site may not be possible in the available response time-frame. If the untreated oil is likely to drift ashore and impact a sensitive coastal resource within a day or two unless it is dispersed, there will be a very finite period of time for such considerations suggested in the Proposed Rule.

With respect to the proposed ecological thresholds, although it is constructive to have known benchmarks, it is not clear what decision would be forthcoming if a threshold were exceeded and would certainly be misplaced to derive new thresholds during a response. The documented toxicity of dispersed oil to individual laboratory organisms is by no means a measure of the overall population of that

organism, nor of the ecosystem as a whole, to recover from oil exposure. During a spill, dispersants operations might be stopped because of the threshold of an individual species even though there may be the potential for higher environmental damages beyond that species. During a spill, dispersants operations might be stopped based on a threshold for an individual species . The suggestion of using species sensitivity distributions (SSD) during an active response is a misuse of the method (which requires long periods of time to assess) and is counter to establishing frameworks that are relevant in the dynamic ocean setting.

Rather than requiring the Responsible Party to make this real-time assessment, a CERA/NEBA process (conducted as part of contingency planning) should serve as the basis to make operational decisions on whether dispersants and/or other agents should be used during a response. A CERA/NEBA is the only mechanism that allows a full environmental trade-offs analysis of all response options to be conducted.

XX. Section § 300.913(e) Immediate Reporting Requirements

A. *Reporting requirements should be more flexible.*

The Proposed Rule does not include any indication of what happens if such a requirement to immediately report the information is not met for any reason. From a functional standpoint, the idea of reporting is sound, but the OSC should have the discretion to determine the frequency of reporting.

The Agency is also requesting comments on whether similar requirements should be applied to surface dispersant application. There are already practical and agreed reporting requirements for surface dispersant use and the natural weathering and dispersion that takes place at the surface is fundamentally different than what might occur in the subsurface.

XXI. Section § 300.913(e)(1) Daily Sampling and Data Analyses Reporting

A. *The Agency should not develop requirements for daily authorizations of dispersant quantities.*

This section requires reporting of a deviation of more than 10 percent from the mean hourly volume of dispersant authorized for "*24 hours use*." The Proposed Rule does not require authorization of dispersant use in 24 hour increments. Such restrictive authorization requirements tremendously complicate dispersant operations while providing little environmental benefit. The Agency should not develop requirements for daily authorizations of dispersant quantities, as this decision should be based on the ongoing spill scenario and should be left to the OSC. Dispersant application rates may need to vary to account for dynamic spill conditions, environmental conditions, and other ongoing response operations. Placing daily limits on volumes of dispersants that may be used prevents trained response personnel from utilizing appropriate dispersant application rates. Furthermore, it circumvents the NEBA process that evaluates the best response options that protect the environment as a whole.

We suggest modifying the proposed language as follows:

> *(e) Report to the OSC as soon as practicable or at an interval determined by the OSC:*
> *(1) Deviation of more than 10 percent from the mean hourly dispersant use rate for subsurface application, based on the dispersant volume authorized for 24 hours use, and the reason for the deviation; and*
> *(2) Any threatened or endangered species, or other priority ecological receptors formally identified by the OSC in consultation with the Environmental Unit, that may be exposed, based on dispersed plume trajectory modeling and level of concern information.*

XXII. Section § 300.913(e)(2) Immediate Reporting of Ecological Receptors

A. *Real-time ecological receptor analysis is unrealistic and should be part of a CERA/NEBA process.*

The requirement in this section for real -time ecological receptor analysis is unrealistic. Such efforts need time and broad stakeholder participation to be meaningful. This information should be part of a NEBA process to document the resources at risk of the potentially affected ecosystem. Only through this detailed NEBA process can an adequate understating of overall ecosystem recovery be developed and assessed. Further, the process of overall environmental trade -offs is independent of individual species impacts and should be based at the ecosystem level.

XXIII. Section § 300.913(f) Daily Sampling and Data Analyses Reporting

A. *Daily reporting of water sampling data should only apply to subsea dispersant injection and is not useful for dispersant decision-making.*

This section should be amended to clarify that daily reporting of water sampling data only applies to subsea dispersant injection. Further, the requirement in Section 300.913(f)(3) for a 5-day turnaround time for analysis is unrealistic, given that it could take several days for the sample to be transported to shore and additional time for it to reach a qua lified laboratory and put in the queue for analysis. During DWH, the sheer quantity of samples overwhelmed both the regional and the nation's labs processing abilities. In many cases, the backlog of samples lasted 30 days or longer. A blanket requirement o f five days is unrealistic and should be replaced with a negotiated time that is staggered on the basis of sample data priority for operational decision-making. The data may be useful for NRDA, but not for dispersants decision-making because other monitori ng techniques can better inform decision-making. These water samples will provide information about concentrations in water from 5 or more days previously, but will be irrelevant for operational questions that require near real-time feedback.

We recommend combining this section with the proposed "*Immediate Reporting*" section into one section that notes the importance of reporting in supporting the coordination of response actions. Suggest modifying proposed language as follows:

(e) Reporting

(1) Report to the OSC as soon as practicable or at an interval determined by the OSC any:

(i) Deviation of more than 10 percent from the mean hourly dispersant use rate for subsurface application, based on the dispersant volume authorized for 24 hours use, and the reason for the deviation; and

(ii) Ecological receptors, including any threatened or endangered species that may be exposed based on dispersed plume trajectory modeling and level of concern information.

(2) Report to the OSC at an interval determined by the OSC, water sampling and data analyses collected in § 300.913(b) and include:

(i) Specific hourly dispersant application rate and the total amount of dispersant used for the previous reporting period established by the OSC with concurrence from the EPA representative to the RRT;

(ii) All collected data and analyses of those data within a timeframe necessary to make operational decisions, including documented observations, photographs, video, and any other information related to

dispersant use, based on a reasonable and appropriate timeframe authorized by the OSC;
(iii) Estimates of the transport of dispersed and non-dispersed oil and associated volatile petroleum hydrocarbons, and dispersants, using the best available trajectory modeling.

XXIV. Section § 300.915(a) General Information for any Product Category

A. *The proposed information requirements to be submitted by dispersant manufacturers may reduce the number of dispersant suppliers.*

The proposed requirements for information to be submitted, most likely by dispersant manufacturers, as described in 300.915 (a)(1)-(21), are extensive. API and NOIA are concerned that dispersant manufacturers may not have a sufficient business case to meet all proposed data requirements. The Agency therefore needs to demonstrate that this Proposed Rule will not collapse the market for dispersants and drive away all viable producers from supplying products to meet the need. Further, the Agency should consider developing a total re-listing cost analysis.

XXV. Section § 300.915(a)(5) Safety Data Sheet

A. *A Safety Data Sheet for each component in a product is unnecessary.*

The proposed requirement includes *"A Safety Data Sheet ('SDS') for the product."* We believe this is a reasonable request. However, in the preamble, the Agency solicited comments on the value of requiring an SDS for each individual component. We believe that requiring more than just an SDS for the whole product will add unnecessary burden to the submitter that will not add any protection. The information needed to protect responders will be provided in the SDS for the product as a whole.

XXVI. Section § 300.915(a)(11) Environmental Fate Information

A. *Vendors should not be required to generate new environmental fate information for their products.*

The proposed language in this section should be modified to clearly state that this data should be reported *only* if it is already available. As currently written it is unclear if the vendors are being asked to collect new data for their products to cover these parameters.

XXVII. Section § 300.915(a)(13) Identity and Concentration of Product Components

A. *Vendors should not be required to provide the identity and concentration of product components.*

Some vendors may refuse to submit this detailed data as it may threaten a proprietary advantage. This may result in less favorable/effective product being listed in the Product Schedule. We recommend that reporting should be restricted to naming the ingredients, but should not require that the percentage of each ingredient is disclosed. Although Proposed Rule Section 300.950(b) allows this information to be claimed as confidential business information, the requirement under 300.915(a)(13) still presents challenges because there is no guarantee that the claim of confidentiality will be accepted. This may discourage manufacturers from supplying dispersant products.

XXVIII. Section § 300.915(a)(15) Certification

A. *The requirement that product not contain levels exceeding the National Water Quality Standards is unnecessary.*

The agency is proposing certification, including data, methodology, and supporting documentation, indicating that the product does not contain levels that exceed the National Water Quality Standards lowest aquatic life acute value for the following contaminants: metals reasonably expected to be in the product including arsenic, cadmium, chromium, copper, lead, mercury, nickel, vanadium, zinc; cyanide; chlorinated hydrocarbons; pesticides; polychlorinated biphenyls (PCBs); and polynuclear aromatic hydrocarbons (PAHs).

The National Water Quality Standard Contaminants are defined as concentrations in the water column. Water quality criteria are applicable to receiving waters, not formulated products, and this proposal assumes the appropriate exposure is to full-strength (100%) product rather than a reasonable environmental-realistic exposure concentration.

This requirement is not reasonable because of the enormous dilution that occurs when any product is used in an oil spill situation, and it is not required for other chemicals released into the environment. We believe that the existing requirements to communicate hazardous impurities on product SDSs should be sufficient and suggests removing the requirement.

XXIX. Section § 300.915(a)(19) Annual Product Production Volume

A. *The requirement for vendor production capability is not realistic of the market for dispersants.*

Most dispersants are blends of components and are only manufactured upon request. Capacity is not fixed and varies with available blending tankage, existing business demands, other product orders, and component supplies/shipping constraints. While such data are very useful in a large spill where existing stockpiles could be depleted, the information provided in such a request at the time of the application would not be relevant to a future time when product manufacturing could be required during a response. Further, the development of both U.S. stockpiles and international Dispersant Global Stockpiles were designed to ensure that sufficient, effective dispersants will be available when needed. We believe this requirement should be removed. If not removed altogether, the Agency should consider modifying the language to require dispersant or agent producers to be able to provide such information within 24 hours should the OSC need it and make it a condition of product authorization. If the Agency is concerned about the availability of sufficient volume of dispersants required for operations, it should ensure that the main dispersants products that are used around the world and are extensively studied are included on the National Product Schedule and are available for response in the U.S.

XXX. Section § 300.915(a)(20) Recognition

A. *Design for Environment recognition is unnecessary.*

The Agency asks for recognition from EPA's Design for the Environment (DfE) if applicable. DfE recognition should not be included in the Proposed Rule because it is not required, and the Agency has other ways to advance voluntary programs.

XXXI. Section § 300.915(b)(1) Dispersant Efficacy

A. *The new efficacy test cannot predict field dispersant effectiveness.*

API and NOIA support the Agency's proposed change in efficacy testing from the Swirling Flask Test (SFT) to the Baffled Flask Test (BFT) method. The SFT was a very low energy test and required the use of low viscosity test oil s to achieve significant levels of measured dispersant effectiveness. The BFT is a much more energetic test method thus permitting the use of higher viscosity test oils to achieve higher levels of measured effectiveness with the same dispersant. It is impo rtant to recognize that such laboratory tests can evaluate relative effectiveness between different dispersants, but cannot be used to predict the effectiveness of dispersants in the field on specific oils under specific conditions , such as differences in wave height, possible application in high turbulence subsea or using prop wash in ice - covered waters.

B. *The new test oils may not provide comparable results if new test samples are obtained.*

We also support the Agency's proposed changes in test oils from South Louisiana Crude (SLC) and Prudhoe Bay Crude (PBC) to Alaska North Slope (ANS) and Intermediate Fuel Oil (IFO–120), since these new test oils provide a wider range of properties in the oils to be tested. The agency should note that ANS is a blend of c rude oils produced on the North Slope of Alaska, and the composition and properties have varied through the years as the crude oils produced on the Alaska North Slope have changed . Also, IFO-120 composition is entirely dependent on the crude run at the supplying refinery and their blending needs. However, IFO-120 is a blend of residual fuel components including vacuum resid uum cut with a lighter product to achieve a specified viscosity (i.e. , 120 cSt at 100F in this case), but will vary dramatically in composition between lots at a given refinery and between refineries. It is probable that the varying composition of IFO-120 will result in inconsistent DE results over time. This means that a single batch of IFO-120 will have to be preserved for all future pro duct testing to ensure comparability. The Agency should conduct stability tests of ANS and IFO -120 stocks to ensure they can maintain viable samples over time. The Agency could consider substituting a heavy crude oil rather than this heavy refined product or store a large single batch of IFO -120 with data provided on shelf stability or a provision to account for changes over time.

C. *Testing dispersant efficacy at different temperatures will not provide information that will predict dispersant effectiveness in real world conditions.*

We oppose introducing testing at different temperatures. This new approach implies that laboratory tests represent field conditions in some way which is not the case. The Agency proposes that dispersants should only be approved for the type of oil they worked in the lab and temperatures tested in the lab. This is incorrect as:

- different oils will be treated than the two tested in the laboratory;
- even the same oil will weather with potential effects to dispersant efficacy;
- turbulence in environment will surely be different;
- subsea injection even into the same oil in the Arctic is different because of oil temperature and turbulence level subsea; and
- dispersing oil in ice is also different from lab tests because of the mixing provided by vessel propellers.

In the preamble to this same section, the Agency appears to suggest that the Proposed Rule changes are intended to indicate the likely effectiveness of operational dispersant use on oil spilled in the Arctic or Gulf of Mexico (column 3, 80 Fed. Reg. 3403; both locales are specified). Relatively simple efficacy tests such as the BFT are incapable of simulating the range of parameters and processes that will be encountered and influence real -world dispersant effectiveness. The Rule sho uld clearly state that laboratory efficacy testing is a comparative screening tool for different dispersants under laboratory conditions and should recognize that a ctual dispersant effectiveness on oil treated at sea can vary a great deal from

effectiveness data collected in a laboratory. A dispersant/oil combination that produces an effectiveness result in the BFT laboratory method of 70% might result in >95% dispersion at sea (e.g., in a moderate sea state), and less dispersion in other circumstances (e.g., calmer sea state). Therefore as part of dispersant use authorization, divorced from the product approval process, the availability of suitable mixing energy becomes an operational consideration, coupled with the dilution potential for the dispersed oil. We suggest that reference to specific regions should be deleted from this section.

D. *Dispersant efficacy thresholds listed in the Proposed Rule are too high.*

In the preamble to this section (column 2, 80 Fed. Reg. 3403), the Agency's justification for dispersant efficacy thresholds (DE values) includes:

> "*Three of the eight dispersants tested clearly differentiated themselves from the other five dispersants for having the best DE_{LCL95} efficacy results… This natural break in the results provided the Agency with the basis for the proposed threshold criteria.*"

We believe the proposed thresholds of efficacy for listing on the Schedule are high. The supporting documentation in the docket shows that only six (not eight) dispersants were tested and two of these six dispersants were only tested with one oil. The rationale for selecting the proposed efficacy thresholds for listing on the Schedule is not convincing on the basis of the limited data presented. Data from another EPA study[31] shows significant variability in the results obtained with the BFT. Variability in test results is troubling and this variation could lead to confusing data sets where the same dispersant sometimes "passes" and sometimes "fails" because of the high threshold limit that has been set. While the Agency states it tested the dispersants currently listed and found three of them to be sufficiently effective, the EPA study on the BFT funded by BSEE and published in 2011 suggests otherwise. As shown in Table 3 of this BFT study, Corexit 9500 may not be listed based on published Dispersant Effectiveness (expressed as the LCL95) of 69% and 61% on ANS Fresh and IFO-120, respectively, at room temperature (15° C). This suggests that the recommended thresholds are potentially too restrictive and do not sufficiently take into account the variability of the BFT.

The Agency should reconsider the proposed efficacy thresholds for listing on the Schedule. We suggest that these thresholds could be lowered without any significant impairment to the effectiveness of operational dispersant use at a response. In addition, reporting only the DELCL95 reduces the amount of information available on a product. We recommend that the test average and standard deviation should be provided, which would provide additional information on the precision of the testing.

The Agency makes the following statement in the preamble (column 1, 80 Fed. Reg. 3404):

> "*As a result of this increased mixing energy, better dispersion is realized under conditions more realistic of wave action in the sea*"

We believe that this statement would be more accurate if it were re-phrased as follows:

> "*As a result of this increased mixing energy, higher dispersant effectiveness results are obtained.*"

Since the recent subsea dispersant injection development does not have major implications for the rationale behind the current tests for dispersant product approval, it might be important to recognize that the laboratory test data are sufficient to identify whether a product has appropriate effectiveness,

[31] Venosa and Holder, 2011, Laboratory-Scale Testing of Dispersant Effectiveness of 20 Oils Using the Baffled Flask Test

irrespective of whether the product may be considered for use in surface application or subsea injection (SSDI) scenarios. Additional testing for SSDI approval is not necessary.

XXXII. Section § 300.915(b)(2) Dispersant Toxicity tests and listing criteria

We offer the following comments on the proposed revisions to the toxicity testing and has ordered the comments by specific test.

A. *Standard static acute toxicity testing should be used only for the dispersant alone.*

The Agency proposes that a dispersant should be tested using a modified standard static acute toxicity test for the dispersant with *Americamysis bahia* and *Menidia beryllina* using the 48 hour and 96 hour duration LC_{50} procedure. We agree there is a need for toxicity testing of dispersants to prevent highly toxic (LC50 <1ppm) dispersants from being listed on the Schedule. The proposed toxicity test method, although designed for effluent testing and having no relevance to real-world exposures of marine organisms to dispersants during dispersant use on oil releases, is a convenient way to screen individual dispersants. We agree with this proposal for dispersant-only toxicity tests.

The Agency also specifies a threshold for a dispersant to be listed on the Schedule, *"the LC_{50} being that at the lower 95% confidence interval for all acute toxicity tests must be greater than 10 ppm."* We believe this is a reasonable threshold for the "dispersant only" toxicity test.

B. *Standard static acute toxicity testing of dispersant/oil mixtures does not represent real world exposures.*

The purpose of the proposed toxicity testing of dispersant/oil mixtures is not clear. If the objective of the toxicity testing is to ensure that any dispersant that is to be listed has less than a specified level of toxicity measured in the test, then a dispersant alone toxicity test is sufficient.

We oppose the proposed dispersant/oil acute toxicity testing as a requirement for a dispersant to be listed on the Schedule, for the following reasons:

- It is now widely accepted by scientists that any concerns about the potential for toxic effects on marine organisms resulting from the use of modern dispersants should consider the potential effects of dispersed oil, not the dispersant itself. This is logical because dispersant is used at low concentrations, compared to the dispersed oil concentrations produced by their use, and they have much lower toxicity than oil. The potential severity of toxic effects that could be caused to marine organisms by exposure to dispersed oil will be a function of exposure: the concentration of dispersed oil (or oil components) in the water, the duration of that exposure, and oil type and receiving organisms. The Agency proposed dispersant/oil mixture tests will not provide any information about real-world exposure.
- More sophisticated dispersant/oil mixture toxicity testing procedures, using more relevant exposure regimes, can produce information about the potential for toxic effects on marine organisms by oil dispersed (or oil compounds released in to the water) as the result of dispersant use. Such toxicity studies may be relevant to deciding where and when dispersant use may be authorized, but not to dispersants being listed on the Schedule.
- Toxicity testing of dispersant/oil mixtures (i.e., dispersed oil) using the proposed standard static acute LC_{50} procedures will inevitably discriminate against more effective dispersants which disperse more oil into the water, thereby increasing exposure to aquatic organisms. Such testing does not give any indication of the potential for toxic effects to be caused by dispersant use on spilled oil on the sea surface.

- Previous work on dispersant/oil mixture toxicity testing conducted by the Agency in 2010 (Comparative Toxicity of Louisiana Sweet Crude Oil [LSC] and Chemically Dispersed LSC to Two Gulf of Mexico Aquatic Test Species [published by Hemmer, Barron and Greene]) shows that the proposed 10 ppm threshold (determined with LSC oil, not ANS or IFO -120) with *Americamysis bahia* would not be met by any of the eight dispersa nts tested at that time. Only one dispersant would have met the 10 ppm threshold with *Menidia beryllina*.

In general, the Agency should clearly distinguish between the requirements of (i) the toxicity testing required to assess which dispersants should be listed on the Schedule, and (ii) toxicological studies with appropriate oils, test organisms and exposure conditions that will inform discussions about how the listed dispersants might cause impacts in U.S. waters under the specific circumstances of an oil spill or release. The two toxicity test approaches required are incompatible. Attempting to use the same standard, static acute LC_{50} procedures to provide information or guidance on both aspects will not achieve these goals. Since the proposed dispersant/oil mixture toxicity testing requirements in this section do not address item (ii) above, the Agency needs to clarify the objective and rationale of the proposed acute exposure toxicity testing of dispersant/oil mixtures and should explain how this relate s to the listing of a product on the Schedule.

C. *Testing of dispersants using the developmental assay for the purple sea urchin is not relevant.*

The Agency proposes a requirement for an EPA test protocol involving sea urchin embryos, routinely used in eff luent testing, to be used to assess the potential for a dispersant product to cause adverse effects on the developmental process. The relevance of this test, which was developed for the assessment of wastewater effluents, to dispersant use is highly questi onable. Again, trying to estimate potential real world consequences to dispersed oil exposure should be part of a NEBA decision -based process. The environmental trade-offs of using dispersants in offshore environments to protect sensitive shoreline habitats from oil exposure is being circumvented. Given that the purple sea urchin is found in shallow coastal waters, there is no relevance of applying purple sea urchin data given that dispersant operations are unlikely to occur in these environments. In additi on, the proposed threshold that the LC_{50} must be greater than 10 ppm is not a relevant indicator to inform any potential real -world effects of dispersant use in the environment. Additionally, if the agency applies their proposed toxicity thresholds to the sub-chronic sea urchin toxicity tests, it is likely that many (maybe all) current and approved dispersants in the U .S. will fail the threshold . Some of them could also fail with the sub -chronic *M. beryllina* tests.

We oppose the proposed developmental ass ay and do not believe it should be a requirement for a dispersant to be listed on the Schedule. API and NOIA are also concerned that little experience is available in application of this assay to dispersants, and it is unclear about the intra -lab precision associated with this proposed requirement and the practical challenges that may arise in interpretation of test results.

D. *Sub-chronic 7 -day static toxicity tests for dispersant are not relevant and are unnecessary.*

The Agency states (300.915(b) (2), 80 Fe d. Reg. 3405) that it " *has limited information concerning the possible sub -lethal effects of dispersants currently listed on the Product Schedule* " and that " *This information would also be of value as guidance to regional responders and OSC's on possible ad verse effects on survival and growth of larval fish and invertebrates caused by longer -term exposure to dispersants.*"

Chronic exposure to dispersant alone is not a relevant indicator of risks posed when dispersant is used to mitigate the effects of an oil release. As stated previously, this test was developed and validated for wastewater effluents and is not relevant to the use of dispersants in offshore spill response. Rather than proposing sub-chronic toxicity testing requirements for any dispersant to be listed on the Schedule, the Agency could undertake studies to establish whether this is a valid concern, or whether it could provide useful information under the likely conditions of dispersant use on offshore oil releases.

The Agency's proposal of a No Observed Effect Concentration (NOEC) equal to or greater than 1 ppm listing threshold level for sub-chronic effects is arbitrary. Although this threshold level provides a ten-fold safety factor over the proposed 10 ppm acute toxicity threshold values, it could also be questioned on the same basis; static toxicity tests over 48 to 96 hours do not represent relevant exposure scenarios in the marine ecosystem following offshore applications of dispersant.

We oppose the proposed sub-chronic toxicity testing and does not believe it should be a requirement for a dispersant to be listed on the Schedule. Sub-lethal/sub-chronic studies are not necessary (acute toxicity endpoints are considered relevant) since the global commercial dispersant products are confirmed as biodegradable so that the surfactants and solvent constituents of the dispersant formulation do not persist in the marine environment causing adverse effects. The French dispersant product approval regulator requires a biodegradability test of the dispersant as part of its product approval process. Commercial dispersants commonly stockpiled around the world are therefore readily biodegradable and pass the French test. If a dispersant is approved in France, it must have passed the biodegradation test (AFNOR standard NF T90-346). It is recommended that ready biodegradability of a dispersant be required for approval in the U.S. as well. Therefore any candidate dispersant product would need to be tested for biodegradability, or the dispersant manufacturer could be required to state that the formulation constituents are biodegradable and provide supporting evidence.

E. *Dispersant testing should only be used for screening individual dispersant products.*

If the objective of the toxicity tests are to select less toxic dispersants (based on an aquatic toxicity threshold), then dispersant alone toxicity tests are sufficient and the maximum toxicity threshold of a candidate dispersant should be set if the dispersant is significantly less toxic than the reference oils. The dispersed oil toxicity testing (CEWAF) should not be considered for dispersant use authorization as it discriminates against the effective dispersant products which disperse more oil into the water thereby increasing exposure to the aquatic test organisms. It is also important to note that CEWAF toxicity testing does not simulate actual dispersant use on spilled oil in the marine environment. Additionally, static toxicity tests over 48 to 96 hours do not represent relevant exposure scenarios in the environment following surface application of dispersants.

In summary, the Agency's suggested toxicity testing changes in the Proposed Rule do not take into account the essential role of NEBA in considering the potential benefits and risks of dispersant use as a response option for an offshore oil release. The Product Schedule should focus on the basic testing to compare the efficacy and toxicity of the dispersants against each other with the sole purpose of screening good products that should be listed. The Proposed Rule should not attempt to translate any laboratory data into possible real-world implications. This process should instead be defined by full stakeholder NEBA discussions specific to a given spill scenario.

XXXIII. Section 300.915(c)(1) Surface Washing Agent Efficacy

A. *Surface Washing Agent (SWA) efficacy testing should not be required until the Agency develops its own test protocol.*

In the preamble the Agency has requested comments on available methodologies and whether the rule should identify the specific methodologies to be used until the Agency develops and adopts a new testing protocol for SWA efficacy testing (column 1, 80 Fed. Reg. 3407). The Agency lists two tests by ASTM and Environment Canada as possible interim tests while the Agency develops its own test. There is no evaluation of how the ASTM test compares to the Environment Canada test. As a result, expecting similar results by both tests is unrealistic. The average efficacy in the published data reported using the Environment Canada test may indeed be approximately 30%, but the variation is high and the tests were performed on a Canadian oil using only one test. We believe the Agency should delay requiring SWA efficacy testing until it develops its own test protocol that utilizes a U.S. oil.

XXXIV. Section § 300.915(d) Bioremediation Agent Testing and Listing Requirements

A. *An additional protocol specific to products containing enzymes only would be appropriate.*

The Agency is requesting comments on whether an additional protocol specific to products containing enzymes only would be appropriate. This would consist only of exposure water, weathered oil and the enzymatic product in the concentrations specified by the manufacturer. A new protocol would be useful because effectiveness data from the testing would help determine whether this technology would be beneficial during a response. Many claims may be made about "safer" products to treat oil and thus more credible scientific information is warranted on products approved on the Schedule.

XXXV. Section § 300.915(e) Solidifier Testing and Listing Requirements

A. *Solidifier toxicity testing would be useful.*

The Agency is requesting comments on the need for acute toxicity tests conducted with solidifiers - reference oil mixtures. Toxicity tests with oil may be beneficial as they will help to evaluate efficiency of solidifiers in retaining water soluble hydrocarbons and preventing them from leaching into water. Simple efficiency tests may not provide such data.

XXXVI. Section § 300.915(g) Sorbent Requirements

A. *The proposed Sorbent Product List should not exclude natural sorbent materials.*

The Agency proposes to make available a Sorbent Product List that includes certain publically available non-proprietary sorbent materials. We believe this should be a generic list and should not exclude natural sorbent materials (e.g., hay) that could be obtained locally at a spill site.

XXXVII. Section § 300.950 Submission of Confidential Business Information (CBI)

A. *Full public disclosure of product information may reduce the number of products being made available in the U.S.*

In 300.950 (column 3, 80 Fed. Reg. 3426), the Agency requires everything in the product listing be made public except the actual concentrations of product ingredients. While the Agency may need full disclosure of product formulae, we do not believe the Agency needs to make them public and can accept products with both the ingredients and the concentrations as CBI. Any disclosure of information on product formulae (either ingredients or % concentrations) could put a manufacturer at a competitive disadvantage. This may discourage some manufacturers from listing their product at all and could result in effective dispersant products not being available in the United States.

XXXVIII. Section § 300.955 Addition of a Product to the Schedule

A. *The transition period for currently listed products is too short.*

In 300.955(f), the Agency specifies a 24 -month transition period for currently listed products. This is a very short timeframe given the variety of products listed and depth of technical work (e.g., toxicology studies) required to be contracted, conduc ted, analyzed, and reported. We believe the Agency should extend the transition period to the lesser of five years, the current product expiration date, or after suitable replacement products are listed and commercially available.

We also believe that this section should include a discussion of how currently owned stockpiles purchased in 2010 and 2011 (more than one million gallons of Corexit, in the U .S.) will be tested to comply with the proposed existing stockpile testing requirements of being tested every five years. It is recommended the Agency state that currently held stockpiles will have five years to be re-tested after that dispersant product is listed on the new Product Schedule.

XXXIX. Appendix C to Part 300 Requirements for Product Testing Protocols and Summary Test Data

A. *The dispersant-to-oil ratio (DOR) ratio used in the BFT should be 1:20.*

In Appendix C, Section 2.1 (column 3, 80 Fed. Reg. 3428), the BFT mandates a DOR of 1:25. A DOR of 1:20 has commonly been accepted for use in the U.S. and abroad. Further, the 1:25 DOR may not even be within the manufacturer's recommended use ratio. The Agency needs to ju stify this test requirement. We believe that the DOR for the BFT should be changed to 1:20 to align with the regulatory requirements in 33 CFR 154 and 155 for calculating aerial and vessel dispersant capabilities and to align with standard dispersant spray system calibration. A DOR of 1:20 leads to a 5 gallon per acre dosag e for surface spray systems and is the minimum amount of dispersant to oil slicks that can be visually identified as having sufficient thickness to warrant dispersant application. Having the testing procedure completed for the same DOR would provide more reliance that, when applied, the dispersant will be effective.

B. *The Agency should explain how it will address changes in the refe rence oils as they age and as new samples are acquired for the future.*

In Appendix C, Section 2.3.2, the Agency requires the u se of ANS and IFO -120 as standard reference oils. The Agency is supplying these materials to labs but no data is presented showing shelf stability over time for either and whether stable equivalent materials can be provided in the future. No provision is provided for addressing changes in dispersant efficacy due to changes in composition of ANS (e.g., field production changes, new fields in pipeline blend, etc.).

Also, IFO -120 composition is entirely dependent on the crude run at the supplying refinery an d their blending needs. It is a blend of residual fuel components including vacuum residue cut with a lighter product to achieve a specified viscosity (i.e., 120 cSt at 100 degrees F in this case), but it will vary dramatically in composition between lots at a given refinery and between refineries. If multiple IFO -120 samples were provided from different refineries to a toxicity laboratory, there would be varying results because IFO-120 composition changes from day to day and between refineries. This means that a single batch of IFO -120 will have to be preserved for all future product testing to ensure comparability. The Agency should conduct stability tests of ANS and IFO -120 stocks to ensure they can maintain viable samples over time.

CONCLUSIONS

In conclusion, as evidenced by the extensive substantive comments provided herein, it is clear that much work needs to be done before the Agency should finalize a rule in this key area of spill response, including to make sure that the final rule does not have the unintended consequence of eliminating all or most commercially available and future dispersants for use in spill response. We believe the Proposed Rule will likely result in dispersants being eliminated as a response technique, for the following reasons:

- The Proposed Rule does not recognize that response option decisions must be based on NEBA and that dispersing oil in offshore environments , where it may dilute and biodegrade, is often preferred over the long -term environmental damages that will occur when untreated oil strands and persists in shoreline environments;
- The Proposed Rule focuses on potential risks of dispersants without recognizing the primary purpose of dispersants, which is to rapidly dilute the spilled oil and enhance removal of the o il from the environment through microbial degradation, resulting in reduced VOCs (personnel safety), and a reduction in persistent, stranded oil in shoreline ecosystems (leading to faster ecosystem recovery);
- The Proposed Rule's dispersed oil toxicity tes ting thresholds could eliminate all dispersants that are on the current NCP list and could preclude the listing of future dispersants that are currently in development. Furthermore, the proposed dispersed oil toxicity testing thresholds favor ineffective dispersants over effective products and will mistakenly measure the toxicity of the standard test oils, not of the dispersant product;
- The Proposed Rule adversely constrains the ability of the OSC to make the necessary operational decisions to ensure for an expeditious, efficient, and effective response to mitigate the impacts of a spill to the greatest extent possible;
- The Proposed Rule raises significant issues related to USCG and BSEE facility and vessel oil spill response plan compliance and could resul t in unnecessary and increased environmental impacts and corresponding spill claims as a result of increased damages;
- The Proposed Rule's stockpile re-testing procedures have not taken into account manufacturer recommendations, nor considered scientific publications on the demonstrated, lengthy shelf-life of dispersant products; and
- The Proposed Rule's dispersant monitoring requirements are not focused on collecting data that can provide useful information regarding an ongoing dispersant operation. Instead, these requirements have the potential to delay dispersant use resulting in unnecessary environmental damage.

In addition, the RIA conducted by EPA is substantially flawed. The RIA falls woefully short of EPA's regulatory requirements. EPA fails to provide any quantification of the potential social benefits of the Rule; in fact, the RIA lists benefits associated with avoiding and limiting the impacts of oil spills as potential benefits of this Rule, even though the Proposed Rule has the potential to ag gravate the impacts of an oil spill by limiting response options. As a result, the RIA significantly underestimates the potential costs of the Proposed Rule , while also underestimating the direct costs that the Rule would impose on small businesses, government, and the greater industry.

Accordingly, API and NOIA strongly urge the Agency to consider these comments and suggested revisions to the Proposed Rule to ensure that the best dispersants and dispersant-use practices are available for offshore oil spill response. We recommend that there be further discussions between the Federal agencies and industry scientific and operational experts to add value to further revisions of the Proposed Rule to ensure that the proposed changes to Subpart J align with the latest scientific practices and do not artificially bias against the use of certain response options, such as dispersants.

Furthermore, API and NOIA recommend EPA initiate a Negotiated Rulemaking which has proven to be effective in controversial rulemakings such as this one. At a minimum, we urge the Agency to publish a Supplemental Proposed Rule in the Federal Register for additional public comments before publishing a final rule to ultimately make sure that responders, both from the government and industry, are able to use dispersants in the most effective and expeditious manner, taking into consideration necessary environmental and safety factors, to provide for the best response possible depending on the circumstances of a particular spill event. Given the time it will take to initiate and complete a new rulemaking after the final rule is published it is imperative for the general public and all stakeholders that we get it right the first time.

Thank you for your time and attention to these comments on the Proposed Rule. API, NOIA and our member companies share EPA's goal of establishing sound Dispersants Use Policy and are committed to working with the Agency and the other Federal Agencies involved in oil spill response to ensure the health and safety of people and minimize environmental and community impacts during an oil spill. Please do not hesitate to contact Emily Hague (202-682-8260, Hague@api.org) or Nicolette Nye (202-465-8463, nnye@noia.org) if you have any questions.

Sincerely,

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Analysis of EPA's Regulatory Impact Analysis for the Proposed Revisions to the National Oil and Hazardous Substances Pollution Contingency Plan in 40 CFR 300 Subpart J

Submitted by:

Policy Navigation Group

April 2015

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EXECUTIVE SUMMARY

Policy Navigation Group (PNG) was asked by the American Petroleum Institute to review the Regulatory Impact Analysis (RIA) for U.S. Environmental Protection Agency's (EPA) proposed rule entitled *National Oil and Hazardous Substances Pollution Contingency Plan.*[1] We were asked to evaluate whether the RIA for the proposed rule is consistent with the analytical standards set forward in OMB Circular A-4 and EPA's Guidelines for Preparing Economic Analyses and to perform an independent cost analysis.[2] In our analysis, the proposed RIA has the following principal deficiencies:

- The proposed rule's RIA does not have a consistent baseline that allows the public and policy officials to compare the incremental social costs and the incremental social benefits of EPA's proposed regulation and the individual policy options within the proposal.
- The RIA fails to estimate many policy scenarios and requirements issued in the proposed rulemaking. The RIA thus fails to provide the public a full description of the proposal's impact and undermines the public's opportunity to provide meaningful comment on the proposed rule.
- Further, for the provisions that it does give quantified social cost estimates, the RIA often underestimates compliance costs. The RIA thus underestimates the full social cost to comply and to administer the changes for both private firms and government agencies.
- The RIA does not provide any quantified social benefit estimates either for the proposal as a whole or for its individual options. Moreover, its qualitative description of social benefits is inaccurate and at times actually describes social costs of the proposal. Without estimates of the incremental social benefits of the rulemaking and the proposal's regulatory options, the public cannot provide meaningful comments on the merits of EPA's proposal.
- The RIA's methodology is designed to underestimate the small business impact. EPA's economic impact analysis is inconsistent with EPA's economic analysis guidelines and EPA's requirements under the Regulatory Flexibility Act (RFA).[3] In this analysis, we address some of the RIA's deficiencies and find that the rulemaking could have a significant impact on a substantial number of small businesses subject to the rulemaking.

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[1] 80 FR 3380. Also, U.S. Environmental Protection Agency, *Regulatory Impact Analysis for Proposed Revisions to the National Oil and Hazardous Substances Pollution Contingency Plan Regulations*, December 3, 2014.

[2] U.S. Environmental Protection Agency, *Guidelines for Preparing Economic Analyses*, 2014.

[3] 5 U.S.C. 601-612

- These principal issues are among many aspects of the analysis that are inconsistent with Executive orders on regulatory review, OMB guidance, and EPA's own guidance for economic analysis.[4]

In the RIA, EPA estimates that the total incremental net present value (at 7 percent) social cost of the rule is $7.8 million, or approximately an annualized cost of $0.7 million over 20 years. In our analysis, we find that the estimated social costs are at least three times higher than EPA's estimate. The cost of the major provisions are given below:

Table ES-1. Estimated Social Costs of the Proposal

	NPV at 7% ($)	Annualized Cost over 20 years at 7% ($)
Product Loss Costs	4,000,000-7,300,000	380,000-720,000
Product Testing Costs	5,300,000	500,000
Stranded Capital/Stockpile Value Loss	1,000,000 -- 25,000,000	90,000-2,400,000
Label	180,000	20,000
Recovery Costs	1,700,000	160,000
Monitoring Costs	11,000,000	1,000,000
Preauthorization Costs	200,000	20,000
EPA Costs	800,000	80,000
Totals[5]	24,000,000-52,000,000	2,300,000 --4,900,000

These costs disproportionately burden small businesses. Most producers in this market are small businesses. The RIA did not find a significant effect on a substantial number of these small businesses. However, when we adjust for the more significant costs in Table ES-1 for the provisions the RIA omits and for real cost of capital, 43 percent of small businesses that the RIA analyzed have compliance costs greater than three percent of their 2011 revenues. As shown in Table ES-2, many small businesses face severe impacts. EPA should evaluate whether it must comply with the procedural and other analytic requirements of the Small Business Regulatory Enforcement Fairness Act (SBREFA).

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[4] Executive Order 12866 Regulatory Review, September 30, 1993.

[5] Throughout this report, totals and summaries may be different due to rounding. Reflecting the likely precision of these estimates, figures are presented to two significant digits or less.

Table ES-2. Economic Impact of the Proposal on Small Businesses

Pct of 2011 Revenue	Number of Product Types	Percent of Companies
<3%	17	57%
3%-5%	5	17%
>5%	8	27%

We recommend that EPA correct these deficiencies including undertaking a comprehensive benefit analysis to determine if the rule is in the national interest. Once EPA conducts its analysis of the incremental net social benefits of each proposed provision, it should select the regulatory options that maximize net social benefits. As EPA's economic analysis guidelines states:

> Preparing high -quality economic analysis can greatly enhance the effectiveness of environmental policy decisions by providing policy makers with the ability to systematically assess the consequences of various actions. An economic analysis can describe the implications of policy alternatives not just in terms of economic efficiency, but also in terms of the magnitude and distribution of an array of impacts.[6]

This report discusses the major issues with the RIA in more detail, provides alternative estimates for the proposal's social costs, and recommends how EPA should correct these flaws before reissuing a proposed rule.

[6] U.S. EPA, *Guidelines*, pg. 1-2.

SECTION 1. INCONSISTENCY BETWEEN BASELINE AND POST-REGULATION MARKET SCENARIOS

1.1. BASELINE IS INCOMPLETE AND INCONSISTENT WITH OMB GUIDANCE

The RIA's description of the analytic baseline is incomplete and inconsistent with OMB guidance.[7] There are several problems with the RIA's regulatory baseline:

- The RIA does not establish baseline conditions for many proposed requirements. As discussed in Section 2 below, the RIA does not fully estimate the social benefits and costs of all of the provisions of the proposal. As it corrects the serious deficiency of omitting cost estimates for proposed provisions, EPA must apply a consistent framework for both baseline and post-proposal market conditions in any final rulemaking.

- The RIA assumes a regulatory baseline where all existing manufacturers must pay to test their products. Even in absence of a rule, manufacturers may choose to conduct additional toxicity testing to demonstrate the inherent low hazard of their product and thus to differentiate their products in the market. Oil spill response organizations and responsible parties may also insist on further toxicity testing from producers due to liability concerns. Other jurisdictions also require testing of oil response products. For example, the corresponding European Union (EU) authority, the European Maritime Safety Agency, lists the dispersant testing requirements as of 2014 in the EU member states.[8] Eight EU members require testing of dispersant products. For all these reasons, producers may have some or all of the proposed testing data already available.

Recommendation. EPA should gather additional information on available data not only to prepare a more accurate economic analysis, but also to properly estimate the incremental social costs of this rule. If additional data already exists, EPA could tailor the final rule's requirements to this data and only mandate additional testing where meaningful data gaps exist.

1.2. PROPOSAL DOES NOT HAVE CONSISTENT SCENARIO FOR THE SOCIAL BENEFITS AND SOCIAL COST ESTIMATES

The RIA assumes all existing products comply with the new testing requirements and remain on the market.[9] The RIA also assumes new products are approved by EPA at the same

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[7] U.S. Office of Management and Budget, Circular A-4 Regulatory Analysis, September 2003.

[8] European Maritime Safety Agency, *Inventory of National Policies Regarding the Use of Oil Spill Dispersants in the EU Member States*, 2014

[9] U.S. Environmental Protection Agency, *Regulatory Impact Analysis for Proposed Revisions to the National Oil and Hazardous Substances Pollution Contingency Plan Regulations*, December 3, 2014.

pace as in the past. In other words, society gains the same benefits from products with the same capabilities and efficacy with or without the rule.

If this post-regulatory scenario is true, the rule has few, if any, social benefits.[10] For example, EPA cites reduced product toxicity on marine life as a potential social benefit. However, any potential ecological harm could only possibly be reduced if some existing (and future) products are withdrawn, not used, or disallowed due to the new toxicity testing requirement and due to the new EPA approval process.

However, the RIA's scenario is not the most plausible post-regulation scenario. It is more likely that some existing products will not remain on the approved list after the rulemaking. This outcome is more likely than the RIA scenario for two reasons. First, EPA may decide not to approve some of the existing products. It seems unlikely that EPA would use its scarce resources to promulgate increased toxicity testing standards if it did not have concerns with the toxicity of some existing products.

Second, given the uncertain sales volume, producers may not make a competitive expected rate of return with the additional testing and application expense and the greater risk of disapproval. In this case, they can be expected not to remain on the schedule after the rule is effective.

There is ample evidence that existing producers face a non-zero risk of product disapproval:

- Interest groups and media alleged significant concerns with oil spill product safety during the 2010 SONS.[11,12] Media attention and interest group attention to the issue does not mean that products are toxic per se; however, the threat of media scrutiny dampens producers' interest in bringing products to market. Increased attention is likely to lengthen EPA's approval process and the costs for the producer to respond to media inquiries. For producers, these response costs decrease the rate of return for oil spill products and potentially raise the costs for other company products.[13]

- Many producers are small businesses and need certain rates of return to compensate for their cost of capital and for the opportunity cost to innovate in

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[10] There is the argument that there is an information externality - the producers of the agents have a more concentrated interest and easier access to the potential toxicity information than the purchasers. However, since the producers are mostly small businesses and the purchasers are typically government agencies or large businesses, the purchasers can be expected to have sufficient resources and potential legal liability to overcome any potential information externality.

[11] See for example, http://www.biologicaldiversity.org/programs/public_lands/energy/dirty_energy_development/oil_and_gas/gulf_oil_spill/dispersants.html.

[12] E. Rothsenthal, *In Gulf of Mexico, Chemicals under Scrutiny*, The New York Times, May 5, 2010.

[13] For example, the parent company, and not individual product, may face public criticism.

other markets. Their internal rate of return requirements may preclude further investments once the costs and the risk increase.

In addition to the effect on existing products, the rulemaking is likely to affect the number of future products. By requiring additional testing and approval, the rulemaking increases market barriers. Some new products may not reach the market in the future due to the costs and risks that new products will not pass the new testing requirements.

1.2.1. Social Cost Estimate

To overcome these limitations, we conduct an alternative estimate to illustrate the importance of considering how the rule will raise market barriers. In Section 6 below, we demonstrate that many smaller producers could face a significant economic impact from the rule, i.e., greater than three percent of their annual revenue. As EPA and Small Business Administration guidance suggests, we assume those firms fail or leave the market due to the regulatory costs.[14]

The social cost is the lost value added to society from these products that leave the market. Value added is the remaining revenue after the costs of the inputs (e.g., labor, materials, and energy) are subtracted. Since value added is often proprietary information and varies from firm to firm, we use a recent value added metric for the chemical industry as a whole. From 2013 Bureau of Economic Analysis data, the average valued added in chemical manufacturing is 44 percent of revenue.[15] We assume that each company in the oil spill product market has a value added of 44 percent of revenue.

Once existing firms leave the market, society loses the value added of their products for Subpart J responses. However, in a competitive marketplace, other firms will enter and offer their own products. Since the regulation is not changing the demand for oil spill response products or acting to reduce the likelihood of spills, post-regulatory supply will rise to meet this unchanged demand. Society, therefore, only temporarily loses the availability of some oil response capabilities once existing producers leave the market in response to regulation.

We assume the value added is lost for three years. While three years is an assumption, it is a reasonable one given the proposed rule's timing. Since existing firms have two years to provide EPA with the new test data, if they decide not to reapply, they will likely try to stay on the market for the full two years. Once EPA removes them from the schedule, competitors will then see a market opening. We assume these competitors offer alternatives and submit their applications to EPA one year later.

We recognize other outcomes are possible. Instead of replacing existing products with new products at a 1:1 ratio, fewer new products could enter the marketplace, leaving the

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[14] U.S. Small Business Administration, *Guide for Government Agencies How to Comply with the Regulatory Flexibility Act*, May 2012. See U.S. EPA, *Final Guidance for EPA Rule writers: Regulatory Flexibility Act as amended by the Small Business Regulatory Enforcement Fairness Act*, November 2006.

[15] U.S. Department of Commerce, Bureau of Economic Analysis, *Value Added by Industry*, November 2014

approved products with a greater market share. In this case, compliance costs would be lower than this estimate; however, an additional social cost would be the loss of resiliency to responds to market disruptions. In addition to small firms, large firms may also not submit the new information due to the expense. On an individual product basis, larger firms may not find it profitable to continue.

Recognizing these limitations, based on these assumptions and the revenue information the RIA provides in Exhibit 7-1, Table 1-1 shows our estimate of the social cost of market disruption/transition due to the proposed rule.

Table 1-1. Social Costs from Market Transition

Annual Revenue	Product Type	Assumed Value Added	Social Cost	Discounted Social Cost (7 percent)
$ 62,000	Solidifiers	$ 27,000.00	$ 81,000.00	$ 74,000.00
$ 160,000	Surface Washing Agent	$ 71,000.00	$ 213,000.00	$ 195,000.00
$ 120,000	Solidifiers	$ 53,000.00	$ 159,000.00	$ 146,000.00
$ 200,000	Solidifiers	$ 88,000.00	$ 264,000.00	$ 242,000.00
$ 30,000	Solidifiers	$ 13,000.00	$ 39,000.00	$ 36,000.00
$ 120,000	Surface Washing Agent	$ 53,000.00	$ 159,000.00	$ 146,000.00
$ 150,000	Surface Washing Agent	$ 66,000.00	$ 198,000.00	$ 181,000.00
$ 1,000,000	Dispersant(2) & Surface Washing Agent	$ 441,000.00	$ 1,323,000.00	$ 1,211,000.00
$ 187,000	Surface Washing Agent	$ 82,000.00	$ 246,000.00	$ 225,000.00
$ 290,000	Bioremediation Agent	$ 128,000.00	$ 384,000.00	$ 352,000.00
$ 280,000	Surface Washing Agent	$ 123,000.00	$ 369,000.00	$ 338,000.00
$ 559,000	Bioremediation Agent	$ 246,000.00	$ 738,000.00	$ 676,000.00
$ 120,000	Bioremediation Agent	$ 53,000.00	$ 159,000.00	$ 146,000.00
Total (rounded)				$ 4,000,000.00

Summary	NPV at 7%	Annualized Cost over 20 years at 7%
Product Loss Costs	$4,000,000	$380,000

The social costs for existing products are estimated to be $4 million. If it takes longer for alternative products to enter the market, these costs would be higher. These social costs do not include the loss of efficacy and resiliency to respond to oil spills during this transition period. In Section 2.3 below, we expand this estimate to add the potential product loss social costs from the proposed ban on products containing NP and NPE.

As discussed previously, the regulation will not only discourage existing producers from re-qualifying, but also discourage new entrants by raising the costs and the risks of market

entry. The RIA assumes new entrants arrive after the rule at the same pace as in the baseline, or 10 per year. This assumption is not supported by economic theory. As discussed below in Section 3.4, we predict that application costs would rise by 40-50 percent for surface washing and stabilizer products, 260 percent for bioremediation products, and 120 percent for dispersants compared to current requirements. While we did not find estimates of the supply elasticity in these markets, such significant increases in prices will affect supply. We assume new product applications decrease by 30 percent from 10 to seven per year in response. The cost implications of this change are further discussed in Section 5.

1.2.2. **Recommendation**

Setting the baseline and policy alternative scenario is one of the key foundations of a regulatory analysis. As EPA's Guidelines for Economic Analysis states: "Because the level of detail presented in the baseline specification is an important determinant of the kinds of analysis that can be conducted on proposed regulatory options, careful thought in specifying the baseline is crucial."[16] The RIA has not shown this careful thought. For the final rule, EPA should understand the available toxicity and efficacy data available from producers. EPA should select, at a minimum, alternative market outcomes from the regulation in which some existing products do not return to the approved list. EPA must estimate the incremental social benefits and social costs from more accurate baselines.

[16] U.S. EPA, *Guidelines*, pg. 5-1.

SECTION 2. SOCIAL COSTS NOT INCLUDED IN THE RIA

2.1. STRANDED PRODUCTION CAPITAL AND PRODUCTS

EPA has not estimated the full social costs from a decision not to approve a product or from a producer's decision not to reapply. For the reasons listed in the previous section, it is plausible that some existing products will not be listed in the future due to the new regulatory requirements. In Section 1.2.1, we estimate the temporary lost value to society. The full social costs include the net change in value of the oil spill response product and the stranded human and physical capital used to produce the product. In addition, existing stockpiles of the dis-approved product can be expected to suddenly have lower value due to the disapproval. While on scene coordinators (OSC) could still allow their use during a spill response, the likelihood is lower once the product is no longer approved.

These costs are potentially significant. Stockpiling response products is an essential strategy to minimize oil spills' consequences. Response products must be deployed within hours of an oil spill; there is not time to ramp up production once a spill happens. Stockpiles are substantial and deployed across the globe. For example, a 2014 EU report lists nearly 3,500 metric tons of more than 40 different compounds in EU member state stockpiles.[17]

EPA has recognized this social cost category in other rulemakings. EPA has banned or phased-out products in other environmental programs. For example, EPA regulates the phase-out of ozone-depleting substances (ODS) under the Clean Air Act (CAA). EPA has conducted several major RIAs for the multiple phase-out decisions for ODS use under Title VI of the CAA. For example, in its Section 604 and Section 606 rulemakings, EPA considered the stranded capital and product costs for the ODS subject to the phase-out. EPA also attempted to estimate the social costs of the reduced efficacy of the substitutes.[18]

2.1.1. Social Cost Estimate

We consider the stranded capital and product costs separately. For the stranded capital, there are several considerations in estimating the social cost. First, the regulation does not destroy the labor and physical capital, but blocks its highest valued use. Workers and entrepreneurs can use their knowledge and machinery to make other products and/or the same product. Second, there is a distinct loss as suppliers move their capital from this highest valued use before the regulation to a lower valued use after the regulation. They also have costs as they retrain and retool their equipment for this shift.

This information guides our estimate. At one extreme, if the regulation completely destroyed the economic value of the enterprise, the loss could be estimated as the enterprise values of the firms. Using a standard financial estimation of small business enterprise value, the loss would be three to five times the firm's intrinsic value (i.e., value added). In this

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[17] European Maritime Safety Agency, *Inventory of National Policies Regarding the Use of Oil Spill Dispersants in the EU Member States*, 2014

[18] For a good summary, see Appendix G of *The Benefits and Costs of the Clean Air Act, 1990 to 2010*, U.S. EPA, 1999.

case, the maximum social cost would be $6 million to $8 million. At the other extreme, in a dynamic economy, excess capital and labor is rapidly moved from one use to another, with almost zero transition cost. Since the regulation fundamentally does not change demand, we assume that the stranded human and physical capital costs will be closer to the low end and assume a loss of $1 million.

For the stranded product costs, knowledge of which existing products will not return to the schedule and the amounts of those products are stockpiled is important information. The RIA gives information about the product types that are likely to leave the market due to regulation (see Section 6 below), but not the specific products.

For current amounts in stockpiles, in support of its 2009 vessel response plan (VRP) rulemaking, the Coast Guard complied data on US stockpiles of products listed on Subpart J.[19] Although this data is comprehensive, it is from 1998. The VRP rulemaking required responsible parties to have contracts with oil spill removal organizations (OSRO) or organic capacity to respond to categorical spills.[20] The rulemaking required owners and operators to have response resources capable of applying dispersants. This rulemaking, and subsequent ones, increased the amount of dispersants stockpiled in the United States.

From public information given by OSROs, most advertised dispersant capacity is for Corexit® formulations. While it is very likely that these organizations also stockpile stabilizers, surface washing agents, and potentially bioremediation agents, we did not find a current, comprehensive list of stockpiled substances.

We therefore constructed our estimate under two scenarios: (1) if EPA does not approve Corexit® formulations; and, (2) If EPA does not approve other agents. For the latter, we include these costs in Section 2.4. A potential ban on Corexit® is discussed in this section.

We gathered available data on current and relatively recent reports of Corexit® formulation stockpiles in the United States and globally. Since the chemical is not approved for use in Europe, we found that global stockpiles are located primarily in the United States and Brazil.[21] Table 2-1 gives the organization and the reported stockpile amount.

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[19] U.S. Coast Guard, "Caps" Review of Oil Spill Response Plan Equipment Capability, at https://homeport.uscg.mil/cgibin/st/portal/uscg_docs/MyCG/Editorial/20080725/combined%20document.pdf?id=213ab594d05ab39ffd49d74a2e188eb8246d23ed&user_id=7ee08b44562829c5918c18d08ac87c29.

[20] 74 FR 45004

[21] http://www.oilspillresponse.com/files/OSRL_GDS_Equipment_20Nov2014.pdf

Table 2-1. Estimated Stockpiles of Corexit® Formulations

Organization	Units	gal/unit	Total
MSRC[22]	1	104,000	104,000
Clean Seas Cooperative[23]	1	20,750	20,750
Oil Spill Response[24]	500	264	132,000
Alyeska Pipeline[25]	1	60,000	60,000
Clean Islands[26]	1	37,260	37,260
LOOP[27]	1	33,600	33,600
Clean Gulf Associates[28]	1	34,650	34,650
CISPRI[29]	1	20,570	20,570
Nalco[30]	1	12,000	12,000

Total (rounded)	450,000
Estimated Value	$ 24,000,000

Table 2-1 may overestimate the amount stockpiled since different organizations may have overlapping agreements to use the same stockpile. The estimates may also be underestimates since we could not find publicly available data on the stockpiles of some of the larger OSROs such as NRC.[31] Based on a recently reported retail price from an OSRO of

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[22] https://www-msrc-org-documents.s3.amazonaws.com/major-equipment-list/MSRC_Major_Equipment_List.pdf?AWSAccessKeyId=AKIAIGH7YZWA2HRSZUFA&Expires=1427976589&Signature=lYm5WdnIB7M4XV%2BR1foyl5kUg70%3D

[23] http://www.cleanseas.com/equipment.htm#ABSORBENTS/DISPERSANTS/SPRAY

[24] http://www.oilspillresponse.com/files/OSRL_GDS_Equipment_20Nov2014.pdf

[25] Minerals Management Service, *Assessment of the Use of Dispersants on Oil Spills in California Marine Waters*, S.L. Ross Environmental Research Ltd, June 2002.

[26] http://www.cleanislands.com/

[27] Minerals Management Service, *Assessment of the Use of Dispersants on Oil Spills in California Marine Waters*, S.L. Ross Environmental Research Ltd, June 2002.

[28] http://www.cleangulfassoc.com/equipment.

[29] Minerals Management Service, *Assessment of the Use of Dispersants on Oil Spills in California Marine Waters*, S.L. Ross Environmental Research Ltd, June 2002.

[30] http://www.rrt9.org/external/content/document/2763/904415/1/Nalco%20Dispersant%20Mfgr%20Capability.pdf

[31] http://nrcc.com/our-services/response-services/response-equipment-rental-packages/

$52 per gallon, the reported stockpiles in Table 2-1 are worth $24 million.[32] Since the product is not approved in jurisdictions with sufficient demand or stockpiles to absorb the US stockpile volume, if EPA did not approve its continued use, it is likely that current stockpiles could have little residual value.

In summary, the stranded capital/stockpile value loss is the sum of the loss of enterprise value (assumed to be $1 million) and the potential loss of in value of Corexit® formulations. Since the loss in Corexit® formulations is speculative, we present our estimate for this rulemaking outcome as a range.

Summary	NPV at 7%	Annualized Cost over 20 years at 7%
Stranded Capital/Stockpile Value Loss	$ 1,000,000-$25,000,000	$90,000-$2,400,000

2.1.2. Recommendation

Once EPA establishes a more plausible baseline and post-regulation market conditions, it must account for all social costs that flow from an EPA decision not to approve products currently on the list. These costs include the stranded physical and human production capital, the loss in value of stockpiled products, and any loss in oil spill response efficacy from these decisions. EPA has access to data on oil response product stockpiles that it should use to better estimate the social costs of this rulemaking. EPA's analysis for the final rule should at least be as comprehensive as EPA's approaches in other comparable EPA rulemakings.

2.2. Periodic Revisions of Preauthorization plans

In the proposal, EPA requires Regional Response Teams (RRTs) to review and to update their preauthorization plans for chemical and biological response agents after major oil spills or at least once every five years. The RIA does not estimate the social costs of this proposed requirement.[33]

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[32] http://www.cleancaribbean.org/cart_detail.cfm?x=35

[33] On page 37 of the RIA, under the section entitled "Authorization of Agent Use (part 300.910)," the RIA notes that RRTs and Area Committees are required to provide a preauthorization plan and to follow other requirements. The RIA states: "The incremental burden for members of the RRT and Area Committees requires labor hours to participate in the development of preauthorization plans and to add them to RCPS and ACPs." However, it is not clear whether the extremely low burden the RIA uses (2 hours) is to update the 11 or more preauthorization plans or the title of section, authorization of agent use. In either case, the RIA's estimate is far too low to comply with the proposed requirement.

There is evidence that this provision would have meaningful costs if finalized. Recently, EPA's Inspector General (IG) issued a report finding defects in emergency management planning and contingency planning for oil spills.[34] In response, EPA stated:

> Thus, although we generally agree with the recommendations in this report, and they parallel our efforts, two key obstacles (i.e., limited involvement by other agencies and stakeholders and resources) must be overcome fo r their successful implementation.[35]

The EPA program response to the IG suggests that resources, not interest, is the barrier to updating preauthorization plans. If local governments and other RRT team members are constrained by a lack of resources, then it is not clear how a regulation will alter this reality. The social costs then must reflect this scarcity. The social costs are not limited to the full compensation costs and capital costs necessary to maintain that employee. Unlike private markets, the supply of government officials' time does not increase with greater demand. For this reason, the social costs are the opportunity costs of that official's time - i.e., the social benefits society would gain if the government official spends the time on the next most valuable use of that person's time--enforcement, policy setting, permit approvals, or other public matters. The opportunity cost of this resource - a government agency official's work time - is how EPA's Guidelines for Economic Analysis defines social cost.[36]

2.2.1. **Estimated Social Costs**

Based on the IG's analysis, we estimate the social costs as the resources required to update preauthorization plans more frequently than is current practice. We assume in the baseline that plans are currently revised once every seven years; the proposal requires them every five years or after major oil spills. Based on the IG report finding that some plans had not been updated since the 1990s, a seven year update frequency in the baseline may underestimate social cost. For the post-rule scenario, we use a five year frequency since the other trigger, major spills, are rare and may be expected to lead to preauthorization plan reviews even in the absence of this rulemaking.

The resources required are the time spent revising each plan and the review of each plan by the member organizations. From the agenda of recent RRT meetings, we count the number of distinct Federal and state agencies. In a recent Region 6 RRT meeting, 13 Federal agencies sent staff.[37] We assume that 13 Federal agencies are part of each RRT. States, territories, and Tribes also serve on the RRTs. Among the 11 RRTs (one for each EPA region

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[34] U.S. Environmental Protection Agency, Office of the Inspector General, *EPA Could Improve Contingency Planning for Oil and Hazardous Substance Response*, February 15, 2013.

[35] Ibid, pg. 19.

[36] "Social cost represents the total burden that a regulation will impose on the economy. It is defined as the sum of all opportunity costs incurred as a result of a regulation where an opportunity cost is the value lost to society of any goods and services that will not be produced and consumed as a result of a regulation," *Guidelines*, p.8-1.

[37] http://www.rrt6.org/Uploads/Files/rrt_semi_annual_meeting_summary_2014_November.pdf

and one for Alaska), we assume 56 States, Tribes, and territories send representatives and participants.

We make some assumptions on the effort needed to revise each preauthorization plan. We assume 20 percent of the RRT's member organizations assign one staff person to serve on an RRT subgroup to revise the plan. Each assigned staff person spends 40 total hours in this revision process. Then, each Federal, State, Tribe, and territory agency reviews the draft revised plan in their organization. Three people in each organization are a part of the review to account for the agency's management and likely legal review. Each person reviewing the draft plan spends six hours reading and discussing the revised plan.

For the costs of government staff time, we use median and mean wages for Federal employees and State employees, respectively.[38] To these wages, we apply recent Federal government values for benefits and overhead to the Federal and State hourly wage values.[39] For the reasons discussed above, this estimate of the opportunity cost of this resource likely underestimates its true social value and thus the social cost of this proposed requirement.

We then compare the social costs for the baseline and proposed requirements - the costs of revising the plans on a seven versus five year frequency. We discount the baseline and proposal time stream of costs at a discount rate of seven percent and take the difference between those time streams as the social cost. The net present value of the additional social cost at a discount rate of seven percent is $0.18 million.

Summary	NPV at 7%	Annualized cost over 20 years at 7%
Preauthorization costs	$180,000	$20,000

2.2.2. Recommendation

The RIA must fully include the social costs and social benefits of this provision and calculate the social costs as the opportunity cost of government agency staff time.

2.3. Prohibition on Chemicals and Proposal to Ban EDCs

The RIA does not estimate the social benefits or the social costs for the proposed option to prohibit approving products containing nonylphenol (NP) and nonylphenol ethoxylates (NPE). More significantly, the RIA did not estimate the social benefits and costs of a regulatory option discussed in the preamble, a ban on endocrine disrupting compounds in approved products.

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[38] U.S. Bureau of Labor Statistics, May 2014 State Occupational Employment and Wage Estimates, http://www.bls.gov/oes/current/oes_ms.htm#11-0000.

[39] See for example, U.S. Office of Personnel Management, Federal Investigative Services Division, *White Paper: Support Services Contract Cost Benefit Analysis.*

Banning any compounds will have social costs and potentially social benefits. As discussed elsewhere in these comments, EPA has acknowledged in other rulemakings the loss of income and loss of productive capital from product bans. These costs must be included in the economic analysis of this option.

One notable option EPA lists is to prohibit materials containing endocrine disrupting compounds from the approved list. More broadly, EPA's proposed prohibition - without any stated criteria for the ban - raises significant market uncertainty. Without transparency into EPA's rationale for the prohibition, producers may decide not to pay for testing costs and risk disapproval, reducing the overall efficacy and variety of products available.

However, the social costs are more significant than the loss of net value in the oil spill response market. Bans by a government agency will cast a cloud over the public's perception of the health and safety of a chemical compound. States and companies maintain lists of "toxic" chemicals and have policies that discourage purchasing and use of chemicals on these lists.[40] By banning a substance in oil spill response products, it is more likely that the market for NP and NPE compounds will shrink throughout the overall economy.

Moreover, the incremental social benefits of the proposed NP and NPE ban are uncertain. The RIA did not quantify these benefits. There is reason to believe that any such social benefits will be small. EPA's own test data provides evidence that the proposed bans would have minimal, if any, social benefits. EPA conducted tests of eight dispersant compound-oil mixtures, some of which contained NPE, for their endocrine activity.[41] EPA found:

> None of the eight dispersants tested displayed biologically significant endocrine disrupting activity, with the exception of a weak response for two of the dispersants (Nokomis 3-F4 and ZI- 400) in one of the tests. This estrogenic result is likely not of biological significance. Cell death (degree the dispersant is toxic to living cells) was observed in some tests at concentrations above 10 parts per million. The endocrine and the cytotoxicity screening were conducted at dispersant concentrations from 0.001 parts per million up to 10,000 parts per million. None of the dispersants triggered cell death at the likely concentrations of dispersants expected in the Gulf.[42]

Therefore, although EPA's study had a small sample set, EPA's test data provides no evidence that these oil spill response compounds with NP and NPE pose any inherent hazard that would justify the social costs of a precautionary ban. The preamble does not provide quantified social benefit estimates to support a ban over other policy alternatives.

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[40] See, for example, Maine's "Chemicals of High Concern," at http://www.maine.gov/dep/safechem/highconcern/.

[41] Judson, R. S., Martin, M. T., Reif, D. M., Houck, K. A., Knudsen, T. B., Rotroff, D. M., Dix, D. J. (2010). *Analysis of Eight Oil Spill Dispersants Using Rapid, In Vitro Tests for Endocrine and Other Biological Activity.* Environmental Science & Technology, 44(15), 5979-5985. doi:10.1021/es102150z

[42] http://www.epa.gov/bpspill/dispersants-qanda.html#toxtest8. See also U.S. Environmental Protection Agency, *Toxicity of Louisiana Sweet Crude Oil (LSC) and chemical dispersed LSC to two Gulf of Mexico aquatic test species,* August 2010.

EPA failed to consider and to evaluate policy alternatives to its proposed ban. Under the Executive orders, EPA must evaluate available policy alternatives and select the ones in which the benefits justify the costs.[43] There are several policy alternatives EPA could choose and could evaluate besides a ban on NP and NPE compounds, such as imposing lesser restrictions or requirements. Such options could tailor the social costs more directly to any potential hazard than a product ban. Only through objective, transparent policy analysis of these alternatives can senior officials and the public weigh the options to decide upon the best policy.

2.3.1. **Estimated Social Costs**

We searched PubMED for published, peer-reviewed articles that found evidence of NP and NPE-containing oil spill response agents. The only study that specifically listed these compounds was EPA's 2010 work in response to the SONS.[44] It identified NP and NPE compounds in two listed dispersants, Nokomis 3-F4 and ZI-400. For the purpose of this estimate, we assume these products are subject to the proposal's ban.

Based on our evaluation, the manufacturers of these products are likely small businesses. To estimate the impact of the ban, we use a similar approach as in Section 1.2.1. The social costs are not permanent; the social value of the banned products is eventually replaced by substitutes or through greater sales of other dispersants. In EPA's testing, the most widely-used dispersant did not contain NP and NPE. The social costs, therefore, are limited to the immediate disruption in the market.

Since we do not know the actual sales of these dispersant products, we average the annual revenue from the three small business manufacturers of dispersant products given in the RIA. As done is Section 1.2.1, we use the value added of the chemical industry to estimate the added value from these products. The social cost of the ban is the lost value from these two products for a three year period.

There are several reasons this approach underestimates the likely social cost. First, medium and large companies may have their products banned also. While these companies may have resources to reformulate their products, there still will be social costs to switch to substitutes. Second, our estimate of two banned products comes from our search of the public, peer-reviewed literature. Given the controversy over dispersants during the SONS and EPA's proposed rule, companies have an incentive not to disclose voluntarily NP and NPE ingredients. Third, it is possible that NP and NPE compounds are used in other product types such as surface washing agents. Fourth, the manufacturers of the two dispersants that EPA identified as containing NP and NPE have similar products on the schedule. If these products also contain NP and NPE, they would also face bans under the proposal.

Finally, we do not estimate the social costs of a more sweeping ban on all EDC compounds. EPA's proposal is too vague for the public to understand its implications. First,

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[43] U.S. Office of Management and Budget, Circular A-4 Regulatory Analysis, September 2003, pg. 16.

[44] Judson RS, Martin MT, Reif DM, et al. Analysis of Eight Oil Spill Dispersants Using Rapid, In Vitro Tests for Endocrine and Other Biological Activity. *Environmental science & technology.* 2010; 44(15):5979-5985. doi:10.1021/es102150z.

EPA does not define what it means to be an EDC. Second, EPA does not state whether all compounded named as an EDC are banned as ingredients or whether *de minimis* amounts are permitted.

Since some of these same products may drop out of the market due to the new testing requirement, we structure our NP product ban cost estimate so as not to double count the product loss estimates already presented. In Section 1.2.1, one product is a dispersant. Our range is simply whether this product's loss is included in the $4 million product loss calculated in Section 1.2.1 or is an additional social cost.

Summary	NPV at 7%	Annualized Cost over 20 years at 7%
Product Loss Costs	$4,000,000-$7,300,000	$380,000-$720,000

2.3.2. Recommendation

The RIA must fully estimate the social costs and the social benefits of the proposal to ban NP and NPE compounds in listed products and the alternative to ban EDCs. To comply with the Executive orders and OMB guidance, EPA must also evaluate policy alternatives to banning compounds and select the one with the greatest net social benefits.

2.4. Expired Product Testing and/or Replacement Costs

EPA proposes that stockpiled products must be tested in order to be used after their expiration date. The RIA does not estimate the social costs of this requirement.

This provision has social costs and potentially social benefits. There are two costs: increased product testing costs and potentially the cost of more frequent product shipments to stockpile locations. The social benefits are potentially more effective products due to this requirement.

2.4.1. Estimated Social Costs

Over time organizations that stockpile oil response products will attempt to minimize the cost of this requirement through inventory management. They can change their ordering procedures to better match inventory to use. More significantly, they can shift sales of products past their official expiration date to other markets. Numerous oil spills and cleanups occur that do not involve Federal OSCs. Since many expiration dates are minimal (e.g., "at least two years"), buyers may be willing to accept response products with older shelf lives for a discount or because their spill response need is less. Vendors/organizations that stockpile will, over time, manage their inventories so that products with young shelf lives are reserved for any Subpart J needs and then, rather than retest to verify their continued use, are migrated to other markets.

This strategy can only work if the major stockpiled products have sufficiently long shelf lives. In the Attachment, the recommended shelf lives for each existing product are listed. We assign a shelf life of 20 years to products reporting unlimited shelf life.

Bioremediation products have the shortest average shelf life of less than three years. Dispersants have the longest average shelf life, with the most widely stockpiled dispersant having an unlimited shelf life. While products vary significantly, there are numerous products in each category with relatively long shelf lives to allow inventory management. To the degree there are effects, management of existing bioremediation products could be most vulnerable to the requirement for additional testing.

For these reasons, we model the social cost as a one-time event to shift management of existing inventories. We assume future purchases and sales will direct products with older shelf lives to cleanups outside National Contingency Plan jurisdiction. We also assume that some operators of existing stockpiles and inventories will decide it is more cost-effective to test rather than replace their existing inventory.[45] They may have quantities of the surface washing products with shorter shelf lives than the average nine year life-span of these products. Different stockpiles will have different products; therefore, the testing decision is based on the number of stockpile-product combinations. We assume that operators find 20 stockpile-product combinations where testing is more cost-effective than selling into other markets or discarding and replacing the product. Since dispersants have a much longer shelf live on average, we only assume four stockpile-product decisions to test. Table 2.2 presents the results based on these assumptions. This provision could have social costs of $1.7 million.

Table 2-2 Estimated Costs of Testing Expired Products

Product	Testing Cost	Number of Stockpiles-Products	Total Cost
Bioremediation Agent	$31,800	20	$1,270,000
Dispersant	$13,050	4	$52,200
Surface Washing Agent	$10,300	20	$206,000
Solidifier	$10,300	20	$206,000
Total			**$1,740,000**

In Section 2.1.1, we consider the social cost of managing stockpiles of existing products that are not approved in the post-regulatory scenario. We assume that OSRO and others manage their inventories of surface washing agents, sorbents, and other products to market them to non-NCP spill responses. In Section 5 we combine all of the provisions that require testing into one estimate so that the analysis makes consistent predictions of market dynamics after the rulemaking.

2.4.2. **Recommendation**

EPA must estimate the social benefits and social costs of this provision if it is included in the final rule. EPA should use current data on stockpile amounts and their expiration dates.

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[45] Or they will replace products in response to the rule up to the expected value of testing them to prove their efficacy. We use the testing cost as the upper limit of the cost to replace existing inventories.

2.5. RECOVERY OF AGENTS FROM ENVIRONMENT

In the proposal, EPA adds a regulatory requirement that responsible parties are obligated to recover certain oil spill response products from the environment. When stabilizers, surface washing agents, and sorbents are used, responsible parties must recover them when it is safe to do so. The RIA does not estimate any social benefits or social costs from this provision.

This requirement has social costs and potentially social benefits. For major spills, it is likely the regulation formalizes the likely site-specific orders by the OSC. By making it a regulatory requirement, the major change is that it subjects the responsible party to the full enforcement authorities under the Clean Water Act. The proposal reduces the government's administrative effort to levy fines and penalties.

The marginal increase in the threat of fines and penalties may change responsible party behavior. Responsible parties may put greater effort into recovery operations and respond to reports of agents in the environment after the spill for a longer period of time. More effort at recovery may then yield some environmental benefits on the margin. However, greater human activity - boats, motors, skimmers - in environmentally-sensitive areas may cause damage while recovering response products. The current framework - to take actions which have the greatest net environmental benefits - is more flexible and allows site-specific balancing of ecological, human safety, and response product use.

2.5.1. Estimated Social Costs

As a practical matter, this provision may not have any additional social costs for major Tier I, Tier II, or Tier III oil spills. On scene coordinators effectively order product recovery for these major spills. For larger spills, the greater level of government oversight in both the baseline and the post-regulation may be expected to lead to similar levels of responsible party activity. For smaller spills, the proposed regulatory requirement could increase social costs by diverting resources into product recovery, especially after the immediate spill response. It is difficult to estimate the additional costs in these site-specific decisions.

Since 2000, there have been on average 13 spills per year of between 5,000-10,000 gallons of oil products into U.S. navigable waters.[46] We assume that these spills are large enough that responsible parties use significant amounts of response products, but not so large that they trigger substantial government oversight.

We assume that the regulatory provision triggers an additional $10,000 in response costs per spill of this medium-to-large spill size. Since daily penalties under the Clean Water Act are up to $37,500 per day per violation, a responsible party may be willing to respond to reports of sorbents and other products in the environment after a spill rather than risk a penalty. They may be willing to spend much more than $10,000 per incident to avoid the fines. However, assuming an average per incident additional cost of $10,000, the net present value (at seven percent) social cost of this requirement is $1.7 million.

[46] United States Coast Guard, *Polluting Incidents In and Around U.S. Waters: A Spill/Release Compendium: 1969 – 2011*, December 2012.

2.5.2. **Recommendation**

EPA should articulate in any final rule the specific social benefits and social costs it believes will occur as a result of this provision. Specifically, EPA should explain the value of this requirement as a regulation as opposed to a site-specific/incident-specific decision that maximizes net environmental benefits.

SECTION 3. UNDERESTIMATED COSTS

3.1. MONITORING COSTS

The proposal requires responsible parties to carry out extensive monitoring of dispersant use, oil concentrations, and ecological effects in the event of a major oil spill where dispersants are used. The RIA estimates the cost of these monitoring requirements to be $500,000 per year for an average of one applicable major, off-shore oil spill per year.

The justification for the cost estimate in the RIA is two studies. However, these studies do not replicate the specific proposed requirements and therefore do not provide adequate justification for the RIA's estimate.

3.1.1. Estimated Social Costs

We build a bottom-up estimate of the social costs to monitor and to report the information listed in the proposed rule. We first make some assumptions concerning the duration of the spill. We assume the responsible party conducts active monitoring of the oil plume and dispersant use for 14 days, followed by 21 days of monitoring of the dissolved oil/dispersant mixture in the water column. Modeling of the oil movement in the water is carried out for 14 days; fluorescence monitoring occurs for the entire 35-day period.

Since dispersants are used, the oil spill is assumed to occur off shore, meaning boats are needed to obtain the water samples and to gather data for the modeling. Background samples are assumed to be gathered at four points upwind and downwind of the plume. In-plume measurements are assumed to be gathered at five points, with three different sampling points in the water column at each point. After the 14 day period, monitoring requirements for the next 21 days fall from five locations in the plume to four areas in the affected area. Background samples are still collected.

Field and test blanks are assumed to be analyzed for each background and plume collection point. The proposal also requires the responsible party to submit a quality assurance plan for the sampling and analysis.

Given the need for rapid decisions, the ecological characterization and risk assessment requirements are divided into two phases. For immediate decisions during the 14 day active response, experts gather available information from already-published studies and regional ecological evaluations. This study also sets the acute toxicity level from available data. Once the response moves to the 21-day monitoring of the ultimate dispersion, a more complete, written ecological characterization report is compiled.

The responsible party assigns 10 managerial and technical staff to manage, carry out, and to report compliance with the monitoring requirements during the 35-day event.

Based on this scenario, we gathered publicly-available price data from OSROs and commercial laboratories to build a social cost estimate. The Oil Spill Response Limited

organization has a global price list and cost data for their Florida-based response location.[47] Table 3-1 gives the principal data used in this cost estimate:

Table 3-1. Prices for Oil Spill Dispersant Use Modeling

Fluorescence Tracking[48]	659	GBP/day
Boat Rental[49]	400	GBP/day
Oil Modeling[50]	2,300	GBP/day
Heavy Metal Analysis[51]	350	$/sample
Volatile Organic Compounds and Benzene, Toluene, Ethylbenzene, and Xylenes[52]	250	$/sample
Total Petroleum Hydrocarbons[53]	150	$/sample
Other Parameters[54]	150	$/sample

Based on this scenario, the estimated monitoring costs are approximately $850,000 per spill. This value is substantially greater than the RIA estimate. This estimate does not include insurance costs, contingency costs, surcharges for rapid delivery, sample shipping costs, travel costs, or other logistical needs. Including these costs would increase the social costs of this provision.

Given the frequency of one spill per year, the net present value and annualized value of these social costs are given below.

Summary	NPV at 7%	Annualized Cost over 20 years at 7%
Monitoring Costs	$11,000,000	$1,000,000

[47] http://www.oilspillresponse.com/

[48] http://www.oilspillresponse.com/files/ScaleOfFees2015.pdf.

[49] Ibid

[50] http://www.oilspillresponse.com/files/ScaleOfFees2015.pdf.

[51] See for example, Price List from Water Testing Labs at http://www.wtlmd.com/wastewater-testing-pricing-maryland-md-va-dc-de.php.

[52] Ibid

[53] Ibid

[54] Ibid

3.1.2. Recommendation

EPA should use the available data from OSRO equipment price lists and laboratory sampling costs to build up a more complete cost estimate for all of the required parameters for dispersant modeling in the proposed rule. With a frequency of dispersant use of approximately once per year, there is sufficient existing data and markets to use market prices to estimate the social cost. EPA should also characterize plume size and expected monitoring requirements from past spill responses. Gathering this data will provide more support for a social cost estimate.

3.2. EPA Costs to Administer the Rule

The RIA underestimates the total resource cost for EPA to administer the rule because it fails to include the total compensation and overhead costs to employ Federal agency staff and it omits the time necessary for EPA to administer the new requirements. The RIA's approach does not comply with EPA's obligations under the Paperwork Reduction Act's implementing regulations (PRA).[55]

The RIA use BLS data from 2011 as estimates of the opportunity cost of government employees. There are several problems with this data:

- It is out of date. The BLS has compensation data available through September 2014.[56] Moreover, the General Services schedule of Federal wages for 2014 is also available as it determines EPA employees' paychecks.

- It underestimates total compensation. It is unclear whether the data the RIA uses is for salary and wages only or for total compensation. It appears that the RIA uses a labor cost of approximately $54 per hour for EPA employees.[57] The

[55] See 5 CFR 1320.3(a)(1):

(1) *Burden* means the total time, effort, or financial resources expended by persons to generate, maintain, retain, or disclose or provide information to or for a Federal agency, including:

(i) Reviewing instructions;

(ii) Developing, acquiring, installing, and utilizing technology and systems for the purpose of collecting, validating, and verifying information;

(iii) Developing, acquiring, installing, and utilizing technology and systems for the purpose of processing and maintaining information;

(iv) Developing, acquiring, installing, and utilizing technology and systems for the purpose of disclosing and providing information;

(v) Adjusting the existing ways to comply with any previously applicable instructions and requirements;

(vi) Training personnel to be able to respond to a collection of information;

(vii) Searching data sources;

(viii) Completing and reviewing the collection of information; and

(ix) Transmitting, or otherwise disclosing the information.

[56] See the Employment Compensation Survey, http://www.bls.gov/ncs/tables.htm.

[57] Calculated from data in RIA, pg. 36.

RIA should use total compensation measures to account for Federal employee benefits such as pension, health care, disability insurance, and personal leave. This information is readily available in EPA budget documents, in OMB budget memoranda, and from the Office of Personnel and Management.

- The total resource costs for government services is more than the total compensation cost of labor. Government workers do not work in the open air. They need buildings, electricity, computers, telephones, water, and many other overhead costs. Estimating the overhead costs for government employment is a routine practice in Federal budgeting, in program evaluation, and for compliance with the Paperwork Reduction Act.[58]

Further, the RIA does not include the costs for EPA to administer certain provisions of the rule. In addition to the costs to participate in the RRT and AC meetings included in Section 2.2.1, the RIA fails to include the EPA resources necessary to remove a product from the listing schedule.

3.2.1. Estimated Social Costs

We estimate the social costs of EPA resources to oversee the proposed requirements. Although it is likely an underestimate, we retain the RIA's estimate of 26.5 hours for EPA staff to review each product application. Interestingly, the RIA estimates producers of existing products spend only 7.7 to 27.7 hours to submit the required testing data to EPA. Thus, by the RIA, EPA's review time is longer - up to three times longer - than the time needed to prepare the information. If this ratio is correct, EPA's review process could take over 100 hours. We also agree with the RIA's estimate that the same number of hours is needed when a manufacturer submits new testing data after a product has been reformulated.

However, the RIA assumes EPA spends only 2.5 hours reviewing resubmissions of data from applicants. Since EPA has only 90 days to review an application, it is likely to extend its review by asking applicants for additional information. It seems implausible that EPA would need less than 10 percent of its estimated total review time to review resubmitted data. We use an estimate of 20 hours. We also double the amount of time the RIA estimates to review an appeal of a product disapproval. We believe other divisions of EPA, including the Office of General Counsel, will support the Administrator's review of an appeal and a final Agency decision.

For the opportunity cost of EPA personnel time, we use the fully-loaded employment costs. In FY13, the median EPA employee salary was nearly $108,000, or nearly $55 per hour.[59] We apply OPM's benefit and overhead percentages to calculate a fully-loaded rate of

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[58] 5 CFR 1320.3(a)(1).

[59] U.S. Office of Personnel Management, *Salary Information for the Executive Branch Fiscal Year 2013*, April 2014.

$81.50 per hour.[60] This estimate is a slight underestimate of the likely median wage due to general schedule increases since FY13.

Using the post-regulation rate of existing product submissions and new product submissions, we calculate a net present value (at seven percent) of $0.81 million in social costs for EPA to administer the testing requirements.

3.2.2. Recommendation

The RIA should include costs of EPA to carry out all the proposal in its entirety. EPA should include the total compensation cost for government personnel and the overhead costs necessary to house and to equip these employees so that they can perform their new tasks under this proposed regulation. EPA must include these costs and the resources to oversee all of the provisions of the rule in subsequent analyses.

3.3. Testing and Product Listing Costs

The RIA underestimates the costs an organization expends to understand and to comply with this regulation. The RIA assumes essentially that one or two individuals are solitary actors that read, plan, and implement a regulation for a company. In reality, many employees and managers in an organization will be involved in a product's application.

In addition to underestimating the costs for producers, the RIA underestimates the costs to understand, to comply, and to submit product applications. For example, the RIA does not include these costs:

- Laboratory Personnel Understanding the Rule. The RIA does not include the cost for laboratory personnel either within the manufacturer or at a commercial lab to understand the new testing requirements.
- Legal Personnel Time. It seems implausible that a company would file an important submission to EPA without it undergoing legal review. The submission could determine the entire market for a product.
- Response Costs. Often EPA staff will seek clarifications from respondents on their data submissions to the agency. Seeking clarifications in lieu of outright denials/approvals conserves resources for both EPA and respondents. Oddly, the RIA includes EPA's cost to review these re-submissions, but not those of the respondents to prepare them.[61]

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[60] See for example, U.S. Office of Personnel Management, Federal Investigative Services Division, *White Paper: Support Services Contract Cost Benefit Analysis.*

[61] Even if the RIA estimates the full resource cost for the respondent to submit a "perfect" application that does not require clarification, the respondent is not in control of EPA staff comprehension of the submission and their ability to ask questions, triggering respondent costs.

3.3.1. Estimated Social Costs

In Table 3-2 below, we present alternative labor estimates for producers to comply with the rule that addresses the RIA's limitations. We include hours for all the provisions required of producers, including ones the RIA omits like the product label redesign.

Table 3-2. Estimated Skilled Labor Resources Producers Require to Comply with Proposal's Testing Requirements

(Hours)

	Labor Hours Needed		
	Managerial	Technical	Clerical
Hourly Compensation	$ 55.56	$ 55.56	$23.57
Understand Rule	4	8	2
Contract for Tests	2	16	4
Manage Tests	0	8	8
Prepare Documentation	4	40	16
Design Label	0.5	8	8
Legal Review	4	0	2
Revise Documentation	2	4	45
Respond/Follow up	4	16	8
Total (Hours)	20.5	100	93
Total ($) including overhead rate of 17 percent			$10,400

We include hours for essential tasks to prepare the required information. First, the producer must find and contract with an independent certified laboratory for the efficacy and toxicity testing. They must manage the outside laboratory's performance and review the results. In addition, the producer must prepare the written submission to EPA and follow up with any EPA questions.

For labor rates, we use the BLS Employer Cost for Employment Survey data for December 2014.[62] We use the same overhead rate as the RIA, 17 percent, and use the RIA's relative proportion of the application costs among dispersants, solidifiers, surface washing agents, and bioremediation agents. We use these labor costs for product testing in the multiple provisions in the proposal that require product testing.

[62] http://www.bls.gov/ncs/ect/sp/ececqrtn.pdf.

3.3.2. Recommendation

EPA should include all the costs to understand, to explain, and to incorporate the proposed rule into their organizations' operations. EPA is required to perform this analysis under the PRA regulations. In addition, from past applications, EPA should review whether, and if so, the scope of additional information requests it gave to applicants and include these costs in the any final rule. These costs must be assigned to the regulation.

3.4. Limitation To Tested Waters and Efficacy and Toxicity Testing Costs

In the proposal, EPA limits use of a product to the water characteristics of its toxicity and efficacy testing. Product data with just freshwater test data are limited to freshwater uses, for example. The proposed rule expands the number of efficacy tests for bioremediation agents and alters the efficacy test for dispersants. The proposed rule adds new toxicity tests for dispersants and freshwater/saltwater tests for bioremediation, solidifiers, surface washing agents, and other products.

The RIA makes a global assumption that producers chose just one testing environment, salt water or freshwater, and bear the costs for only one test protocol. Rather than chase market demand and maximize net profits, producers instead make their marketing decisions based on the testing cost. The RIA's assumption violates basic economic theory and thus underestimates social costs.

EPA's own data demonstrates this point. Producers list which of the current required toxicity and efficacy testing they have conducted. This information is available on the Subpart J schedule. Except for the bioremediation products, all other products list test data in both the reference saltwater and freshwater species. For bioremediation products, 27 products do not list any information; 21 report test data in both species. In other words, producers currently want to sell in both markets due to the demand for oil spill remediation in both waters. The rulemaking does not change this market demand.

3.4.1. Estimated Social Costs

Since producers currently market to oil spill response demands in both freshwater and saltwater environments, we assume existing and new product manufacturers will pay for the new efficacy and toxicity tests required for both environments. Using the RIA's testing costs, the total laboratory testing cost per product is listed in Table 3-3.

Table 3-3. Testing Costs by Product Type

Dispersants	$13,050
Bioremediation	$31,800
Solidifiers,	$10,300
Surface Washing	$10,300

We use these testing costs to estimate the application cost and the economic impact of the proposed rule. The labor and laboratory testing costs are combined and presented in Section 6.

3.4.2. Recommendation

Consumer demand will drive producers' decisions on marketing, not the testing requirements of the rule. EPA should align its economic analysis to observed producer decisions and thus expect increased testing costs rather than the estimates found in the RIA.

3.5. Retesting Whenever Chemical Composition Changes

In the proposal, producers would be required to retest its products and submit the results to EPA whenever they change the chemical compounds or their concentrations in an approved product. The proposal calls for comment on an option for allowing *de minimis* changes in concentrations or formulations, but proposes retesting for any change. The RIA assigns the same amount of cost to this requirement as it does for a new product application. For the reasons discussed in Section 3.3 above, the RIA underestimates social costs.

3.5.1. Estimated Social Costs

For a cost estimate, we assume that on average one product each year undergoes a change that triggers the requirement to retest. With more than 100 products and product lines on the Subpart J list, the RIA's assumption seems reasonable that approximately one product would undergo a change each year to trigger retesting.

Since we do not know which product type will undergo change, we take an average of the estimated testing costs for the four product types. Therefore, if one product triggers the retesting requirement per year, the net present value (at seven percent) of this proposed provision is $1.7 million/year.

3.5.2. Recommendation

EPA should articulate in any final rule the specific social benefits and social costs it believes will occur as a result of this provision. Specifically, EPA should explain the value of this requirement as opposed to a performance standard that makes manufacturers responsible to demonstrate that formulation changes do not affect toxicity or efficacy.

3.6. Product Label Redesign

In the proposed rule, applicants must submit a sample product label that includes the manufacture and expiration date, the storage conditions, and the mandatory disclaimer language. Producers must not only change the description on the label on the physical product, but also the description on any promotional material, websites, and other presentation forms. The RIA includes the social cost of submitting the sample label in its overall producer cost estimates.

EPA has estimated the social costs of mandatory labeling and labeling changes in multiple rulemakings.[63] The social costs include the one-time labor and capital costs to craft the new label design, any on-going incremental costs to produce the new label, and costs to digitize the information for electronic media.

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[63] See, for example, U.S. Environmental Protection Agency, *Final Technical Support Document, Fuel Economy Labeling of Motor Vehicles: Revisions to Improve Calculation of Fuel Economy Estimates*, EPA420-R-06-017, December 2006.

3.6.1. Estimated Social Costs

We include additional labor hours to account for the changes to a producer's website and marketing materials. Table 3-4 shows the labor costs for this requirement. We add $500 for each producer in capital and material costs to create the new label.

3.6.2. Recommendation

In any final rulemaking RIA, EPA should draw upon other EPA analyses to estimate the labor hours and capital cost requirements to redesign labels and marketing materials.

3.7. Accredited Laboratory Requirement

The proposed rule requires test data be generated from an accredited laboratory. In the baseline, companies could use any laboratory or generate the information in their own laboratories. While the RIA states that it gathered costs from laboratories to conduct the tests, it is unclear whether this cost information is from accredited labs.

3.7.1. Estimated Social Costs

If the RIA data is from accredited labs, then the costs of this requirement is included in the test costs used in the RIA. If it is not, then the RIA's costs for each test is likely underestimated.

3.7.2. Recommendation

In any final rule, the accompanying RIA should disclose the sources of its information so that policy officials and the public can evaluate the incremental social benefits and social costs of this provision as required by the Executive orders on regulatory review.

SECTION 4. THE RIA'S SOCIAL BENEFIT DESCRIPTION IS INACCURATE AND DOES NOT COMPLY WITH EPA'S REGULATORY ANALYSIS REQUIREMENTS

Fundamentally, the RIA fails to comply with the Executive orders on regulatory review because it does not quantify the potential social benefits either in dollars or in any other metric.[64]

Even more troubling, the RIA lists social benefits that are irrelevant to this rule and, if applicable at all, are actually social costs. The RIA lists qualitative benefits from avoiding oil spills such as lost tourism revenue and enjoyment. However, this rulemaking has the potential for aggravating the potential damages from oil spills. To the degree this rulemaking reduces chemical and biological agent availability and innovation, the nation will have less tools available to fight oil spill damage. A possible, but hopefully remote, outcome of this rule is that future oil spill damages would be more severe than they would be if the rule did not occur. Therefore, the potential social costs from oil spills should be considered, if at all, as a social cost of this rulemaking, not a benefit.

The RIA also does not quantify the marginal social benefits from each provision and each regulatory option. Under Circular A-4, agencies are required to estimate the marginal social costs and benefits for each regulatory provision.[65] Since this rulemaking proposes multiple changes to Subpart J, the public and policy officials cannot determine which provisions have net social benefits and which provision provides the most social benefits.

As discussed in Section 1, the other fundamental problem is that the RIA does not have a consistent baseline and post-regulatory alternative to allow a consistent measurement of social benefits. We present our recommended post-regulatory scenario in Section 5.

Recommendation. The RIA does not comply with the basic requirements of a social benefit estimate. First, it must define clearly what the social benefits are from this rulemaking and describe the real social goods that increase from the baseline to the post-regulation scenario. Second, an RIA for any final rulemaking must attempt to quantify the incremental amount of these social goods that can be attributed to this rulemaking and to the specific provisions of the rulemaking that will generate these social goods. Finally, EPA must use the established literature to value the gains, if any, in ecological services from the rulemaking.

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[64] OMB, Circular A-4, pg. 27.

[65] OMB, Circular A-4, pg. 7.

SECTION 5. TOTAL SOCIAL COSTS

5.1. POST-MARKET CONDITIONS

As discussed in Section 1, EPA's economic analysis guidelines emphasize the need for a clear and consistent market baseline and description of post-regulation market conditions. This guidance is especially relevant for this rulemaking because of the interaction of the requirements, the effect on regulated parties' behavior, and the ultimate social cost of the rulemaking.

This section describes a potential sequence of actions flowing from EPA's promulgation of the final rule. The social cost of these actions, and the time they occur, is the structure of our social cost estimates:

- In year 1, EPA promulgates the final rule.
- In year 1 and 2, existing products remain on the market. At the end of year 2, 13 existing products do not submit testing data due to high costs. The value of 13 comes from the results of the economic impact analysis in Section 6. Therefore, the number of existing submitted application is 13 less than the baseline. It is likely that these 13 products include the products banned due to the NP and NPE formulation ban.[66]
- Starting in year 1 and continuing, the rate of new product applications falls from 10 per year to 7 due to increased costs and market barriers
- In year 3, 13 new product applications are submitted to fill the baseline market demand.
- In years 1-3, 64 expired product applications come as suppliers adjust their inventory. We assume 24 in year 1 and 20 each in years 2 and 3.
- One new application appears each year for product reformulation.

[66] In other words, the social costs of the product loss from the banned products are estimated. However, we assume that for the one or two potential products subject to the ban, only one new product is added in the future.

Table 5-1. Pace of Product Applications

	Year						
	1	2	3	4	5	6	7
Baseline							
Existing Products	109						
Annual New Products	10	10	10	10	10	10	10
New Estimate							
Existing Products	59	27					
Expired Products	24	20	20				
Annual New Products/New Formulations	7	8	8	21	8	8	8
Total	**90**	**55**	**28**	**21**	**8**	**8**	**8**

5.2. ADDITIONAL SOCIAL COSTS

5.2.1. Additional Social Costs from this Analysis

Based on the information in Table 5-1, we can integrate the social cost estimates for the different provisions of the rule. Table 5-2 gives the net present value and annualized social costs for the provisions with estimates in this analysis. As in Table 5-1, the social cost for testing includes the costs for expired products, for new products, for retesting of existing products, and for impact of existing products dropping out of the market.

Table 5-2. Additional Social Costs of the Proposal

	NPV at 7% ($)	Annualized Cost over 20 years at 7% ($)
Product Loss Costs	4,000,000-7,300,000	380,000-720,000
Product Testing Costs	5,300,000[67]	500,000
Stranded Capital/Stockpile Value Loss	1,000,000 -- 25,000,000	90,000-2,400,000
Label	180,000	20,000

[67] This number is the net present value of the weighted annual testing cost multiplied by the number of products per year that is given in Table 5-1. The weighted annual testing cost is that year's mix of dispersant, solidifiers, surface washing, and bioremediation products that submit testing information. For existing products, the each yearly mix of different product types is proportional to the number of each type on Subpart J and the number of each type subtracted/added to the additional testing cost. As discussed in Table 2-2, different product types also have a different frequency of expired product testing. This proportion thus changes the number of each product type tested per year and thus the weighted annual testing cost.

Recovery Costs	1,700,000	160,000
Monitoring Costs	11,000,000	1,000,000
Preauthorization Costs	200,000	20,000
EPA Costs	800,000	80,000

Totals[68]	24,000,000-52,000,000	2,300,000 --4,900,000

5.2.2. Other Costs from the RIA

The RIA included social costs estimates for other proposed requirements that are not re-estimated in this analysis. The RIA estimates the costs for some sorbent manufacturers to submit technical data to be considered on a Sorbent Product List. The RIA estimates the annualized cost to be approximately $15,000. Adding this provision to the costs in Table 5-2 does not materially change the social cost estimate.

[68] Throughout this report, totals and summaries may be different due to rounding. Reflecting the likely precision of these estimates, figures are presented to two significant digits or less.

SECTION 6. THE RIA UNDERESTIMATES THE SMALL BUSINESS IMPACT

The RIA's methodology underestimates the rule's economic impact on small businesses. The proposed rulemaking may have a substantial effect on a significant number of small businesses in the oil spill response product market. EPA should evaluate whether it must comply the procedural and other analytic requirements of the Small Business Regulatory Enforcement Fairness Act (SBREFA).

EPA's methodology underestimates the economic impact in two principal ways. First, as discussed above, it underestimates the direct labor and capital costs to comply with the rule. Second, it underestimates the cost of capital in at least two ways: (1) by assuming owners can finance testing requirements over a longer time period than is likely; and, (2) by underestimating the cost of capital for small businesses. Each of these issues is discussed below.

First, firms producing existing listed products only have two years to reapply and to resubmit the newly-required information. Yet, the RIA annualizes a firm's costs over a 20 year period. It is highly unlikely that a small business could borrow funds over a 20 year period for a product that may only have a limited market for two years. Nor would rational business owners with high opportunity costs for capital tie up their capital for such a long time period. A more realistic financing period is two years.

Second, as EPA's economic guidelines state for economic impact analyses, EPA should use the private cost of capital for small businesses.[69] EPA uses the social cost of capital established by OMB. However, due to the increased loss risk, capital lending institutions or capital investors charge higher effective interest rates for loans to small businesses. The Federal Reserve conducts routine survey of small business lending conditions.[70] In recent months, they have found completed, Small Business Administration-backed small business loans at an interest rate of between 5.1 and 5.6 percent. However, the average effective borrowing rate across all small businesses is much higher. As firms report, if they do not qualify for commercial credit, they use instruments with higher interest rates such as credit cards, trade credit, or debt consolidation. The average effective borrowing rate across all small businesses and all credit needs is substantially greater than seven percent.

We present an alternative estimate of economic impact to small business as an illustration of how large the impacts are likely to be. Table 6-1 shows the testing and the labor costs for existing producers to comply with the proposed rule using different discount rates and annualization periods.

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[69] EPA, *Guidelines*, pg. 9-16.

[70] Federal Reserve Banks of New York, Atlanta, Cleveland and Philadelphia, *Joint Small Business Credit Survey Report, 2014*, February 2015.

Table 6-1. Annualized Compliance Costs for New Testing Requirements, RIA Estimate and Revised Estimate

	Testing Costs	Estimated Labor Costs	RIA's Total Costs	Estimated Total Costs	Annualized at 7% over 20 Years	Annualized at 7% over 5 Years	Annualized at 7% over 2 Years
Dispersants	$13,050	$10,398	$14,240	$23,448	$1,344	$3,473	$12,969
Bioremediation	$31,800	$7,728	$14,042	$39,528	$1,325	$3,425	$21,863
Solidifiers,	$10,300	$6,412	$5,986	$16,712	$565	$1,460	$9,243
Surface Washing	$10,300	$5,077	$5,880	$15,377	$555	$1,434	$8,505

Table 6-2 replicates Exhibit 7-1 of the RIA to present the testing and application costs as a percentage of the firm's annual sales. For economic impact analyses, if a regulation's cost to a firm is three percent of its revenue or more, the general conclusion is that the firm is at risk of closure.[71] The RIA reviewed 30 of the 35 small businesses and found that none exceeded the three percent significant impact threshold. However, using a more realistic financing period and more realistic estimates of costs, 43 percent (13/30) of the firms would face compliance costs greater than three percent of their annual 2011 sales. We recognize that Table 3 uses 2014 values for labor costs and 2011 data for revenue. In any final rule, EPA should update the revenue estimates and recalculate the economic impact using costs and financing options that reflect market conditions.

[71] U.S. Small Business Administration, *Guide for Government Agencies How to Comply with the Regulatory Flexibility Act*, May 2012. See U.S. EPA, *Final Guidance for EPA Rulewriters: Regulatory Flexibility Act as amended by the Small Business Regulatory Enforcement Fairness Act*, November 2006.

Table 6-2. Economic Impact on Small Businesses

Company	Number of Employees	Annual Revenue	Product Type	Annualized Cost	Pct of Revenue
1	1	$ 62,000	Solidifiers	$9,243	14.9%
2	1	$ 1,000,000	Surface Washing Agent	$8,505	0.9%
3	1	$ 160,000	Surface Washing Agent	$8,505	5.3%
4	2	$ 2,500,000	Bioremediation Agent	$21,863	0.9%
5	2	$ 120,000	Solidifiers	$9,243	7.7%
6	2	$ 200,000	Solidifiers	$9,243	4.6%
7	2	$ 30,000	Solidifiers	$9,243	30.8%
8	2	$ 10,000,000	Solidifiers	$9,243	0.1%
9	2	$ 120,000	Surface Washing Agent	$8,505	7.1%
10	3	$ 280,000	Surface Washing Agent	$8,505	3.0%
11	3	$ 1,300,000	Surface Washing Agent	$8,505	0.7%
12	3	$ 150,000	Surface Washing Agent	$8,505	5.7%
13	3	$ 5,000,000	Surface Washing Agent	$8,505	0.2%
14	4	$ 559,000	Bioremediation Agent	$21,863	3.9%
15	4	$ 1,000,000	Dispersant(2) & Surface Washing Agent	$34,442.26	3.4%
16	4	$ 730,000	Solidifiers	$9,243	1.3%
17	4	$ 500,000	Surface Washing Agent	$8,505	1.7%
18	4	$ 187,000	Surface Washing Agent	$8,505	4.5%
19	4	$ 350,000	Surface Washing Agent	$8,505	2.4%
20	5	$ 5,000,000	Bioremediation Agent	$21,863	0.4%
21	5	$ 290,000	Bioremediation Agent	$21,863	7.5%
22	6	$ 120,000	Bioremediation Agent	$21,863	18.2%
23	6	$ 15,000,000	Dispersant(1) & Surface Washing Agent	$21,473	0.1%
24	6	$ 500,000	Surface Washing Agent	$8,505	1.7%
25	6	$ 5,000,000	Surface Washing Agent	$8,505	0.2%
26	7	$ 660,000	Surface Washing Agent	$8,505	1.3%
27	8	$ 3,054,214	Bioremediation Agent	$21,863	0.7%
28	8	$ 2,500,000	Surface Washing Agent	$8,505	0.3%
29	8	$ 1,500,000	Surface Washing Agent	$8,505	0.6%
30	9	$ 2,500,000	Surface Washing Agent	$8,505	0.3%

ATTACHMENT: SHELF LIFE OF LISTED AGENTS[72]

Product	Type	Shelf Life	Assumed Shelf Life (years)
AGROREMED (see SPILLREMED (MARINE)®)	Bioremediation Agent	one year	1
BILGEREMED (see SPILLREMED (MARINE)®)	Bioremediation Agent	one year	1
HYDROREMED (see SPILLREMED (MARINE)®)	Bioremediation Agent	one year	1
INIPOL EAP 22	Bioremediation Agent	one year	1
MUNOX SR®	Bioremediation Agent	over one year when stored at temperatures from 35°F to 95°F	1
OILCLEAN w/ACTIVATOR (see PRO-ACT)	Bioremediation Agent	one year	1
PRISTINE SEA II	Bioremediation Agent	As a dry bacterial blend, the shelf life is 1 year, and as a liquid bacterial mixture, the shelf life is 6 months	1
PRO-ACT	Bioremediation Agent	One year	1
SPILLREMED (INDUSTRIAL)	Bioremediation Agent	one year	1
VAPORREMED (see SPILLREMED (MARINE)®)	Bioremediation Agent	one year	1
BILGE CLEAR (see S-200)	Bioremediation Agent	1½ years if kept in the unopened original container	1.5
NANOBITE (see S-200)	Bioremediation Agent	1½ years	1.5
OIL GONE EASY (see S-200)	Bioremediation Agent	1½ years if kept in the unopened original container	1.5
S-200	Bioremediation Agent	1½ years	1.5
S-200C (see S-200)	Bioremediation Agent	1½ years	1.5

[72] Information compiled from individual products listed on schedule as of March, 2015. http://www2.epa.gov/emergency-response/alphabetical-list-ncp-product-schedule-products-available-use-during-oil-spill.

S-200 OIL CLEAN (see S-200)	Bioremediation Agent	1½ years	1.5
S-200 OIL GONE (see S-200)	Bioremediation Agent	1½ years	1.5
SHEENCLEAN (see S-200)	Bioremediation Agent	1½ years	1.5
Z-11 (see S-200)	Bioremediation Agent	1½ years	1.5
BIO-REGEN HYDROCARBON (see SOIL RX)	Bioremediation Agent	Shelf life exceeds 2 years when properly stored in the unopened original container	2
BIOREM-2000 OIL DIGESTER™	Bioremediation Agent	Two years when stored within the storage temperature range in the original container	2
BIOREM-2000 SC (see BIOREM-2000 OIL DIGESTER™)	Bioremediation Agent	Two years when stored within the storage temperature range in the original container	2
JE1058BS	Bioremediation Agent	2 years if stored in a cool dry area	2
REMEDIADE™	Bioremediation Agent	unopened is 2 years	2
SOIL RX	Bioremediation Agent	two years	2
SP 7010 (see REMEDIADE™)	Bioremediation Agent	two years	2
SUMP SAFE BIO-RECLAIM	Bioremediation Agent	The material must be used within 24-48 hours of constitution of the powdered bacteria portion in water. The dry material must be kept at -20°C and is stable for two years at this temperature. Once sent to the field, the material may be stored on ice for up to two weeks prior to constitution	2
SYSTEM E.T. 20 (formerly MCW.B 20)	Bioremediation Agent	2 years if maintained at 4ºC (39ºF)	2
WASTE AWAY®	Bioremediation Agent	Two years	2
WMI-2000	Bioremediation Agent	2 years if stored at ambient temperatures	2
B&S INDUSTRIAL (see STEP ONE)	Bioremediation Agent	Over 3 years	3
BET BIOPETRO (formerly BET BIOPETRO HEAVY)	Bioremediation Agent	More than 3 years in unopened original shipping container, stored in cool dry area	3
BIOWORLD BIOREMEDIATION HYDROCARBON TREATMENT PRODUCTS	Bioremediation Agent	exceeds 3 years when stored properly in cool, dry place out of direct sun light	3
SHAMANTRA BIO (see SHAMANTRA GREEN)	Bioremediation Agent	3 years when stored in sealed silos, polydrums, poly bags or totes	3
SHAMANTRA GREEN	Bioremediation Agent	3 years when stored in sealed silos, polydrums, poly bags or totes	3
STEP ONE	Bioremediation Agent	Over 3 years	3

VB591™, VB997™, BINUTRIX®	Bioremediation Agent	three years	3
ACT TERRA FIRMA	Bioremediation Agent	If kept in a sealed container with desiccant bag the shelf life is 5 years	5
ACT-TF (see ACT TERRA FIRMA)	Bioremediation Agent	If kept in a sealed container with desiccant bag the shelf life is 5 years	5
DRYLET™ MB BIOREMEDIATION	Bioremediation Agent	Minimum 5 years, with proper storage, in original packaging. Freezing does not harm shelf life; however, extreme heat (over 180°F) for long periods of time can shorten shelf life	5
DUALZORB®	Bioremediation Agent	unopened product is 5 years if not exposed to weather or direct sunlight	5
ERGOFIT MICRO MIX AQUA	Bioremediation Agent	5 years	5
LAND AND SEA RESTORATION	Bioremediation Agent	More than 5 years in unopened original shipping container, store in a cool, dry place	5
MICROSORB SC (see OPPENHEIMER FORMULA)	Bioremediation Agent	5 years	5
OIL SPILL EATER II	Bioremediation Agent	5 years	5
OPPENHEIMER FORMULA	Bioremediation Agent	5 years	5
The OPPENHEIMER FORMULA I (see OPPENHEIMER FORMULA)	Bioremediation Agent	5 year	5
TRAILZORB (see DUALZORB®)	Bioremediation Agent	5 years if not exposed to weather or direct sunlight	5
WHITZORB (see DUALZORB®)	Bioremediation Agent	unopened product is 5 years if not exposed to weather or direct sunlight	5
MICRO-BLAZE®	Bioremediation Agent	Minimum 10 years	10
SUPERSPERSE™ WAO2500	Dispersant	one year	1
MARINE D-BLUE CLEAN™	Dispersant	2 years, if unopened	2
NOKOMIS 3-AA	Dispersant	two years	2
FFT-SOLUTION™	Dispersant	5 years	5
NEOS AB3000	Dispersant	five years	5
MARE CLEAN 200 (formerly MARE CLEAN 505)	Dispersant	10 years when stored indoors	10
NOKOMIS 3-F4	Dispersant	15 years or more if stored correctly in plastic drums	15
ACCELL CLEAN® DWD	Dispersant	unopened drums of ACCELL CLEAN® DWD is unlimited	20

BIODISPERS (formerly PETROBIODISPERS)	Dispersant	unlimited	20
COREXIT® EC9500A (formerly COREXIT 9500)	Dispersant	The shelf life of unopened drums of COREXIT® EC9500A is unlimited	20
COREXIT® EC9500B	Dispersant	The shelf life of unopened drums of COREXIT® EC9500B is potentially unlimited when containers remain capped and sealed to prevent contamination and evaporation of solvents	20
COREXIT® EC9527A (formerly COREXIT 9527)	Dispersant	The shelf life of unopened drums of COREXIT® EC9580A is unlimited	20
DISPERSIT SPC 1000™	Dispersant	The shelf life of Dispersit SPC 1000™ is unlimited in unopened containers	20
FINASOL® OSR 52	Dispersant	unlimited when the containers remain capped and sealed	20
JD-109	Dispersant	unlimited	20
JD-2000™	Dispersant	unlimited	20
SAF-RON GOLD	Dispersant	unlimited in unopened containers	20
SEA BRAT #4	Dispersant	Indefinite when stored properly	20
SEACARE ECOSPERSE 52 (see FINASOL® OSR 52)	Dispersant	potentially unlimited when the containers remain capped and sealed to prevent contamination and evaporation of solvents, and are stored in a place with stable temperatures and are unexposed to direct sunlight	20
SEACARE E.P.A. (see DISPERSIT SPC 1000™)	Dispersant	unlimited in unopened containers	20
SF-GOLD DISPERSANT (see SAF-RON GOLD)	Dispersant	unlimited	20
ZI-400	Dispersant	Unlimited in sealed polydrums of totes	20
ZI-400 OIL SPILL DISPERSANT (see ZI-400)	Dispersant	Unlimited in sealed polydrums of totes	20
MARI-ZYME (see ZYME-FLOW)	Miscellaneous Oil Spill Control Agent – MOSCA	1 year minimum	1
UNITED 658 PETRO-ZYME (see ZYME-FLOW)	Miscellaneous Oil Spill Control Agent – MOSCA	1 year minimum	1
ZYME-FLOW	Miscellaneous Oil Spill Control Agent – MOSCA	1 year minimum	1
ZYME-TREAT (see ZYME-FLOW)	Miscellaneous Oil Spill Control Agent – MOSCA	1 year minimum	1
PX 700™	Miscellaneous Oil Spill Control Agent – MOSCA	Two years	2

NORSOREX® APX	Miscellaneous Oil Spill Control Agent – MOSCA	3 years from date of production	3
ALSOCUP	Miscellaneous Oil Spill Control Agent – MOSCA	five years	5
CIAGENT (formerly CI AGENT, CHEAP INSURANCE, and PETRO-CAPTURE)	Miscellaneous Oil Spill Control Agent – MOSCA	5 years, if stored in cool dry area, away from direct sunlight	5
ELASTOL	Miscellaneous Oil Spill Control Agent – MOSCA	5 years when stored at temperatures below 150ºF	5
LIQUID ELASTOL (see ELASTOL)	Miscellaneous Oil Spill Control Agent – MOSCA	5 years when stored at temperatures below 150ºF	5
OIL BOND®	Miscellaneous Oil Spill Control Agent – MOSCA	5 years	5
OPFLEX®	Miscellaneous Oil Spill Control Agent – MOSCA	5 years	5
SEPARATE (see ELASTOL)	Miscellaneous Oil Spill Control Agent – MOSCA	5 years	5
PES-51	Miscellaneous Oil Spill Control Agent – MOSCA	6 years (unopened drum), 1 year (opened drum)	6
GELCO 200	Miscellaneous Oil Spill Control Agent – MOSCA	10 years when stored in dry, cool area out of sunlight	10
AQUA N-CAP™ POLYMER (see OIL SOLUTIONS POWDER)	Miscellaneous Oil Spill Control Agent – MOSCA	Not Limited	20
OIL SOLUTIONS POWDER	Miscellaneous Oil Spill Control Agent – MOSCA	Not limited	20
RAPIDGRAB 2000™	Miscellaneous Oil Spill Control Agent – MOSCA	unlimited	20
WASTE-SET #3200®	Miscellaneous Oil Spill Control Agent – MOSCA	unlimited	20
WASTE-SET #3400®	Miscellaneous Oil Spill Control Agent – MOSCA	unlimited	20
SILTECH OP-40	Surface Collecting Agent	three years	3
THICKSLICK 6535	Surface Collecting Agent	three years	3
CLEAN SPLIT (see SPLIT DECISION SC)	Surface Washing Agent	one year	1

DUO-SPLIT (see SPLIT DECISION SC)	Surface Washing Agent	one year	1
GREEN TECHNOLOGIES SOLUTIONS-OIL RECOVERY (GTS-OR)	Surface Washing Agent	One year minimum when stored between 50°F and 100°F	1
SPLIT DECISION SC (formerly SPLIT DECISION)	Surface Washing Agent	one year	1
TXCHEM HE-1000™	Surface Washing Agent	One year in a sealed container	1
AQUACLEAN	Surface Washing Agent	18 months if stored between 50ºF and 104ºF, and away from acids	1.5
BIOGRASS® EXTRA	Surface Washing Agent	Two years minimum	2
CN-110	Surface Washing Agent	2 years	2
CORIBA 700 ER (see CORIBA 700 SR)	Surface Washing Agent	Two years unopened minimum	2
CORIBA 700 OS (see CORIBA 700 SR)	Surface Washing Agent	Two years unopened minimum	2
CORIBA 700 SR	Surface Washing Agent	Two years unopened minimum	2
CORIBA 713 ER (see CORIBA 713 SR)	Surface Washing Agent	Two years unopened minimum	2
CORIBA 713 OS (see CORIBA 713 SR)	Surface Washing Agent	Two years unopened minimum	2
CORIBA 713 SR	Surface Washing Agent	Two years unopened minimum	2
DE-SOLV-IT CLEAN AWAY APC SUPER CONCENTRATE	Surface Washing Agent	Two years in sealed drums or totes	2
DE-SOLV-IT INDUSTRIAL FORMULA	Surface Washing Agent	Two years in sealed polydrums or totes	2
DO-ALL #18	Surface Washing Agent	at least two years	2
ECOVOOM-MARINE (see JEP-MARINE CLEAN)	Surface Washing Agent	minimum 2 years	2
ETHOS CLEAN	Surface Washing Agent	2 years in a sealed (unopened) container (tote, drum, pail) as delivered. 1 year in an opened container).	2
JEP-MARINE CLEAN	Surface Washing Agent	minimum 2 years	2
MARINE GREEN CLEAN™	Surface Washing Agent	2 years	2
MARINE GREEN CLEAN PLUS™	Surface Washing Agent	2 years	2

NONTOX™	Surface Washing Agent	minimum of two years	2
OSR-10	Surface Washing Agent	2 years in a sealed (unopened) container (tote, drum, pail)	2
PROCLEANS	Surface Washing Agent	2 years at recommended temperatures if unopened	2
SOC 10	Surface Washing Agent	two years	2
SUPERALL #38 (see TOPSALL #30)	Surface Washing Agent	two years	2
TOPSALL #30	Surface Washing Agent	two years	2
TULXA	Surface Washing Agent	Two years if stored in dry, fresh environment	2
EO ALL PURPOSE SOAP-LAVENDER	Surface Washing Agent	Three years	3
FIREMAN'S BRAND SPILLCLEAN (see SPILLCLEAN)	Surface Washing Agent	3 years. Avoid extreme heat and store in a dry, cool area	3
SPILLCLEAN or SPILLCLEAN ["Concentrate"]	Surface Washing Agent	three years	3
CLEAN GREEN	Surface Washing Agent	5 years in sealed polydrums or totes	5
CLEANGREEN® PLANET WASH (see CLEAN GREEN)	Surface Washing Agent	5 years in sealed polydrums or totes	5
MICRO CLEAN (see NATURE'S WAY HS)	Surface Washing Agent	five years	5
NATURE'S WAY HS	Surface Washing Agent	five years	5
NATURE'S WAY PC (see NATURE'S WAY HS)	Surface Washing Agent	five years	5
POWERCLEAN (see NATURE'S WAY HS)	Surface Washing Agent	five years	5
PREMIER 99	Surface Washing Agent	5 years	5
SAFE KLEEN	Surface Washing Agent	Five years if stored in tightly closed containers under dry conditions within temperature range	5
SC-1000™	Surface Washing Agent	Minimum of 5 years	5
SIMPLE GREEN®2013 Reformulation	Surface Washing Agent	five years	5
G-CLEAN OSC-1809	Surface Washing Agent	Five to ten years in sealed polydrums or totes	7.5
OIL SPILL CLEANUP (see G-CLEAN OSC-1809)	Surface Washing Agent	Five to ten years in sealed polydrums or totes	7.5
DYNAMIC GREEN™	Surface Washing Agent	6-10 years in sealed poly drums or totes	8

BIOSOLVE® HYDROCARBON MITIGATION™ AGENT	Surface Washing Agent	10+ year shelf life if unopened	10
CYTOSOL	Surface Washing Agent	Closed container: 10 years in a dry environment. Open container: 1 year in a warm, humid environment. The product does not deteriorate appreciably over time, but will grow bacteria if water condensation accumulates in the container.	10
F-500	Surface Washing Agent	15 years when stored between 35ºF - 130ºF in unopened containers	15
NOKOMIS 5-W	Surface Washing Agent	15 years or more if stored correctly in plastic drums	15
ACCELL CLEAN® SWA	Surface Washing Agent	unopened drums of ACCELL CLEAN® SWA is unlimited	20
ALL PURPOSE CLEANER & REMEDIATOR (see GREEN BEAST™ OIL SPILL & ODOR REMEDIATOR)	Surface Washing Agent	Unlimited in sealed polydrums or totes	20
AWAN PRA OIL FIELD SOLUTION™ (see EPA OIL FIELD SOLUTION™)	Surface Washing Agent	Unlimited in sealed polydrums or totes (as delivered). Avoid direct sunlight.	20
BG-CLEAN™ 401	Surface Washing Agent	unlimited	20
COREXIT® EC9580A (formerly COREXIT 9580 SHORELINE CLEANER)	Surface Washing Agent	unlimited	20
ENVIROCLEAN (formerly ENVIRO CLEAN 165)	Surface Washing Agent	Unlimited if unopened	20
ENVIRONMENTAL 1 CRUDE OIL CLEANER	Surface Washing Agent	Unlimited in sealed polydrums or totes	20
ENVIRONMENTAL 1 WASHING AGENT (see ENVIRONMENTAL 1 CRUDE OIL CLEANER)	Surface Washing Agent	Unlimited in sealed polydrums or totes	20
EPA OIL FIELD SOLUTION™	Surface Washing Agent	Unlimited in sealed polydrums or totes (as delivered). Avoid direct sunlight.	20
E-SAFE©	Surface Washing Agent	Unlimited if left in unopened containers stored at 40º - 110ºF and away from direct sunlight	20
GLOBAL ENVIRONMENTAL CLEANER™ (see EPA OIL FIELD SOLUTION™)	Surface Washing Agent	Unlimited in sealed polydrums or totes	20
GOLD CREW SW	Surface Washing Agent	20 years (unopened)	20

GREEN BEAST OIL SPILL & ODOR REMEDIATOR	Surface Washing Agent	Unlimited in sealed polydrums or totes	20
GREEN BEAST WASHING AGENT (see GREEN BEAST OIL SPILL & ODOR REMEDIATOR	Surface Washing Agent	Unlimited in sealed polydrums or totes	20
HYDRO-CLEAN™ (see EPA OIL FIELD SOLUTION™)	Surface Washing Agent	Unlimited in sealed polydrums or totes	20
NALE-IT	Surface Washing Agent	Indefinite	20
NATURAMA G3 A-5	Surface Washing Agent	unlimited	20
PETRO-CLEAN	Surface Washing Agent	Indefinite when stored properly	20
PETRO-GREEN ADP-7	Surface Washing Agent	indefinite	20
PETROMAX PSC 3	Surface Washing Agent	Unlimited when stored in unopened, sealed 5 gallon containers, 55 gallon drums, polydrums, and totes	20
PETROMAX SOIL CLEANING AND WASHING AGENT (see PETROMAX PSC 3)	Surface Washing Agent	Unlimited when stored in unopened, sealed 5 gallon containers, 55 gallon drums, polydrums, and totes	20
PETROTECH 25	Surface Washing Agent	unlimited shelf-life when maintained in the factory sealed containers and stored within the prescribed temperature limits	20
SANDKLENE 950	Surface Washing Agent	Unlimited in sealed drums or totes	20
SHEEN-MAGIC©	Surface Washing Agent	Unlimited if left in unopened containers stored at 40º - 110ºF and away from direct sunlight	20
SIMPLE GREEN®	Surface Washing Agent	unlimited	20
VERU-SOLVE™ MARINE 200 HP	Surface Washing Agent	Indefinite, product will not degrade over time	20

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From: Vocke, William CIV
Sent: Wed 10/7/2015 4:01:45 PM
Subject: R&T Plan posted & press release
Approved 2015 ICCOPR R&T Plan.pdf

All,

The approved Oil Pollution Research and Technology Plan (attached) is now posted on the ICCOPR website. You can link to it at:
http://www.uscg.mil/iccopr/files/Approved 2015 ICCOPR R&T Plan.pdf

BSEE and the Coast Guard issued a joint press release:
http://www.bsee.gov/BSEE-Newsroom/Press-Releases/2015/Interagency-Committee-Approves-Updated-Oil-Pollution-Research-Plan/

Bill
(202) 372-2019

OIL POLLUTION RESEARCH AND TECHNOLOGY PLAN

Fiscal Years 2015-2021

INTERAGENCY COORDINATING COMMITEE
ON OIL POLLUTION RESEARCH (ICCOPR)

September 2015

DISCLAIMER

This Oil Pollution Research and Technology Plan (OPRTP) presents the collective opinion of the 15 departments and agencies that constitute the members of Interagency Coordinating Committee on Oil Pollution Research (ICCOPR), regarding the status and current focus of the federal oil pollution research, development, and demonstration program (established pursuant to section 7001(c) of the Oil Pollution Act of 1990 (33 U.S.C. 2761(c))). The statements, positions, and research priorities contained in this OPRTP may not necessarily reflect the views or policies of an individual department or agency, including any component of a department or agency that is a member of ICCOPR. This OPRTP does not establish any regulatory requirement or interpretation, nor implies the need to establish a new regulatory requirement or modify an existing regulatory requirement.

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LIST OF ACRONYMS

A-CORE	Arctic Center for Oil-Spill Research & Education
AAR	After Action Review
AC	Area Committee
ACP	Area Committee Plan
ADEC	Alaska Department of Environmental Conservation
ADEQ	Arkansas Division of Environmental Quality
AESC	Arctic Executive Steering Committee
AIP	Australian Institute of Petroleum
AMOSC	Australian Marine Oil Spill Centre
AMSA	Australian Maritime Safety Authority
API	American Petroleum Institute
APICOM	Association of Petroleum Industry Co-op Managers
ARTES	Alternative Response Technologies Evaluation System
BAST	Best Available and Safest Technology
bbl (s)	Barrel (equals 42 U.S. Gallons)
BIO COOGER	DFO Canada's Bedford Institute of Oceanography Center for Offshore Oil, Gas and Energy Research
BOEM	Bureau of Ocean Energy Management
BOEMRE	[former] Bureau of Ocean Energy Management, Regulation and Enforcement
BP	British Petroleum
Bpd	Barrels per day
BSEE	Bureau of Safety & Environmental Enforcement
CAOSPR	California Office of Oil Spill Prevention and Response
CASP	Center for Arctic Study & Policy
CEC	CEDRE Experimentation Column
CEDRE	Centre of Documentation, Research and Experimentation on Accidental Water Pollution
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Resource, Compensation, and Liability Act
CFR	Code of Federal Regulations
CGHQ	Coast Guard Headquarters
CIRCAC	Cook Inlet Regional Citizen's Advisory Committee
CMR	Center of Excellence for Maritime Research
COP	Common Operating Picture
CPF	Coastal Protection Fund
CRADA	Cooperative Research and Development Agreement
CRRC	Coastal Response Research Center
CRREL	Cold Regions Research and Engineering Laboratory

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CSE	Center for Spills in the Environment
CSIRO	Commonwealth Scientific and Industrial Research Organization
CWA	Clean Water Act
DDO	Dispersants and dispersed oil
DECC	Department of Energy and Climate Change
DFO	Department of Fisheries and Oceans Canada
DHHS	Department of Health and Human Services
DOC	Department of Commerce
DOD	Department of Defense
DOE	Department of Energy
DOI	Department of the Interior
DOR	Dispersant to Oil Ratio
DOT	Department of Transportation
DWH	*Deepwater Horizon*
E&P	Exploration & Production
EC	Environment Canada; European Union
EDDM	Environmental Disasters Data Management
EDRC	Effective Daily Recovery Capacity
EDRP	Emergency Disaster Recovery Program
EEZ	Exclusive Economic Zone
EIA	U.S. Energy Information Administration
EMERCOM	Russian Ministry of Civil Defense, Emergencies and Disaster Response
EMSA	European Maritime Safety Agency
EOI	Expression of Interest
EOP	Executive Office of the President
EPA	Environmental Protection Agency
EPAct	Energy Policy Act of 2005
EPPR	Emergency Prevention, Preparedness and Response Working Group
ERA	Environmental Risk Assessments
ERDC	U.S. Army Engineer Research and Development Center
ERRC	European Response Coordination Center
ERT	Environmental Response Team
ERW	Electric resistance welded pipe
ESA	Endangered Species Act
ESB	Environmental Specimen Bank
ESI	Environmental Sensitivity Index
ESP	Environmental Studies Program
EU	European Union
FACA	Federal Advisory Committee Act
FMSAS	Florida Marine Spill Analysis System

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FEMA	Federal Emergency Management Agency
FIO	Florida Institute of Oceanography
FOSC	Federal-On Scene Coordinator
FOSTERRS	Federal Oil Spill Team for Emergency Response Remote Sensing
FWPCA	Federal Water Pollution Control Administration
GIRG	Global Industry Response Group
GIS	Geographic Information Systems
GMFMC	Gulf of Mexico Fishery Management Council
GOMA	Gulf of Mexico Alliance
GoMRI	Gulf of Mexico Research Initiative
GOMURC	Gulf of Mexico University Research Collaborative
GRP	[National Academy of Science] Gulf Research Program
GSMFC	Gulf States Marine Fisheries Commission
HAZMAT	Hazardous Material
HML	Hollings Marine Laboratory
HMTA	Hazardous Materials Transportation Act
ICCOPR	Interagency Coordinating Committee on Oil Pollution Research
ICS	Incident Command System
ILI	In-Line Inspection
IMO	International Maritime Organization
IOM	Institute of Medicine
IOOS	Integrated Ocean Observing System
IOSC	International Oil Spill Conference
IPIECA	International Petroleum Industry Environmental Conservation Association
ISB	In-situ Burn
ISCO	International Spill Control Organization
ISPR	Incident Specific Preparedness Reviews
ITAC	Industry Technical Advisory Committee
ITOPF	International Tanker Owners Pollution Federation Limited
JITF	Joint Industry Oil Spill Preparedness and Response Task Force
JIP	Joint Industry Programme; Joint Industry Program
LEGEEPA	General Law of Ecological Equilibrium and Environmental Protection
LiDAR	Light Detection and Ranging
LNG	Liquefied Natural Gas
MARAD	Maritime Administration
MARPOL	Marine Pollution (International convention for the Prevention of Pollution from Ships)
MCA	Maritime and Coastguard Agency
MER	Marine Environmental Response
META	Maritime Environmental and Technical Assistance
MMC	U.S. Marine Mammal Commission

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MMPA	Marine Mammal Protection Act
MMS	[former] Minerals Management Service
MOC-A	Marine Operations Center, Atlantic
MOC-P	Marine Operations Center, Pacific
MOC-PI	Marine Operations Center, Pacific Islands
MODU	Mobile Offshore Drilling Units
MPCSA	State Marine Pollution Control, Salvage and Rescue Administration
MPD	Managed pressure drilling
MRCC	Marine Rescue Coordination Centres
MSA	China Maritime Safety Administration
MSL	USCG Marine Safety Laboratory
MTBE	Methyl Tertiary Butyl Ether
NAS	National Academy of Sciences
NASA	National Aeronautics & Space Administration
NAVSEA	Naval Sea Systems Command
NAWCA	North American Wetlands Conservation Act
NDRF	National Defense Reserve Fleet
NEBA	Net Environmental Benefit Analysis
NEPA	National Environmental Policy Act
NCP	National Contingency Plan
NETL	DOE's National Energy Technology Laboratory
NFWF	National Fish and Wildlife Federation
NGO	Non-governmental Organization
NIEHS	National Institute of Environmental Health Sciences
NIH	National Institutes of Health
NIST	National Institute of Standards and Technology
NOAA	National Oceanic and Atmospheric Administration
NPC	National Petroleum Council
NPFC	U.S. Coast Guard's National Pollution Funds Center
NRC	National Response Center; National Research Council
NRDA	Natural Resource Damage Assessment
NRDAR	Natural Resource Damage Assessment and Restoration
NRF	National Response Framework
NRL	U.S. Naval Research Laboratory
NRMR	U.S. EPA National Risk Management Research Laboratory
NRP	National Response Plan
NRT	National Response Team
S&T	National Response Team Science & Technology Committee
NSAR	National Strategy for the Arctic Region
NSCS	National Spill Control School

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NSF	National Science Foundation
NSTC	National Science and Technology Council
NTIS	National Technical Information Service
NTNU	Norwegian University of Science and Technology
NTSB	National Transportation Safety Board
NURail	National University Rail (NURail) Center
OCRE	Ocean Coastal Research Engineering
OCS	Outer Continental Shelf
ODRP	Oil Disaster Recovery Program
OESI	Ocean Energy Safety Institute
OGP	Oil and Gas Producers
OMAO	NOAA's Office of Marine and Aviation Operations
OPA 90	Oil Pollution Act of 1990
OPRTP	Oil Pollution Research & Technology Plan
OR&R	NOAA Office of Response & Restoration
OSC	On Scene Coordinator
OSHA	Occupational Safety & Health Administration
OSPR	Oil Spill Preparedness and Response
OSRADP	Oil Spill Research and Development Program
OSRI	Oil Spill Recovery Institute
OSRO	Oil Spill Removal Organization
OSP	Oil Sands Products
OSLTF	Oil Spill Liability Trust Fund
OST	[Executive Office of the President] Office of Science & Technology
OSV	Ocean Survey Vessel
OSWG	Oil Spill Working Group
PAJ	Petroleum Association of Japan
PCT	Pew Charitable Trusts
PEMEX	Petróleos Mexicanos
PERF	Petroleum Environmental Research Forum
PHMSA	Pipeline & Hazardous Materials Safety Administration
PI	Principal investigators
P.L.	Public Law
PNNL	Pacific Northwest National Laboratory
PRCI	Pipeline Research Council International
PRI	Paleontological Research Institution
PROMAM	Navy's Marine Environment Protection Division
PSBCOSTF	Pacific States/British Columbia Oil Spill Task Force
PTSA	Port and Tanker Safety Act of 1978
PWS	Prince William Sound

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PWSA	Ports and Waterways Safety Act of 1972
PWSRCAC	Prince William Sound Regional Citizen's Advisory Committee
RAPID	Rapid Response Research
RAR	Resources at Risk
RDC	Coast Guard Research & Development Center
RDT&E	Research, Development, Test, and Evaluation
R&D	Research & Development
R&T	Research & Technology
RESTORE	Resources and Ecosystem Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act
RFP	Request for Proposal
ROV	Remotely Operated Vehicle
ROW	Right of Way
RP	Responsible Party
RRT	Regional Response Team
RSPA	[former] Research and Special Projects Administration
S&T	Science and Technology
SCAA	Spill Control Association of America
SCAT	Shoreline Cleanup Assessment Technique
SETAC	Society of Environmental Toxicology and Chemistry
SIO	Scripps Institution of Oceanography
SIT	Stevens Institute of Technology
SMART	Special Monitoring of Applied Response Technologies
SME	Subject Matter Expert
SONS	Spill of National Significance
SPCC	Spill Prevention, Control & Countermeasures
SRA	Standing Research Areas
SRM	Standard Reference Materials
SSC	NOAA Scientific Support Coordinator
SUPSALV	NAVSEA Supervisor of Salvage and Diving
SwRI	Southwest Research Institute
TCEQ	Texas Commission on Environmental Quality
TDC	Technology Development Center
TPWD	Texas Parks and Wildlife Department
TRB	Transportation Research Board
TXGLO	Texas General Land Office
UAA	University of Alaska Anchorage
UAF	University of Alaska Fairbanks
UDAC	Ultra-Deepwater Advisory Committee
UDW	Ultra-Deepwater

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UIUC	University of Illinois Urbana
UNEP	United Nations Environment Programme
UNH	University of New Hampshire
USACE	United States Army Corps of Engineers
USARC	United States Arctic Research Commission
USCG	United States Coast Guard
USGS	United States Geological Survey
USFA	United States Fire Administration
USFWS	United States Fish and Wildlife Service
USN	United States Navy
UTC	University Transportation Center
VOC	Volatile Organic Compound
VTS	Vessel Traffic Service
VTSS	Vessel Traffic Service / Separation
WADOE	Washington Department of Ecology
WHOI	Woods Hole Oceanographic Institution

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DEFINITIONS

ICCOPR uses the following definitions solely for purposes of this Oil Pollution Research and Technology Plan (OPRTP). These definitions do not reflect all existing/relevant statutory and/or regulatory definitions and do not supersede any statutory or regulatory requirements.

Allision is the running of one vessel against another vessel or structure that is stationary. An allision is different from a collision in that a collision is the running of two moving vessels against each other.

Applied Research is any systematic study to gain knowledge or understanding necessary to determine the means by which a recognized and specific need may be met, in this case related to advancing knowledge about oil spill prevention, preparedness, response, mitigation, and restoration/recovery.

Basic Research is any systematic study directed toward fuller knowledge or understanding of the fundamental aspects of phenomena and of observable facts without specific applications towards processes or products in mind.

Baseline Study refers to studies conducted to gather a set of critical observations or data that provide a basis for comparing conditions before and after an action or event. Baseline studies document the ecological and socioeconomic conditions of an area before an oil system activity or potential spill occurs. These studies provide a basis for assessing changes or damages that occur as a result of the activities or a spill.

Collision means the running of two vessels against each other (both under power). A collision is different from an allision where only a single vessel is underway and strikes a stationary vessel or structure.

Damages means injury to natural resources, to real or personal property, loss of subsistence use of natural resources, loss of governmental revenues, loss of profits or earning capacity, and increased cost of additional public services. Damages also include the cost of assessing these injuries. Removal costs and damages covered by OPA 90 are defined in 33 U.S.C § 2702(b)(2).

Demonstration refers to activities that are part of research or development (i.e., that are intended to prove or to test whether a technology or method does, in fact, work). Demonstrations intended primarily to make information available about new technologies or methods should not be included in this definition (NSF, 2009).

Development is any systematic application of knowledge or understanding, directed toward the production of useful materials, devices, and systems or methods,

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including design, development, and improvement of prototypes and new processes to meet specific requirements.

Discharge means any emission (other than natural seepage), intentional or unintentional, and includes, but is not limited to spilling, leaking, pumping, pouring, emitting, or dumping of oil that is not permitted.

Dispersants means those chemical agents that emulsify, disperse, or solubilize oil into the water column or promote the surface spreading of oil slicks to facilitate dispersal of the oil into the water column

Facility means any structure, group of structures, equipment, or device (other than a vessel) that is used for one or more of the following purposes: exploring for, drilling for, producing, storing, handling, transferring, processing, or transporting oil. This term includes any motor vehicle, rolling stock, or pipeline used for one or more of these purposes. The OPA 90 definition of a facility is codified at 33 U.S.C § 2702(b)(2).

National Contingency Plan (NCP) refers to the National Oil and Hazardous Substances Pollution Contingency Plan (40 CFR Part 300), the federal government's blueprint for responding to both oil spills and hazardous substance releases. The NCP is the result of efforts to develop a national response capability and promote coordination among the hierarchy of responders and contingency plans.

Natural Resource Damage Assessment (or assessment) means the process of collecting and analyzing information to evaluate the nature and extent of injuries resulting from an incident, and determine the restoration actions needed to bring injured natural resources and services back to baseline and make the environment and public whole for interim losses.

Natural Resources, for purposes of injury assessment and restoration, refers to land, fish, wildlife, biota, air, water, ground water, drinking water supplies, and other such resources belonging to, managed by, held in trust by, appertaining to, or otherwise controlled by the United States (including the resources of the exclusive economic zone), any State or local government or Indian tribe, or any foreign government. Natural resources, for other purposes, may include minerals such as oil and gas.

Oil refers to oil of any kind or in any form, including, but not limited to, petroleum, fuel oil, sludge, oil refuse, and oil mixed with wastes other than dredged spoil. It may also refer to: fats, oils, or greases of animal, fish, or marine mammal origin; vegetable oils, including oils from seeds, nuts, fruits, or kernels; and, other oils and greases, including synthetic and mineral oils. The CWA definition of oil is codified at 33 U.S.C. § 1251 *et seq.*; the OPA definition of oil is codified at 33 U.S.C. § 2701 *et seq.*

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The ***Oil Pollution Act of 1990*** (OPA 90), codified at 33 U.S.C § 2701 *et seq.*, is a law that amended the Clean Water Act (CWA) and addressed the wide range of problems associated with preventing, responding to, and paying for oil pollution incidents in navigable waters of the United States. Title VII of OPA 90 established ICCOPR.

An ***Oil Spill*** is a non-permitted occurrence or series of occurrences having the same origin, involving one or more vessels, facilities, or any combination thereof, resulting in the discharge or substantial threat of discharge of oil into or upon navigable waters of the United States, adjoining shorelines, or the exclusive economic zone (e.g., oil spill in coastal waters from a tanker). This term also includes discharges of oil on land with the potential to reach any waters of the United States.

Oil Spill Response Organizations (OSROs) are companies that specialize in cleaning up oil spills. They often serve as contractors or subcontractors for spill response efforts.

An ***On-Scene Coordinator*** (OSC) is the federal official pre-designated by EPA or the USCG to coordinate and direct responses under Subpart D of the NCP. It also refers to a designated representative of a lead Federal agency to coordinate and direct removal actions under Subpart E of the NCP. General responsibilities of OSCs are found in 40 CFR 300.120. OSCs are sometimes referred to as Federal On-Scene Coordinators (FOSCs).

The ***Ports and Waterways Safety Act*** (PWSA) 1972, as amended by the Port and Tanker Safety Act of 1978 (PTSA), and the Oil Pollution Act of 1990 (OPA), is designed to promote navigation, vessel safety, and protection of the marine environment. The PWSA authorizes the U.S. Coast Guard (USCG) to establish vessel traffic service/separation (VTSS) schemes for ports, harbors, and other waters subject to congested vessel traffic.

The ***Ports and Tanker Safety Act*** (PTSA) of 1978 amended the PWSA. Under the PTSA, Congress found that navigation and vessel safety and protection of the marine environment are matters of major national importance and that increased vessel traffic in the nation's ports and waterways creates substantial hazard to life, property or the marine environment. In addition, increased supervision of vessel and port operations was deemed necessary.

Preparedness is an activity, program, or system developed prior to an oil spill to support and enhance the ability of personnel and organizations to prevent, respond to, and recover from an oil spill or other adverse event.

Prevention is an on-going activity to minimize the likelihood of discharges of oil into the environment. Prevention may be a long-term approach to looking at the

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fundamentals of minimizing the potential of oil spills with the goal to identify, minimize, and mitigate risks.

Release means any spilling, leaking, pumping, pouring, emptying, discharging, injecting, escaping, leaching, dumping, or disposing of oil into the environment.

Research is the systematic study directed toward fuller scientific knowledge or understanding of the subject studied. (NSF, 2009)

Response includes all activities involved in containing and cleaning up oil in order to: 1: maintain safety of human life; 2: stabilize a situation to preclude it from worsening, and; 3: minimize adverse environmental and socioeconomic impacts by coordinating all containment and removal activities to carry out a timely, effective response.

The ***Responsible Party*** (RP) of an incident is the person, business, or entity that has been identified as owning or operating a vessel or facility that caused an oil spill. The OPA definition of responsible party is codified at 33 U.S.C. § 2701 *et seq.*

Restoration is the process of restoring an affected area or resource to its pre-incident state. Restoration can take several months to many years and may require technical and financial assistance from a variety of sources. Restoration efforts are primarily concerned with actions that involve rebuilding destroyed property, re-employment of effected stakeholders, rehabilitating, replacing, or acquiring the equivalent of injured natural resources and the services they provided prior to the damage being inflicted and the repair of other essential infrastructure.

Submerged and subsurface oil refers to oil that is not floating on the water surface.

Surface Washing Agent is any product that removes oil from solid surfaces, such as beaches and rocks, through a detergency mechanism and does not involve dispersing or solubilizing the oil into the water column.

Technology is the study, development, and application of devices, machines and techniques for manufacturing and productive processes. Technology also includes tools, equipment, and methods or methodologies that apply scientific knowledge or tools. For purposes of this plan, technology represents the application of knowledge or widgets to the development and/or usage of equipment, systems and organizational capabilities for oil spill prevention, preparedness, response, and restoration.

Vessel means every description of watercraft or other artificial contrivance used, or capable of being used, as a means of transportation on water.

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EXECUTIVE SUMMARY

Title VII of the Oil Pollution Act of 1990 (OPA 90) established the Interagency Coordinating Committee on Oil Pollution Research (ICCOPR) to coordinate a comprehensive program of oil pollution research, technology development, and demonstration. Pursuant to Section 7001(b) of OPA 90, ICCOPR developed the Oil Pollution Research and Technology Plan (OPRTP) to implement the Federal research and development program.

ICCOPR published its first version of the OPRTP in 1992 and published a revised version in 1997. These two versions provided an initial baseline assessment and analysis of: agency roles and responsibilities; status of knowledge of oil pollution prevention, response, and mitigation technologies; priority research and development needs; and an estimate of resources and time needed to implement the program.

The purpose of the FY 2015-2021 version of the OPRTP, and subsequent revisions, is to provide current assessments of the oil pollution research needs and priorities. ICCOPR intends to update this OPRTP every six years to reflect advancements in oil pollution technology and changing research needs. This ongoing planning process will capitalize on the unique roles and responsibilities of member agencies to address oil pollution research and development needs and maintain awareness of research needs.

This version of the OPRTP includes two parts. Part One, Oil Pollution Research, explains why oil pollution research is needed, the parties that are involved in the research, and presents ICCOPR's Oil Pollution Research Categorization Framework for tracking research activities and successes. Part Two, Establishing Research Priorities, presents ICCOPR's priority Research Needs. It also explains the process that ICCOPR used to identify the research gaps and priorities, noteworthy oil spill events, and the current state of oil pollution knowledge. In future versions, Part One will remain relatively static; however, Part Two is expected to change significantly as research advances the state of knowledge and priority Research Needs are successfully addressed.

The Introduction and Chapter 1, The Need for Oil Pollution Research, describes the historical basis for oil pollution research and reviews trends in oil spills from different sources. ICCOPR member agencies share responsibilities to monitor changes in the oil spill system and find opportunities to improve technologies to meet changing needs. ICCOPR recognizes that activities in the Arctic and Alaska, the Gulf of Mexico, inland areas, and the Atlantic Outer Continental Shelf are all of high importance at this time.

Chapter 2, Federal Oil Pollution Research, describes the Federal entities involved in oil pollution research including the ICCOPR member agencies, other Federal research organizations and facilities. Similarly, Chapter 3, Non-Federal Oil Pollution Research Entities, describes state, industry, independent organizations, academia, and international oil pollution research entities.

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Chapter 4, Structuring Oil Pollution Research, presents ICCOPR's Oil Pollution Research Categorization Framework, which provides a common language and planning framework that would enable researchers and interested parties to identify and track research in each topic area. The Framework groups research into four broad Classes: Prevention, Preparedness, Response, and Injury Assessment and Restoration. ICCOPR further classified research within each Class into 25 Standing Research Areas (SRAs), which represent the most common research themes encountered for oil spills.

Chapter 5, Knowledge Transfer and Advancement, describes ICCOPR's efforts to promote continuous improvement in the nation's ability to address oil pollution by monitoring the state of knowledge and adjusting the program to meet changing needs. The R&T planning process emphasizes and strengthens the roles and responsibilities of the member agencies to assure that research advances the capabilities to reduce oil pollution.

Chapter 6, Oil Pollution Research Needs Identification and Prioritization Process, documents the process ICCOPR employed to establish the research priorities. ICCOPR established an R&T Working Group that identified more than 900 research gaps, consolidated them into 570 unique Research Needs, and evaluated them with the assistance of the results from a survey of 280 subject matter experts.

Chapter 7, Noteworthy Oil Spill Incidents, describes important oil spill events and lists the oil pollution research gaps that they illuminated. Spills associated with vessels, drilling operations, on-shore pipelines, facilities, and railroads are included.

Chapter 8, Current State of Oil Pollution Knowledge, describes the sources and mechanisms that ICCOPR uses to obtain and share information on research needs and accomplishments.

Chapter 9, Oil Spill Research and Technology Research Priorities, presents ICCOPR's priority Research Needs. ICCOPR identified three top priorities for each SRA. For SRAs with a large number of Research Needs (i.e., Dispersants), ICCOPR established subcategories of similar research. Three priority Research Needs were assigned to each subcategory.

There are eight SRAs and 33 priorities within the Prevention Class. Two SRAs and 12 priorities are in the Preparedness Class. The Response Class has the largest number of priorities with 72 in 11 SRAs. The four SRAs in the Injury Assessment and Restoration Class have 33 priorities.

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INTRODUCTION

Title VII of the Oil Pollution Act of 1990 (OPA 90) established the Interagency Coordinating Committee on Oil Pollution Research (ICCOPR) to "… coordinate a comprehensive program of oil pollution research, technology development, and demonstration among the Federal agencies, in cooperation and coordination with industry, universities, research institutions, State governments, and other nations, as appropriate, and shall foster cost-effective research mechanisms, including the joint funding of research." Section 7001(c) of OPA 90 required ICCOPR to establish a Federal oil pollution research and development (R&D) program. Pursuant to Section 7001(b) of OPA 90, ICCOPR developed the Oil Pollution Research and Technology Plan (OPRTP) to implement the Federal research and development program.

Background

Federal oil pollution research efforts began to take shape in the late 1960s following the *Torrey Canyon* oil spill off the coast of England. At that time, the U.S. had neither the technical or operational capacity to deal with a large oil spill in the marine environment (EOP-OST, 1969). The Federal government developed the first National Contingency Plan (FWPCA, 1968) to address oil spills and began extensive oil pollution research over the next 20 years. Coordination of the Federal research efforts was informal and on an ad hoc basis through conferences, workshops, and committees of researchers scheduling their projects at the Ohmsett facility. The challenges posed by the response to the *Exxon Valdez* oil spill in 1989 revealed the need for Federal agencies to better coordinate their research. Efforts to coordinate the research resulted in Title VII of OPA 90 and the first requirement for a comprehensive and coordinated research and technology plan.

ICCOPR submitted the original OPRTP to Congress in April 1992. As directed by OPA 90, ICCOPR provided the OPRTP to the National Research Council's (NRC's) Committee on Oil Spill Research and Development for review. Using input from the NRC's Marine Board, ICCOPR started a revision of the plan in May 1993 to include topics related to spill prevention, human factors, and the field testing/demonstration of developed response technologies. ICCOPR released a revised version in April 1997, which identified 21 research areas divided into three levels of priority and served as a strategic planning document for ICCOPR to communicate and coordinate research needs.

This version of the OPRTP is the first in a new series of revisions covering six-year planning cycles, and presents ICCOPR's coordinated research and technology plan for FY 2015-2021. This ongoing planning process will capitalize on the unique roles and responsibilities of member agencies to address oil pollution research and development needs and maintain awareness of research needs.

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Purpose of the Plan

The 1992 version of the OPRTP provided Congress with an implementation plan for the new research and development program established by OPA 90. That version, and the 1997 revisions, provided an initial baseline assessment and analysis of: agency roles and responsibilities; status of knowledge of oil pollution prevention, response, and mitigation technologies; priority research and development needs; and an estimate of resources and time needed to implement the program. The purpose of the FY 2015-2021 version, and subsequent revisions, is to provide current assessments of the oil pollution research needs and priorities. To that end, the principal objectives of the OPRTP are to:

1. define common research themes related to oil pollution research;
2. identify on a regular basis the knowledge gaps associated with common research themes and recommend what gaps should be considered as high research priorities within them;
3. act as an umbrella or connecting document with other strategic Federal research plans (or accomplishment reports) that also address research support for oil pollution topics;
4. document the interagency research coordination process, as well as the feedback processes developed by Federal research, management and regulatory agencies; and
5. promote research information transfer between the government, the public and other stakeholders.
6. encourage and track efforts to implement improvements and technological change within agency roles and responsibilities via updates in the biennial reports to Congress.

Scope and Use of the Plan

This OPRTP provides a basis for coordinating research to address oil pollution issues in the U.S. It is primarily directed at Federal agencies with responsibilities for conducting or funding oil pollution research, but can serve as a research planning guide for industry, academia, State governments, research institutions, and other nations.

Research, in the context of the OPRTP, includes both basic and applied studies that are considered as peer-reviewed and published as well as studies reported in the "grey literature," which is publically available scientific literature that has not been peer reviewed. The following National Science Foundation definitions apply with respect to the OPRTP:

- **Basic research** is any systematic study directed toward fuller knowledge or understanding of the fundamental aspects of phenomena and of observable facts without specific applications towards processes or products in mind.
- **Applied research** is any systematic study to gain knowledge or understanding necessary to determine the means by which a recognized and specific need may be met. ICCOPR

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interprets this to mean studies to advance knowledge about oil spill prevention, preparedness, response, mitigation, and restoration/recovery.

- **Development** is any systematic application of knowledge or understanding, directed toward the production of useful materials, devices, and systems or methods, including design, development, and improvement of prototypes and new processes to meet specific requirements.
- **Technology** is defined as making, usage, and knowledge of tools, machines, techniques, crafts, systems or methods of organization in order to solve a problem or perform a specific function. ICCOPR believes this definition represents the application of knowledge as well as the development and usage of the equipment, systems and organizational capabilities concerning oil spill prevention, preparedness, response, mitigation, and restoration/recovery.

At the federal level, this OPRTP provides information that can be used as a basis to conduct interagency coordination and track progress toward addressing the nation's research needs. It can also help Federal agencies:

1. identify high-priority research emphasis areas;
2. promote needed research based on priorities; and
3. synchronize and collaborate research activities to avoid overlapping research efforts.
4. track progress of key efforts to aid implementation of needed improvements.

ICCOPR recognizes that there are a large number of oil pollution research programs conducted by non-Federal organizations and the private sector. This OPRTP provides these entities with ICCOPR's recommendations on research areas that will best address the nation's oil pollution research needs.

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PART ONE – OIL POLLUTION RESEARCH

1. The Need for Oil Pollution Research

Oil is a dominant source of energy in the United States, supplying the nation with approximately 40 percent of its energy needs (Ramseur, 2012). Oil provides fuel for the transportation, industrial, and residential sectors and serves as a primary feedstock for making plastics. Oil is expected to remain a major source of energy in the U.S. for at least the next several decades. With historical, current and projected use and constant movement, it is inevitable that spills will occur.

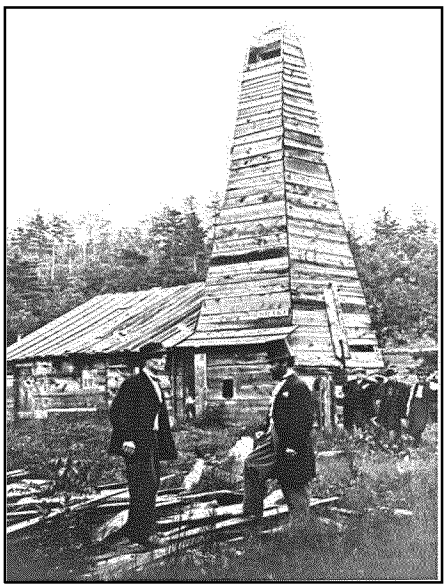

Figure 1-1: The start of the commercial oil industry in the U.S. – Oil Creek, PA, 1859 (Source: Drake Wells Museum)

Spills of oil in the U.S. accompanied the inception of early commercial efforts for petroleum drilling in the early 19th century in the United States and continue to this day. The first oil discovery was on land at Oil Creek, Pennsylvania in 1859 by George Bissel and Edwin Drake (Figure 1-1) (Pees, 2004). This success quickly led to additional commercial investments in oil drilling refining and marketing in the western Appalachian Mountains, where oil seeps were common. Commercial drilling projects rapidly spread to include areas in Southern California, Kansas, Oklahoma, Arkansas, North Louisiana and Texas by the late 1890's.

In 1910, the largest onshore blowout in the U.S. and the world occurred at the Lakeview No. 1 well in the San Joaquin Valley, CA (Figure 1-2). The initial flow estimates ranged from 125,000 barrels per day (bpd) at the start to 90,000 bpd after a month. The well remained uncontrolled for 544 days with an estimated 9.4 million bbl of crude being released into the environment (one barrel = 42 U.S. gallons).

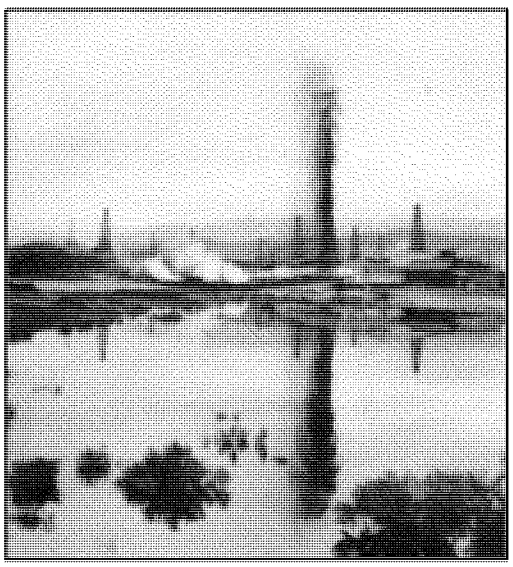

Figure 1-2: The Lakeview Gusher, CA; the US's single largest well blowout, 1910. (Source: San Joaquin Valley Geology)

Oil spills continued to occur but it wasn't until the late 1960s that the national attention focused on the need to address the problems associated with oil spills. In 1967, reaction in the U.S. to the *Torrey Canyon* oil spill off the coast of England resulted in the creation of the original National Multiagency Oil and Hazardous Materials Contingency Plan in 1968 (FWPCA, 1968). That Plan was superseded in 1970 when the Council on Environmental Quality (CEQ) published the National Oil and Hazardous Materials Pollution

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Contingency Plan in the Federal Register at 35 FR 8508 (CEQ, 1970). In 1969, a well blowout and undersea faults spilled an estimated 42 million gallons of oil into the Santa Barbara Channel, one of the largest environmental disasters in the U.S. (NOAA, 2014). This spill increased awareness of oil pollution problems and contributed to creation of the U.S. Environmental Protection Agency, the National Environmental Policy Act, and the National Marine Sanctuaries system. It also prompted several federal agencies to begin oil pollution research programs.

Oil pollution research must continually evolve to keep pace with new oil spill risks and environments where they occur. The process by which oil is produced, processed, and delivered to consumers is ever evolving. The oil industry opens new areas for exploration and production as technological advances make the ventures profitable. In turn, the location and methods of transporting that oil to markets shifts, affecting the potential locations and types of oil spills. For example, the opening of the Alaska North Slope and the Trans-Alaska Pipeline necessitated transportation of crude oil by tanker through Prince William Sound, site of the *Exxon Valdez* oil spill. Similarly, the technological advances that allow deep water oil exploration and production also pose new hazards and risks as evidenced by the British Petroleum (BP) *Deepwater Horizon* oil spill. Those spills posed new response challenges and revealed the need for additional oil pollution research.

There will continue to be a need for oil pollution research as long as there is a demand for oil-based products. Human errors, mechanical failures, natural events, and accidents all have the potential to cause spills. This chapter examines the oil production system and patterns of oil spills that affect the oil pollution research needs addressed in this OPRTP.

1.1 U.S. Oil Production

Figure 1-3 shows the U.S. Energy Information Administration (EIA) Annual Energy Review 2015 (EIA, 2015) and provides a review on the production, import and consumption for petroleum and other liquids for the last 60 years (from 1949 to 2014). The U.S. has experienced a steadily increasing consumption rate that quickly outstripped the U.S. petroleum production capabilities, resulting in a regular increase in net imports of petroleum products to address the shortfall beginning in 1970. Domestic production of oil continued to decrease until 2008 when new finds and improved drilling capabilities began to increase U.S. field production.

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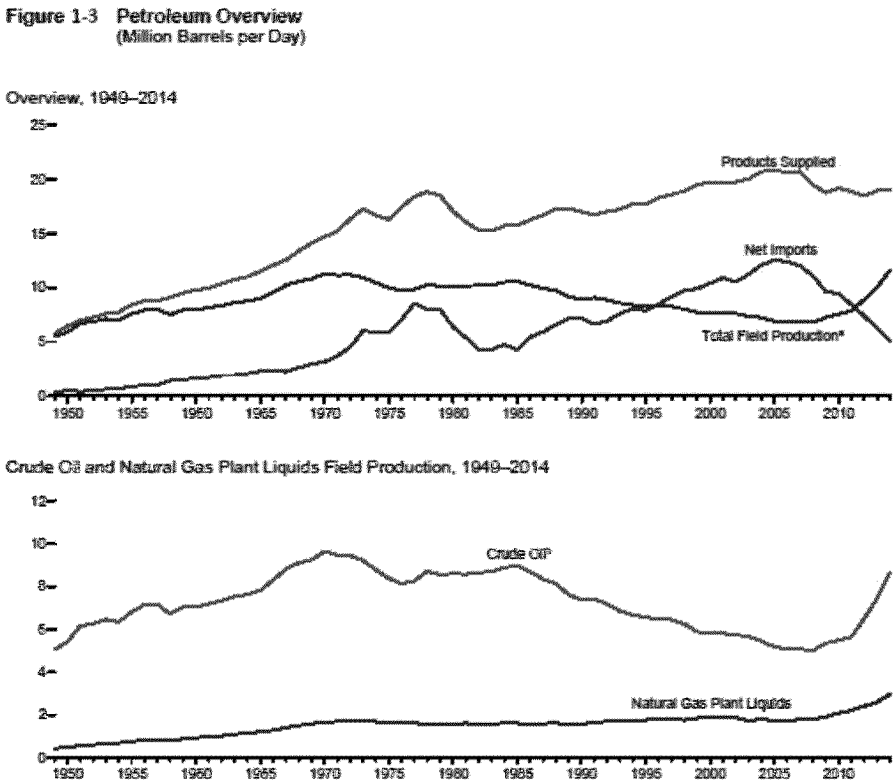

Figure 1-3. Petroleum and other Liquid Estimated Consumption, Production and Net Imports (in million bpd) for 1949 – 2014 in the U.S. Source: EIA. 2015.

Of particular note was the discovery of the Bakken field in North Dakota, Montana and in Canada (Figure 1-4). Significant increases in domestic production from these discoveries resulted in a decrease in net oil imports as shown in Figure 1-3. The increase in production of natural gas has also led to a decrease in net imports. The application of hydraulic fracturing and horizontal drilling technologies caused a significant increase in Bakken production since 2000. By the end of 2010, oil production rates had reached 458,000 bbls per day, outstripping the pipeline capacity to ship oil out of the Bakken. The result was an expansion of rail transportation to move the crude oil to refineries or ports for export.

Shale oil and natural gas resources are found in shale formations that contain significant accumulations of natural gas and/or oil (Figure 1-4). The Barnett Shale in Texas has been producing natural gas for more than a decade. Information gained from developing the Barnett Shale provided the initial technology template for developing other shale plays in the U. S. Another important shale gas play is the Marcellus Shale in the eastern U. S. While the Barnett and Marcellus formations are well-known shale gas plays in the United States, more than 30 U.S. states overlie shale formations. The Marcellus natural gas trend, which encompasses 104,000 square miles and stretches across Pennsylvania and West Virginia, and into southeast Ohio and upstate New York, is the largest source of natural gas in the United States, and production was still growing rapidly as of 2014.

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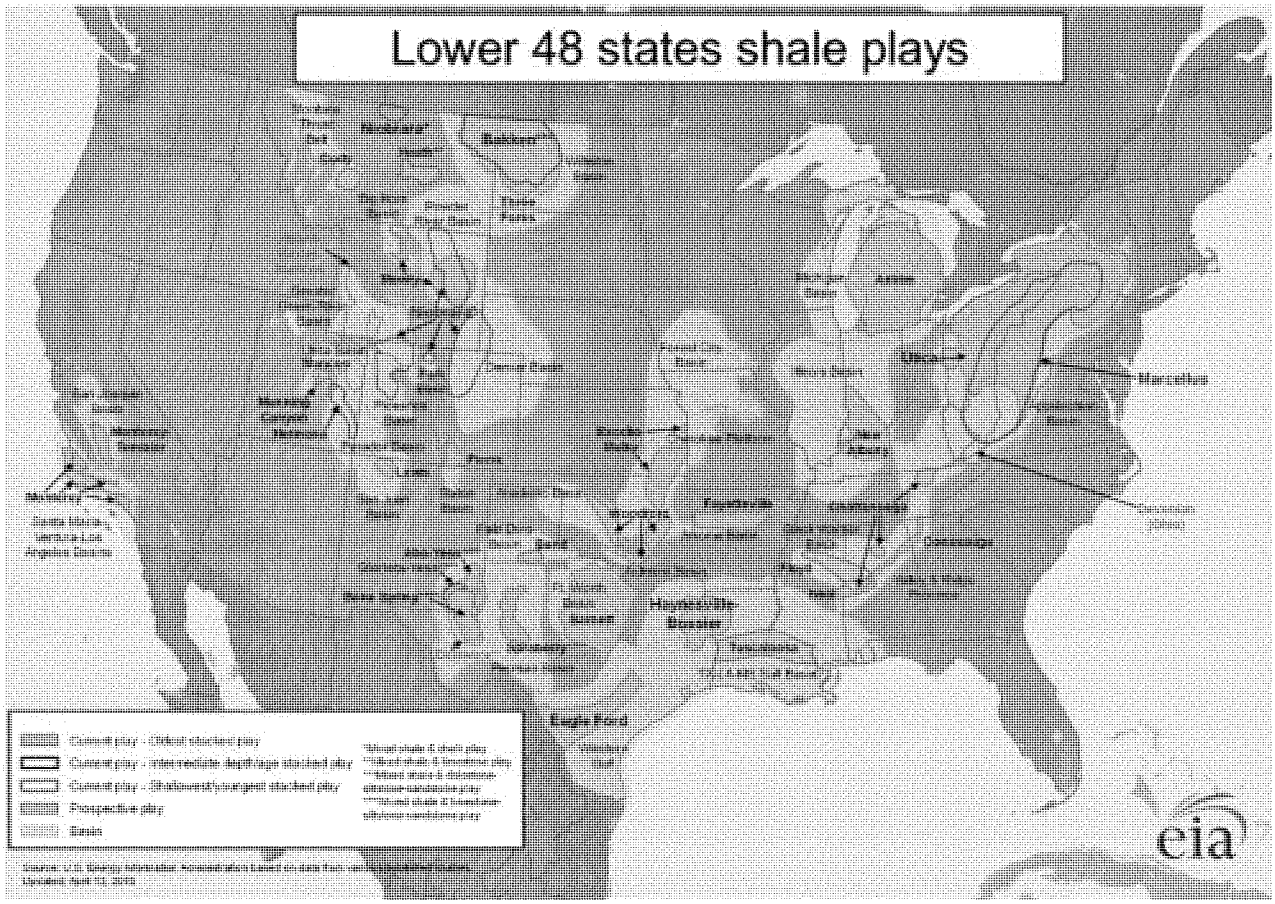

Figure 1-4 Domestic Shale gas plays. Source: EIA 2015

Figure 1-5 shows the location of refineries in the U.S. Figure 1-6 shows the substantial increase in transportation of petroleum from the Midwest to other parts of the country where the refinery capacity exists. The greatest overall volumes were transported to the Gulf coast. The 2010 to 2014 period reflects the increase in U.S. production in the shale-producing locations.

The significant increase in petroleum being transported within the U.S. has taxed the available pipeline capacity significantly. In order to meet some of the increased demand, there has been a significant increase in rail transportation of crude oil.

The large increase in U.S. and North American petroleum production has resulted in a significant change in the transportation patterns. The production from the Bakken field and the Canadian oil sands products (OSP) areas have resulted in a significant change in the number trains and tank cars carrying petroleum. The Association of American Railroads (2015) reports that the number of rail tankers carrying crude oil and petroleum products in the U.S. increased from just under 19,000 carloads in 2008 to more than 1,033,000 carloads in 2014. Figure 1-7 shows the change in the number of rail cars and the change in train movements between 2010 and 2014; this represents the time period when the development of Bakken oil began to be significant.

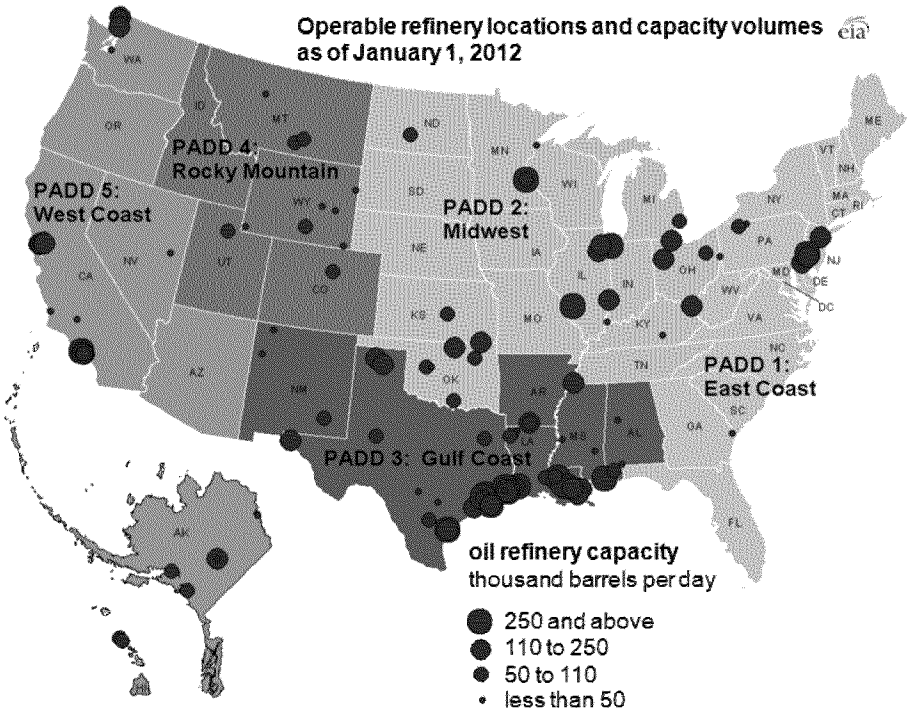

Figure 1-5: Location of U.S. Refineries and Refining Capacity. EIA 2015.

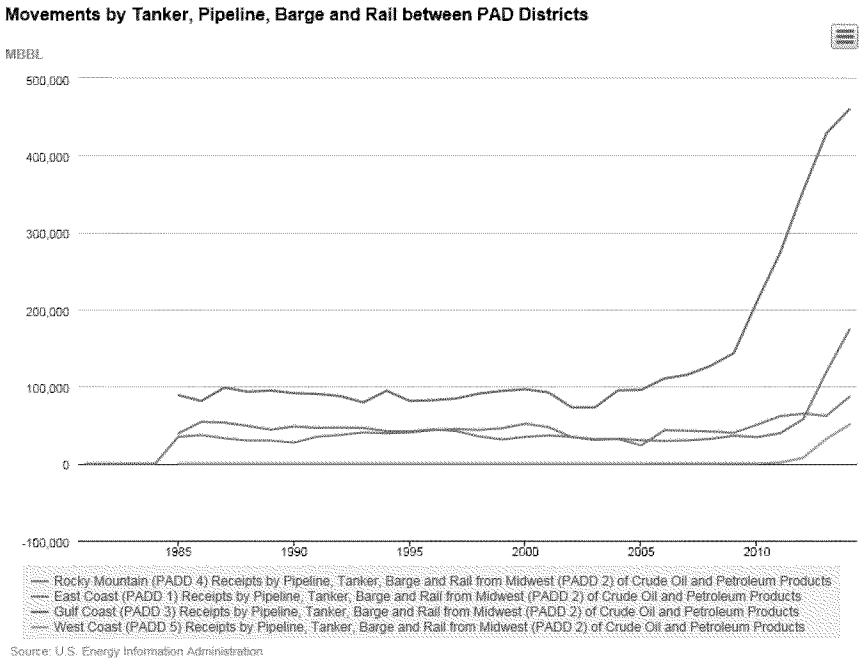

Figure 1-6 Movement of crude oil (MBBL) by pipeline, tanker barge and rail tor refinery areas. Source: EIA 2015.

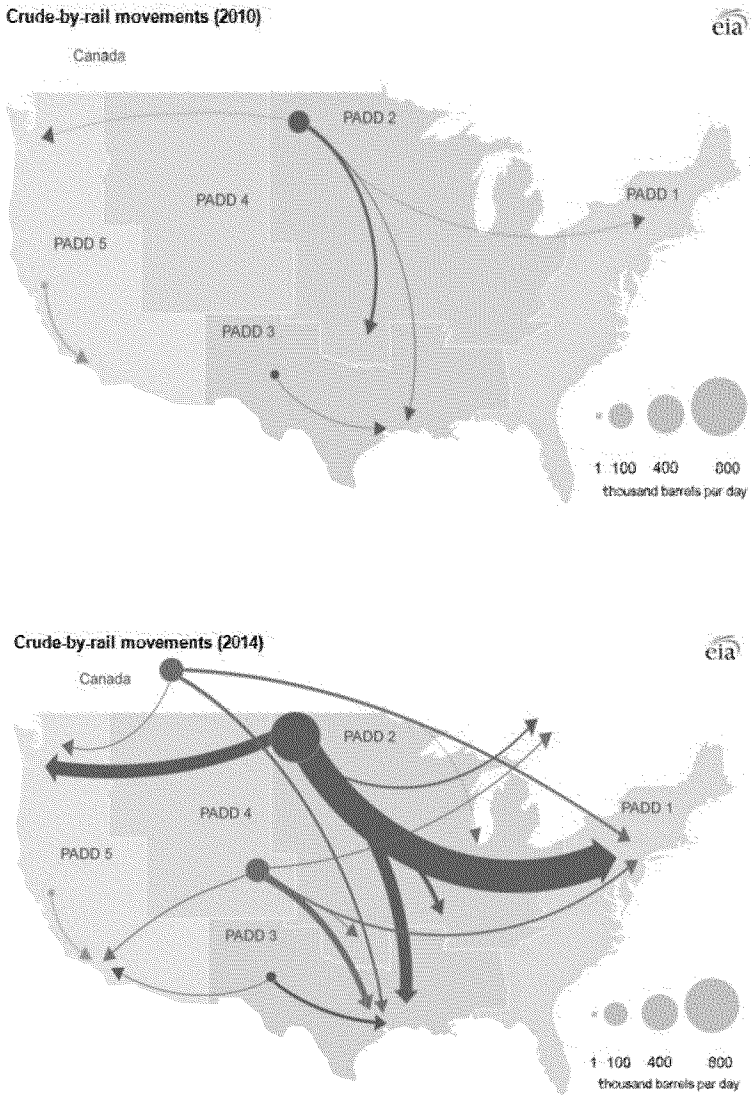

Figure 1-7 A comparison of crude oil movements by rail from 2010 and 2014. Source EIA 2015.

1.2 History of Oil Spills in the U.S.

From 1973 to 1990, an average of 2.8 million bbl of oil was spilled every year. Since 1990, that number has reduced to 35,700 bbl a year. Based on data between 1973 and 2009, the annual number and volume of oil spills declined, and in some cases dramatically (Etkin, 2009). Total petroleum industry spillage has decreased consistently over the last 40 years through 2007 (Figure 1-8). Table 1-1 summarizes the average annual oil spillage from petroleum industry

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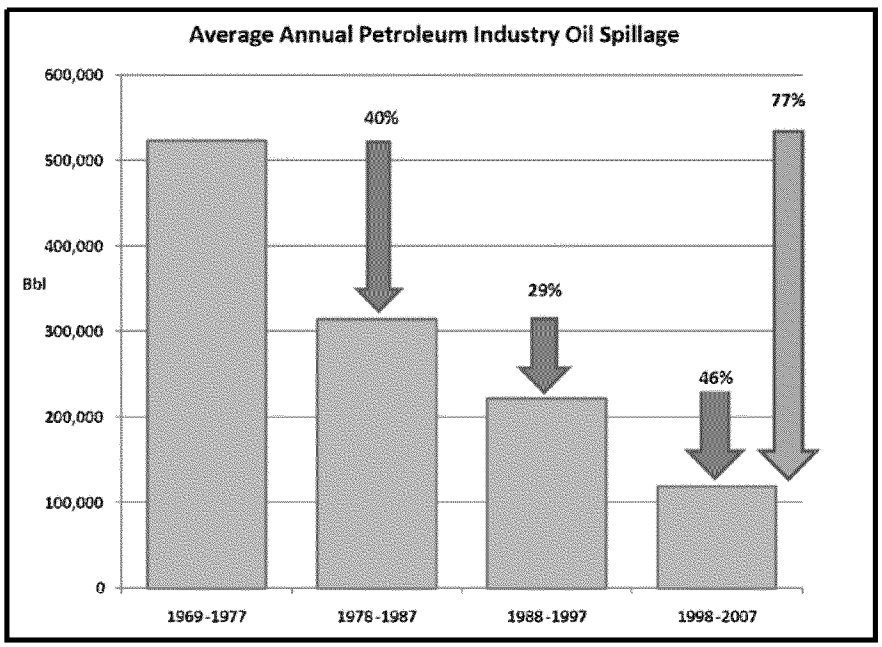
sources, including: spillage related to oil exploration and production platforms and offshore pipelines; spillage from coastal and inland pipelines, tank vessels, railroads, and tanker trucks; spillage from oil refineries; and spillage at gas stations. By multiplying the average annual spill volumes for each decade by 10, the total volume spilled (as recorded) from 1969 to 2007 would approximately equal 17.5 million bbls. (See Table 1-1.)



*NOTE: The average annual oil spillage volumes represented here are gathered from petroleum industry spillage sources, including: spillage related to oil exploration and production, platforms and offshore pipelines; spillage from coastal and inland pipelines; spillage from oil transport by tank vessels, railroads, and tanker trucks; spillage from oil refineries; and spillage from gas stations.

Figure 1-8: Average Annual Oil Spillage from Petroleum Industry Sources by Decade. Etkin, 2009.

These figures do not address any other significant spillage events in the U.S. after 2007, which would include the 2010 Macondo/*Deepwater Horizon* (DWH) well blowout and oil spill and the 2010 Enbridge Pipeline release in the Kalamazoo River in Michigan or any other significant spillage events in the U.S. after 2007. The 4.9 million bbls spilled during the *Deepwater Horizon* oil spill (USCG, 2011b) would reverse this downward trend and increase the total volume spilled between 1969 and 2007 by nearly 1400 percent; this incident represents nearly 95% of the total volume spilled from all oil platforms in the last 42 years. In general, the very largest spills, which constitute only 0.4% of the total spills, comprise 90.6% of the total volume spilled in the U.S. for the period 1988 – 2007.

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Average Annual Oil Spillage from Petroleum Industry Sources, bbls. Modified From Etkin, 2009				
Source	1969-1977	1978-1987	1988-1997	1998-2007
PRODUCTION	31,435	8,701	15,183	9,938
Offshore Platform Spills	25,858	1,344	1,814	1,273
Offshore Pipelines	4,48	3,462	8,127	2,614
Offshore Supply Vessels	95	245	48	10
Inland Production Wells	1,000	3,650	5,194	6,041
REFINING	3,000	3,512	15,015	12,136
Refinery Spills	3,000	3,512	15,015	12,136
TRANSPORT	488,662	301,645	190,753	96,393
Inland Pipelines	259,340	181,196	118,297	76,754
Tanker Trucks	3,000	4,888	5,213	9,181
Railroads	2,000	2,322	2,164	1,431
Tank Ships	192,492	60,250	42,197	3,598
Tank Barges	31,830	52,989	22,882	5,429
STORAGE AND CONSUMPTION	118,523	97,206	278,525	77,613
Non-Tank Vessels (Cargo Ships)*	5,000	6,786	2,817	1,602
Other Vessels*	14,858	6,574	6,301	4,167
Gas Stations and Truck Stops	1,195	1,195	1,564	814
Residential*	150	179	518	498
Aircraft*	3,700	3,714	3,862	4,044
Inland EPA-Regulated Facilities*	30,000	34,740	245,017	59,676
Coastal Facilities (Non-refining)*	62,220	42,781	15,059	4,230
Inland Unknown*	900	967	2,198	516
Motor Vehicles*	500	270	1,189	2,066
AVERAGE ANNUAL TOTALS	641,620	411,064	499,476	196,080
ESTIMATED DECADE TOTAL	6,416,200	4,110,640	4,994,760	1,960,800
ESTIMATED GRAND TOTAL SPILLAGE for 1969 – 2007	17,482,400 bbls (734,560,800 gallons)			
*Additional storage and consumption data for the 1969-1977 period was provided by Dagmar Schmidt Etkin, 2011, personal communications.				

Table 1-1: Average Annual Oil Spillage from Petroleum Industry Sources, bbl. (Modified from Etkin, 2009).

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1.3 Analysis of the Oil Spill System

In their Congressionally-mandated review of the 1992 OPRTP, the National Research Council (NRC) Marine Board recommended "…an analysis of the marine oil spill system, which consists of a variety of subsystems beginning with drilling for oil and ending at delivery of the product to the consumer." The oil spill system described by the NRC consists of all components and nodes of the oil supply chain (see Figure 1-9) including all aspects of the oil handling and transport processes, succeeding environments affected as a spill spreads, and intervention techniques for preventing or minimizing environmental damage (Marine Board, 1993; 1994). The NRC advocated that such an approach would identify critical nodes of potential failure within the system where ICCOPR could focus its research planning efforts.

ICCOPR agreed with the NRC on the value of a systems analysis approach in research planning but full implementation of the approach has been beyond the funding capabilities of the ICCOPR membership. In 2007, the USCG Research & Development Center (RDC) completed a system analysis of the response system and used the results to identify and evaluate research opportunities as part of strategic planning to improve spill response (VanHaverbeke, 2012). ICCOPR member agencies also have expertise on specific components of the oil spill system. This base of knowledge on the system components provides a general framework from which ICCOPR plans its research coordination, funding allocations, and measures of effectiveness. The oil spill research categorization scheme discussed in Chapter 4 reflects how ICCOPR used its understanding of the oil supply chain and oil spill response system to focus research planning as envisioned by the NRC.

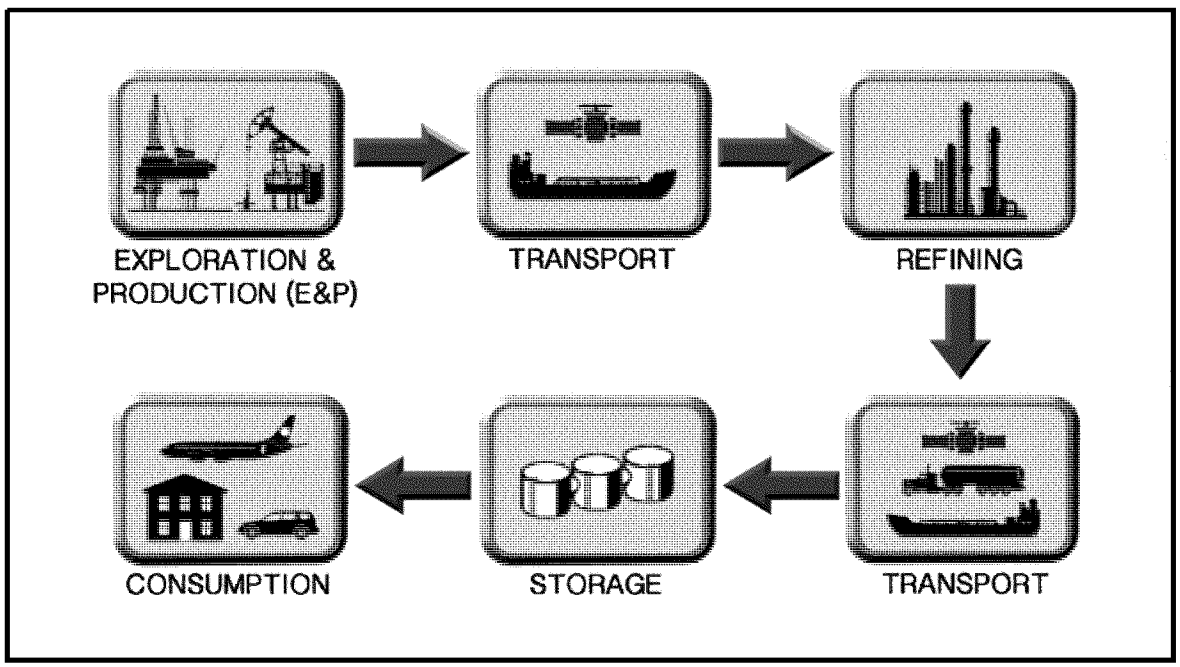

Figure 1-9: Oil Supply Chain.

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For planning R&D activities, the oil supply chain for petroleum oils consists of five subsystems (Figure 1-9):

- **Subsystem 1-Exploration and Production Facilities** - This is the origination point of crude oil and includes onshore and offshore exploration and production facilities.
- **Subsystem 2-Transportation** - This is the transportation of foreign and domestic oil products (generally crude oil) to refineries in the U.S. either by tank vessel (ship and barge), pipeline (offshore and onshore), tank railcar (unit trains), or tanker trucks.
- **Subsystem 3- Refining** - Refining of crude oil into petroleum products including the storage of crude oil, actual refining operations, storage of refined products, and the loading of refined products on tank vessels (ship and barge), tank railcars, and tanker trucks. In addition, refining would also encompass those activities that produce biofuels or vegetable oils. The latter products present many common and novel challenges compared to their traditional petroleum counterparts.
- **Subsystem 4- Transport / Storage/Distribution** - This subsystem involves the transportation of refined products to a bulk distribution storage facility by various modes of transportation, (e.g., product pipeline, tank vessel (ship and barge), tanker truck, tank railcars). Imported refined products would enter the U.S. system, as well as exported refined products would leave the U.S. system at this point. Tanker trucks may also deliver direct from refinery storage to the end user, e.g., residence or retail gas station.
- **Subsystem 5-Consumption/Consumer/Retail/Industrial** - This subsystem includes the retail gas station and the residential home heating oil segments of the oil system as well as industrial users (e.g. electric generation facilities).

There are available historic data to support claims that the improved safety and operating procedures implemented have generally reduced the risk of a spill at any point along the system. However, because accidents cannot be completely eliminated, efforts to improve pollution prevention and response must be sustained. In the following section, five potential high risk spill sources (exploration & production, vessels, onshore and offshore pipelines, railroads and refineries / bulk terminals) are examined to highlight existing weaknesses and concerns, and the efforts being made to address them.

1.4 Exploration and Production Facilities

The spill record for domestic drilling and production over the past 30 years suggested that technology and procedures for preventing oil spills were being employed effectively. However, that trend was interrupted in 2010 when the DWH drilling rig experienced an uncontrollable well blowout and oil spill. Even with modern equipment and modern safety measures, spills are a part of the oil and gas industry. The DWH blowout occurred when human errors circumvented the modern technological safeguards designed to prevent such an accident.

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> "Current technology enables drilling in water twice as deep as Macondo. Drilling at such depths requires all parties to set their standards still higher for difficult issues such as remote containment systems in water depths with extreme pressures and very limited human access, as well as different geological pressures and formations and mixes of hydrocarbons. Desire to tap resources in deeper waters should be accompanied by equivalent investments in subsea equipment, operator training, research and development for containment and response technologies, demonstrated financial capacity, and continuous improvement in and communication of industry practices devoted to safety." *(National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling, 2011)*

Due to the rising energy demands in developed economies and dramatically rising levels of consumption in emerging economies, the world's appetite for oil and other fuels will continue growing for the foreseeable future. This demand will increase pressure for continued and new oil and gas exploration in challenging environments including in the Arctic and in deep and ultra-deep waters. It will also encourage exploration and production of unconventional resources (e.g., oil sands) and the increased use of advanced technologies (e.g., hydraulic fracturing and horizontal drilling).

1.5 Onshore and Offshore Pipelines

Approximately 2.6 million miles of pipelines provide an efficient and fundamentally safe means of transporting gases and liquids. They are an integral part of the U.S. energy supply and provide vital links to other critical infrastructure such as power plants, airports, and military bases. Currently, there are 199,157 miles of pipelines that carry volatile, flammable, or toxic materials with the potential to cause public injury and environmental damage.

Canadian oil exports to the U.S. have been increasing rapidly, primarily due to growing extraction from the oil sands in Western Canada. Oil sands are a mixture of clay, sand, water, and heavy black viscous oil known as bitumen. After extraction, the bitumen is converted into an oil sands product (OSP) suitable for pipeline transport. Canada's OSPs are exported as either light, upgraded synthetic crude ("syncrude") or a heavy crude oil that is a blend of bitumen diluted with lighter hydrocarbons ("dilbit") to ease transport. The bulk of oil sands' supply growth is expected to be in the form of dilbit.

The expansion of petroleum pipelines from Canada has generated considerable controversy in the U.S. One specific area of concern was the potential new risks of the OSPs to pipeline integrity. An NRC panel (TRB, 2013) concluded, however, that diluted bitumen does not have any unique properties that make it more likely to cause internal failure of pipelines than other types of crude oil. However, additional research is needed to understand the fate and transport of unconventional oils, relative to that of traditional crude oils and refined products.

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In the 49 year period between 1964 and 2012, there were 79 oil spills from pipelines on the Outer Continental Shelf according to BSEE (2015) statistics, or about 1.6 per year. However, 25 of those spills were caused by damage from a series of hurricanes in the Gulf of Mexico in 2004, 2005, and 2008. Otherwise, spills from offshore pipelines occur at a rate of about one per year.

Both government and industry have taken numerous steps to improve pipeline safety over the last 10 years such as improved corrosion resistance, integrity testing, and requirements to identify pipelines before digging. According to PHMSA, pipelines are extremely safe when compared to other modes of energy transportation relative to the volumes of products transported (PHMSA, 2007). The trend is down, however, major pipeline incidents in 2010 and 2011 suggest that more work is needed. Figure 1-10 and Table 1-2 provide information from PHMSA on pipeline oil spills over the past 20 years.

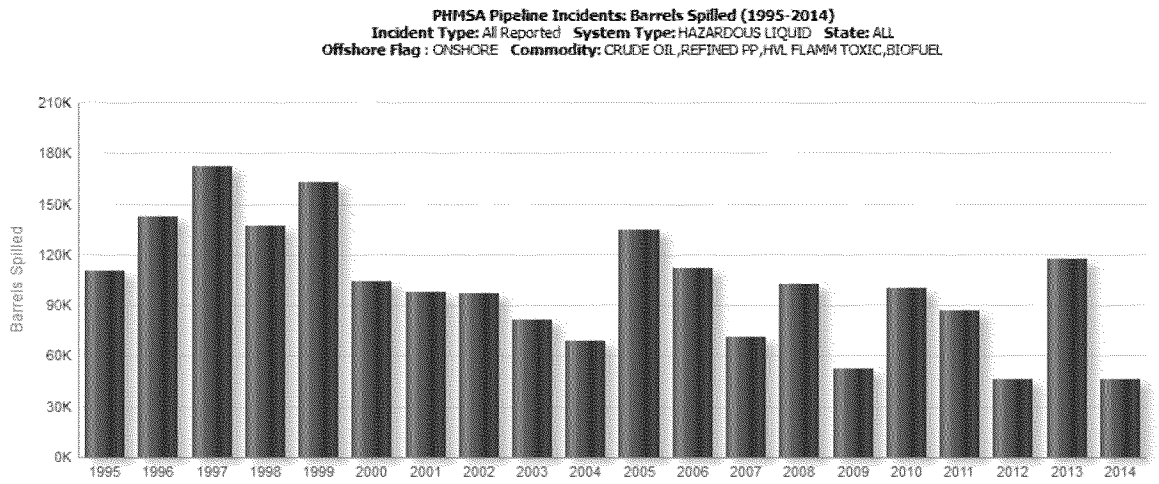

Figure 1-10 Barrels of Oil Spilled by Pipelines (1995-2014)

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PHMSA Pipeline Incidents: (1995-2014)
Incident Type: All Reported **System Type:** HAZARDOUS LIQUID **State:** ALL
Offshore Flag : ONSHORE **Commodity:** CRUDE OIL,REFINED PP,HVL FLAMM TOXIC,BIOFUEL

Calendar Year	Number	Fatalities	Injuries	Property Damage As Reported	Barrels Spilled	Net Barrels Lost
1995	176	0	9	$31,575,189	109,865	0
1996	180	3	7	$74,543,311	141,994	0
1997	155	0	2	$40,836,392	171,988	0
1998	133	1	5	$52,048,979	136,760	0
1999	151	4	17	$81,722,760	162,637	0
2000	131	1	4	$130,605,839	103,806	0
2001	121	0	9	$24,684,499	97,852	0
2002	442	1	0	$49,258,448	96,809	0
2003	421	0	0	$67,314,774	81,292	0
2004	355	5	16	$83,996,433	68,840	0
2005	340	2	2	$275,460,922	134,614	0
2006	326	0	2	$52,848,585	112,029	0
2007	321	4	9	$59,509,192	71,032	0
2008	360	2	2	$136,858,894	101,940	0
2009	325	0	1	$58,112,827	52,437	0
2010	340	1	4	$1,066,323,312	100,223	49,116
2011	339	1	2	$268,056,467	86,490	54,832
2012	359	3	4	$143,694,837	45,861	29,315
2013	392	1	5	$276,271,799	117,415	85,799
2014	438	0	0	$101,402,847	45,975	20,612
Grand Total	**5,805**	**29**	**100**	**$3,075,126,306**	**2,039,859**	**239,675**

Table 1-2, PHMSA Pipeline Spill Statistics (1995-2014)

1.6 Railroads

New technologies and high global oil prices have made it economical for energy companies to develop shale oil and oil sands petroleum reserves in the United States and Canada. The challenge is getting the oil from the oil fields to the appropriate refineries across North America so they can process the oil. That has created an opportunity for railroads to fulfill the transportation demand. In 2011, railroads and other facility and transportation businesses began building loading facilities and adding tank cars to compete with pipelines for a piece of this transportation demand.

The movement of Bakken oil and OSP occurs via unit trains, which can be composed of more than 100 tank cars, all carrying the same cargo. Tank cars are typically double-lined and made of hardened steel to survive a derailment. With the increased use of unit trains there has been an increase in the number of significant spills from derailments.

The American Petroleum Institute's Analysis of U.S. Oil Spillage (Etkin, 2009), which tracks oil spill statistics up through 2007 data, stated that railroads spilled 1,400 bbl of oil annually as cargo in tank cars and as fuel. This was a 34% reduction from the previous decade (1990s). The Association of American Railroads (2015a,b) reports that the number of rail tankers carrying

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crude oil and petroleum products in the U.S. increased from just under 19,000 carloads in 2008 to more than 1,033,000 carloads in 2014. The Federal Railroad Administration (FRA) statistics indicate number of train accidents has continued to decrease from 2005-2014 (Table 1-3). The number of hazmat releases has decreased also over this time period, although the level of damages over $1 million dollars has remained constant. However, the increased transportation of crude oil resulted in a number of significant rail accidents that resulted in damages and deaths. (See section 7.1.5)

In 2014, the U.S. Department of Transportation (DOT) began a comprehensive rulemaking proposal to improve the safe transportation of large quantities of flammable materials by rail - particularly crude oil, denatured alcohol, and ethanol/gasoline mixtures - because of the concern for the quantity of Bakken crude transported by rail and the increase in number of accidents. DOT proposed enhanced tank car standards, a classification and testing program for mined gases and liquids, and new operational requirements for high-hazard flammable trains that include braking controls and speed restrictions. Within two years it proposes the phase out of the use of older DOT 111 tank cars for the shipment of packing group I flammable liquids, including most Bakken crude oil, unless the tank cars are retrofitted to comply with new tank car design standards.

Category(1)	CY05	CY06	CY07	CY08	CY09	CY10	CY11	CY12	CY13	CY14
Freight Train Accidents(2)	3266	2998	2693	2481	1912	1902	2022	1760	1822	1736
Hazmat cars Damaged or Derailed (3)	915	1041	1056	750	743	708	665	671	822	779
Hazmat Releases(4)	39	30	46	21	22	21	21	26	18	15
Cars Releasing	52	71	76	37	44	40	66	50	78	26
Damages >100k	526	571	540	481	385	423	407	347	406	381
Damages >1mil.	57	59	69	52	52	57	53	43	66	58
Deaths	33	6	9	27	4	8	6	9	11	2

(1) Calendar years
(2) Not including crossing collisions and other accidents with death
(3) Total hazard material cars damaged
(4) Accidents with hazard material releases

Table 1-3: Number of Train Accidents and Hazmat Releases 2005-2014. (FRA 2015)

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1.7 Refining and Storage Operations

Potentially damaging discharges of crude oil or petroleum products in a refinery or at a bulk storage terminal can and do occur at every point in this system (offloading, storage, loading), and the factors that can influence the occurrence of these accidental discharges includes: the design, construction, maintenance, and operational activities; and human factors (e.g. training).

Despite a decrease in the number of domestic refineries between 1982 and 2010, the U.S. combined daily throughputs have slowly increased from about 12 million up to approximately 15 million bbl/day (Table 1-4). Increased throughput has occurred in spite of decreased numbers of refineries, because remaining refineries operate at increased capacities/efficiencies to compensate for the lack of production at decommissioned older refineries.

U.S. Gross Inputs to Refineries (Thousands of Barrels per Day)										
Decade	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9
1980s						12,165	12,826	13,003	13,447	13,551
1990s	13,610	13,508	13,600	13,851	14,032	14,119	14,337	14,838	15,113	15,080
2000s	15,299	15,352	15,180	15,508	15,783	15,578	15,602	15,450	15,027	14,659
2010s	15,177	15,289								
Source: U.S. Energy Information Administration (EIA), 2012.										

Table 1-4: U.S. Gross Inputs to Refineries (Thousands of Barrels per Day)

Thousands of above ground crude oil and refined product storage tanks are in service at refineries and other oil/product handling/storage facilities. Buried pipelines within refinery boundaries represent another source of leaks. Aging domestic refinery infrastructure increases the risk of spillage and better systems are needed to detect potential problems. Another possible source of leakage is the refinery process line.

On June 19, 2006, a violent rain storm compromised a waste oil tank at the CITGO Refinery on the Calcasieu River, near Sulfur, Louisiana. Oil booms initially contained the spilled oil but subsequently failed and oil spread down the Calcasieu River and into Calcasieu Lake. The spill released up to an estimated 71,000 bbls (approximately 3 million gallons) of waste oil into the environment. The exact amount of oil spilled and the amount reaching the water is still unknown. Hurricane Katrina also caused considerable damage and oil spills from the refineries and bulk storage terminals in the storm's path (Table 1-5).

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Spill Events that Occurred in the Path of Hurricane Katrina (2005)	
Spill Location	Quantity (bbls)
Bass Enterprises (Cox Bay)	90,000
Shell (Pilot Town)	25,000
Chevron (Empire)	23,600
Murphy Oil (Meraux and Chalmette)	19,500
Bass Enterprises (Pointe à la Hache)	10,980
Chevron (Port Fourchon)	1,260
Venice Energy Services (Venice)	595
Shell Pipeline Oil (Naim)	320
Sundown Energy (West Potash)	310
Source: Pine, 2006	

Table 1-5: Spill Events that Occurred in the Path of Hurricane Katrina (2005).

1.8 Maritime and Riverine Transport - Tank Vessels (Ships & Barges) and Non-Tank Vessels

A combination of Federal, State, and international authorities are responsible for regulating oil spills from vessels in the U.S. They are collectively responsible for creating and implementing legislation to prevent oil spills and handling the decisions and procedures that follow in the aftermath.

There has been a reduction of operational and accidental oil spillage in the U.S. that can largely be attributed to the domestic and international regulations that have improved shipping safety and increased limits of liability for oil spills. These regulations required the phase-out of single hull tank vessels (ships and barges) and development of new tank vessels designs for double hulls to reduce accidental discharges in the event of grounding, collision, and allisions. Operational preventative measures including mandatory tug escorts for tank ships transiting through environmentally-sensitive areas in ports may also have contributed to the downward spillage trend by ensuring immediate assistance to a vessel experiencing a loss of propulsion or steerage.

Section 703 of the Coast Guard Authorization Act of 2010 directed the USCG to conduct a study of oil spills involving commercial vessel sources between 2001 through 2010 (Table 1-6). The Coast Guard released the study in May 2012 and reported that a small number of vessel casualties resulted in the greatest percentage of the overall spill volume. The data also show that most spills do not involve vessel casualties. These non-casualty spills are termed "operational"

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spills. The report addressed casualty and non-casualty groupings separately in order to identify their respective causal factors. The report defined a non-casualty spill as one in which the only reported occurrence is an oil spill (i.e., the incident did not involve an allision or collision).

U.S. Oil Spills from Vessels – 2001 - 2010. From: USCG, 2012		
Vessel Type	Spills	Barrels
MODU*	259	9,842
Tank Barge	1,318	75,044
Tank Ship	426	30,070
Freight Ship	893	17,284
Fishing Vessel	3,619	8,746
Tow / Tugboat	2,965	6,956
Public Vessel	486	3,077
OSV / Oil Recovery	883	2,334
Recreational	5,058	1,696
Unclassified Vessel	2,479	1,511
Passenger	1,100	8,66
Industrial Vessel	604	675
Freight Barge	407	408
Research Vessel	162	107
Other	51	11
TOTALS	**20,710**	**158,633**

*MODU- Mobile Offshore Drilling Units

Table 1-6: U.S. Oil spills from vessels 2001-2010. (USCG, 2012)

The study concluded that the most frequently reported human factors were inattention, procedural errors and situational awareness. However, while the study focused on human factors, it found that more than half of all discharges were the result of material failure. Vessel casualty statistics showed that the combination of material failure and loss of vessel control led to some of the largest oil spill volumes from 2001 through 2010. Material failure was a significant factor for propulsion and steering problems. The potential for damage due to allision, collision, or grounding is significant when such failures occur on large vessels, (e.g. tank ships, freight ships). According to industry feedback, material failures are also a significant factor in near-miss incidents.

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1.9 Oil Tankers

Stricter regulations and improved operations of oil tankers has reduced the number of large (> 5,000 bbls, or 7 tonnes) and medium (50 – 5,000 bbls) oil spills from tankers globally, as well as in the U.S. despite an increase in marine transportation of oil. Following the grounding of the single-hull tank vessel *Exxon Valdez*, OPA 90 mandated that all newly built tank vessels have double hulls and that single-hull tank vessels be phased out and replaced by double-hulled vessels by January 1, 2015 for operations in the U.S. waters. Similarly, requirements stemming from the International Convention for the Prevention of Pollution from Ships (MARPOL) have increased the safety of tanker transport.

The International Tanker Owners Pollution Federation Limited (ITOPF), which tracks oil spills from tankers, reports that 19 of the 20 largest spills from tankers occurred before 1970 (ITOPF, 2015). Figure 1–11 shows the trend in oil tanker transport and the number of spills. Figure 1-12 shows the downward trend in oil spills from tankers since 1970 according to ITOPF.

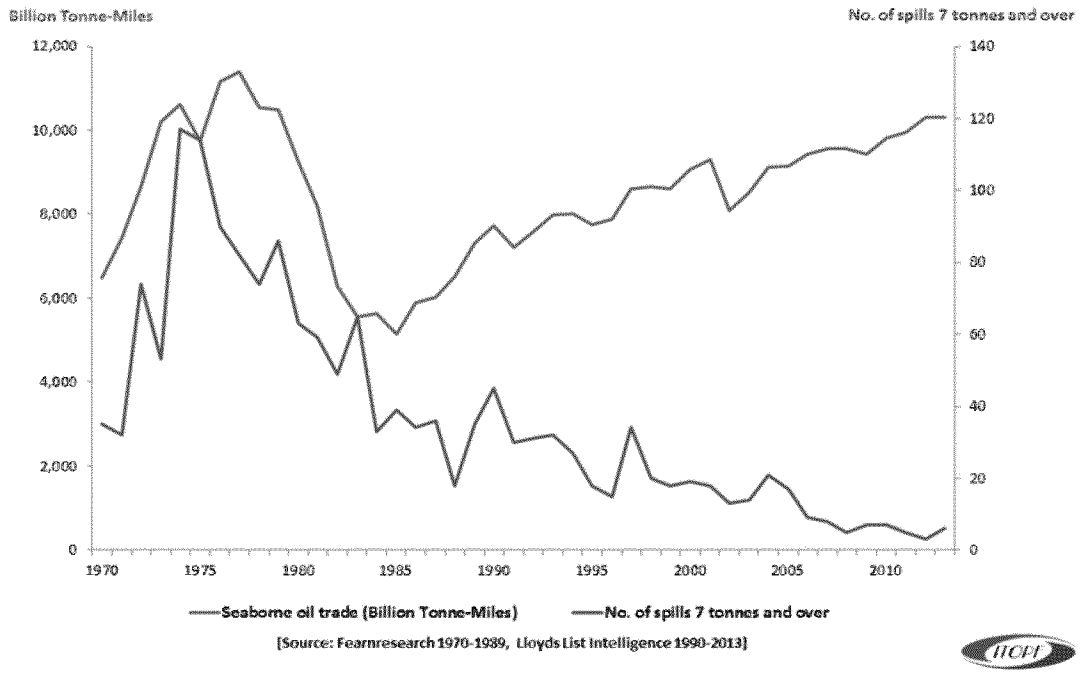

Figure 1-11: Seaborne oil trade and oil spill trends

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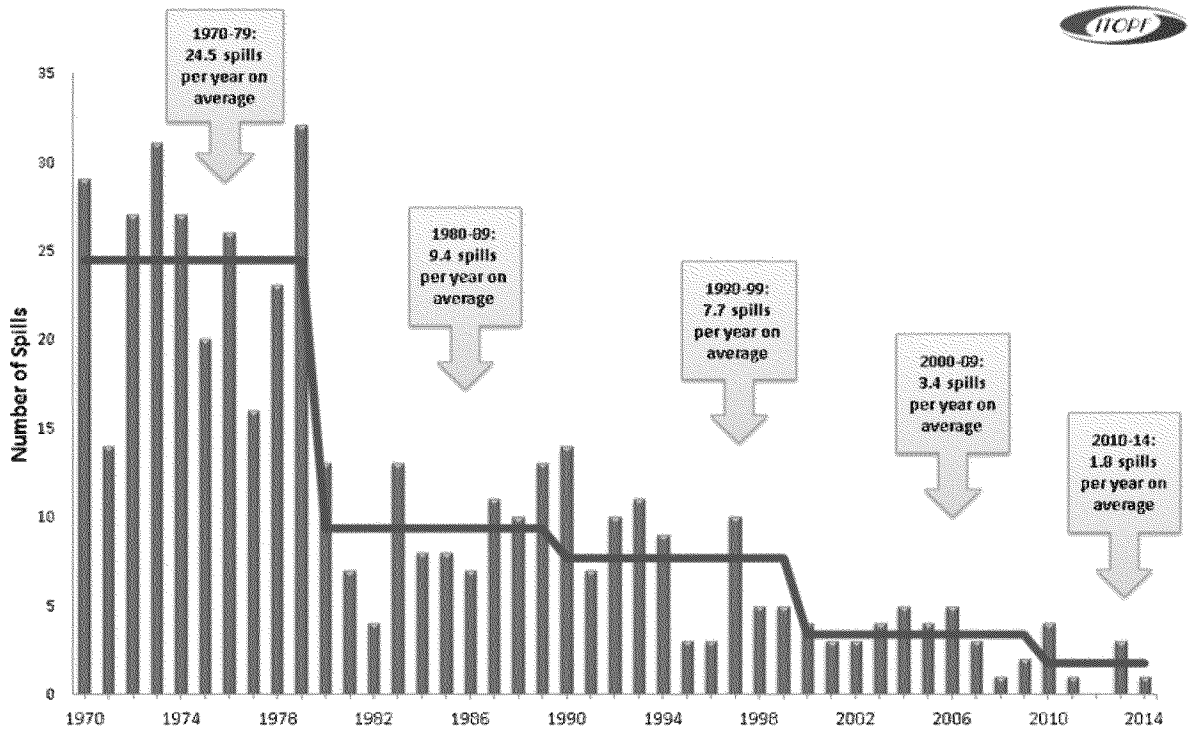

Figure 1-12: Number of Large Spills (>5,000 bbls) from 1970-2014 (ITOPF, 2014)

1.10 Regional and Geographic Areas of Interest

ICCOPR considers regional issues an important element in executing an effective oil pollution R&T program. The applicability of research results can vary significantly between geographic regions due to their unique environmental characteristics. Regional issues are prevalent in the Arctic with its potential for new oil exploitation and related activity, and in the Gulf of Mexico where ultra-deepwater drilling and injury assessment and restoration activity from the *Deepwater Horizon* spill continues. Inland regions, likewise, have evolving issues related to onshore shale oil, oil sand products development, and pipeline and rail transportation safety. Development of other OCS regions will raise their own geographically-specific issues. In its research planning efforts, ICCOPR maintains visibility of regional issues by coordinating with RRTs, states, and regional research groups.

ICCOPR considers the following regional and geographic areas to be of high importance at this time or during the next six-year planning cycle:

The Arctic and Alaska – The extent of sea ice in the Arctic and Alaskan waters has diminished in recent years, a trend that is expected to continue for the foreseeable future. The oil industry is expanding exploration and production operations into the Arctic region as conditions change to make operations feasible in the region. One oil company is drilling in the Arctic Ocean during the 2015 summer season. Understanding and overcoming the operational and logistical

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challenges of responding to an oil spill in the Arctic region is a major focus of ICCOPR member research planning. This focus is reflected in the number of research priorities (see Chapter 9) that apply directly to Arctic conditions.

Gulf of Mexico – The Gulf of Mexico has abundant oil and gas resources, which results in extensive exploration and production activity. Advances in drilling technology have enabled industry to expand operations into progressively deeper areas of the Gulf. It is also the site of two of the largest oil spills from well blowouts, Macondo/*Deepwater Horizon* and *Ixtoc*, as well as numerous other spills. Federal and state agencies are continuing to conduct studies to determine the short- and long-term effects of the *Deepwater Horizon* oil spill. Both Federal and non-Federal Gulf of Mexico research programs established because of the *Deepwater Horizon* oil spill will continue through the next several years.

Inland Areas – As discussed in Section 1.1, the production of oil and gas from the shale plays in the U.S. and tar sand regions in Canada has dramatically increased over the past five years. The resulting increase in oil shipments by rail and pipeline has elevated the importance of research to prevent and prepare for oil spills from train accidents or pipeline breaks. In addition, the potential for these spills to affect freshwater rivers and lakes necessitates greater emphasis on research into non-marine response techniques.

Atlantic Outer Continental Shelf (OCS) – At present, there are no active oil and gas leases in any of the four Atlantic OCS planning areas. However, the Bureau of Ocean Energy Management (BOEM) Draft Proposed Plan for 2017-2022 proposes one lease sale in the Atlantic in 2021. Preparation for leasing in the Atlantic will involve pre-spill baseline studies to document environmental conditions prior to exploration and drilling.

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2. Federal Oil Pollution Research

ICCOPR serves to coordinate research by its member federal agencies and other federal research entities to promote a coordinated approach to addressing oil pollution issues. This section describes ICCOPR and the other federal research entities.

2.1 ICCOPR

2.1.1. Origin

Congress created ICCOPR in the Oil Pollution Act of 1990 (OPA 90). The Committee's membership, roles, and responsibilities are outlined in the original Public Law (P.L.) that mandated its creation, as amended and codified in the United States Code. Consequently, when referencing ICCOPR, it is generally cited with: *Oil Pollution Act of 1990, § 7001, 104 Stat. 484, 559-564 (1990) (33 U.S.C. 2761).*

ICCOPR is charged with two general responsibilities: (1) to prepare a comprehensive, coordinated federal oil pollution research and development plan; and (2) to promote cooperation with industry, universities, research institutions, state governments, and other nations through information sharing, coordinated planning, and joint funding of projects. ICCOPR reports on its activities to Congress every two years.

2.1.2. ICCOPR Membership

ICCOPR is comprised of fifteen federal independent agencies, departments, and department components. The U.S. Coast Guard (USCG) chairs ICCOPR. The National Oceanic and Atmospheric Administration (NOAA), the Bureau of Safety and Environmental Enforcement (BSEE), and the Environmental Protection Agency (EPA) rotate as the vice-chair every two years.

OPA 90 originally stipulated that ICCOPR include representatives from: the Department of Commerce, including NOAA and the National Institute of Standards and Technology (NIST); the Department of Energy (DOE): the Department of the Interior (DOI), including the Minerals Management Service (MMS) and the US Fish and Wildlife Service (USFWS); the Department of Transportation (DOT), including the USCG, the Maritime Administration (MARAD), and the Research and Special Projects Administration (RSPA); the Department of Defense, including the U.S. Army Corps of Engineers (USACE) and the Navy; the EPA; the National Aeronautics and Space Administration; and the US Fire Administration (USFA) in the Federal Emergency Management Agency (FEMA).

Today ICCOPR's original membership remains mostly intact but with some recent changes (Table 2.1). In 2012, the DOI reorganized MMS to form BSEE and the Bureau of Ocean Energy Management (BOEM) – both of which are now members of ICCOPR. Additionally, the USCG and FEMA reorganized under the DHS and DOT re-designated the RSPA as the Pipeline and

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Hazardous Materials Safety Administration (PHMSA). In 2013, ICCOPR welcomed its newest member, the U.S. Arctic Research Commission (USARC), to help address emerging issues associated with the Arctic and cold weather environments.

Table 2.1 - ICCOPR Membership

Member	Current Department	Notes
USCG	Homeland Security	Transferred from Transportation
FEMA/USFA	Homeland Security	Originally Independent
MARAD	Transportation	
PHMSA	Transportation	Agency renamed from RSPA
USFWS	Interior	
BSEE	Interior	Formerly part of MMS
BOEM	Interior	Formerly part of MMS
NOAA	Commerce	
NIST	Commerce	
Navy	Defense	
USACE	Defense	
DOE	Energy	
EPA	Independent	
NASA	Independent	
USARC	Independent	Added in 2013

ICCOPR membership may continue to evolve to fully address new research challenges when agency missions change or there are changes in patterns of oil exploration, production, and transportation. OPA 90 provides that the President may designate other agencies as members of ICCOPR. The President delegated this power to the Secretary of the "Department in which the Coast Guard (USCG) operates" through Executive Order 12777 (October 18, 1991) Section 8 (h) and as amended by Executive Order 13286 (March 5, 2003). The Secretary of Homeland Security delegated this power to the USCG Commandant in DHS Delegation No. 0170.1, II.80. ICCOPR may also invite other federal agencies to participate in a non-voting observer role. Currently the U.S. Geological Survey (USGS) is participating in ICCOPR as a non-voting observer.

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The diversity of ICCOPR's membership reflects Congress' intent to adequately address the full spectrum of oil spill preparedness, response, and restoration research. Each organization in ICCOPR bears unique regulatory responsibilities, research capabilities, and/or technical expertise that collectively give ICCOPR its knowledge and networks for tackling varying oil pollution research and technology issues. The following sections briefly discuss each of ICCOPR's member organizations and their connections to oil pollution research. Some organizations directly oversee oil pollution research programs while others provide guidance and resource support or specialized expertise.

2.1.2.1 U.S. Coast Guard (USCG)

The USCG serves as the Chair of ICCOPR in accordance with OPA 90. It also serves as the vice-chair of the National Response Team (NRT) and a co-chair of Regional Response Teams (RRTs). The USCG, together with the EPA, has the primary responsibility for federal oil spill response activities. In accordance with the National Contingency Plan (NCP), the USCG is the lead agency for response to spills in the U.S. coastal zone as defined in 40 CFR 300.5.

The USCG provides pre-designated Federal On-Scene Coordinators (FOSCs) for spills in the coastal zone (all United States waters). In addition to spill response, the Coast Guard also has statutory and operational responsibility for oversight of ship design and construction, periodic vessel inspections, investigation of marine casualties, waterway management and port safety and security (including the regulation of hazardous cargoes). These activities all help the USCG improve pollution prevention and response capabilities.

Since 1969, the USCG Research & Development Center (RDC) in New London, Connecticut, has been the Coast Guard's sole facility performing applied oil pollution research, development, test, and evaluation (RDT&E) experimentation and demonstrations.

The USCG also hosts the National Response Center (NRC), which serves as the NRT communications center and the official federal point of contact for pollution incident reports. The National Contingency Plan (40 CFR Part 300) requires that the NRC be notified in the event of an oil spill into navigable water. The U.S. Coast Guard's National Pollution Funds Center (NPFC) administers the Oil Spill Liability Trust Fund (OSLTF) and provides funding from the OSLTF Emergency Fund for responses, compensates claimants for cleanup costs and damages, and takes action to recover costs from responsible parties. The NPFC also provides funding from the OSLTF Principal Fund for operations and for research and development.

2.1.2.2 National Oceanic and Atmospheric Administration (NOAA)

NOAA serves as a rotating Vice Chair of ICCOPR. NOAA provides science, service and stewardship for the oceans and atmosphere; with a goal of healthy ecosystems, communities and economies that are resilient in the face of change. Many components of NOAA may support response to a major oil spill (including the National Ocean Service, National Weather Service;

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the National Marine Fisheries Service; the National Environmental Satellite, Data and Information Service; and the Office of Marine and Aviation Operations). A core component of the support is NOAA's Office of Response and Restoration (OR&R) and its network of Scientific Support Coordinators (SSCs) who respond to approximately 120 oil spills annually, primarily in the coastal zone. These SSCs serve as the primary scientific advisors to Federal On-Scene Coordinators (FOSCs), coordinating scientific expertise from federal and State agencies, academia, industry and the local community (40 CFR 300.145). NOAA support includes assessments of hazards, predictions of fate and behavior (trajectories), recommendations on cleanup and mitigation methods and endpoints, emergency consultations on protected resources, environmental information and data management, wildlife operations, meteorological, hydrological and oceanographic observations and forecasts and satellite imagery access and analysis.

NOAA supports the NRT and RRTs as delegated Department of Commerce representatives and serves on workgroups and area committees on activities associated with preparedness, assessment and restoration. NOAA applies and develops tools for emergency response support, transitioning research into operations. In coordination with states and other federal agencies, NOAA produces environmental sensitivity maps, which rank coastal areas by sensitivity to oil and identify priority locations to be protected in a spill. Federal, State and local agencies use these maps to plan and respond to oil spills.

As a Federal Natural Resource Trustee for living marine resources and their habitat, NOAA is required to assess the injuries that result from an oil spill, to determine and recover monetary compensation and, using those sums, to restore, rehabilitate or recover the equivalent of the damaged resources. NOAA is also responsible for the issuance and implementation of regulations governing oil spill damage assessment.

2.1.2.3 National Institute of Standards and Technology (NIST)

Founded in 1901, NIST is a non-regulatory federal agency within the U.S. Department of Commerce. NIST's mission is to promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve our quality of life. NIST has a long history of scientific, technical and measurement support to other federal agencies and U.S. industry on a reimbursable basis.

NIST maintains unique measurement facilities and has an experienced technical staff able to assist with oil spill response and oil pollution research providing a wide variety of scientific and measurement services. NIST's most recent activities relating to oil spills include developing protocols for sampling of protected species, providing for archival for marine animal specimens associated with oil spills, conducting interlaboratory comparison exercises for laboratories involved in assessing oil contamination, providing measurements of contamination in archived marine mammals and seabirds, and assisting with measuring oil flow from well blow-outs. NIST develops Standard Reference Materials (SRMs) for crude oil and other fossil-fuel materials

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and additionally has groups involved with research in Fire and Pipeline Safety. NIST maintains and manages the Marine Environmental Specimen Bank (ESB) that contains marine mammal samples dating back as far as the Exxon Valdez oil spill damage assessment and includes marine organism samples from the Pacific Islands, Alaska, and coastal regions of the lower 48 states. NIST has worked more than 30 years developing environmental specimen banking technology so that samples can be used to understand environmental exposure and effects from oil and other contaminants. Because samples have been collected continuously from many locations they provide a resource in the event of a spill to establish pre-spill baseline conditions.

2.1.2.4 U.S. Department of Energy (DOE)

The DOE works to ensure America's energy security and prosperity by addressing energy and environmental challenges with research and technology solutions. This includes ensuring the prudent development of America's oil and natural gas resources through R&D that improves the safety and environmental performance of oil and natural gas exploration and production.

In its offshore research program, DOE works toward mitigating the risks and challenges associated with drilling and production operations through a research portfolio dedicated to oil spill prevention. Completed and ongoing research focus on the following areas: geologic uncertainty; drilling and completions; surface systems and umbilicals; and subsea systems reliability/automated safety systems.

Onshore DOE focuses on prudent development of unconventional oil and gas resources with emphasis on resource characterization, protecting water quality, increasing water availability, protecting air quality, and reducing induced seismicity associated with waste water injection. The advent of shale gas development also brings a host of safety and environmental issues, including: 1) demand for water for use in hydraulic fracturing; 2) protection of drinking water aquifers; 3) evaluation of the safety of chemicals used in fracturing; 4) environmental impacts resulting from the treatment and/or disposal of produced or fracturing flowback water; 5) air quality impacts; and 6) community safety issues.

DOE's National Energy Technology Laboratory (NETL) conducts laboratory, field, and modeling-based research on offshore oil spill prevention, focusing on reducing the risk and mitigating the risk of a loss of well control that leads to spills. Onshore modeling includes life cycle analysis of natural gas, and modeling of methane emissions.

2.1.2.5 Bureau of Safety and Environmental Enforcement (BSEE)

The DOI's BSEE serves as a rotating Vice Chair of ICCOPR. The Bureau works to promote safety, protect the environment, and conserve energy resources offshore through vigorous regulatory oversight and enforcement. The BSEE develops standards and regulations to enhance operational safety and environmental protection in connection with the exploration and development of offshore oil, natural gas, and renewable energy sources on the U.S. Outer

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Continental Shelf (OCS); and undertakes actions to ensure compliance with those standards and regulations. BSEE has two research programs that support its mission. The Technology Assessment Program supports research regarding operational safety and pollution prevention related to offshore oil and natural gas and renewable energy exploration and development. The Oil Spill Response Research Program is dedicated to improving oil spill response options. The major focus of the program is to support BSEE's mission of ensuring offshore operators are prepared to respond to any potential oil spill. Research is conducted to improve the methods and technologies used for oil spill detection, containment, treatment, recovery and cleanup.

As part of ensuring that offshore operators are prepared to respond to an oil spill BSEE conducts oil spill response plan reviews, government-initiated unannounced exercises, equipment inspections, and audits of oil spill removal organizations and spill management training. Risks identified through these activities are mitigated by directed changes to plans, training programs, equipment, response strategies, and BSEE-funded research projects.

The BSEE also manages the operation of the national Oil Spill Response Research & Renewable Energy Test Facility (Ohmsett), the only facility where full-scale oil spill response equipment testing, research, and training can be conducted in a marine environment with oil under controlled environmental conditions (waves and oil types). OPA 90 mandated continued operation of Ohmsett. (See Section 2.3.1.)

2.1.2.6 Bureau of Ocean Energy Management (BOEM)

The DOI's BOEM manages the exploration and development of the nation's offshore resources on the U.S. Outer Continental Shelf (OCS). It seeks to appropriately balance economic development, energy independence, and environmental protection through oil and gas leases, renewable energy development and environmental reviews and studies. BOEM conducts studies to improve pre-spill baseline information and estimates of oil-spill transport, fate, and impacts to the environment. BOEM manages an Environmental Studies Program (ESP), which, since 1973, has included: development and use of oil transport and weathering models; measurement of oil effects in laboratory and field conditions on marine organisms including birds, fish, and mammals; identification of sensitive biological resources; and assessment of the social and economic impacts of oil development. While some of the ESP consists of in-house investigations, BOEM manages a substantially larger program that is conducted by contractors, industry, universities, and other federal agencies. Interagency coordination of this program is overseen by the National Ocean Pollution Policy Board and the Interagency Arctic Research Policy Committee, in addition to review provided by the OCS Scientific Committee.

2.1.2.7 U.S. Fish and Wildlife Service (USFWS)

The DOI's USFWS has trustee responsibility for migratory birds, threatened and endangered species, certain marine mammals, anadromous and catadromous fish, and national wildlife refuge lands. The USFWS is the primary DOI Bureau that responds to oil spills, provides

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information and advice on safeguarding sensitive habitats and protected species (including advice on use of dispersants and other chemicals), and oversees the rescue and the rehabilitation of oiled birds and certain marine mammals. It works closely with state fish and wildlife agencies to ensure the protection of potentially affected fish and wildlife and takes an active role in protecting USFWS lands, such as national wildlife refuges. USFWS, in its role as trustee, is also the most active DOI bureau in natural resource damage assessment and restorations (NRDAR). In addition to civil actions, USFWS may also pursue criminal violations of the Migratory Bird Treaty Act, Marine Mammal Protection Act, and the Endangered Species Act.

The USFWS R&D efforts are focused on identifying chemical pollutants and their metabolites in biological tissues; defining and mapping wetlands, other critical habitats and natural resources; inventorying species of particular concern, including threatened and endangered species; developing biological indicators and economic tools for damage assessment; and determining biological requirements for sustaining viable populations and habitats and identifying factors contributing to their demise. The USFWS R&D efforts support the needs of the DOI in meeting the operational needs and the requirements of OPA 90.

2.1.2.8 Maritime Administration (MARAD)

The DOT's MARAD is tasked with promoting the use of waterborne transportation and its seamless integration with other segments of the transportation system, and the viability of the U.S. merchant marine. MARAD's role in maritime transportation spans many areas involving ships and shipping, shipbuilding, port operations, vessel operations, national security, environment, and safety. MARAD supports the Maritime Environmental and Technical Assistance (META) program, which focuses on environmental research and demonstration projects. The Maritime Administration collaborates extensively with stakeholders from all transportation sectors and modes in order to accomplish its mission to improve and strengthen the U.S. marine transportation system. Through long range planning and analysis, the Maritime Administration's Office of Policy and Plans looks ahead and develops plans for integrating the Maritime Administration's activities with those of other appropriate government agencies, as well as private sector marine transportation stakeholders.

2.1.2.9 Pipeline & Hazardous Materials Safety Administration (PHMSA)

The mission of DOT's PHMSA is to protect people and the environment from the risks of hazardous materials transportation by establishing national policy, setting and enforcing standards, providing education, and conducting research to prevent oil spills and hazardous materials incidents. PHMSA's Office of Pipeline Safety promulgates and enforces regulations addressing the design, construction, operation and maintenance of pipeline systems. PHMSA's Pipeline Safety Research Program supports the PHMSA mission by: 1) funding technology development research; and 2) generating and sharing new technical knowledge with decision makers in support of planning, evaluating, and implementing pipeline safety programs. This

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research focus is providing near-term solutions that will increase the safety, reduce environmental impact and improve reliability of the Nation's pipeline system.

PHMSA, via its Office of Hazardous Materials Safety, also provides support to federal agencies in oil spill related areas such as logistics management, transportation infrastructure, telecommunications, command and control systems, expert computer systems, facilities maintenance management, mobilization preparedness and hazardous materials transportation by any mode.

2.1.2.10 US Army Corps of Engineers (USACE)

The USACE has specialized equipment and personnel that can be used in oil spill response activities. The Corps has responsibilities for maintaining navigation channels, removing obstructions, performing structural repairs, and maintaining hydropower electric generating equipment. Their Engineer Research and Development Center (ERDC) conducts research and development (R&D) in support of the Soldier, military installations and civil works projects (water resources, environmental missions, etc.) as well as for other federal agencies, state and municipal authorities, and with U.S. industry through innovative work agreements. USACE ERDC has seven laboratories in four states: Construction and Engineering Research laboratory in Champaign, Illinois; Cold Regions Research and Engineering Laboratory (CRREL) in Hanover, New Hampshire; Geospatial Research Laboratory in Alexandria, Virginia; and the Coastal and Hydraulics, Geotechnical and Structures, Environmental, and Information Technology Laboratories in Vicksburg, Mississippi. CRREL, maintains unique cold facilities to conduct research on oil spill detection and response in Arctic and other ice covered waters. Other USACE research with applicability to oil pollution issues include providing technical support on wind and wave effects, diffusion, remote sensing, satellite imaging, image enhancement systems, alternative methods for removing oil, shoreline cleanup and environmental evaluation, effects and mitigation.

The Corps also assists in design and construction and, on a reimbursable basis, provides technical manpower and support for any federal agency involved in any aspect of research and development described in this Plan. Special note should be made of USACE capabilities for assisting in the engineering aspects of conducting various research projects. As the nation's environmental engineer, the USACE manages one of the largest federal environmental missions: restoring degraded ecosystems; constructing sustainable facilities; regulating waterways; managing natural resources; and cleaning up contaminated sites from past military activities.

2.1.2.11 U.S. Navy (USN)

NAVSEA's Directorate of Ocean Engineering, Supervisor of Salvage and Diving (SUPSALV) experts provided technical, operational, and emergency capabilities in marine salvage, pollution abatement, diving, diving system certification, and underwater ship husbandry to improve Fleet readiness and capability across the globe. SUPSALV has been the Navy's oil pollution experts

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since the 1970s, as required by the Federal Water Pollution Control Act. The USN has expertise in preventing and responding to oil spills from ships. Upon the request of an On-Scene Coordinator, the USN may provide technical assistance in the ocean engineering disciplines of marine salvage, shipboard damage control, pollution abatement, diving, diving system certification, and underwater ship husbandry. The USN also owns specialized containment, collection, and removal equipment designed for salvage-related and near shore to open-sea pollution incidents. The equipment design and systems make it transportable and sustainable in the field. The USN has successfully deployed and operated its equipment at almost every major oil spill in the past 35 years.

2.1.2.12 U.S. Fire Administration (USFA)

As an entity of FEMA, USFA provides national leadership to foster a solid foundation for fire and emergency services stakeholders in prevention, preparedness, and response. The Agency was established by Public Law 93-498, the Federal Fire Prevention and Control Act of 1974, which called for: 1) the establishment of a National Fire Academy to advance the professional development of the fire service personnel and of other persons engaged in fire prevention and control activities; 2) a technology program of development, testing, and evaluation of equipment for use by the Nation's fire, rescue, and civil defense services; and 3) the operation of a National Fire Data Center for the selection, analysis, publication, and dissemination of information related to the prevention, occurrence, control and results of fires of all types; and ; 4) education of the public to overcome public indifference toward fire and fire prevention. USFA focuses on supplementing, not duplicating, existing programs of training, technology and research, data collection and analysis, and public education. While USFA does not directly conduct oil spill pollution research, it provides valuable emergency service expertise and connectivity to a number of emergency management programs.

2.1.2.13 U.S. Environmental Protection Agency (EPA)

The EPA serves as the Chair of the National Response Team (NRT), as co-chair of all the Regional Response Teams (RRTs), and as a rotating Vice Chair for ICCOPR. EPA works closely with the USCG in coastal spill response activities. In accordance with the National Contingency Plan (NCP), the EPA is the lead agency for response to spills in the U.S. inland zone. The EPA provides pre-designated On-Scene Coordinators (OSCs) for the inland zone, and maintains assets that can be used for command, control, and surveillance of oil spills. EPA also provides legal expertise on the interpretation of applicable environmental statutes.

The EPA issues and implements federal regulations regarding oil spills under the Clean Water Act, including the NCP. It implements spill prevention regulations for non-transportation-related facilities. Also, through Subpart J of the NCP, EPA maintains a Product Schedule of dispersants and other oil spill mitigating substances and regulates their use during spill response.

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The EPA provides expertise on cleanup technologies and the environmental effects of oil spills. Its Environmental Response Team (ERT) is a group of highly trained scientists and engineers whose capabilities include multimedia sampling and analysis, hazard evaluation, contamination monitoring, cleanup techniques, and overall technical support to the OSCs. The EPA's R&D activities include the development of test protocols to evaluate the efficacy and toxicity of spill mitigating agents (e.g., dispersants), and research to determine the fate and effects of oil following a spill.

2.1.2.14 National Aeronautics and Space Administration (NASA)

NASA develops and maintains several technologically advanced airborne and satellite systems suitable for spill observation and mapping. The agency's multi-disciplinary team of scientists, engineers and computer modelers also analyzes vast archives of data for insights into Earth's interconnected systems -- atmosphere, ocean, ice, land, and biosphere; and openly provides that data to the global community. They design and deploy airborne, ground-based and ocean-going field campaigns to study the earth from the heights of the stratosphere to the depths of the ocean to the remote ice caps at the poles. NASA also works with other government agencies and partner organizations to apply NASA data and computer models to improve decision-making and problem solving.

2.1.2.15 U.S. Arctic Research Commission (USARC)

The USARC is an independent federal agency created by the Arctic Research and Policy Act of 1984, as amended. It consists of a nonpartisan advisory body of scientists, physicians, indigenous leaders, and industry representatives appointed by the President of the U.S. and supported by staff located in Washington, D.C. and Anchorage, AK. The Commission sets U.S. Arctic research policy and builds cooperative links in Arctic research including: 1) the U.S. Arctic research program; 2) to international research partners, and; 3) Alaska. The law requires the Commission to comment to Congress on the progress of the executive branch in reaching goals set by the Commission and on their adoption by the Interagency Arctic Research and Policy Committee. The Commission plays an active role in the work of several interagency committees, including the Arctic Policy Group, chaired by the U.S. Department of State, which oversees U.S. participation in the eight-nation Arctic Council. The Commission is a statutory member of: the North Pacific Research Board and the North Slope Science Initiative. USARC is also a member of: various committees of the National Ocean Governance Structure; the interagency Extended Continental Shelf Task Force; the Scientific Ice Expeditions Interagency Committee, involving U.S. Navy nuclear submarines in the Arctic; the Alaska Ocean Observing System; the International Permafrost Association; and the Consortium for Ocean Leadership.

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2.2. Other Federal Stakeholders and Entities

Several Federal stakeholders and organizations also conduct research or affect oil pollution research. These include Federal independent organizations (i.e., committees, councils), agencies not currently members of ICCOPR, and ICCOPR member components that do not actively participate within ICCOPR. Other entities set Federal policies that guide or focus research initiatives on specific topics. ICCOPR maintains awareness of these stakeholders and works with them to coordinate research efforts.

2.2.1 Arctic Executive Steering Committee (AESC)

The AESC was formed in 2015 by Executive Order to provide guidance to executive departments and agencies (agencies) and enhance coordination of Federal Arctic policies across agencies and offices, and, where applicable, with State, local, and Alaska Native tribal governments and similar Alaska Native organizations, academic and research institutions, and the private and nonprofit sectors. The AESC provides guidance and coordinate efforts to implement the priorities, objectives, activities, and responsibilities identified in National Security Presidential Directive 66/Homeland Security Presidential Directive 25, Arctic Region Policy, the National Strategy for the Arctic Region (NSAR), the NSAR Implementation Plan (NSAR-IP), and related agency plans. The AESC does not conduct oil pollution research but can influence the policies guiding research in the Arctic.

2.2.2 Federal Oil Spill Team for Emergency Response Remote Sensing (FOSTERRS)

The Federal Oil Spill Team for Emergency Response Remote Sensing (FOSTERRS) is an interagency working group organized in 2015 to facilitate the sharing of remote sensing capabilities and to discuss improvements in disaster response using remote sensing. Specifically, FOSTERRS seeks to connect agency information on airborne and space borne asset's availability, limitations, capabilities and performance, and ancillary data needs to stake holders and responders. FOSTERRS includes members from agencies (NOAA, NASA, and USGS) with remote sensing assets and key end users. It also reaches out to the larger community involved in marine disaster response and the development and implementation of remote sensing best practices.

2.2.3 Federal Rail Administration (FRA)

The Department of Transportation Act of 1966 created the FRA with a mission to enable the safe, reliable, and efficient movement of people and goods for a strong America, now and in the future. It is one of ten agencies within the DOT concerned with intermodal transportation.

FRA's Office of Railroad Safety promotes and regulates safety throughout the Nation's railroad industry. The office executes its regulatory and inspection responsibilities through a diverse staff

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of railroad safety experts who are responsible for five safety disciplines focusing on compliance and enforcement in:

- Hazardous Materials;
- Motive Power and Equipment;
- Operating Practices;
- Signal and Train Control; and
- Track.

2.2.4 U.S. Geologic Survey (USGS)

The USGS supports an array of scientific capabilities and assets that address many elements of oil pollution research. As a science agency for DOI, the USGS provides science leadership and collaborations with other federal agencies during oil spill response. USGS research capabilities related to oil pollution include the development of objective and reliable scientific information needed to inform policies and practices that help avoid exposure to toxic substances, mitigate environmental deterioration from contaminants, provide cost-effective cleanup and waste-disposal strategies, and reduce future risk of contamination. USGS science primarily focuses on inland area but also includes near-shore and off-shore environments.

USGS oil pollution related capabilities include long-term monitoring of the Exxon Valdez, Deepwater Horizon, and inland oil spills. Also, the USGS Patuxent Wildlife Research Center has been studying the effects of crude oil and petroleum products on birds since the late 1970's. The USGS Coastal and Marine Program develops 3-D hydrodynamic models that can predict the nearshore sources, transport, and fate of oil. The USGS Energy Program provides capabilities to characterize chemical fingerprints of oil to identify sources of tar balls and support post-spill shoreline assessments.

2.2.5 Gulf Coast Ecosystem Restoration Council

The RESTORE Act established a Gulf Coast Ecosystem Restoration Council (the Council), which is comprised of governors from the five affected Gulf States, the Secretaries from the U.S. Departments of the Interior, Commerce, Agriculture, and Homeland Security as well as the Secretary of the Army and the Administrator of the U.S. Environmental Protection Agency. The Gulf States recommended and President Obama appointed the Secretary of Commerce as the Council's Chair.

2.2.6 Gulf of Mexico Fishery Management Council (GMFMC)

The GMFMC is one of eight regional Fishery Management Councils established by the Fishery Conservation and Management Act of 1976. The Council prepares fishery management plans designed to manage fishery resources from where state waters end, out to the 200-mile limit of the Gulf of Mexico. These waters are also known as the Exclusive Economic Zone (EEZ). The

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Council consists of voting members from the NMFS, the five Gulf state marine resource management agencies, and nominees by the State governors. In addition, there are four nonvoting members representing the USCG, U.S. Fish and Wildlife Service, Department of State, and the Gulf States Marine Fisheries Commission. The GMFMC provides an advisory role in directing scientists on where to focus their research. Current priorities include research on species recovering from the Deepwater Horizon oil spill and broad research on long-term fisheries data.

2.2.7 U.S. Marine Mammal Commission (MMC)

The MMC is an independent agency of the U.S. government established under Title II of the Marine Mammal Protection Act (MMPA). The Commission provides independent oversight of the marine mammal conservation policies and programs of federal agencies. The Commission's main roles with respect to oil spills are oversight of the agencies charged with response, assessment, and restoration activities, and convening of interagency working groups to coordinate those activities.

The Commission, in consultation with its Committee of Scientific Advisors on Marine Mammals, has prepared a report "Assessing the Long-term Effects of the BP Deepwater Horizon Oil Spill on Marine Mammals in the Gulf of Mexico: A Statement of Research Needs" (2011). The objectives of the report were to (1) guide assessment of the long-term effects of the Gulf spill and associated risk factors on marine mammals, (2) guide mitigation and restoration efforts for Gulf marine mammal populations, (3) help track the changes in the Gulf ecosystem, including recovery and restoration, and (4) help guide assessment of future spills in the Gulf and elsewhere.

The Commission administers a small annual grant program that supports projects aimed at meeting the conservation and protection goals of the MMPA. In addition, the Commission has initiated an annual survey of federally funded research on marine mammals to determine the nature of research conducted or supported by each agency. Information from the survey is used to assess ways to target and enhance specific marine mammal research and conservation activities.

2.2.8 National Institute of Environmental Health Sciences (NIEHS)

NIEHS is one of 27 research institutes and centers that comprise the National Institutes of Health (NIH) of the Department of Health and Human Services (DHHS). The mission of the NIEHS is to reduce the burden of human illness and disability by understanding how the environment influences the development and progression of human disease. The NIEHS, part of the NIH, activated programs throughout the institute to provide timely and responsive services following the DWH oil spill.

In June 2010, NIEHS initiated the GuLF STUDY to conduct research on the health of the workers and volunteers most directly involved in responding to the Deepwater Horizon oil spill.

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The GuLF STUDY will help determine if oil spills and the exposure to crude oil and dispersants, affects physical and mental health. Almost 33,000 cleanup workers are enrolled in the 10-year health study, making a significant contribution to their communities and to answering important public health questions.

2.2.9 U.S. National Response Team (NRT) - Science and Technology (S&T) Committee

The NRT is an organization of 15 federal departments and agencies responsible for coordinating emergency preparedness and response to oil and hazardous substance pollution incidents. The EPA and the USCG serve as Chair and Vice Chair respectively. The NCP and the Code of Federal Regulations (40 CFR part 300) outline the role of the NRT and Regional Response Teams (RRTs). Various federal statutes cite the NRT and RRTs including the Superfund Amendments and Reauthorization Act - Title III and the Hazardous Materials Transportation Act (HMTA).

The NRT's S&T Committee provides a forum to fulfill the NRT's NCP delegated responsibilities in R&D. Specifically, NCP regulation 40 CFR 300.110(h)(6) lists as one of the NRT's responsibilities "Monitoring response-related research and development, testing, and evaluation activities of NRT agencies to enhance coordination, avoid duplication of effort, and facilitate research in support of response activities." Additionally, 40 CFR 300.110(g) states, "the NRT may consider and make recommendations to appropriate agencies on ... necessary research, development, demonstration, and evaluation to improve response capabilities."

2.2.10 National Science Foundation (NSF)

The NSF is an independent federal agency created by Congress in 1950 "to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense…" The NSF is the funding source for approximately 24 percent of all federally supported basic research conducted by America's colleges and universities. NSF fulfills their mission chiefly by issuing limited-term grants to fund specific research proposals judged to be the most promising by a rigorous and objective merit-review system. Currently, they issue about 11,000 new awards per year, with an average duration of three years. NSF-funded research addresses a number of scientific areas with applications to oil pollution research including engineering, materials science, biology, and the Arctic. NSF also has a Rapid Response Research (RAPID) mechanism that enables research on unanticipated events such as the *Deepwater Horizon* oil spill.

2.2.11 NOAA RESTORE Act Science Program

In 2012, the U.S. Congress passed (P.L. 112-141) the "Resources and Ecosystem Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act" (RESTORE Act). The RESTORE Act transfers 80% of all administrative and civil penalties paid by responsible parties in connection with the Deepwater Horizon incident to a Gulf Coast Restoration Trust

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Fund. The RESTORE Act also establishes several programs, funded by the Trust Fund, to aid in the ecological and economic recovery of the Gulf Coast states. Under Section 1604 of the RESTORE Act directed NOAA to establish a Gulf Coast Ecosystem Restoration Science, Observation, Monitoring, and Technology Program (NOAA RESTORE Act Science Program). This program is to be funded by 2.5 percent of the Gulf Coast Ecosystem Restoration Trust Fund plus 25 percent of the Trust Fund accrued interest. The Program can expend funds for marine and estuarine research; marine and estuarine ecosystem monitoring and ocean observation; data collection and stock assessments; pilot programs for fishery independent data and reduction of exploitation of spawning aggregations; and cooperative research.

2.2.12 North American Wetlands Conservation Act (NAWCA) Gulf of Mexico Funds

The NAWCA provides matching grants from the North American Wetlands Conservation Fund to organizations and individuals who have developed partnerships to carry out wetlands conservation projects in the United States, Canada, and Mexico for the benefit of wetlands-associated migratory birds and other wildlife. As part of their criminal settlement agreement, BP paid $100 million to the Fund for the purpose of wetlands restoration and conservation located in states bordering the Gulf of Mexico or otherwise designed to benefit migratory bird species and other wildlife affected by the Macondo oil spill. The USFWS administers the Fund. The restoration projects include research to monitor and evaluate restoration success.

2.3 Federal Research Laboratories and Testing Facilities

Several federal facilities and locations provide opportunities for both federal and non-federal oil pollution research.

2.3.1 Ohmsett

Ohmsett, located at the Naval Weapons Station Earle Waterfront in Leonardo, New Jersey, is managed by BSEE. The facility includes an above ground concrete test tank that is one of the largest of its kind, measuring 203 meters long by 20 meters wide by 3.4 meters deep. The tank holds with 2.6 million gallons of crystal clear saltwater.

The Ohmsett test tank allows testing of full-scale oil pollution response equipment. The tank includes a wave generator that creates realistic sea environments, while state-of-the-art data collection and video systems record test results. The facility has proven to be ideal for testing equipment, evaluating acquisition options, and validating research findings.

Government agencies, academia, public and private companies use Ohmsett as a research center to test oil spill containment/clean-up equipment and techniques, to test new designs in response equipment, and to conduct training with actual oil spill response technologies.

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2.3.2 USCG Research & Development Center (RDC)

The RDC, located in New London, Conn. is the USCG's sole facility performing research, development, and test and evaluation in support of the service's major missions. The RDC is responsible for evaluating the feasibility and affordability of mission execution solutions and providing operational and risk-management analysis at all stages of the acquisition process.

At any given time, the RDT&E program is working on more than 80 projects that support USCG requirements across all mission areas. The program also provides Coast Guard leadership with knowledge necessary for making strategic decisions. The RDT&E program leverages partnerships with academia and other government agencies. The RDC also leverages Cooperative Research and Development Agreements (CRADAs) under the Technology Transfer Act to work with private industry to anticipate and research solutions to current and future technological challenges.

2.3.3 USCG RDC Joint Maritime Test Facility

The USCG RDC's Joint Maritime Test Facility *In Situ* Burn Pan is working in conjunction with the Naval Research Laboratory and the BSEE to refurbish its *in-situ* burn test pan located on Little Sand Island in Mobile, Alabama. The burn pan is the nation's only permitted open air *in-situ* burn pan for fire boom research. Once refurbished, this burn pan will help the RDC's Joint Maritime Test Facility meet its mission to support the maritime safety efforts by providing full-scale tests and evaluation under close to actual operating and environmental conditions.

2.3.4 USCG Marine Safety Laboratory

The USCG Marine Safety Laboratory (MSL) provides forensic oil analysis and expert testimony in support of the oil pollution law enforcement efforts for Marine Investigators, Districts, Hearing Officers, National Pollution Funds Center, Department of Justice, and other federal agencies. The MSL is the USCG's sole facility for performing forensic oil analysis.

2.3.5 U.S. EPA National Risk Management Research Laboratory (NRMRL)

The NRMRL is EPA's premiere laboratory for risk management research. It conducts research at the basic level, as well as bench-scale and pilot-scale levels, to explore innovative solutions to pollution problems. Environmental risk management seeks to determine what environmental risks exist and how to manage those risk in a way best suited to protect human health and the environment. Its mission is to advance scientific and engineering solutions to manage current and future environmental risk.

NRMRL's research directly supports efforts to manage chemical risks, clean up hazardous waste sites, protect water, reduce greenhouse gas emissions, and improve air quality.

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2.3.6 Cold Regions Research and Engineering Laboratory (CRREL)

CRREL, located in Hanover, New Hampshire is one of seven US Army Corps of Engineers (USACE) Engineering Research and Development Center (ERDC) laboratories. The laboratory's mission is to solve interdisciplinary and strategically important problems by advancing and applying science and engineering to complex environments, materials and processes in all seasons and climates, with unique core competencies related to the Earth's cold regions. CRREL maintains several unique and specialized research facilities at its Hanover, New Hampshire location, to include: 26 low-temperature research cold rooms; a refrigerated Ice Engineering Facility comprised of a 12,800 square foot research area, a 3,600 square foot by 8 foot deep test basin, and a 120 foot long water flume with tilting bed; a 1,320 square foot by 7 foot deep outdoor Geophysical Research Facility; a 40 foot working length portable wave tank that can be located indoors within a cold facility for year round cold research or outdoors to support in situ burn tests; and a 29,000 square foot environmentally controlled Frost Effects Research Facility. CRREL also maintains a research permafrost tunnel in Fox, Alaska, a 135-acre permafrost research site near Fairbanks, Alaska, and has project offices in Anchorage and Fairbanks, Alaska. CRREL works with partners from industry, government agencies, and educational institutions, to develop scientific tools that can aid in effective oil spill response, and provides unique facilities and cold region expertise to stake-holders to create effective spill response techniques for ice covered environments.

2.3.7 U.S. Army Engineer Research and Development Center (ERDC)

The ERDC is the world's largest laboratory primarily devoted to civil engineering and environmental sciences research, development, test, and evaluation. The ERDC, which includes seven laboratories located in four geographic locations, provides a broad array of services ranging from basic research to test and evaluation. The ERDC Laboratories maintain state of the art modeling and experimentation facilities which support a broad array of capabilities in oil spill response from modeling impacts to remediation techniques.

ERDC capabilities to support Oil Spill efforts are categorized into three phases. Phase 1, Emergency Response/Mitigation, includes those activities that that enhance the ability to conduct emergency response and mitigation. Phase 2, Remediation, includes activities designed to support tasks such as active intervention to ameliorate the oil contamination. Phase 3, Recovery/Long Term Monitoring/Assessment, includes activities supporting the monitoring and assessment of long term environmental impacts associate with the spill.

2.3.8 Hollings Marine Laboratory (HML)

The Hollings Marine Laboratory is located in Charleston, SC and was established as a joint facility combining partners from NOAA, NIST, the Medical University of South Carolina, the College of Charleston, and the South Carolina Department of Natural Resources. The laboratory is operated by the NOAA National Ocean Service and houses NIST's Environmental Specimen

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Bank, NIST and NOAA environmental chemistry laboratories, as well as NOAA personnel and facilities for assessing the health of living marine resources. Immediately after the Deepwater Horizon oil spill, the co-location of NOAA and NIST personnel was instrumental in planning and mounting NOAA's response to the event with regard to, sample archival, monitoring protected species and evaluating data quality being produced by different laboratories providing chemistry data related to the spill. Oil spill-related research continues at the HML with projects including aiming to understand biomarkers of oil exposure in protected species and exploring the effects of dispersants on marine organisms and humans.

2.2.9 U.S. Naval Research Laboratory (NRL) Stennis Space Center

The NRL detachment at Stennis Space Center focuses on marine geosciences, oceanography, and underwater acoustics. The Oceanography Division and the Marine Geosciences Division conduct studies applicable to oil pollution research.

The Oceanography Division is known for its combination of theoretical, numerical, and experimental approaches to oceanographic problems. The Division numerically models the ocean on the world's most powerful supercomputers and operates a number of highly sophisticated graphics systems to visualize ocean model results. The Division maintains two satellite receiving systems, a computer network with automated processing capabilities for ocean color and advanced optical instrumentation and calibration facilities.

The Marine Geosciences Division conducts a broadly-based, multidisciplinary program of scientific research and advanced technology development directed towards maritime and other national applications of geosciences, geospatial information and related technologies. Research includes investigations of basic processes within ocean basins and littoral regions. The Division develops models, sensors, techniques and systems to exploit this knowledge for applications to enhance Navy and Marine Corps systems, plans and operations

2.3.10 Pacific Northwest National Laboratory (PNNL)

The PNNL's Marine Sciences Laboratory (MSL), located in Sequim, Washington on the Strait of Juan de Fuca, provides a platform for marine and freshwater ecological research, instrument and method development, and biotechnology research. The laboratory has regional access to oceans and rivers that have experienced human impacts ranging from the uninhabited and protected coastlines of Olympic National Park to heavily developed shores around Seattle and Tacoma. The Marine Research Operations' Wet Laboratory provides a large space in which to perform innovative, water-oriented research. A variety of indoor and outdoor tank configurations provide capacity for bench-scale tests through large-scale outdoor mesocosm systems and for other studies using aquatic plants and animals.

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2.3.11 Coastal and Ocean Research Vessels

2.3.10.1 USCG Cutter Healy

The USCG's cutter *Healy* is designed to conduct a wide range of research activities, providing more than 4,200 square feet of scientific laboratory space, numerous electronic sensor systems, and accommodations for up to 50 scientists. HEALY is designed to break 4½ feet of ice continuously at three knots and can operate in temperatures as low as -50 °F. *Healy* substantially enhances the U.S. Arctic research capability. It serves as a platform for research activities as part of the Arctic Shield demonstrations where components of an Arctic oil spill response are tested. *Healy* is also a capable platform for supporting other potential missions in the polar regions, including logistics, search and rescue, ship escort, environmental protection, and enforcement of laws and treaties.

2.3.11.2 EPA Vessels

The EPA operates two ships that monitor and assess impacts from ecological disturbances and ocean-based human activities on the ocean, Great Lakes, and coastal waters. EPA's Ocean Survey Vessel (OSV) *Bold* operates under the statutory requirement to monitor the deposition of dredged materials under the Marine Protection, Research, and Sanctuaries Act of 1972. This Act regulates intentional ocean disposal of materials, authorizes any related research and provides for the designation and regulation of marine sanctuaries. OSV *Bold* operates in the Atlantic and Pacific Oceans and the Caribbean Sea to monitor water quality, effects of dredged material, coral reef health, and other special assessments.

EPA's Great Lakes National Program Office based in Chicago, Illinois operates R/V *Lake Guardian*, which conducts monitoring programs that sample the water, aquatic life, sediments, and air in order to assess the health of the Great Lakes ecosystem.

2.3.11.3 MARAD Vessels

MARAD operates the National Defense Reserve Fleet (NDRF) of 100 ships that are available for use during oil spill exercises, providing housing during a spill response, or for education and training. The NDRF is available to support emergency shipping operations during war and national emergencies. The fleet has anchorages in Fort Eustis, Virginia; Beaumont, Texas; Suisun Bay in Benicia, California; and at designated port facility berths.

2.3.11.4 NOAA Vessels

NOAA's Office of Marine and Aviation Operations (OMAO) operates a wide assortment of hydrographic survey, oceanographic research, and fisheries survey vessels. Five ships located in the Pacific are managed by the Marine Operations Center, Pacific (MOC-P) in Newport, Oregon. Nine ships located in the Atlantic are managed by the Marine Operations Center,

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Atlantic (MOC-A) in Norfolk, Virginia. Two ships located in Hawaii are managed by the Marine Operations Center, Pacific Islands (MOC-PI).

NOAA's research and survey ships compose the largest fleet of federal research ships in the nation. The fleet ranges from large oceanographic research vessels capable of exploring the world's deepest ocean, to smaller ships responsible for charting the shallow bays and inlets of the United States. The fleet supports a wide range of marine activities including fisheries research, nautical charting, and ocean and climate studies.

The OMAO's aircrafts operate throughout the world providing a wide range of capabilities including hurricane reconnaissance and research, marine mammal and fisheries assessment, and coastal mapping.

2.3.12 Oil Spill Field Research

Federal oil pollution research is not limited to research facilities and laboratories. Oil spills can provide opportunities for federal agencies to conduct research on the fate, effects, and physical and chemical behavior of the spilled oil and the responses to the spills in the natural environment. NOAA and USGS have ongoing research projects to study the long-term fate and effects of the *Exxon Valdez* oil spill. The *Deepwater Horizon* oil spill is also providing many opportunities to study both the near-term and long-term effects of the spill and response. Other potential research locations include the Santa Barbara oil seeps off the California coast and the submerged Taylor Energy platform in the Gulf of Mexico, which is a continuing source of sheens.

Intentional releases have been used by many countries, most notably Norway, to demonstrate the effectiveness of spill control equipment or processes. Under controlled circumstances, these releases may provide an opportunity to conduct tests under actual spill conditions.

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3. Non-Federal Oil Pollution Research Entities

Consistent with the mandates of OPA 90, ICCOPR cooperates with research programs of state governments, industry, academia, non-government organizations/institutions, and other nations. The cooperation of federal and non-federal entities provides whole community approach to oil pollution research. The following sections describe non-federal entities that conduct or sponsor oil pollution research.

3.1 State Organizations

Several coastal states have established oil pollution research programs. These programs are in states affected by previous oil spills or where there are active oil exploration and production activities. Increasing shale oil production has prompted other states to study the risks of hydraulic fracturing and transporting oil by rail and pipeline. This section describes on-going state research programs.

3.1.1 Alaska Department of Environmental Conservation (ADEC)

Judgments entered in the criminal cases for the *Exxon Valdez* oil spill resulted in appropriation of funds to the State of Alaska to enhance the ability of the State and industry to respond to oil spills. A total of $2,500,000 was made available to ADEC for projects under this program. The funds are used for research programs directed toward the prevention, containment, cleanup and amelioration of oil spills in Alaska. In cooperation with other stakeholders, ADEC has developed a list of more than 30 R&D projects dealing with such subjects as cleanup technology, non-mechanical response techniques, the fate and effects of spilled oil, oil-spill contingency planning and preparedness, spill response training, incident-management systems and spill prevention. Alaskan oil-spill response cooperatives, private consultants, universities, and other state and federal agencies have conducted research under the program.

3.1.2 California Office of Oil Spill Prevention and Response (CAOSPR)

As both a prevention and response organization, CAOSPR has the Department of Fish and Game's public trustee and custodial responsibilities for protecting, managing and restoring the state's fish, wildlife, and plants. It is one of the few state agencies in the nation with both major pollution response authority and public trustee authority for wildlife and habitat. This mandate ensures that prevention, preparedness, restoration and response will provide the best protection for California's natural resources.

In 2014 California expanded the CAOSPR program to cover all state surface waters at risk of oil spills from any source, including pipelines, production facilities, and the increasing shipments of oil transported by railroads. This expansion provided critical administrative funding for industry preparedness, spill response, and continued coordination with local, state and federal government along with industry and non-governmental organizations.

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3.1.3 Florida

The Oil Spill Academic Task Force (OSATF) is a consortium of scientists and scholars from institutions in the State University System as well as from five of Florida's private universities and two marine laboratories working in collaboration with the Florida Department of Environmental Protection (DEP). The OSATF brings together expertise and resources to assist the state of Florida and the Gulf region in responding to and studying the Deepwater Horizon oil spill.

The Fish and Wildlife Research Institute's work includes assessment and restoration of ecosystems and studies of freshwater and marine fisheries, aquatic and terrestrial wildlife, imperiled species, and red tides. The institute develops the information science required to analyze and disseminate research products, and engages in outreach activities to complement all programs.

The Florida Marine Spill Analysis System (FMSAS) is a powerful geographic information system (GIS) application that allows users to conduct oil spill planning activities and manage response and mitigation efforts during an actual spill. Spill planning and response activities have always relied on maps and charts to display information. From simple notes on nautical charts to specialized maps showing the location of sensitive resources or the location of an oil slick, many of the essential information components of planning and response actions require geospatial data. The FMSAS is designed to address five aspects of oil spill management:

- Contingency planning;
- On-scene spill tracking and "Resources At Risk" (RAR) analysis;
- Long-term monitoring;
- Damage assessment; and
- General oil spill GIS data management.

3.1.4 Louisiana Applied and Educational Oil Spill Research and Development Program (OSRADP)

The Louisiana OSRADP provided oil spill planners and response personnel with practical, scientifically-sound and cost effective spill prevention, management and mitigation tools for two decades until 2011 when OSRADP became part of the Center for Energy Studies.

3.1.5 Gulf States Marine Fisheries Commission (GSMFC)

The Gulf States Marine Fisheries Commission was established by an act of Congress (P.L. 81-66) in 1949 as a compact of the five Gulf States with a charge to: "to promote better utilization of the fisheries, marine, shell and anadromous, of the seaboard of the Gulf of Mexico, by the development of a joint program for the promotion and protection of such fisheries and the prevention of the physical waste of the fisheries from any cause."

The GSMFC Oil Disaster Recovery Program (ODRP) evolved from the receipt of $15 million dollars in October of 2010 and aims to improve the public perception and confidence in Gulf of

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Mexico seafood following the 2010 *Deepwater Horizon* oil disaster. Funding for this program, like that of the post-Katrina Emergency Disaster Recovery Program (EDRP), came from the U.S. Congress following fishery disaster declarations by the U.S. Secretary of Commerce. Scheduled to be completed in September of 2015, the activities under the program are identified through an ad-hoc advisory committee consisting of the marine resource directors from each of the five Gulf of Mexico states. Under this component, multiple post-disaster recovery elements were executed to address issues relative to improving both the perception of and confidence in Gulf of Mexico seafood products.

3.1.6 Minnesota National Crude Oil Spill Fate and Natural Attenuation Site

The Minnesota National Crude Oil Spill Fate and Natural Attenuation Site dates back to 1979, when a dramatic pipeline rupture released 10,000 bbl of crude petroleum to the land surface and shallow subsurface. In 1983, research began at the site through the support of the USGS' Toxic Substances Hydrology Program. Continuing USGS support has allowed hundreds of scientists from across the globe to visit this "underground observatory" and study the effects of a terrestrial crude oil spill including the physical, chemical and biological processes driving the degradation and transport of crude petroleum. Research from the site has been included in more than 200 scientific papers.

In 2008 and 2009, the Minnesota Pollution Control Agency, Enbridge Energy LLC, the USGS and Beltrami County created several agreements to formally establish the "National Crude Oil Spill Research Site in Bemidji, Minn." The objective of these agreements is to create a self-sustaining research facility that brings academic researchers and practitioners (e.g., consultants, petroleum and pipeline industry representatives and pollution control officials) together thereby linking novel ideas to practical, on-the-ground applications.

3.1.7 Pacific States/British Columbia Oil Spill Task Force (PSBCOSTF)

In 1989, following the *Nestucca* and *Exxon Valdez* oil spills, the Governors of Alaska, Washington, Oregon, and California, and the Premier of British Columbia, signed a Memorandum of Agreement that authorized PSBCOSTF. These events highlighted their common concerns regarding oil spill risks and the need for cooperation across shared borders. In June 2001, a revised Memorandum of Cooperation was adopted to include the State of Hawaii and expand the focus to spill preparedness and prevention needs of the 21st century. Now in its third decade, the PSBCOSTF provides a forum where its members can work with stakeholders from the Western US and Canada to implement regional initiatives that protect 56,660 miles of coastline from Alaska to California and the Hawaiian archipelago.

3.1.8 Texas General Land Office (TXGLO)

The TXGLO is a national leader in oil spill research. The TXGLO R&D program has funded groundbreaking work on oil dispersants, shoreline cleaners, bioremediation and high-frequency

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radar. The R&D program is improving response technology and developing alternative methods for removing oil from coastal waters.

Over the years, the TXGLO has coordinated with other state agencies, the state's higher education institutions and private industry to establish viable research projects for oil spill prevention and response. Funded projects have involved preventive technologies, spill detection, environmental data collection, chemical countermeasures, recovered materials management and in situ burning

The TXGLO, as a NRDA Trustee, acts on behalf of the public to identify the injured natural resources and determine the extent of the impact. They also recover damages from the responsible party to plan and carry out restoration activities. In addition to the TXGLO, two other state agencies are designated as NRDA trustees: the Texas Parks and Wildlife Department (TPWD) and the Texas Commission on Environmental Quality (TCEQ).

3.1.9 Washington Department of Ecology (WADOE)

The WADOE has program offices for oil pollution prevention, preparedness, and response, which include resource damage assessments and recovery. The Department conducts studies on the risks of oil transportation through the state and provides guidance to industry and the public on oil pollution issues. WADOE also manages a Coastal Protection Fund (CPF) that collects monies from oil and hazardous materials spill damage assessments and penalties. The CPF uses the money to fund projects to: restore or enhance public natural resources; investigate long-term effects of oil spills; and develop and implement aquatic land geographic information systems. Funds may also be allocated for R&D on the causes, effects, and removal of pollution caused by the discharge of oil.

3.2 Industry

The oil industry plays an important part in oil pollution research. Industry approaches to exploration, production, transportation, and spill prevention evolve as new techniques are identified or new resources are found. Industry has several research programs to improve their practices to prevent oil spills and to better respond to spills when they occur.

3.2.1 American Petroleum Institute Joint Industry Task Force (API JITF)

In the wake of the *Deepwater Horizon* oil spill of 2010, the petroleum industry launched four JITFs to critically assess capabilities and performance. Each JITF used subject matter experts to identify best practices in offshore drilling operations and oil spill response and to share that knowledge across industry with the goal of ensuring environmental protection through enhanced safety.

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The Oil Spill Preparedness and Response JITF examined industry's ability to respond to a "Spill of National Significance (SONS)" and the actual response to the *Deepwater Horizon* oil spill. This program covers:

- Spill Response Planning
- Oils Sensing and Tracking
- Dispersant
- In Situ Burning
- Mechanical recovery
- Shoreline protection
- Alternate response technologies

The industry has also has also begun to improve public outreach in a number of focus areas including:

- Oil spill preparedness and response framework;
- Net environmental benefit analysis (NEBA);
- Role of dispersants in oil spill response;
- Tiered preparedness and response framework;
- Incident management system; and
- Regulatory approval and use of dispersants.

The JITF also initiated subcommittees to address response issues related to inland spills including railroad spills and pipeline emergency response.

3.2.2 American Salvage Association (ASA)

The ASA was created in 2000 as an association of professional salvors dedicated to improving marine casualty response in North American coastal and inland waters. The ASA promotes cooperation among its members and works with Federal and state agencies to identify ways to improve salvage and firefighting response capabilities. The ASA encourages research to identify risks from sunken vessels and uses its members' experience to identify areas for additional research or technology development.

3.2.3 Association of Petroleum Industry Co-op Managers (APICOM)

APICOM, founded in 1972, is an association of unaffiliated petroleum industry oil spill cooperative managers. APICOM exists for the purpose of exchanging information related to the management of an oil spill response cooperative. It also serves as a forum for the exchange of ideas related to oil spill response technologies, operations, regulations and other issues of common interest to its members.

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3.2.4 Industry Technical Advisory Committee (ITAC)

The ITAC includes members from the oil spill response community within the oil industry, and other organizations that have oil pollution preparedness and response as their principal goal. ITAC acts as a focal point for technical issues and as a forum for exchanging information on preparedness, oil spill response operations, response technology and response training.

3.2.5 International Maritime Organization (IMO)

The IMO is a specialized agency of the United Nations, which is responsible for measures to improve the safety and security of international shipping and to prevent marine pollution from ships. It is also involved in legal matters, including liability and compensation issues and the facilitation of international maritime traffic. IMO's governing body is the assembly, made up of all 170 Member States, which meets once every two years. The Maritime Safety, Marine Environment Protection, Legal, Technical Co-operation and Facilitation Committees, and a number of sub-committees carry out the main technical work. Since 1967, the IMO has adopted a series of conventions covering prevention of marine pollution by ships, preparedness and response to incidents involving oil and hazardous and noxious substances, prevention of use of harmful anti-fouling systems and the international convention on ballast water management to prevent the spread of harmful aquatic organisms in ballast water.

3.2.6 International Petroleum Industry Environmental Conservation Association (IPIECA)

IPIECA is the global oil and gas industry association for environmental and social issues. It develops, shares, and promotes good practices and knowledge to help the industry improve its environmental and social performance. It is the industry's principal channel of communication with the United Nations.

IPIECA's Oil Spill Working Group (OSWG) was established in 1987 and serves as a key international industry forum to help improve oil spill contingency planning and response around the world. The OSWG aims to improve oil spill preparedness and response around the world by:

- Enabling members to exchange information and best practices
- Supporting industry and government cooperation at all levels
- Encouraging ratification and implementation of relevant international conventions
- Promoting the principle of 'Net Environmental Benefit Analysis' and the 'Tiered Response' approach to designing response strategies; and
- Developing and communicating the industry's views and activities to external audiences'

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3.2.7 International Spill Control Organization (ISCO)

The International Spill Control Organization (ISCO) is a not-for-profit organization incorporated in London in 1984 with membership in 36 countries around the world. ISCO aims to raise worldwide preparedness and co-operation in response to oil and chemical spills, to promote technical development and professional competency, and to provide a focus for making the knowledge and experience of spill control professionals available to IMO, United Nations Environment Programme (UNEP), European Commission (EC) and other organizations. ISCO provides organizations with information on experiences, problems solved, and lessons learned by spill responders. They also keep the spill response community informed of new developments and news through their website and newsletters.

3.2.8 International Tanker Owners Pollution Federation (ITOPF)

ITOPF is a not-for-profit organization established on behalf of the world's ship owners and their insurers to promote effective response to marine spills of oil, chemicals, and other hazardous substances. ITOPF provides a range of technical services including emergency response, advice on clean up techniques, pollution damage assessment, assistance with spill response planning, and training. It is recognized and respected globally as a source of objective technical expertise in the area of accidental spills of oil and chemicals from ships and ITOPF is a source of comprehensive information on marine pollution. Investing in R&D is one way ITOPF meets this objective. ITOPF invests in R&D to help fulfill their mission of promoting effective response to marine spills of oil, chemicals and other substances.

3.2.9 Oil Spill Response (OSR) Joint Industry Program (JIP)

The OSR JIP is an initiative of the Oil and Gas Producers (OGP) to address issues related to the Macondo well blowout. In response to the incident, the OGP formed the Global Industry Response Group (GIRG), which was tasked to identify the key issues that could prevent recurrence of such an incident and identify learning opportunities on both the causation, and the subsequent response to the incident. The OSR JIP has initiated discreet projects or supported projects of other groups in many oil spill related subject areas resulting from the OGP GIRG-OSR studies.

3.2.10 Petroleum Environmental Research Forum (PERF)

The PERF is a research and development joint venture, formed to provide a stimulus to and forum for the collection, exchange, and analysis of research information relating to the development of technology for health, environment and safety, waste reduction and system security in the petroleum industry. PERF is a non-profit organization of member corporations in the petroleum industry. PERF does not itself participate in research projects but provides a forum for members to collect, exchange, and research information relating to practical and

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theoretical science and technology concerning the petroleum industry and a mechanism to establish joint research projects in the field.

3.2.11 Pipeline Research Council International (PRCI)

The PRCI was established in 1952 as the Pipeline Research Committee of the American Gas Association to address the problem of long-running brittle fractures in natural gas transmission pipelines. In substantially solving that problem within two years, the committee demonstrated the benefit of industry collaboration and leveraging voluntary industry funding. Unique among all pipeline research organizations, the mission of PRCI is to be the global leader in collaborative energy pipeline research that provides safe, reliable, environmentally conscious and efficient means of energy delivery. The committee will be used to improve current inspection and integrity assessment technologies, and to promote the development of new technologies for pipeline integrity management.

Some of PRCI's recent research has addressed:

- Corrosion — location and assessment;
- Mechanical damage — location and assessment;
- Right of Way (ROW) monitoring;
- Growth of construction defects;
- Compressor and pump station; and
- Measurement.

3.2.12 Spill Control Association of America (SCAA)

SCAA organized in 1973 to actively promote the interests of all groups within the spill response community. They represent spill response contractors, manufacturers, distributors, consultants, instructors, government and training institutions and corporations working in the industry. SCAA partners with the USCG and the Association of Petroleum Industry Co-op Managers (APICOM) in the quality partnership for marine safety and environmental protection, which was created to improve the effectiveness of spill response and to promote sound risk management among/between private and governmental response organizations.

3.3 Independent Research Interests

Several independent organizations conduct or manage oil pollution research programs. These include non-governmental organizations, non-profit organizations, and committees with a mix of memberships including citizens, industry, and government organizations.

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3.3.1 Cook Inlet Regional Citizen's Advisory Committee (CIRCAC)

OPA 90 established CIRCAC to create an avenue for public participation in the oversight of the Cook Inlet oil industry. Since its inception, the CIRCAC has formed environmental monitoring and oil spill prevention programs to promote safe production and transportation of oil in Cook Inlet. These programs seek to develop an understanding of efficacy, fate, transport, and effects of oil and oil treated by various response methods likely to be used on oil spills in the area of concern. It also monitors the biological and chemical environment in Cook Inlet and nearby areas to detect effects of oil industry operations. The CIRCAC also has a Coastal Habitat Mapping Program to assess coastal habitats with an oil spill prevention and response tool that incorporates detailed coastal habitat data.

3.3.2 Gulf of Mexico Alliance (GOMA)

The Gulf State Governors established the Gulf of Mexico Alliance (GOMA) in 2004 in response to the President's Ocean Action Plan. GOMA's mission is to enhance the ecological and economic health of the Gulf region by encouraging collaboration among government agencies, businesses, education providers and non-governmental organizations. It is a state-led network of partners working together on projects related to the priority issues identified by the Governors in early discussions. The GOMA structure allows federal and state agency partners to focus funding priorities on the needs of the Gulf, and it provides a forum to share knowledge, expertise, and collaborate to reduce duplication of efforts.

3.3.3 Gulf of Mexico Research Initiative (GoMRI)

On May 24, 2010, shortly after the *Deepwater Horizon* oil spill, BP announced a $500 million commitment to fund a Gulf of Mexico Research Initiative (GoMRI), a 10-year independent research program designed to study the effects of the oil spill and its associated response on the environment and public health in the Gulf of Mexico. GoMRI awards funds competitively for scientists to investigate the impacts of the oil, dispersed oil, and dispersants on the ecosystems of the Gulf of Mexico and affected coastal States in a broad context of improving fundamental understanding of the dynamics of such events and their environmental stresses and public health implications. GoMRI also seeks to develop improved spill mitigation, oil and gas detection, characterization and remediation technologies.

As directed by an independent 20-member Research Board, GoMRI issues grants for independent scientific research conducted primarily at academic institutions in the U.S. Gulf Coast States. However, institutions from outside the Gulf region, as well as for-profit entities, can participate. The funds are distributed using peer evaluations (National Science Board Process) and are used strictly for research activities such as sampling, modeling and studies, but not acquisition of infrastructure. Researchers are required to publish their results in peer-reviewed scientific journals with no requirement for BP approval.

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The ultimate goal of GoMRI is to improve society's ability to understand, respond to and mitigate the impacts of petroleum pollution and related stressors of the marine and coastal ecosystems, with an emphasis on conditions found in the Gulf of Mexico. Knowledge accrued will be applied to restoration and to improving the long-term environmental health of the Gulf of Mexico.

3.3.4 Gulf Restoration Science Programs Ad Hoc Coordination Forum

The Gulf Restoration Science Programs Ad Hoc Coordination Forum serves to provide regular communication and coordination on Gulf of Mexico restoration related science between the ecological sciences programs funded from criminal penalties, settlement agreements, and programs funded due to the Deepwater Horizon oil spill.

3.3.5 National Academy of Sciences Gulf Research Program (GRP)

As part of the criminal settlement agreements following the *Deepwater Horizon* Oil Spill, the federal government asked the National Academy of Sciences (NAS) to establish a new program to fund and conduct activities to enhance oil system safety, human health, and environmental resources in the Gulf of Mexico and other U.S. outer continental shelf regions that support oil and gas production. The settlement agreements provide a total of $500 million over the first five years of the 30-year program. The Gulf Research Program works to enhance oil system safety and the protection of human health and the environment in the Gulf of Mexico and other U.S. outer continental shelf areas by seeking to improve understanding of the region's interconnecting human, environmental, and energy systems and fostering application of these insights to benefit Gulf communities, ecosystems, and the Nation. Initial funding of projects began in 2015.

3.3.6 National Fish and Wildlife Federation (NFWF)

Congress created NFWF in 1984. They serve as a non-profit agency to aid in the protection and restoration of fish and wildlife and their habitats. The BP and Transocean Settlement Agreements with the United States established NFWF's Gulf Environmental Benefit Fund to support projects that remedy harm to natural resources (habitats, species) where there has been injury to, or destruction of, loss of, or loss of use of those resources resulting from the *Deepwater Horizon* oil spill. The Fund will distribute $2.544 billion for projects that contribute significantly to restoring and maintaining the ecological functions of landscape-scale coastal habitats, ensuring long-term viability and resilience of habitats, restoring and maintaining the ecological integrity of priority coastal bays and estuaries, and replenishing and protecting living resources.

3.3.7 Ocean Energy Safety Institute (OESI)

The OESI was established under BSEE sponsorship to facilitate research and development, training of Federal workers to remain current on state-of the art technology associated with oil and gas development. It provides recommendations and technical assistance on the

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determination of Best Available and Safest Technology (BAST), and implementation of operational improvements in the areas of offshore drilling safety and environmental protection, blowout containment and oil spill response. The OESI is a collaborative initiative involving government, academia and scientific experts.

The Texas A&M Engineering Experiment Station's (TEES) Mary Kay O'Connor Process Safety Center manages the OESI, in partnership with the University of Texas at Austin and the University of Houston. The OESI provides a forum for dialogue, shared learning and cooperative research among academia, government, industry, and other non-governmental organizations, in offshore energy-related technologies and activities that ensure safe and environmentally responsible offshore operations.

Specific objectives of OESI are:

- Develop a program of research, technical assistance, and education that serves as a center of expertise in offshore oil and gas exploration, development, and production technology, including technology specific to deepwater and Arctic exploration and development;
- Provide recommendations and technical assistance to the Bureau of Safety and Environmental Enforcement (BSEE) and the Bureau of Ocean Energy Management (BOEM) related to emerging technologies and the determination of BAST, and environmentally sound oil and gas development practices on the Outer Continental Shelf (OCS);
- Provide recommendations and technical assistance related to geological and geophysical sciences relevant to understanding the technical challenges of exploration and development, such as reservoir characteristics, geohazards, and worst case discharge analyses;
- Develop and maintain a domestic and international equipment failure reporting system and database of critical equipment failures related to control of the well that will allow the Institute to identify reliability issues and industry trends. This system should engage both the user and manufacturer of the equipment;
- Engage employees of the Federal agencies to participate in research and training to remain current on state-of-the-art technology associated with offshore oil and gas development;
- Promote collaboration among Federal agencies, industry, standards organizations, academia, and the National Academy of Sciences.

3.3.8 Oil Spill Recovery Institute (OSRI)

OPA 90 established OSRI (http://pws-osri.org/) in response to the 1989 *Exxon Valdez* oil spill. The Prince William Sound Science Center, a non-profit research and education organization located in Cordova, Alaska, administers and houses OSRI. The Congressional mandate given to OSRI is to: 1) identify and develop the best available techniques, equipment and materials for dealing with oil spills in the Arctic and sub-Arctic marine environment; 2) complement federal

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and state damage assessment efforts and determine, document, assess and understand the long-range effects of Arctic and sub-Arctic oil spills on the natural resources of Prince William Sound; and, 3) understand and document the effects to the environment, the economy and the lifestyle and well-being of the people who are dependent on those resources. Subsequent legislation has provided OSRI with a funding mechanism to assure the research continues as long as oil exploration and development occurs in Alaska. Since 1998, OSRI has awarded approximately one million dollars a year to support a wide range of projects.

3.3.9 Pew Charitable Trusts (PCT) Arctic Science Program

The PCT's Arctic Science Program engages in numerous scientific activities to support conservation campaigns throughout the Arctic. These efforts include original fieldwork, analyses of existing data, and the sharing of scientific findings with a range of audiences. Scientists provide expertise on marine conservation-related issues to the U.S., Canada, Greenland, and elsewhere.

3.3.10 Prince William Sound Regional Citizen's Advisory Committee (PWSRCAC)

OPA 90 established the PWSRCAC to promote partnership and cooperation among local citizens, industry and government. The PWSRCAC conducts long-term environmental monitoring program and oil spill prevention programs to promote safe production and transportation of oil in Prince William Sound. Its programs include a hydrocarbon toxicity project to study and address the gaps in knowledge regarding chronic toxic effects of oil, dispersed oil, and *in-situ* burn residue under study conditions similar to the cold marine Alaskan waters.

3.3.11 Ship Structure Committee

Since its inception in 1943, the Ship Structure Committee has sponsored and coordinated R&D projects to improve ship design, construction, operation, inspection, maintenance, and repair methodologies. The Committee's mission is to enhance the safety of life at sea, promote technology and education advancements in marine transportation, and to protect the marine environment. This is done through advocating, participating in, and supporting cooperative R&D in structural design, life cycle risk management of marine structures, and production technologies. The Committee includes representatives from the USCG, Navy, MARAD, American Bureau of Shipping, Transport Canada, Defense Research and Development Canada Atlantic, and the Society of Naval Architects and Engineers.

3.4 Academia

Extensive oil pollution research is conducted at academic institutions, either individually or as part of university consortia. These entities provide opportunities to explore basic and applied scientific concepts to address oil pollution issues.

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3.4.1 Gulf of Mexico Research Consortia

Several university research consortia have been created to study the effects of the Deepwater Horizon oil spill. These consortia bring together researchers from universities, research institutes and other academic entities to collaborate on scientific studies in the Gulf of Mexico. The consortia activities combine research with scientific knowledge of the ecosystems of the Gulf of Mexico to advance the understanding of interactions that occurred and continue to occur among the marine and coastal ecosystems, oil, and dispersants produced by the oil spill.

GoMRI (see Section 3.3.3) provides funding for these consortia or their individual studies. To date, GoMRI issued four one-year block grants in 2010 followed by a series of Request for Proposals (RFPs) for academic consortia and individual investigators to propose research ideas. To date, GoMRI funded 15 different consortia in two rounds of grants, as shown on Table 3-1. In their funding decisions, GoMRI emphasizes: interdisciplinary science and technology involving experts in physical, chemical, geological, and biological oceanography; marine biology; coastal and reef ecosystems, fisheries and wildlife ecology; public health; and associated development of physical, chemical, and biological instrumentation, advanced modeling, and informatics. The activities combine research with scientific knowledge of the ecosystems of the Gulf of Mexico to advance the understanding of interactions that occurred and continue to occur among the marine and coastal ecosystems, oil, and dispersants produced by the oil spill.

Table 4-1: GoMRI-funded Consortia 2010-2014

Consortia	2010 Block Grants	2011 Consortia	2014 Consortia
Florida Inst. of Oceanography	X		
Louisiana State University (LSU)	X		
Marine Environmental Science Consortium	X		
Northern Gulf Institute	X		
Center for Integrated Modeling and Analysis of Gulf Ecosystems (C-IMAGE)		X	X
Consortium for Advanced Research on Transport of Hydrocarbon in the Environment (CARTHE)		X	X
Consortium for the Molecular Engineering of Dispersant Systems (C-MEDS)		X	
Coastal Waters Consortium (CWC)		X	X
Gulf of Mexico Integrated Spill Response Consortium		X	

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(GISR)		
Deepsea to Coast Connectivity in the Eastern Gulf of Mexico (DEEP-C)	X	
Dispersion Research on Oil: Physics and Plankton Studies (DROPPS)	X	X
Ecosystem Impacts of Oil and Gas Inputs to the Gulf (ECOGIG)	X	X
Aggregation and Degradation of Dispersants and Oil by Microbial Exopolymers (ADDOMEx)		X
Alabama Center for Ecological Resilience (ACER)		X
Consortium for Oil Spill Exposure Pathways in Coastal River-Dominated Ecosystems (CONCORDE)		X
Consortium for Resilient Gulf Communities (CRGC)		X
Deep-Pelagic Nekton Dynamics of the Gulf of Mexico (DEEPEND)		X
Littoral Acoustic Demonstration Center - Gulf Ecological Monitoring and Modeling (LADC-GEMM)		X
Relationship of Effects of Cardiac Outcomes in Fish for Validation of Ecological Risk (RECOVER)		X

3.4.2 Gulf of Mexico University Research Collaborative (GOMURC)

Universities across five U.S. Gulf of Mexico states initiated several marine research consortia over the past decades. GOMURC's region-wide alliance of these consortia promotes large-scale, long-term research initiatives required to address Gulf ecosystem-wide stressors such as oil spills, hurricanes, and climate change. GOMURC's mission goals and objectives include advocating for science and education activities that support science-based policies to restore and sustain Gulf natural resources and economy. The following five university consortia members of GOMURC represent 80 universities in the Gulf States:

- Alabama Marine Environmental Sciences Consortium, led by Dauphin Island Sea Lab;
- Florida Institute of Oceanography (FIO), led by University of South Florida;
- Louisiana Universities Gulf Research Collaborative, led by Louisiana State University;
- Mississippi Research Consortium, led by University of Southern Mississippi; and
- Texas Research Consortium, led by the Texas A&M University-Corpus Christi

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3.4.3 Harte Research Institute for Gulf of Mexico Studies

The Harte Research Institute, an endowed research component of Texas A&M University-Corpus Christi, is dedicated to advancing the long-term sustainable use and conservation of the Gulf of Mexico. The Institute serves as a research center of excellence in generating and disseminating knowledge about the Gulf of Mexico ecosystem and its critical role in the economies of the North American region. The Institute's ecosystems group focuses on environmental flows and the effects of deep sea oil and gas activities.

3.4.4 NOAA's Sea Grant Program

NOAA's National Sea Grant College Program is a network of 33 individual programs located in universities in every coastal and Great Lakes state, Puerto Rico, Lake Champlain and Guam. These programs serve as the core of a dynamic, national university-based network of over 300 institutions involving more than 3,000 scientists, engineers, educators, students and outreach experts. The network engages the power of academia and a wide variety of partners to address issues such as coastal hazards, sustainable coastal development, and seafood safety.

3.4.5 National University Rail (NURail) Center

In January 2012, the U.S. Department of Transportation awarded a grant of $3.5 million to a multi-university consortium led by University of Illinois Urbana (UIUC) to establish a rail transportation and engineering research center. Headquartered within the Department of Civil and Environmental Engineering at UICC, NURail is a consortium of seven partner colleges and universities with a combination of strengths in railway transportation engineering research and education in North America. The NURail is the first University Transportation Center (UTC) focused solely on rail and concentrates on rail education and research to improve railroad safety, efficiency and reliability. Particular focus is on challenges associated with rail corridors in which higher-speed passenger trains share infrastructure with freight trains.

The NURail has identified six thematic research topics that will be the subject of strategic development planning and ongoing technical research:

- Integrated railroad vehicle/track interaction and dynamic;
- Railroad safety and risk;
- Rail network capacity analysis and planning,
- Urban, regional and high-speed passenger rail implementation
- Multimodal freight transportation; and
- Funding, finance, community and economic development.

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3.4.6 Oil Spill Academic Task Force (OSATF)

The Oil Spill Academic Task Force (OSATF) is a consortium of scientists and scholars from institutions in Florida's State University System as well as from five of Florida's private universities and two marine laboratories working in collaboration with the Florida Department of Environmental Protection (DEP). The OSATF brings together expertise and resources to assist the state of Florida and the Gulf region in responding to and studying the Deepwater Horizon oil spill.

3.4.7 Scripps Institution of Oceanography (SIO)

SIO, a department of the University of California San Diego, is one of the oldest and largest centers for ocean, earth and atmospheric science research, education, and public service in the world. Research at Scripps encompasses physical, chemical, biological, geological, and geophysical studies of the oceans, earth, and planets. Researchers at SIO engage in basic research to expand our knowledge and understanding of natural hazards, including earthquakes, volcanoes, tsunamis, storm waves, floods, erosion, hurricanes, tornadoes, wildfires, and harmful algal blooms, as well as their impacts.

Some important programs include: the Southern California Coastal Ocean Observing System's real-time surface current mapping network for tracking and mitigating response to oil spills and improving search and rescue operations and safe boating; and the ANZA Seismic Network, providing real-time seismic information for Southern California.

3.4.8 UAA/SIT Center of Excellence for Maritime Research (CMR)

The DHS Science and Technology (S&T) Directorate selected the University of Alaska Anchorage (UAA) and the Stevens Institute of Technology (SIT) as co-leads for a Center of Excellence for Maritime Research (CMR). The CMR will provide research to identify better ways to create transparency in the maritime domain along coastal regions and inland waterways, while integrating information and intelligence among stakeholders. DHS charged the CMR to develop new ideas to address these challenges, provide a scientific basis, and develop new approaches for USCG and other DHS maritime missions.

3.4.9 UAF Arctic Center for Oil-Spill Research & Education (A-CORE)

The University of Alaska-Fairbanks (UAF) A-CORE is a leading academic institution in Arctic research that focuses on research applicable to Arctic oil spills. A-CORE partners with state and federal agencies, industry, and other academic institutions to support wise decision-making concerning Arctic oil spill response and prevention by working to fill gaps in existing knowledge.

In March 2015, UAF began operating the *Sikuliaq*, a new 261-foot oceanographic research vessel owned by the National Science Foundation. The *Sikuliaq* can cut through 2.5 feet of first-

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year sea ice and is the only ice-capable vessel in the U.S. academic research fleet. The ship is outfitted with state-of-the-art equipment to bring scientists to previously inaccessible ice-choked polar regions of the globe. The *Sikuliaq* will advance polar and sub-polar research. *Sikuliaq* can accommodate up to 24 scientists and students, including those with disabilities.

3.4.10 U.S. Coast Guard Academy

The United States Coast Guard Academy is the Department of Homeland Security's only institution of higher education. Academy cadets as well as faculty continue to undertake academic research in oil spill science, policy, and in marine engineering. The Academy also provides education to cadets in these fields.

The United States Coast Guard established a Center for Arctic Study & Policy (CASP) at the Academy to promote academic research on Arctic policy and strategy by facilitating collaboration, partnerships, and dialogue among specialists from academia, government, tribal organizations, non-governmental organizations (NGOs), industry, and the USCG. CASP serves as an operationally-focused academic think tank to promote research, broaden partnerships, and educate future leaders about the complexities of this unique region. Through collaborative efforts, the Center will promote effective solutions to address present and future Arctic maritime challenges as the Coast Guard increases its Arctic presence.

3.4.11 University of New Hampshire (UNH) Oil Spill Centers

UNH in Durham, NH, administers the Coastal Response Research Center (CRRC) and the Center for Spills in the Environment (CSE). CRRC was established in 2004 as a partnership between the NOAA Office of Response and Restoration (OR&R) and UNH. The CRRC partnership stimulates innovation in spill preparedness, response, assessment, and recovery strategies. The primary purpose of the CRRC is to bring together the resources of non-governmental scientists and the field expertise of OR&R to conduct and oversee basic and applied research, conduct outreach, and encourage strategic partnerships in spill response, assessment and restoration.

The CSE expands the scope of interaction and cooperation with the private sector, other governmental agencies and universities. The CSE involves individuals and institutions, public and private, at local, regional, national and international levels in identifying needs, evaluating and demonstrating promising technologies, and fostering their use as part of new, integrative approaches to response and restoration.

3.4.12 Woods Hole Oceanographic Institution (WHOI)

WHOI is a non-profit oceanographic research organization with a mission to explore and understand the ocean and to educate scientists, students, decision-makers, and the public. WHOI scientists and engineers maintain expertise across a range of oceanographic research areas. They work collaboratively within and across six research departments to advance knowledge of the

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global ocean and its fundamental importance to other planetary systems. WHOI research provides information of value to a wide range of ICCOPR research areas including pre-spill baseline studies, injury assessment and restoration, and multiple response research areas.

3.5 International Efforts

Oil pollution is a global issue and requires international cooperation and research to address. ICCOPR and its members work cooperatively with other nations and international entities to conduct research and to better respond to oil spills.

3.5.1 Arctic Council

The Ottawa Declaration of 1996 formally established the Arctic Council as a high level intergovernmental forum to provide a means for promoting cooperation, coordination and interaction among the Arctic States, with the involvement of the Arctic indigenous communities and other Arctic inhabitants on common issues, in particular issues of sustainable development and environmental protection. Arctic Council member states are: Canada, Denmark (including Greenland and the Faroe Islands), Finland, Iceland, Norway, Russian Federation, Sweden, and the United States.

The Council established a series of guidelines intended to define a set of recommended practices and outline strategic actions for consideration by those responsible for regulation of offshore oil and gas activities (including transportation and related onshore activities) in the Arctic. The goal is for regulators to identify the key aspects related to protection of human health and safety and protection of the environment for the management of offshore activities, remaining sufficiently flexible in the application of these regimes to permit alternative regulatory approaches. In May, 2013, all member agencies of the Arctic Council signed the "Agreement on Cooperation on Marine Oil Pollution Preparedness and Response in the Arctic," providing support for interactions between all eight parties relative to response and preparedness. The eight Arctic nations have different systems with different emphases on the division of responsibility between the operator and the regulator. The Council's goal is to assist regulators in developing standards that are consistently applied and enforced for all offshore Arctic oil and gas operators.

The Council established an Emergency Prevention, Preparedness and Response Working Group (EPPR) to addresses various aspects of prevention, preparedness and response to environmental emergencies in the Arctic. The goal of the EPPR Working Group is to contribute to the protection of the Arctic environment from the threat or impact that may result from an accidental release of pollutants or radionuclides. In addition, the Working Group considers questions related to the consequences of natural disasters.

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3.5.2 Australia

Australia's Commonwealth Scientific and Industrial Research Organization (CSIRO) helps to unlock Australia's offshore oil and gas resources through research focused on the safe, efficient and sustainable use of their marine natural resources. CSIRO works with industry, government agencies, and academia to provide scientific knowledge and advice for offshore oil and gas; it conducts research and provides advice on the environmental, economic and social factors associated with the entire oil and gas value chain (CSIRO 2015).

The primary objective for Australia is to develop the knowledge and technology to prevent marine incidents and understand pre-spill ecosystems so should an incident occur Australia is prepared to respond effectively. CSIRO has conducted a significant amount of research in a wide variety of areas that support a broad array of prevention and response initiatives. Recent research projects include:

- BLUElink ocean forecasting technology;
- Hydrocarbon sensor arrays to monitor the movement of hydrocarbons during an oil spill;
- Hydrocarbon fingerprinting technique;
- The Hydrates flow loop simulation techniques to help to prevent pipeline blockages;
- Microbial degradation research;
- Biomarker research;
- Dispersant assessments; and
- Ecotoxicology assessments.

The Australian Maritime Safety Authority (AMSA), a federal government self-funded maritime safety agency established in 1990, is responsible for providing a national response capability for marine pollution. The AMSA administers the "National Plan to Combat Pollution of the Sea by Oil and other Noxious and Hazardous Substances", a cooperative arrangement between the federal, state and northern territory (NT) Governments and the shipping, oil exploration and chemical industries, emergency services, and fire brigades.

The oil industry maintains resources for spills occurring at their facilities. For incidents that may require beyond individual company capabilities, the Australian Institute of Petroleum (AIP) through its Australian Marine Oil Spill Centre (AMOSC) subsidiary has established the AMOS Plan formalizing mutual aid arrangements among member companies.

3.5.3 Canada

Environment Canada (EC) is a diverse science-based organization that implements the Government of Canada's environmental agenda. It provides science and technology to support decisions about the environment. The EC conducts and publishes 80 percent of its research in collaboration with external researchers. The EC operates 15 research institutes and laboratories,

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seven storm prediction centers, and 32 water survey offices. The EC has worked with EPA, MMS (now BSEE), and the Navy to conduct oil pollution research at the Ohmsett facility since the early 1970s.

The Department of Fisheries and Oceans Canada (DFO) has Canada's most complex and comprehensive science programs, in terms of function and geography. Its program areas applicable to oil pollution research address ecosystem effects of energy production and operational oceanography. The DFO's research on ecosystem effects addresses expanded energy development in Canada, mainly offshore oil and gas, hydroelectricity, and oil sands. The DFO's operational oceanography programs study oceanic processes and circulation patterns to predict the ocean's present and future state, and include ocean modeling, ecosystem modeling, and near-shore processes.

3.5.4 Centre of Documentation, Research and Experimentation on Accidental Water Pollution (CEDRE)

CEDRE is a not-for-profit association created as part of the measures taken in the aftermath of the Amoco Cadiz oil spill. CEDRE's headquarters, technical facilities and the majority of its personnel are based in Brest, Brittany, France. It provides advice and expertise to the authorities responsible for oil spill response for marine waters and inland surface waters. CEDRE's advice and expertise is available to foreign authorities or private companies. CEDRE conducts its own research projects and contributes to French and international research programs. Their main research and development activities focus on themes of: enhancing knowledge in the field of spill response; fate of oil and chemicals on the surface and in the water column; response equipment and product assessments; and spill impact and post-spill monitoring.

3.5.5 China

The China Maritime Safety Administration (MSA), part of the Ministry of Transport, has the mandate to investigate and respond to marine pollution incidents in Chinese waters. The China MSA headquarters in Beijing provides central control with 14 subordinate bureaus and about 100 local branches along the coast and the Yangtze River. In recent years, China promulgated a series of new pollution regulations relating to ships, which progressively came into force in the period 2010-12. These cover a wide range of issues, including oil pollution response planning, pre-spill clean-up arrangements, and the emergency handling of pollution accidents. Regulations have also introduced a domestic ship-source oil pollution compensation fund.

3.5.6 European Union (EU)

Since 1978, the EU has played a vital role in the response to marine pollution and today its role has become even greater with the response coordination ensured by its European Response

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Coordination Center (ERRC) and with marine pollution preparedness and response services provided by the European Maritime Safety Agency (EMSA).

EMSA assumes the leading role in ensuring a uniform and effective level of maritime safety, maritime security, prevention of and response to pollution caused by ships as well as response to marine pollution caused by oil and gas installations, and provide technical and scientific assistance to the European Commission and member states. EMSA manages a network of standby at-sea oil spill recovery vessels based in all the regional seas of Europe. These normally commercial vessels that cease their normal activities and quickly move to the scene of the oil spill upon request. The agency also provides satellite imagery for detection and monitoring of oil spills, pollution response experts to give operational and technical assistance, and information service for chemical spills at sea.

In September 2008, the European Commission, the EU's executive body, issued their Communication on 'A European Strategy for Marine and Maritime Research' delineated an action plan for better integration of research between the maritime and marine communities in order to address the problems of marine degradation caused by human activities and develop new technologies for sustainable development of maritime activities.

The European Commission is currently funding projects aimed at developing new technologies to mitigate the effects of pollution in the seas and oceans. The 'Argomarine' project ('Automatic oil spill recognition and geopositioning integrated in a marine monitoring network') is one example.

3.5.7 France

Oil represents approximately one-third of France's total primary energy consumption and that share has been falling over the past 10 years. France imports crude oil through three major sea ports (Marseille, Le Havre, and Saint-Nazaire). France has very little domestic natural gas production, and since the French government banned the use of hydraulic fracturing, France imports natural gas through a variety of cross-border pipelines from the Netherlands, Norway, and Russia. France also imports liquefied natural gas (LNG) from countries around the world, notably Algeria , Nigeria, Qatar, and Egypt.

Response arrangements are governed by the "at sea pollution response" section of ORSEC MARITIME (Organisation de la Réponse de SÉcurité Civile), France's civil defense plan. Responsibility for preparing for and conducting clean-up operations at sea lies with one of three Maritime Préfets (one for the Mediterranean Sea, one for the Atlantic and one for the North Sea/Channel). The Maritime Préfet will work in cooperation with the Secrétariat Général de la Mer who has the authority to access the various stockpiles of equipment. Coordination of sea and shoreline clean-up would be supervised locally by a permanent conference with representatives of the Maritime Préfet and the Préfet of the particular Department concerned.

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3.5.8 Kill-Spill

Kill-Spill is an EU-funded research program with the mission to develop highly efficient, economically- and environmentally-viable biotechnological solutions for the clean-up of oil spills caused by maritime transport or offshore oil exploration and related processes. The program will deliver innovative biotechnological tools for oil spills remediation.

These new developments include biosensors to monitor hydrocarbon degradation, new environmentally-friendly dispersants and adsorbents, combined microbial and additives formulations, multifunctional bioremediation agents, and tools for sediments decontamination. The impact and toxicity of these newly developed products will be evaluated; and they will be validated in mesocosms and on actual oil spills.

3.5.9 Mexico

A National Contingency Plan was developed in 1981 by a sub-committee of the Mexican Inter-Departmental Commission for Environmental Health. It aims to establish a national response network and provide overall coordination of resources in the event of a spill. The Mexican navy maintains a regional and local organizational structure to implement the National Plan at these levels. Under the General Law of Ecological Equilibrium and Environmental Protection (LEGEEPA), overall responsibility for oil pollution matters in Mexican ports and territorial waters rests with the Mexican navy. Response to a spill is likely to be initiated through the Navy's Marine Environment Protection Division (PROMAM). Assistance is also likely to be sought from the national oil company, Petróleos Mexicanos (PEMEX).

3.5.10 Norway

As a major energy nation, Norway has a particular responsibility to ensure an adequate energy supply and to develop knowledge and technology for efficient and sustainable energy systems. Norway has significant expertise in petroleum and hydropower science and engineering. In addition, Norway is conducting important research efforts in the field of environment and climate research. Despite extensive recovery of petroleum resources during the past 30 years, the petroleum industry still represents a large potential for future value creation in Norway. Research and technological innovation, combined with strict environmental regulations and other policy instruments, are needed to make the environmental impact of the exploration and production of oil and gas as small as possible.

The Norwegian Government's goal is to be a pioneer in developing an integrated, ecosystem-based management regime for marine areas. The purpose of this management plan is to provide a framework for the sustainable use of natural resources and ecosystem services derived from the North Sea and Skagerrak and at the same time maintain the structure, functioning, productivity

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and diversity of the area's ecosystems. Norway utilizes its major universities to conduct major research programs with respect to oil and gas.

3.5.11 Russia

The Federal Agency of Maritime and River Transport, part of the Ministry of Transport, is the federal executive body with responsibility for preparedness and response for oil spill incidents in Russia. Oil pollution response is assigned to the State Marine Pollution Control, Salvage and Rescue Administration (MPCSA). The MPCSA is responsible for the Marine Rescue Coordination Centres (MRCC), which serves as the focal point for communication during marine spill incidents at the regional level. The "Federal Contingency Plan on Oil Spill Prevention and Response at Sea" was adopted by the Ministry of Transport, the Ministry of Natural Resources and the Ministry of Civil Defense, Emergencies and Disaster Response (EMERCOM) in July 2003. The Plan complies with IMO Guidelines on contingency planning. There are three levels of planning: local, regional and federal. Ports, oil terminals, and harbors have local contingency plans and capabilities which, if exceeded, can be supplemented by regional plans and resources.

3.5.12 SINTEF

SINTEF is the largest independent research organization in Scandinavia, which operates in partnership with the Norwegian University of Science and Technology (NTNU) in Trondheim. NTNU personnel work on SINTEF projects, and many SINTEF staff members teach at NTNU. SINTEF is known worldwide for its work on oil spills, dispersants, and is one of the world's largest independent research organizations within the oil spill research community and offers expertise in many areas, including:

- Studies of oil weathering;
- Characterization of oil spills including thickness and chemistry;
- Oil spill identification - "fingerprinting";
- Marine environmental technology development;
- Surface water chemistry;
- Net Environmental Benefit Analysis (NEBA) oil spills in the Arctic; and
- Subsea and deepwater releases.

3.5.13 United Kingdom (UK)

The Department of Energy and Climate Change (DECC) works to insure that the UK has secure, clean, affordable energy supplies and promotes international action to mitigate climate change.

DECC is a ministerial department, supported by nine agencies and public bodies. The Oil and Gas Authority, an executive office of the DECC, works with government and industry to make sure that the UK gets the maximum economic benefit from its oil and gas reserves. The Oil and

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Gas Authority is responsible for regulating offshore and onshore oil and gas operations in the UK including:

- Oil and gas licensing;
- Oil and gas exploration and production;
- Oil and gas fields and wells;
- Oil and gas infrastructure; and
- Carbon capture and storage (CCS) licensing.

The Maritime and Coastguard Agency (MCA) is the UK's authority responsible for the provision of response procedures designed to deal with any emergency at sea that threatens or causes actual pollution. The national contingency plan for marine pollution from shipping and offshore installations sets out revised procedures for incident response. The national contingency plan ("National Contingency Plan for Marine Pollution from Shipping and Offshore Installations") underwent a major review in 2000, was revised again in 2006 to take advantage of lessons learned during actual incidents and major exercises, and is currently under review. MCA develops and participates in maritime exercises designed to maintain the operational readiness of its staff and equipment. The Counter Pollution and Response Branch also organizes training courses for local authorities to prepare their staff when responding to shoreline pollution.

3.6 Non-Federal Oil Pollution Testing Facilities

Several non-federal facilities provide opportunities for oil pollution testing.

3.6.1 Bedford Institute of Oceanography Center for Offshore Oil, Gas and Energy Research (BIO COOGER)

The DFO Canada's BIO COOGER, located in Dartmouth, Nova Scotia, maintains a wave tank facility for oil pollution research. Each tank measures 32 m long, 0.6 m wide, and 2 m high (1.5 m water depth; 28,800 L volume). Water from the Bedford Basin of Halifax Harbor is pumped into the tanks through a coarse (25 μm pore size) and fine (5 μm pore size) serial filtration system. The tanks are capable of generating various types of wave energies in either static or flow-through mode. Breaking and non-breaking waves (computer-controlled flat-type wave maker) provide mixing energies to achieve dispersant effectiveness similar to that of field conditions. The tanks are equipped with subsea injection systems from pressurized, heated canisters. Experiments benefit from the ability of the tanks to be drained and cleaned (tank walls, bottom, wave maker and absorbers) after each experiment to remove all oil and surfactants.

3.6.2 CEDRE Technical Facilities

CEDRE's technical facilities cover 300 acres and constitute a completely watertight area, which includes a man-made beach, water body, and a deep-water basin. These facilities allow full scale

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simulation of real life spills in an environmentally friendly manner. The CEDRE Experimentation Column (CEC) is a tool to study the behavior of a substance as it rises up or settles through the water column. The facilities include a flume tank, or Polludrome, that is designed to simulate offshore, shoreline and river conditions on a pilot scale. The facilities also include a greenhouse for experimentation on living organisms.

3.6.3 Churchill Marine Observatory.

A multi-government, multi-university research centre is being developed in Churchill, Manitoba, Canada. The Churchill Marine Observatory will be a multidisciplinary research facility where researchers will study the detection, impact and mitigation of oil spills in sea ice and investigate issues facing Arctic marine transportation. The research will help address technological, scientific and economic issues pertaining to Arctic marine transportation and oil and gas exploration and development throughout the Arctic. The facility is scheduled to open in 2017.

3.6.4 Ocean Coastal Research Engineering (OCRE)

The National Research Council of Canada's OCRE assists industry and government to develop solutions to engineering challenges within ocean, coastal and river environments with a particular focus on harsh and extreme conditions. The approach includes physical and numerical modeling, engineering analysis, technology development, as well as full scale experiments and field work conducted with the support of a comprehensive suite of world-class model test basins and tanks capable of reproducing a wide range of ice, wave, current and wind conditions. OCRE provides technology and facilities to support problems related to: the Arctic; marine infrastructure, and; marine vehicles. OCRE maintains several testing facilities that provide real world conditions:

- Coastal wave basin;
- Offshore engineering basin;
- Multidirectional wave basin;
- Large area basin;
- Ice tank;
- Coastal wave basin; and
- Multidirectional wave basin.

3.6.5 PRCI Technology Development Center

The Pipeline Research Council International (PRCI) opened its new Technology Development Center (TDC) in Houston, Texas in July 2015. The TDC covers eight acres, including a state-of-the-art pull test facility, an over 20,000 sq. ft. workshop, and test facility with an additional 9,000 sq. ft. of office and meeting space. The TDC will provide the industry with an independent third

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party site to fully understand the capabilities of current pipeline tools and to guide the development of new technologies needed to push toward that goal.

3.6.6 SINTEF Sealab

SINTEF Sealab is a cooperative effort of SINTEF Fisheries and Aquaculture and the Norwegian University of Science and Technology (NTNU) and offers a variety of experimental facilities covering the key elements of marine food webs. The emphasis is on developing experimental systems that simulate natural processes and mimic the fate, behavior and effects of pollutants in the recipient.

The SINTEF Sealab provides:

- Cold climate laboratories with basin facilities;
- Chemical and microbiological laboratories;
- Ecotoxicological laboratories;
- Oil spill research facilities;
    - Shoreline basins;
    - Simulated seabed basin;
    - Dynamic and static test basins/systems; and
    - Tank facilities for subsea studies.

3.6.7 Southwest Research Institute (SwRI)

The Chemical Engineering Department at SwRI specializes in finding solutions to difficult problems and providing exacting services. Staff expertise and world-class facilities provide services such as wastewater cleanup, catalyst screening, pilot plant design and operation, reaction kinetics and enthalpy analyses. Typical services include;

- Analytical testing;
- Personal safety equipment testing;
- Waste disposal characterization; and
- Waste cleanup.

An Ocean Simulation Lab at SwRI provides government and commercial clients with quality facilities and experienced staff to conduct testing and performance evaluation services in more than 10,500 square feet of air conditioned laboratory space and 12 ocean simulation test chambers that range in pressures to 30,000 psig and sizes to 90-inch diameter. Capabilities are available for the complete evaluation of your marine products including: development of testing procedures; test design; test setup; and static and cyclic structural/pressure/thermal testing.

3.6.8 Texas A&M Corpus Christi Center for Coastal Studies (CCS)

The CCS comprises 10,000 square feet of office and laboratory space within the Carlos F. Truan

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Natural Resources Center. The CCS facilities include:

- Plankton laboratory;
- Marine ecotoxicology laboratory;
- Marine invertebrate environmental physiology laboratory; and
- Benthic ecology laboratory.

The National Spill Control School (NSCS) was established in 1977 and was named as a consulting, training, and research resource for the National Response Team in OPA 90. The NSCS offers specialized hands-on OSHA mandated training for professionals and workers in the oil spill, hazardous material (HAZMAT), and emergency management industries as well as others in exploration, production, and transportation who deal with spill prevention, planning, and response.

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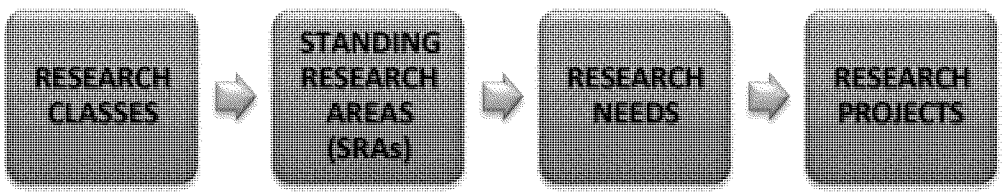
4. Structuring Oil Pollution Research

The field of oil pollution research covers an array of subjects depending on the interests and needs of researcher or the research funding institution. The focus of oil pollution research extends well beyond removing or mitigating spilled oil from the environment to involve other themes such as developing new means for preventing oil discharges, assessing impacts on the natural and human environment, and restoring an affected ecosystem as best as possible to pre-spill conditions. Each of these areas includes a broad spectrum of subjects and topics for oil pollution research, which creates challenges for tracking research activities.

ICCOPR established a new Oil Pollution Research Categorization Framework to provide a common language and planning framework that would enable researchers and interested parties to identify and track research in each topic area. This new approach will be used by ICCOPR to better facilitate communication with Congress, Federal partners, industry, academia, and the general public. It provides a basis for the 15 member organizations to translate their different research needs and perspectives into one federal voice through ICCOPR.

4.1 Introduction to the Oil Spill Research Framework

The Categorization Framework provides a hierarchy of terms to classify, discuss, and prioritize oil pollution research. It is analogous to the taxonomic classification of organisms (i.e., Kingdom, Phylum, Class, Order, Family, Genus, and Species). ICCOPR's oil pollution research classification scheme contains four elements:



Research Classes and Standing Research Areas (SRAs) are generally fixed while the Research Needs and Projects assigned to the SRAs will vary over time. Each of these categorization terms is defined later in this chapter. The following example shows how this new classification scheme works for one project:

Class: Prevention
SRA: Pipeline Systems
Need: Develop advanced pipeline break sensing technologies
Project: Smart Pipeline Network – Seal Sensor System (PHMSA DTRT57-12-C-10050)

Chapter 9 of this OPRTP provides a prioritized list of current Research Needs suggested for 2015-2012 for each SRA. Throughout the six-year life of this Plan, ICCOPR will monitor relevant planned, ongoing, and completed Projects to gauge how government, NGOs, industry,

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and academia are addressing the published priority Research Needs. ICCOPR will use this information to provide updates on research progress in the Biennial Reports to Congress and to modify or replace existing Research Needs. At the end of the 6-year cycle, ICCOPR will revise the OPRTP for the next 6-year cycle and include a summary of the previous version's accomplishments and a new set of prioritized Research Needs.

4.2 Classes

The overarching Oil Pollution Research Categorization Framework includes four Classes that represent the general groupings of oil spill research: Preparedness, Prevention, Response, and Injury Assessment and Restoration. Figure 4-1 depicts this framework of Classes. It shows that the research in each Class can inform and support the research from other Classes and that the Preparedness Class plays a central role in supporting the others. ICCOPR's member organizations may conduct or support research across one or multiple Classes depending on their specific mission, regulatory responsibilities, and/or expertise.

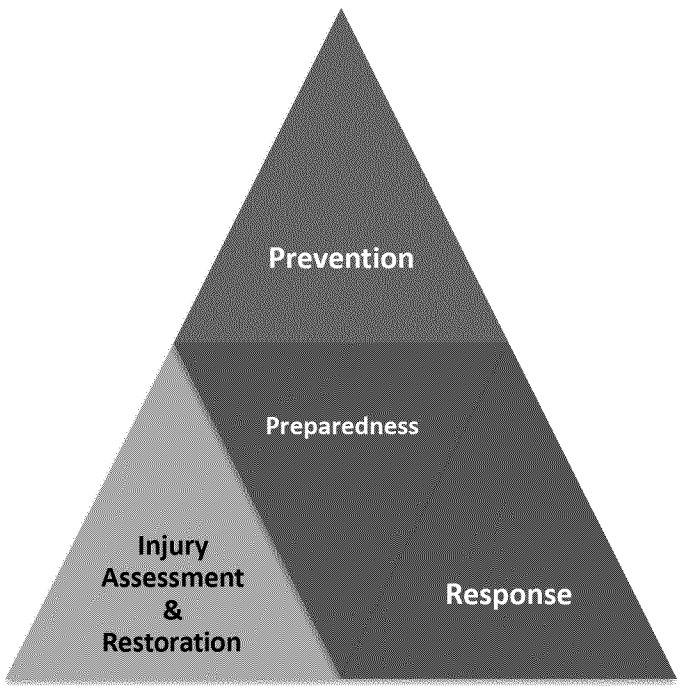

Figure 4.1. The Oil Pollution Research Categorization Framework Classes

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The following section describes the research pertinent to each Class.

Prevention Class

Research that supports the development of practices and technologies designed to predict, reduce, or eliminate the likelihood of discharges, or minimize the volume of oil discharges into the environment.

Preparedness Class

Research that supports the activities, programs, and systems developed prior to an oil spill to improve the planning, decision-making and management processes needed for responding to and recovering from oil spills.

Response Class

Research that supports techniques and technologies that address the immediate and short-term effects of an oil spill and encompasses all activities involved in containing, cleaning up, treating, and disposing oil in order to: 1) maintain safety of human life; 2) stabilize a situation to preclude further damage; and, 3) minimize adverse environmental and socioeconomic effects.

Injury Assessment and Restoration Class

Research that involves the collection and analysis of information to: 1) evaluate the nature and extent of environmental, human health, and socioeconomic injuries resulting from an incident; 2) determine the restoration actions needed to restore natural resources and their services to pre-spill conditions; and, 3) make the environment and public whole after interim losses.

4.3 Standing Research Areas (SRAs)

The backbone of ICCOPR's oil pollution research categorization scheme is the SRAs that exist within the four Classes. The SRAs represent the most common research themes encountered for oil spills – many of which have been studied over several decades. Their topical content supports the themes of the Classes for which they are assigned. For this OPRTP, ICCOPR identified 25 SRAs within the four Classes. The number of SRAs will, for the most part, remain consistent; however, changes may occur based on emerging research themes. Specifically, ICCOPR is monitoring on-going activities to determine whether the current SRA structure adequately addresses worker exposure and hydraulic fracturing issues. If not, ICCOPR may add additional SRAs.

Table 4.1 lists the current SRAs by Research Class. ICCOPR uses a numbering scheme to facilitate tracking of research within each SRA (1000 – 4400). The numbering series associated with each SRA is included in the SRA descriptions in the subsections below and in Appendix A.

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Table 4-1. Standing Research Areas assigned within the four research Classes.

Prevention	Preparedness	Response	Injury Assessment & Restoration
• Human Error Factors • Offshore Facilities and Systems • Onshore Facilities and Systems • Waterways Management • Vessel Design • Drilling • Rail & Truck Transportation • Pipeline Systems	• Pre-spill Baseline Studies • Response Management Systems	• Structural Damage Assessment and Salvage • At Source Control and Containment • Chemical and Physical Behavior Modeling • Oil Spill Detection and Surveillance • In- and On-water Containment and Recovery • Shore Containment and Recovery • Dispersants • In-situ Burning • Alternative Countermeasures • Oily and Oil Waste Disposal • Bioremediation	• Environmental Impacts and Ecosystem Recovery • Environmental Restoration Methods and Technologies • Human Safety and Health • Sociological and Economic Impacts

4.3.1 Prevention SRAs

ICCOPR has identified eight SRAs that address development of practices and technologies designed to reduce or eliminate the likelihood of oil discharges into the environment and to reduce the potential for consequences of any oil discharges on life, property, and the environment.

4.3.1.1 Human Error Factors [1000 series]

Description: This SRA focuses on how human performance and factors contribute to accidents in the oil production/transportation system. It includes the development of advanced methods and systems for training operational personnel, basic research on operating personnel performance in preventing oil spills (safe navigation on vessels, proper oil transfer practices, analysis/evaluation of equipment monitoring systems, decision-making processes), and the

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development of methods and technologies to evaluate the ability and knowledge of operating personnel in performing their duties. This may extend to evaluation of the overall management culture and its ability to foster the appropriate organizational safety, preparedness and response operating environment.

Importance: A significant proportion of accidents in oil production/transportation and related industries are attributed to "human errors." A Coast Guard analysis of oil spill causes found that human error factors were responsible for more than one third of non-casualty discharges from ships (USCG, 2012). Non-casualty spills typically include spills from actions such as overfilling of tanks and equipment failures not related to a vessel accident. More than half of these human errors were due to inattention, but also resulted from inadequate training, management and organizational culture. Identifying and solving various human error factors can significantly reduce oil spills at far less cost than more expensive technology-based solutions once the oil is discharged into the environment.

4.3.1.2 Offshore Facilities and Systems [1100 series]

Description: This SRA includes: offshore exploration and development wells, platforms, and well control systems; the methods, techniques, and equipment for system reliability inspections; systems to detect, prevent, and mitigate oil and gas discharges; and equipment to regain control of a well blowout or any other accidental discharge. It also includes transfer equipment, storage units, and piping used to transfer oil within the offshore system and connect the system to transfer pipelines. This technology is relevant for the multiple operating environments of exploration and production activities (e.g., Arctic, shallow, deep and ultra-deep waters).

Importance: Offshore oil and gas facilities are responsible for a significant percentage of oil and natural gas production in the U.S. Globally, three of the ten largest oil spills came from offshore facilities, including the *Deepwater Horizon* oil spill, the largest marine oil spill in U.S. history. (Oil & Gas IQ, 2015) Important new and potential offshore discoveries will continue to be made in frontier environments of increasingly deeper waters and arctic conditions, creating new technical challenges. Research is needed to determine the effects of deepwater conditions, ice forces, and increasingly severe weather conditions (hurricanes, blizzards, etc.) on offshore structures built in these environments. Research is also needed to address issues due to the aging of existing offshore facility infrastructure. Older well spills result from both internal damage (chemical/mechanical corrosion) and external damage (e.g., electrochemical corrosion, mechanical damage, and structural failures). Advanced system designs and the effective application of improved inspection technologies have the potential to detect problems before failures occur, while improved leak detection and well control systems have the ability to identify leaks when they are still small and can be quickly isolated and mitigated to minimize spillage.

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4.3.1.3 Onshore Facilities and Systems [1200 series]

Description: This SRA includes designs, techniques, operational procedures and equipment for fixed onshore facilities including wells. It covers inspections and systems to detect, prevent, and mitigate oil and gas discharges from the facilities and their systems, including transfer equipment, storage, and piping.

Importance: A significant number of discharges occur from onshore facilities, coastal bunkering facilities, and cargo transfer operations. Studies conducted by industry estimate that almost a third of oil discharges between 1998 and 2007 occurred at inland facilities subject to EPA's Spill Prevention, Control, and Countermeasures (SPCC) program (API, 2009). Advanced system designs and the effective application of improved inspection technology have the potential to detect, or predict the likelihood of potential failures before they occur. Improved leak detection systems have the ability to identify leaks quickly, potentially reducing the size and impacts of the discharge. It is also important to understand the ability of onshore structures to withstand changes in soil bearing capacity caused by changes in the climate and other factors.

4.3.1.4 Waterways Management [1300 series]

Description: This SRA includes methods, equipment, and integrated systems designed to improve navigation at sea and in ports, rivers, and inland waterways. It includes on-board navigation systems, such as integrated navigation and bridge systems and collision avoidance systems. It also includes systems external to the vessel, such as vessel traffic and tracking systems, navigational aids and piloting systems, as well as includes general research into navigation risks, the effects of navigational safety programs, and the development of decision support tools for waterways management efforts. This SRA includes development of navigational channel maintenance programs and analysis of voyage pre-planning processes.

Importance: A navigation-related marine casualty, such as a collision, allision, or grounding, causes most major spills from vessels underway. Collisions are when two moving vessels run into each other. Allisions are when a moving vessel strikes a stationary object such as a bridge abutment or an anchored ship. Groundings occur when a vessel runs ashore or strikes the bottom. According to ITOPF (2015), these causes accounted for 59 percent of large tanker spills in open waters and about 99 percent of tanker spills in restricted or inland waters. Improving navigation and waterways management, particularly in congested port areas and the approaches to ports, can prevent many of these accidents. In addition, improved waterways management can facilitate safe navigation through the Arctic and other ice-infested waterways as shipping increases in these areas.

4.3.1.5 Vessel Design [1400 series]

Description: This SRA includes the development, physical and numerical modeling, and testing of advanced tanker and barge designs to make these vessels less susceptible to damage and less

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likely to spill their cargoes into the waterways if an accidental grounding, collision or structural failure occurs. This SRA also includes research on non-tank vessel designs (e.g., double-hulled fuel and lube oil tanks) to minimize the possibility of spillage from collisions, allisions, and groundings.

Importance: OPA 90 required a phased in double-hull program for all tank vessels entering U.S. ports with all remaining tank barges having double hulls by January 1, 2014. Additional research and development is needed to verify these design approaches and investigate other measures to reduce oil spillage from tank vessel damage. IMO Regulation 12A established double-hull fuel tank construction for certain vessels. Congress has likewise considered double-hull fuel tank requirements for non-tank vessels to minimize the possibility of discharges from groundings, collisions, and allisions. In addition, the anticipated increase in shipping in the Arctic seas has created a need to evaluate and develop new vessel designs to ensure safe operations under arctic conditions where ice filled waters and icing conditions around ships and structures create additional structural stresses and corrosion hazards.

4.3.1.6 Drilling [1500 series]

Description: This SRA focuses on: the design, construction, and placement of wells (shallow, deepwater and ultra-deepwater, and onshore); materials, sensors, and systems needed for offshore drilling and production platforms, and well heads/risers; and techniques and equipment for well and facility monitoring and inspection under extreme pressure and temperature environments. Also included are efforts aimed at understanding the chemical and physical characteristics for the full range of petroleum oils under varying conditions of pressure and temperature; predicting their phase/state, behavior and their physical interaction with other materials in the environment (e.g., rock and sediments); and their impact on engineered systems. Example issues include: early kick detection; systems for communicating and responding to changes in downhole parameters; strategies and methods for training operational personnel on the use of advanced technology; systems to detect and prevent oil and gas discharges; and well-head systems and equipment to control wild wells and cap well blowouts.

Importance: The trend toward drilling in deep- and ultra-deepwater and Arctic conditions increases the difficulty in responding to a well blowout and oil spill. Systems to improve safe drilling operations and prevent loss of well control need to adjust as drilling operations advance into deeper waters and the Arctic. Of key importance is the ability to detect changes in rock and fluid properties at the bit-rock interface or even in the rock and fluids ahead of the bit so that measures can be taken to bring the well under control. Advanced system designs and materials, and the effective application of improved sensors, monitoring systems, and more in depth inspection technology have the potential to detect and measure well integrity and prevent failures, while improved leak detection and other systems have the ability to identify leaks while they are still small and can be quickly isolated and mitigated to prevent or minimize spillage. A fundamental understanding of the chemical and phase behavior, especially under extreme

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conditions of pressure and temperature and effects on engineered systems is critical to effective well construction planning, long-term monitoring, and long-term well integrity.

4.3.1.7 Rail & Truck Transportation [1600 series]

Description: This SRA includes the development and testing of rail and truck transport system designs, operations, and infrastructure to make oil tanks less susceptible to damage and loss of cargo during normal operations, train accidents and derailments, or truck accidents. This SRA includes evaluation of vehicle designs, construction materials, spill prevention devices, and loading/unloading systems and equipment. It also includes evaluations of: the physical and chemical characteristics and behavior of the crude oils being shipped, the effects of those characteristics on the tanks during operations and under accident conditions, and systems to control these characteristics. This SRA also includes evaluations of safety systems and processes to: manage the movement and composition of trains and trucks carrying crude oil, prevent accidents and derailments, select preferred shipping routes, and respond safely to an oil spill emergency.

Importance: North America has experienced a rapid expansion in crude oil supply due to the growing non-conventional oil production activities such as the oil sands products (OSP) from Canada and shale oil from the Bakken fields in North Dakota and Montana as well as the Eagle Ford and Permian Basins in Texas. This expansion in supply resulted in a four-fold increase in the number of crude oil rail car shipments in the past five years. Similarly, crude oil imports from Canada have increased more than 20-fold since 2011. A series of major US crude oil unit train accidents and the Lac Mégantic, Quebec disaster, which resulted in 47 deaths and destroyed much of the town, have underscored the need for safe rail transport of crude oil. The DOT has issued a safety warning that the crude oils being shipped by rail from the Bakken region may be more flammable than traditional heavy crude oil. In May 2015, the DOT issued a final rule to strengthen safety of tank cars transporting flammable liquids.

4.3.1.8 Pipeline Systems [1700 series]

Description: This SRA includes the development, operation, monitoring, and inspection of offshore and onshore pipeline systems used to transport oil between facilities. It covers the pipeline system design, procedures, and equipment for pipeline operations and inspection protocols to prevent, detect, and mitigate oil discharges. Pipeline research under this SRA also includes technologies to prevent (detection/characterization and repair of anomalies before failure) and detect failures, as well as monitor/control systems that can rapidly isolate and shut down operations in order to minimize spillage when failures occur.

Importance: A significant number of oil discharges occur from the more than 182,000 miles of hazardous liquid pipelines in the U.S. PHMSA (2015) pipeline spill statistics document that between 1995 and 2014, there were 2,694 significant hazardous liquid pipeline incidents, 2,614 (97 percent) were onshore. These incidents accounted for the discharge of about 2.2 million

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barrels and more than three billion dollars in property damages. Several major pipeline spills have occurred causing significant damage to aquatic environments and residential areas. Other pipeline spills in remote areas have gone undetected for long periods of time. Advanced system designs and the effective application of improved inspection technology have the potential to detect potential failures before they occur, while improved detection systems have the ability to identify leaks quickly, potentially reducing the size and effects of the discharge.

4.3.2 Preparedness SRAs

The two SRAs under the Preparedness Class cover research that: 1) supports the collection of baseline data needed to assess the effects of oil spills under the Injury Assessment and Restoration Class, and 2) develops information management tools and systems to improve the ability of response organizations and responders to collect and analyze information during an incident.

4.3.2.1 Pre-spill Baseline Studies [2000 series]

Description: This SRA includes research to characterize and analyze baseline data on the natural environment, human health, and socio-economic characteristics in areas at risk for oil spills. Research includes risk assessments conducted in areas involved in the oil production and transportation systems to identify locations most at risk from pollution events and therefore priority candidates for baseline studies. Baseline information and studies may include: location and population data on species and their habitats, especially ecologically sensitive species; the epidemiology/human health characteristics of people in potential impact areas; and potential community and economic impacts in these areas (e.g., tourism, commercial/recreational fishing, and seafood industry).

Importance: Having baseline information and data enables scientists to compare pre-and post-oil spill changes in natural, human health, and socio-economic systems to support response decision-making and post-spill damage assessments and restoration activities. It is common to conduct a credible post-spill environmental and economic damage assessment without pre-spill baseline information, using reference sites that were not contaminated for comparative studies. However, the availability of pre-spill baseline information makes the post-spill natural and socio-economic damage assessment task much easier, accurate, and more defensible. Essentially, the better environmental and economic systems are understood before a pollution event, the easier it will be to assess changes to those systems, estimate damage and develop appropriate restoration strategies afterward.

4.3.2.2 Response Management Systems [2100 series]

Description: This SRA includes analysis and development of systems to manage how data and information are collected, analyzed, documented, and shared between and among, the planning/preparedness and response communities, the Incident Command System (ICS), and the

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public. These systems are used to integrate diverse sets of narrative, graphic, and video information and many sets and types of raw and analyzed data. Examples of oil spill information systems include: ICS forms; computer systems; data management software and databases; Geographic Information Systems (GIS); routing, spill and incident management tracking systems; electronic mail and web content; documents, photographs, and video management and archiving systems; communication systems; public information messages and protocols; and graphical displays.

Importance: Information management and decision-making tools are critical to successfully planning for and managing a response and meeting external demands for information about an incident. These systems provide a tool for the incident command to obtain a common operating picture of an incident, to make resource management decisions, and to share appropriate information with all relevant parties. Improving the accuracy and timeliness of the data increases the ability of the incident command to stay abreast of changing situations. Efficient information systems also provide personnel with timely information to give to the public and media, which have a high demand for information to support the 24-hour news cycle.

4.3.3 Response SRAs

The Response Class of research includes 11 SRAs that support improvements to the activities, technologies, techniques, and equipment used during response operations. These SRAs cover all areas from oil detection, behavior modeling, cleanup, and waste disposal.

4.3.3.1 Structural Damage Assessment and Salvage [3000 series]

Description: This SRA includes the development of methodologies and equipment to assess the extent of damage to a stricken vessel caused by collision, allision, grounding, or improper hull stresses during cargo transfers or explosion. This area also includes development of methods and technology to graphically present the implications of various measures that can be implemented to stabilize the vessel's condition, reduce the potential for further pollution, and allow it to be moved safely for repairs or disposal.

Importance: A critical consideration in responding to a casualty is stabilizing the condition of the vessel to prevent loss of life, minimize loss of property, and prevent or minimize discharges of oil. To accomplish this, on-scene personnel must be able to rapidly assess the overall structural integrity and hydrodynamic stability of the vessel to determine the appropriate response measures.

4.3.3.2 At Source Control and Containment [3100 series]

Description: This SRA includes the development of methods, systems, and equipment for containing and recovering the oil at or from the source and for mitigating oil flow from a damaged vessel, onshore/offshore pipeline, and an exploration or production platform,

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temporarily abandoned (plugged) well, or well head once the spill has begun. Such technologies include well-head capping systems, remotely operated vehicles (ROVs) for subsea containment activities, and patching, plugging and sealing systems. This technology is applicable to all geographic/environmental areas (Arctic, terrestrial, water surface, subsurface shallow, and deep and ultra-deep water).

Importance: The logistical difficulties, enormous costs, and limited success experienced during on-water and shoreline cleanup operations make clear the advantages of containing or recovering oil within, or at least near, the source of the oil flow. Recent technological breakthroughs arose from experiences acquired during the 2010 *Deepwater Horizon* oil spill incident. Additional advances in this area could provide substantial return on R&D investment to contain/recover oil at the source and thereby reduce the extent of contamination and ecological and socio-economic impacts if a spill occurs.

4.3.3.3 Chemical and Physical Behavior Modeling [3200 series]

Description: This SRA includes laboratory and theoretical research and field studies aimed at understanding the behavior and characteristics of the full range of petroleum oils including: behavior and transport in the environment, partitioning of hydrocarbon constituents, and physical interaction with other materials in the environment (rock, sediments, and ice). It includes studies of oil behavior and changes throughout the water column from deepwater blowouts. There is particular interest in non-conventional oils such as those produced in the Bakken and Canadian Tars sands (diluted bitumen (dilbit) and synthetic bitumen (synbit)). It also includes the development and verification of numerical models to predict the surface and subsurface movement and weathering (i.e., spreading, evaporation, dispersion, and dissolution) of oil spills. This SRA also includes methodologies to provide accurate model input data to verify model outputs. This SRA includes development of user-friendly programs to enhance contingency planning and to serve as training aides for spill response teams. Models should be available for various spill scenarios at specific locations for different tidal, current, and weather conditions to pre-plan potential boom deployment strategies and estimate response resource needs.

Importance: Predicting the trajectory (movement) and the weathering of spilled oil, its resultant physical properties and behavior in the water, and the extent of contamination are all critical to identifying the appropriate mix of spill response equipment and countermeasures. A fundamental understanding of the fate (chemical behavior and transport) and effects of oil in the environment is critical to effective contingency planning, response operations management, long-term monitoring, and restoration. In addition, knowledge of longer-term fractionation and transport of hydrocarbons, coupled with potential effects on aquatic resources, provide valuable information to help focus monitoring efforts and develop environmentally-relevant restoration plans.

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4.3.3.4 Oil Spill Detection and Surveillance [3300 series]

Description: This SRA principally refers to methods and equipment for characterizing and monitoring oil pre- and post-implementation of response options, and the detection of unknown discharges. This SRA includes surface and subsurface oil spill surveillance including devices, sensors, and systems for detecting and tracking oil spills, determining the area and thickness of the oil slick, and measuring the physical properties of the oil. Examples of equipment considered in this area are: surface oil spill tracking buoys; airborne remote sensors and data analysis systems; fluorometers and light-scattering sensors; and satellite remote sensing data and on/in-water oil detection devices with the ability to conduct nighttime and low light recovery operations. It includes research that provides information to support development of monitoring protocols for subsea and surface responses or improvements to existing ones such as the NRT Atypical guidance or the SMART guidance, as applicable. This SRA also includes evaluation of techniques for autonomous sensing operations and reporting from remote locations where logistical challenges limit human accessibility.

Importance: Finding and characterizing areas of subsurface or submerged oil in onshore (inland) and offshore waters remains a significant research and technology need. Surveillance technologies provide opportunities to locate spills and their source, determine their extent and volume, provide important data to support response operations, and determine the effectiveness of response. The ability to locate concentrations of oil and track slick movements for countermeasures and cleanup planning supports response operations. Thickness and physical properties measurement allow responders to determine the feasibility of mechanical recovery, *in situ* burning and dispersant use. The data obtained from the surveillance can facilitate the efficient deployment of resources for response operations. Surveillance data from response operations can also be useful for improving and validating spill behavior models.

4.3.3.5 In- and On-water Containment and Recovery [3400 series]

Description: This SRA includes the development of methods, equipment, and materials for physically containing and removing oil from the surface of the water, the water column, or on the bottom of the sea/river bed. This SRA focuses on improving traditional equipment such as booms, skimmers, and sorbent materials, as well as developing new approaches to surface containment, and equipment and systems specific to containment and recovery of subsurface oils.

Importance: Mechanical recovery is often the preferred option to physically remove oil from the environment because the use of these devices to respond to oil spills generally does not pose the potential for additional environmental harm. Containment booms are subject to entrainment and splash over when they encounter certain current velocities or wave heights, thereby reducing their containment effectiveness. Developing new boom designs could improve oil containment across a wider range of environmental conditions, including ice-infested and brash-ice infested

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waters. Mechanical recovery is often the most viable recovery option since it is not subject to agency pre-approval requirements (as are the use of dispersant and *in situ* burning (ISB)). The total average on-water recovery effectiveness for larger spills ranges from 5-30 percent of the oil spilled depending upon the type of oil spilled, ambient conditions, and available equipment. Improvements in the speed of skimmer advance and encounter rates, onboard separation/decanting, and enhanced skimming abilities at higher speeds and wave heights, and rapid systems for temporary oil storage of skimmers could significantly improve mechanical recovery efficiencies. Existing technologies have limited success in recovering oil suspended in the water column or located on the sea/river bed.

4.3.3.6 Shoreline Containment and Recovery [3500 series]

Description: This SRA covers new methods, treating agents, and equipment for removing oil from shorelines, as well as mitigating the environmental impact of oil that cannot be removed. Specifically, this SRA includes water washing and flooding techniques, the use of chemical treating agents, and novel applications of mechanical removal techniques and equipment. It also includes analysis, evaluation and decision-making (risk and benefits) for the use of active shoreline oil removal techniques versus passive naturally-occurring processes.

Importance: Oil spills that impact shorelines often result in oiling of natural resources (e.g., beaches, marshes, coral reefs, mangroves) and man-made structures (e.g., breakwaters, seawalls, piers, vessels). Removing the oil or mitigating the impacts of the oil requires a range of viable technologies that can remove/mitigate the oil while minimizing environmental damage from the technology. Implementing technologies also requires knowledge of the relative benefits of foregoing cleanup activities and allowing natural processes to remove the oil.

4.3.3.7 Dispersants [3600 series]

Description: This SRA addresses the use of chemical products designed to interact with marine oil slicks by reducing the oil/water interfacial tension and breaking up the slick into tiny droplets with the aid of wave or other energy sources. Research areas for dispersants include: developing appropriate dispersant applications for cold weather and deep sea environments; increasing dispersant effectiveness for water surface and subsurface applications (e.g., effective on a wider viscosity and emulsification range, and calm sea conditions); reducing ecological effects of individual dispersant components and combined components in the water column; refining vessel, aircraft, and subsurface application methodologies and equipment; developing enhanced monitoring methods and systems for determining the effectiveness of surface and subsurface application of dispersants; determining how to distinguish physically versus chemically dispersed oil; studying the distribution and impact of the chemicals and dispersed oil in the environment; and understanding regional variations in dispersant performance and environmental effects. This SRA may include characterization to enhance the ability to predict dispersant effectiveness on various oil types and at varying application rates, including the

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effectiveness of dispersants on weathered/emulsified oils and in a range of water salinities. This SRA also encompasses studies to determine the suitability of subsea application of dispersants in the Arctic region where the unique conditions (e.g., shallow depths, water salinity, ice-infested water, under-ice discharges) could influence their fate and effects. An important supporting activity is the development of an information database on dispersant product effectiveness, application procedures, and effects. Since dispersants shift the risk from the surface to the water column, additional research is needed to address questions about the potential acute and chronic effects of dispersants on water column organisms and populations at various depths.

Importance: Dispersants are an important tool in spill response when it is critical to mitigate oil slicks, especially those that are large and offshore. Refinements in dispersant formulations to improve their effectiveness, reduce environmental effects, and/or increase understanding about their potential benefits and risks, can allow dispersants to remain a viable option, especially for large offshore spills and other areas where mechanical techniques can fall short in reaching desired levels of effectiveness to remediate spilled oil. Research is needed to address environmental tradeoffs, worker and public health exposures and provide the conditions under which they may be used appropriately.

4.3.3.8 In-situ Burning [3700 series]

Description: This SRA includes equipment and techniques required to ignite and sustain combustion of oil spills on the water, along shorelines, and on land. A source of ignition must be present for the mix of fuel (e.g., oil) and oxidant (e.g. oxygen) in a slick to burn. Because slick thickness is a key variable in determining whether the oil will burn, this research area includes development of equipment such as fire-resistant booms and herders to concentrate the slick thickness, and improved ignition devices. This SRA also includes developing knowledge of the conditions under which this equipment and technique can be applied effectively, including evaluation of use in frigid (i.e., Arctic) environments, where cold conditions and ice limit operational effectiveness of mechanical containment and recovery of spilled oil. This SRA also includes research to develop new methods to enhance burn efficiency and burn weathered, emulsified, and more viscous oils. Research into the production of residuals including soot and other ISB residues, and the techniques and equipment to recover these residues is also included in this SRA.

Importance: The *Deepwater Horizon* incident demonstrated that ISB is a very promising technique for removing large amounts of oil from the surface of the water. For example, on a single day (on June 18, 2010), 16 on-water ISBs resulted in removal of approximately 60,000 barrels of oil from the Gulf of Mexico (USCG, 2011). Another benefit of this technology is that it also reduces the extent of onshore disposal of recovered oil. In addition it can be an effective method of mitigating spills on land and in coastal areas by removing the spilled oil from the surface in lieu of the potential for damage caused by certain mechanical removal techniques or

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longer-term, passive natural degradation processes. An important consideration in Arctic regions is how soot deposition affects the thickness of snow and ice.

4.3.3.9 Alternative Countermeasures [3800 series]

Description: This SRA includes the development and use of various spill response chemicals to treat oil slicks on the surface of the water making the oil more amenable to other recovery techniques, such as mechanical recovery and ISB. These chemicals include solidifiers, herding agents, elasticity modifiers, shoreline pre-treatment agents, and emulsion treating agents (demulsifiers). Development activities include improving chemical formulations, refining application techniques, and conducting studies of effectiveness and environmental effects.

Importance: Alternative countermeasure employing chemicals to treat oil slicks are not frequently used but, in certain cases, can be very effective in improving oil recovery and oil impact mitigation. At present, the countermeasures included in this SRA would typically be used on smaller spills close to shore due to the logistics involved in using them. Their use for larger spills is currently limited. However, development of new formulations of these agents has the potential to increase their utility. Emulsion breakers used on recovered oil could decrease the amount of material for disposal.

4.3.3.10 Oily and Oil Waste Disposal [3900 series]

Description: This SRA includes study and development of analytical methods, procedures, equipment and techniques to manage and dispose of oil, oily water, oiled soils, and oiled debris recovered during both on-water and on land oil pollution incidents. Specific technologies include, but are not limited to, waste segregation, temporary storage, solidification and stabilization prior to landfill disposal or recycling, oil reclamation, incineration, and biological treatment (i.e., land farming and composting). It also includes techniques and equipment for onsite oil-water separation, filtration, and decanting operations that would reduce the volumes of oil/water material that would need to be handled, transported, and disposed.

Importance: Disposal of oil and oiled debris can be a significant problem during major spills, particularly in remote areas. Oil in water tends to emulsify (wave action results in water becoming incorporated into the oil forming "mousse"). Emulsified oil generally occupies a larger volume than the same amount of fresh oil, making waste disposal a significant issue during spill response. In addition to waste recovered during the active response, waste is also generated by decontamination activities, such as cleaning of oiled vessels, hard booms and skimmers, and mechanical shoreline cleanup equipment. Disposal of decontamination waste will likely include the oil, water, and cleaning agents, which further complicates waste disposal options. Research is needed to advance recycling opportunities and disposal treatment technologies for recovered oil waste and reduce the overall waste following a significant oil spill.

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4.3.3.11 Bioremediation [4000 series]

Description: This SRA includes research and technology to exploit the capabilities of microorganisms and plants to accelerate the rate of degradation of oil typically through aerobic degradation, but also through anaerobic degradation processes. Bioremediation is largely an *in-situ* technology as *ex-situ* use requires excavation and further manipulations that may have a greater potential for environmental harm. Research and development opportunities include the development of methodologies for the use of nutrient enrichment and possibly microbes to accelerate the biodegradation process on land, a process called bio-augmentation. This topic area also covers research to understand the conditions needed for effective bioremediation in the presence or absence of dispersants, herders, and other chemical agents. In areas such as coastal wetlands, where stranded oil may have penetrated into the anaerobic subsurface, this research area would include studies to wick the oil up to the surface where aerobic conditions and nutrient enrichment may result in enhanced biodegradation. This SRA also includes development of methodologies to apply bioremediation for more effective response and restoration efforts. For purposes of this OPRTP, bioremediation includes phytoremediation (remediation using plants), a longer-term restoration technique.

Importance: Bioremediation in many cases is used as a polishing step to follow mechanical recovery or other ex-situ treatment strategies. Bioremediation is a less-intrusive alternative to mechanical recovery techniques. This is especially important in environmental habitats and sensitive areas that could be seriously damaged by the use of mechanical recovery techniques

4.3.4 Injury Assessment and Restoration SRAs

The four SRAs in the Injury Assessment and Restoration Class address the development of strategies to recovery from the effects of an oil spill by determining the level of effects and the implications of those effects on the environmental and sociological resources of the affected area. These SRAs primarily support the Natural Resource Damage Assessment (NRDA) process as well as the need to improve restoration techniques and determine ways to minimize the adverse effects of response activities.

4.3.4.1 Environmental Impacts and Ecosystem Recovery [4100 series]

Description: This SRA includes laboratory research, field studies, and modeling efforts to better understand and predict the short- and long-term effects of oil spills at the ecosystem level. It includes research into the short- and long-term recovery of various types of environments and the chronic effects of oil spills on habitat, species, recovery and rehabilitation of wildlife, and community structures. This SRA includes the effects of the oil and the countermeasures and cleanup techniques used to remove the oil. It also includes research to determine the rate of ecosystem recovery both with and without countermeasures and cleanup.

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Importance: This research provides important feedback on the effectiveness of past responses, forms the basis for future decision-making during spill response, and provides input for damage assessment, restoration planning, and development of decision support tools. Knowledge of the environmental and ecosystem effects of different response measures provides decision-makers the opportunity to identify and select methods that maximize recovery and reduce the adverse effects of response.

4.3.4.2 Environmental Restoration Methods and Technologies [4200 series]

Description: This SRA includes development of methods and technologies to facilitate and accelerate the recovery of resources following an oil spill. It includes research into the effectiveness of approaches for environmental restoration. It also includes evaluations and comparisons of the factors affecting success of the restoration methods and technologies. It also involves studying previous restoration efforts, as well as natural recovery, to better understand ways to improve or enhance future recovery from oil spills.

Importance: OPA 90 mandated restoration activities and specifically required that funds obtained through damage assessment and compensation litigation be expended on restoration activities. However, very few proven methods, technologies, or monitoring protocols exist to support restoration activities. Knowing the conditions affecting the success of the methods and technologies provides decision makers with tools for selecting the approaches that would enhance the chance for successful restoration.

4.3.4.3 Human Safety and Health [4300 series]

Description: This SRA includes studies on the effects of spilled oil and oil spill response activities on human health and safety for both workers and the public. It includes the study of oil weathering throughout the water column and the potential concerns relative to worker health and safety. It focuses on the development of monitoring instruments, procedures, and processes to inform personnel engaged in oil spill response activities, as well as the general public, who could be affected by the oil spill and response options. It also includes studies of the safety of fish and shellfish in a spill area to determine if they are safe to market and consume. Research on seafood safety may include petrochemical toxicology and profiling, risk analysis, sampling and testing methodology development, and risk communications.

Importance: Protecting the health and safety of responders and the public is the highest priority during a response. Potential hazards in dealing with oil include fire and explosion, vapor toxicity, and danger from dermal exposure. Physical health hazards can be acute or chronic. There are processes and procedures that can be implemented to reduce these potential hazards. However, some hazards require a further understanding of how oil behaves to inform the potential concerns relative to worker health and safety. Benzene, for example, can present a potential for chronic health hazards such as leukemia, for which an understanding of oil weathering would inform the needed levels of protection. Response operations conducted on the water or shoreline present

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inherent dangers to personnel health and safety ranging from trips, falls, and cuts; injuries from equipment accidents; working in extreme weather conditions (e.g., heat stroke and freezing); and working around environmental hazards. Some response options present additional health concerns such as: the chemicals in dispersants and oil, other chemical countermeasures; bioremediation; and ISB fires. An additional aspect of human health and safety is seafood safety, which is a complex topic involving sampling and analytical plans, equipment and methods, and data interpretation to assess the potential effects on the health of consumers. Development of health and safety techniques and equipment to mitigate these hazards helps the incident command meet its fundamental responsibility to safeguard both responders and the public.

4.3.4.4 Sociological and Economic Impacts [4400 series]

Description: This SRA includes studies on how oil spills and the response to oil spills affect the sociological fabric of communities and their economies. Disciplines encompassed in this research area include sociology, economics, behavioral sciences, political science, and law. It also involves studies on risk communication and community resilience.

Importance: Research is needed to improve communication of risk, decrease scientific uncertainty, and address socioeconomic concerns associated with oil spills. Oil spills and spill response may cause high levels of stress and psychological trauma, including post-traumatic stress. These effects may begin at the individual level and frequently spread to other members of families, and communities whose culture and livelihood are dependent upon the waters and shorelines near an oil spill. Unemployment and loss of income are additional stressors on peoples' lives. Oil spills can also adversely affect social relationships and have disastrous effects on specific individuals and communities in areas where livelihoods depend on use of renewable resources (e.g., fishing). An oil spill can affect the economic livelihood and aspirations of a family as well as an entire community. Typically, the commercial and recreational fisheries and tourism industries experience the greatest economic effects, although a significant number of other economic sectors also may be affected. Research that supplies a broad understanding of the human dimensions of oil spill hazards and identifies better ways to engage and share information using risk communication principles could enhance future decisions concerning sociological and economic effects on community stakeholders and assist those communities in successfully overcoming these obstacles.

4.4 Research Needs

This category represents the research gaps that ICCOPR identified within the SRAs. ICCOPR identifies oil pollution Research Needs during the OPRTP planning cycle through a number of means, including:

- Reports on research programs and results;

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- Analyses of lessons learned from recent oil spill incidents;
- Data and information shared at various workshops, conferences, and technical and policy meetings;
- Development or enactment of new regulations;
- Input shared and collected from correspondence, quarterly meetings, or scheduled public meetings;
- Numbers and types of research projects conducted/managed by industry, academia, and non-governmental organizations; and
- Forecasts of issues or problems associated with changes or expansion in any aspect of the energy distribution system.

For this FY2015-2021 version of the OPRTP, ICCOPR compiled a new baseline list of Research Needs that incorporates those needs identified in previous versions and new ones identified since 1997 as described in Chapter 9. Future versions of the OPRTP will: 1) update the needs to remove those already addressed; and, 2) add new needs that ICCOPR identifies through the needs identification process.

4.5 Projects

Projects are the specific research experiments and studies conducted by a primary investigator that addresses a Research Need. Projects involve a methodological study or technology development with assigned budgets, resources, and personnel. ICCOPR tracks projects conducted by any entity, not just those conducted specifically by ICCOPR member organizations. ICCOPR recognizes the value of research projects by other entities and encourages its partners from industry, NGOs, state research programs, research institutions, academia, and international organizations to identify and pursue projects that address the needs.

ICCOPR will monitor oil pollution research projects from any identified source and classify identified needs within the Research Categorization Framework by SRA. ICCOPR will use the lists of projects and information on the research results as a basis for assessing how well the Research Needs were addressed.

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5. Knowledge Transfer and Advancement

ICCOPR's ultimate goal for the research and technology (R&T) program is to advance information, technologies and regulations that increase the effectiveness of oil spill prevention, preparedness, response, and injury assessment and restoration efforts. The R&T planning process emphasizes and strengthens the roles and responsibilities of the member agencies to assure that research advances the capabilities to reduce oil pollution. The degree to which practitioners implement the results of the R&T program will depend upon the success of the research and how well results are communicated to the oil spill response community. As part of the program, ICCOPR promotes continuous improvement by monitoring the state of knowledge and adjusting the program to meet changing needs.

5.1 Factors Affecting Research and Technology Program Success

The success of the federal oil pollution R&T program depends on several factors: 1) funding; 2) continuity of research; 3) field testing; 4) regional issues; 5) development of new researchers; and, 6) public perception. The importance of these factors to the success of the federal program is discussed below.

5.1.1 Funding

A steady funding stream at appropriate levels is a primary factor to support a successful R&T program. Funding for oil pollution research has been a recognized challenge since the passage of OPA 90. In their review of the 1992 OPRTP, the NAS Marine Board (1993) acknowledged the need for steady funding:

> "An important unresolved issue is funding. The continued evolution and effectiveness of the (OPRTP) plan is in doubt because the additional funding authorized by Congress has not been appropriated. Moreover, little funding under OPA 90 is expected. This short term funding approach poses a significant barrier to most multi-year research. For example, scientists cannot undertake basic research dealing with the nature of oil and sea water mixtures and their response to mechanical and chemical treatment, oceanic environments, and time, because several years of laboratory work and additional time for field testing would be required." *(NAS, Marine Board Commission on Engineering Technical Systems, 1993)*

The Marine Board also noted the problems caused by the boom and bust cycle of research and funding efforts for oil spill cleanup technology:

> "Research and development (R&D) related to oil spills follows a boom-and-bust cycle. After catastrophic spills, when the acute effects of oiled beaches, polluted waterways, and dying wildlife are featured in all the media, there is public outcry and political interest, accompanied by calls for action, for more research, and for better prevention and control measures. Later, as acute effects fade, but longer term and less obvious

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> problems may continue, public interest-and with it political interest-fade. By the time the calls for action are translated into R&D plans, the interest is gone, and the plans typically are neither supported nor funded. When the next catastrophe occurs, everyone wonders why no one has learned more about how to deal with the problem since the last spill. The phenomenon of cyclical attention and lack of sustained interest and resources, coupled with the natural distribution of research assignments among a group of agencies with different underlying responsibilities, has made it difficult to create a coherently planned R&D program." *(NAS, Marine Board Commission on Engineering Technical Systems, 1993)*

Similarly, the National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling (2011) discussed the continued need for funding at an appropriate level:

> "The technology available for cleaning up oil spills has improved only incrementally since 1990. Federal research and development programs in this area are underfunded: In fact, Congress has never appropriated even half the full amount authorized by the Oil Pollution Act of 1990 for oil spill research and development. In addition, the major oil companies have committed minimal resources to in-house research and development related to spill response technology. Oil spill removal organizations are underfunded in general and dedicate few if any resources to research and development..."
>
> "Recommendation: Congress should provide mandatory funding for oil spill response research and development and provide incentives for private-sector research and development." *(National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling, 2011)*

The oil production and distribution system is constantly changing, posing new challenges to managing oil pollution. Wells are being drilled at increasingly greater water depths and in more challenging environments. A warming Arctic Ocean is expected to lead to greater activity there, both in exploration and transportation. Exploration of onshore shale oils and oil sands products, along with transportation by rail and pipeline is also increasing. The ability of research and technology efforts to keep pace with the challenges will be affected by long-term funding levels.

ICCOPR does not receive funding for research. Instead, ICCOPR members fund research using their agency's annual budget appropriations or the Oil Spill Liability Trust Fund (OSLTF) R&T funds. At this time, ICCOPR agencies with access to the OSLTF R&T funds are the USCG, EPA, BSEE, and PHMSA. However, federal budgetary rules count any funds withdrawn from the OSLTF for research purposes against an agency's overall budget, which means that oil pollution research initiatives still must compete against other agency missions to obtain funding. The National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling (2011) made the following comment on the funding levels for oil pollution research:

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> "Specifically, Congress should provide mandatory funding (i.e. funding not subject to the annual appropriations process) at a level equal to or greater than the amount authorized by the Oil Pollution Act of 1990 to increase federal funding for oil spill response research by agencies such as Interior, the Coast Guard, EPA, and NOAA—including NOAA's Office of Response and Restoration."

While mandatory funding, not subject to appropriations, may be impractical, Federal funding for coordinated Federal research, presumably through ICCOPR, is generally recognized as beneficial to the goal of improved prevention of and response to oil spills.

ICCOPR initially used Regional Research Grants authorized by Section 7001(c)(8) of OPA 90 to address regional oil spill issues. The objective of the Regional Research Program was to "coordinate a program of competitive grants to universities or other research institutions, or groups of universities or research institutions, for the purposes of conducting a coordinated research program related to the regional aspects of oil pollution, such as prevention, removal, mitigation, and the effects of discharged oil on regional environments." Congress authorized funding for the program for the fiscal years 1991 through 1995 but not for subsequent years. ICCOPR will consider additional Regional Research Grants if Congress authorizes funding in the future.

5.1.2 Continuity of Research

The ability of research programs or projects to continue to their logical conclusion is an important factor in successfully addressing oil pollution research needs. Changing agency missions, funding priorities, staffing, or site access may interrupt research programs. Breaks in research continuity, if long enough, can result in a "hiatus effect" where key knowledge or learning opportunities are lost. Particularly vulnerable are studies that measure trends over time (i.e., baseline and impact assessment biological studies, oil fate and effects studies, ocean current monitoring). The institutional knowledge resulting from research efforts can also be lost when program lapses or changes prompt employees to leave their federal positions.

5.1.3 Field Testing

ICCOPR recognizes that field testing is a valuable tool to validate laboratory results and to study techniques, treatments and equipment *in situ*. In 1993, the NAS Marine Board recommended that the federal R&T program include controlled field experiments that involve a deliberate, limited discharge of oil to advance research areas (i.e., oil dispersants, ISB, incineration, and bioremediation). The NAS Marine Board noted that laboratory experiments alone cannot replicate real-world process interactions and variables, and accidental spills provide limited learning opportunities because data on pre-spill conditions and/or spill volume usually are lacking. An independent report, "Responding to Oil Spill in the U.S. Arctic Marine Environment", also echoed the need for field testing (NRC, 2014). The report noted that

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countries such as Norway have consistently supported this type of research by permitting controlled spills when clear research needs, methods, and goals have been identified, and responsible cleanup and monitoring plans have been established.

Field tests may be justified when laboratory or other simulated settings (e.g., test tanks) cannot address specific Research Needs and no other open water research projects have addressed them. Experiments in large test tanks (i.e., Ohmsett) provide opportunities to simulate real environmental conditions and bridge the gap between laboratory and actual field experiments; however, they cannot completely replicate actual field conditions. ICCOPR will continue working with policy makers and permitting authorities to explore field testing opportunities. Field tests may be justified when laboratory or other simulated settings (e.g., test tanks) cannot address specific Research Needs and no other open water research projects have addressed them.

5.1.4 Building the Next Generation of Researchers

The federal oil pollution R&T program needs an adequate pool of researchers and policy makers interested in oil pollution research to replace those that are retiring or leaving for other opportunities. College students need to view the oil pollution management and research fields as a viable career path. Interest in pursuing these areas is strongest in the years following a major spill (i.e. *Exxon Valdez*, *Deepwater Horizon*) and decreases as events fade from national consciousness. Thus, generating and maintaining interest by college students about to enter the workforce in oil spill R&T careers is an important element of ICCOPR's efforts.

Several of the ICCOPR member agencies have programs to encourage students to become interested in oil pollution research or management. NOAA and the University of New Hampshire's Coastal Response Research Center (CRRC), educate students on issues related to oil spills and response and works with other university programs to encourage academic interest in the field. The U.S. Coast Guard Academy includes environmental protection and marine safety topics across its curriculum in many forms ranging from drilling technology and petroleum chemistry to the history of spills of national significance. In particular the Marine and Environmental Science major includes specific courses in geochemistry, analytical chemistry, and petroleum and oil spill science, and the Engineering Department offers marine engineering courses focused on the needs of the prevention community. Cadet research projects, which are part of their curriculum, from the Science and Engineering Departments often address oil spill issues.

NASA's DEVELOP National Program fosters an interdisciplinary research environment for students, where applied science research projects are conducted under the guidance of the agency and its partner science advisors. DEVELOP is unique in that young professionals lead projects that utilize NASA Earth observations to address community concerns and public policy issues, including oil pollution research.

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The International Oil Spill Conference (IOSC) Executive Committee, which includes several ICCOPR members, offers a scholarship program and student awards to promote interest in oil pollution research.

ICCOPR also provides annual advice to the NAS GRP on the direction of the GRP program, which includes education and training. A key program objective of the GRP is to support the development of future professionals and leaders in science, industry, health, policy, and education who can apply cross-boundary approaches to critical issues that span oil system safety, human health, and environmental resources.

The DOI's Youth Initiative includes outreach to students at the Ohmsett facility and at the annual Clean Gulf Conference. At the 2014 Clean Gulf Conference several ICCOPR members participated in a day-long outreach session with a local high school's Advanced Placement environmental science class.

5.1.5 Public Perceptions

The NAS Marine Board observed that public reactions and perceptions can play a significant part in making oil spill response decisions, regardless of their scientific validity. Adverse reactions to the use of a technology can lead to political pressures to limit its use. In 2010, public concerns about the use of dispersants during the *Deepwater Horizon* oil spill response prompted interest groups and state agencies to oppose the use of dispersants. Such opposition may increase the need for research to provide additional validation of dispersant safety and efficacy before approval as a response option. The ICCOPR agencies' research programs need to recognize public perceptions about different technologies and factor them into decisions about research initiatives.

5.2 Communicating Research and Technology Efforts

Researchers must effectively communicate their results to the broader oil spill research and response communities to provide the greatest benefit from their efforts. There are many avenues for transferring research knowledge (i.e., meetings, conferences, workshop, seminars, papers, presentations, journal publications, consensus-based best practice reports, and websites of organizations involved or interested in spill response). ICCOPR views communication as a two-way street and uses a variety of mechanisms, discussed below, to transfer research knowledge to stakeholders and to learn of advances by non-federal researchers.

5.2.1 ICCOPR OPRTP

OPA 90 established the ICCOPR OPRTP as the mechanism to inform Congress and the public on the status of oil pollution technologies, research needs and priorities, and agency roles and responsibilities. The 1992 and 1997 versions of the OPRTP provided ICCOPR's assessments of the state of knowledge at that time. This 2015 version updates the assessment of oil pollution

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R&T. ICCOPR intends for future versions of the OPRTP to serve as information sharing documents that provide the current federal perspective on oil pollution research. ICCOPR plans to update the OPRTP every six years to maintain timely information and may publish supplements if warranted.

5.2.2 ICCOPR Biennial Reports to Congress

Section 7001(e) of OPA 90 requires that ICCOPR submit a report biennially on its activities and those of its members during the previous two fiscal years and the anticipated activities for the next two fiscal years. The ICCOPR Biennial Reports to Congress serve as a reference document on ICCOPR activities, member initiatives, and planned activities. Appendices to the reports provide listings of publications by ICCOPR member agencies and descriptions of their research projects.

5.2.3 ICCOPR Meetings

ICCOPR conducts quarterly membership meetings and special meetings with interested stakeholders. The quarterly meetings include a session for agencies to present updates and share results of their research and development efforts. These sessions promotes coordination and collaboration among member agencies. The quarterly meetings also include time for presentations from invited speakers to discuss subjects of interest to the membership.

ICCOPR conducts public and other special meetings with outside organizations to discuss their issues and share oil pollution related information. ICCOPR conducted public meetings to gather input as part of efforts to revitalize ICCOPR and to identify areas of concern for future oil pollution research.

5.2.4 Meetings with Non-Federal Entities

ICCOPR participates in meetings with industry, state governments, NGOs, associations, academia, and other nations to exchange information and promote collaboration and cooperation. Stakeholders frequently ask ICCOPR to address these bodies to explain federal research priorities and initiatives. ICCOPR will continue participating in these meetings and encourage the entities to address the ICCOPR priority Research Needs.

5.2.5 Demonstration Projects

Section 7001(c)(6) of OPA 90 directed that ICCOPR conduct Port Oil Pollution Minimization Demonstration Projects in New York, New Orleans, and Los Angeles/Long Beach. The Great Lakes Oil Pollution Research and Development Act of 1990 amended OPA 90 to include a fourth demonstration in ports of the Great Lakes. ICCOPR conducted two demonstration projects in New Orleans (December 1994) and New York (October 1995). After these first two projects were completed, the USCG determined that they were cost prohibitive and ICCOPR

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agreed that the objectives for the demonstration projects requirement could be met through other means (ICCOPR, 2003). Since 1995, ICCOPR has addressed the objectives through interagency participation in, and support for, regularly scheduled domestic and international oil spill conferences (i.e., IOSC, Interspill, Spillcon).

In 2014, BSEE sponsored a demonstration of oil spill response processes at the 2014 IOSC in Savannah, Georgia. The theme of the On Water and Aerial Technical Demonstration was "A Complete Spill Response System." The objective is to demonstrate oil spill response resources involving new and existing technology configured to increase the response effectiveness through improved detection, tracking and increased encounter and recovery rates.

The 45-minute demonstration on the Savannah River followed a scripted, simulated spill scenario that included: a remote oil detection device that initiated an oil spill alert message with coordinates to the responsible party, spill management team, identified OSROs, and USCG Sector or Captain of the Port and interested parties. Surface oil spill response vessels, unmanned aerial vehicles and submersible response equipment all participated in the joint response effort. A mobile command center managed the demonstration and broadcast information via a live feed to conference participants.

ICCOPR and its member agencies will consider future demonstrations of response technologies within budgetary considerations.

5.2.6 Conferences

Participation in conferences is an important way to communicate research results, showcase technology, and provide opportunities for researchers and response professionals to interact. ICCOPR and its member agencies sponsor, support, and participate in several oil spill-related conferences domestically and internationally. Primary conferences promoted by ICCOPR include:

- International Oil Spill Conference (triennial in U.S.),
- Interspill (triennial in Europe),
- Spillcon (triennial in Australia),
- Clean Pacific (biennial) and Clean Gulf Conferences (annual),
- Offshore Technology Conference (annual),
- Gulf Oil Spill & Ecosystem Science Conference (annual), and
- Arctic Marine Oilspill Program Technical Seminars (annual).

These domestic and international conferences include both technical programs and equipment tradeshows that present the latest issues, products, and technologies available for oil spill and hazardous materials response, spill prevention, marine salvage, cleanup and remediation,

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professional services, and regulatory compliance.

The American Petroleum Institute (API) and the IOSC Executive Committee, which includes several of the ICCOPR agency representatives, worked to make all papers presented at the IOSC since its inception in 1969 available free of charge on the internet (http://ioscproceedings.org/loi/). This service provides a wealth of information specific to the oil spill research community.

5.2.7 Workshops and Seminars

Workshops and seminars are widely used in the oil pollution control community to bring together professionals to discuss specific topics and challenges. ICCOPR member agencies sponsor workshops on a wide variety of topics that address priority research issues.

5.2.8 Publications

The researchers funded by ICCOPR are encouraged to publish their research in peer reviewed journals, conference proceedings, books, special reports, and other publications. Literature generated from research could be from researchers within the traditional oil spill community or from academic scientists and engineers. Research published in peer-review journals, especially ones with high impact factors have value in oil spill litigation cases.

Examples of high impact factor peer-review journals and publications that address marine pollution topics include:

- *Applied and Environmental Microbiology,*
- *Environmental Science & Technology (SETAC),*
- *Environmental Toxicology and Chemistry,*
- *Human and Environmental Risk Assessment,*
- *Journal of the American Medical Association,*
- *Journal of Petroleum Technology*
- *Journal of Toxicology and Environmental Health,*
- *Marine Pollution Bulletin,*
- *Microbial Ecology Journal of Environmental Monitoring,*
- *Nature,*
- *Science, and*
- *Water Research.*

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5.2.9 Newsletters

ICCOPR monitors newsletters published by many organizations that announce news of their activities, highlight specific programs or initiatives, or summarize advancements in R&T. In addition, several of the ICCOPR member agencies also publish newsletters addressing elements of their oil pollution research missions.

5.2.10 Internet and Social Media

ICCOPR and the member agencies use the internet as a tool to provide oil spill research results and news to stakeholders and other users. ICCOPR maintains an internet site (www.uscg.mil/iccopr) to: share documents, provide links to other programs and resources, distribute research reports, announce conferences and other events, and provide news about research developments.

Some of the ICCOPR member agencies maintain websites and are using blogs and social media platforms (i.e., Facebook and Twitter) to share information with the public and researchers.

5.3 Monitoring the Status of Oil Pollution Technologies

The 2015-2021 version of the OPRTP marks a new baseline in ICCOPR's oil pollution research planning efforts, documenting the status of oil pollution Research Needs at the start of the planning process. Future OPRTP revisions, to be issued every six years, will include revised assessments of the status of oil pollution R&T.

Throughout each six-year planning cycle, ICCOPR will track newly identified Research Needs conducted by members, federal partners, NGOs, academia, and industry. ICCOPR will use the Oil Pollution Research Characterization Framework and research protocol described in Chapter 6 of this OPRTP, to compile information on studies that address future priority Research Needs.

ICCOPR will also assess the compiled information to determine the degree to which the priority Research Needs from the previous plan were addressed and then develop a new set of research priorities for the subsequent planning period. ICCOPR may also issue supplements to the OPRTP during a planning cycle to address emerging Research Needs that increase in priority. ICCOPR may periodically review after action reports, GAO reports, and other sources of identified gaps to inform the Oil Pollution Research Characterization Framework for future research needs

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PART TWO – ESTABLISHING RESEARCH PRIORITIES

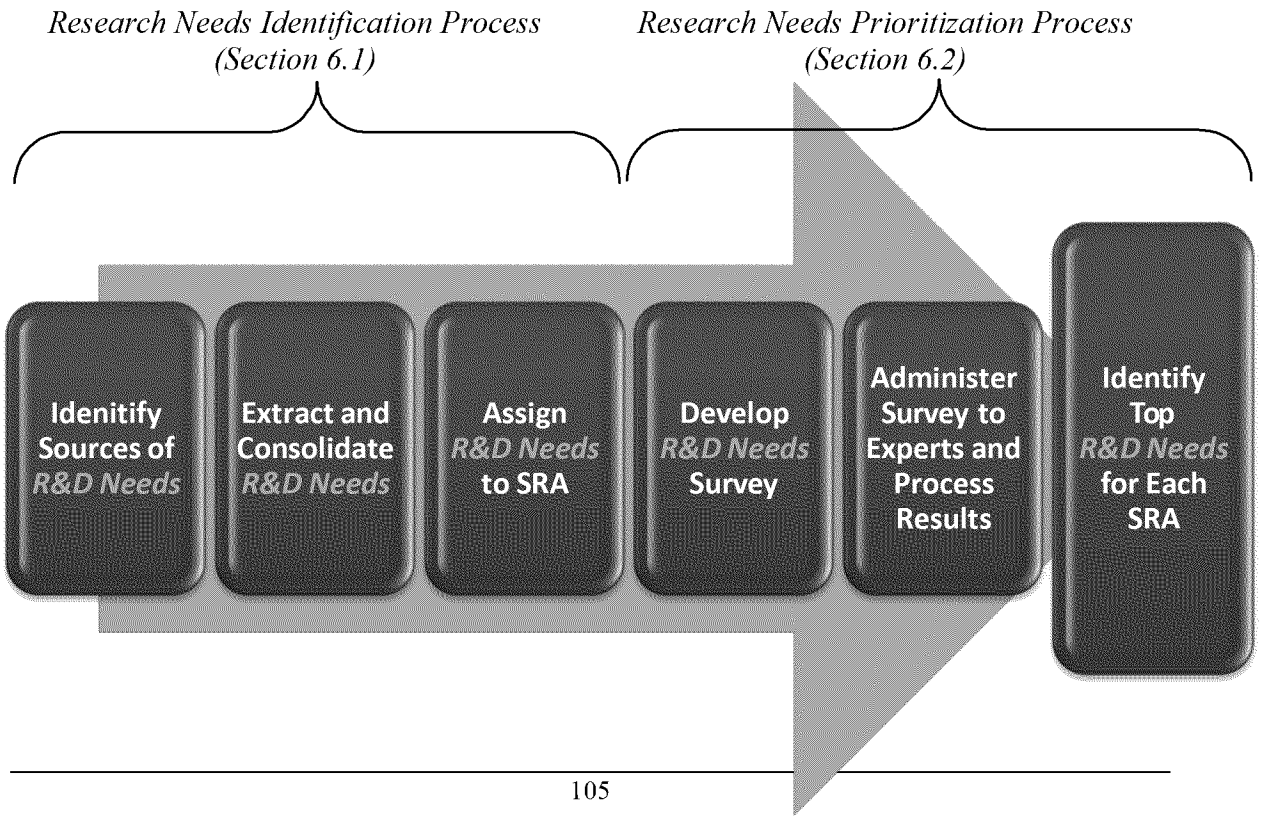
6. Oil Pollution Research Needs Identification and Prioritization Process

A significant number of oil pollution incidents have occurred and a substantial amount of research has been conducted since the completion of the 1997 version of the Oil Pollution Research and Technology Plan (OPRTP). In order to update the OPRTP, ICCOPR needed to develop a process for reviewing the lessons learned from these incidents and addressing any recommendations and gaps noted in the completed research.

ICCOPR established a Research and Technology (R&T) Workgroup with representatives from BSEE, DOE, EPA, NOAA, and USCG to lead development of the revised OPRTP and the Needs Identification and Prioritization Process. The R&T Workgroup was responsible for defining the SRAs, reviewing the Research Needs, and developing the proposed list of research priorities for overall ICCOPR approval.

This chapter describes the systematic process used by the R&T Workgroup to identify and prioritize the nation's future oil pollution Research Needs. Sections 6.1 and 6.2 describe in detail the elements of the process (Figure 6-1). Appendices B through E provide supporting information to the process.

Figure 6-1. Major steps in the Research Needs Identification and Prioritization Processes



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6.1 Research Needs Identification Process

The Research Needs identification process consisted of three steps: 1) identification of Research sources; 2) extracting Research Needs and consolidating them into a database; and, 3) assigning Research Needs to SRAs (Figure 6-1). Research Needs were identified through internet searches; discussions with experts; and detailed review of reports, meeting notes and workshop summaries. The R&T Workgroup considered sources that were published prior to initiation of the identification process in 2013. Needs identified in sources published after the process began will be evaluated and prioritized in the next planning cycle.

6.1.1 Identification of Sources of Research Needs

The first step was to identify all possible sources of new Research Needs published since the 1997 version of the OPRT Plan was released. For purposes of this plan, ICCOPR defined sources as: accident case studies; published papers; research reports; workshop or meeting proceedings; white papers; lessons learned; and agency or organizational opinions. More than 50 unique sources were identified as describing Research Needs that should be included in the database. Examples of sources reviewed include: oil spill incident after-action reports; the 1992 and 1997 versions of the OPRTP; Coastal Response Research Center (CRRC) workshop reports; ICCOPR Public Meeting transcripts; interagency reports; research solicitations and publications.

A complete list of the initial sources reviewed can be found in Table 6-1 and Appendix C. Although it was not possible to review every potential source of oil pollution Research Needs since 1997, the sources used in this plan addressed all of the initial set of 23 SRAs and were viewed as representing a comprehensive list.

Table 6-1. List of Sources Reviewed for Research Needs

Sources Reviewed for the ICCOPR Research Needs (by date)
Title 33 U.S. Code Chapter 40 Subchapter IV 2761 (Aug 1990)
Interagency Coordinating Committee on Oil Pollution Research and Technology Plan (April 1992)
Interagency Coordinating Committee on Oil Pollution Research and Technology Plan (1997)
Coastal Response Research Center - Research and Development Priorities: An Oil Spill Workshop (November 2003)

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Coastal Response Research Center – Workshop: Research & Development Needs For Making Decisions Regarding Dispersing Oil (September 2005)
National Research Council. Oil Spill Dispersants: Efficacy and Effects. Washington, DC: The National Academies Press (2005)
Potentially Polluting Wrecks in Marine Waters: An Issue Paper Prepared for the 2005 International Oil Spill Conference (2005)
EPA Act 2005 Section 999A(b)(4) DOE National Energy Technology Laboratory Complementary Research Program (2005)
Coastal Response Research Center – Workshop: R&D Needs for Addressing the Human Dimensions of Oil Spills (June 2006)
Coastal Response Research Center - Submerged Oil Workshop Report (December 2006)
DOE 2007 Annual Plan Ultra-Deepwater and Unconventional Natural Gas and Other Petroleum Resources Research and Development Program, Report (January 2008)
DOE 2009 Annual Plan Ultra-Deepwater and Unconventional Natural Gas and Other Petroleum Resources Research and Development Program, Report (December 2008)
Coastal Response Research Center - R&D Priorities: Oil Spill Workshop (March 2009)
House of Representatives, Committee on Science & Technology "A New Direction for Federal Oil Spill Research & Development" (June 2009)
DOE 2010 Annual Plan Ultra-Deepwater and Unconventional Natural Gas and Other Petroleum Resources Research and Development Program, Report (December 2009)
Wreck Oil Removal Program Overview (2009)
Prince William Sound Oil Spill Recovery Institute Research Plan 2011-2015 (February 2010)
Gulf of Mexico Research Initiative: Research Themes (May 2010)
Interagency Coordinating Committee on Oil Pollution Research Public Meetings - West (May 2010)
Pacific States/British Columbia Oil Spill Task Force Letter to Interagency Coordinating Committee on Oil Pollution Research (May 2010)

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House of Representatives, Committee on Science & Technology "Deluge of Oil Highlights Research & Technology Needs for Effective Cleanup of Oil Spills" (June 9, 2010)
U.S. Arctic Research Commission - White Paper (July 2010)
Interagency Coordinating Committee on Oil Pollution Research Public Meetings - East (September 2010)
Marine Mammal Commission Letter to Interagency Coordinating Committee on Oil Pollution Research (September 2010)
National Science and Technology Council Joint Subcommittee on Ocean Science and Technology - DWH Oil Spill Principal Investigator Conference Report (October 2010)
Interagency Coordinating Committee on Oil Pollution Research Public Meetings - Gulf (November 2010)
National Academy of Sciences Institutes of Medicine Research priorities for Assessing Health Effects from the Gulf of Mexico Oil Spill (2010)
Deepwater Horizon Incident Specific Preparedness Review (January 2011)
Environmental Protection Agency Draft Oil Spill Research Strategy (January 2011)
National Commission on BP Deepwater Horizon - Final Report (January 2011)
Ultra-Deepwater Advisory Committee 2011 Plan: Comments, Findings and Recommendations (April 2011)
Coastal Response Research Center - Coordinating R&D on Oil Spill Response In the Wake of Deepwater Horizon (July 2011)
Assessing the Long-term Effects of the BP Deepwater Horizon Oil Spill on Marine Mammals in the Gulf of Mexico: A Statement of Research Needs (August 2011)
DOE 2011 Annual Plan Ultra-Deepwater and Unconventional Natural Gas and Other Petroleum Resources Research and Development Program, Report To Congress (August 2011)
U.S. Department of Energy - 2011 Ultra-Deepwater and Unconventional Natural Gas and Other Petroleum Resources R&D Program (August 2011)
Science Advisory Board Review of Environmental Protection Agency's Draft Oil Spill Research Strategy (September 2011)

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National Science and Technology Council's Joint Subcommittee on Ocean Science and Technology - Deepwater Horizon Oil Spill Principal Investigator Conference Final Report (October 2011)
Oil Spill Preparedness and Response Joint Industry Task Force (November 2011)
U.S. Geological Survey. An Evaluation of the Science Needs to Inform Decisions on Outer Continental Shelf Energy Development in the Chukchi and Beaufort Seas (2011)
International Association of Oil and Gas Producers - Joint Industry Programme Solicitation for Expression of Interest (EOI) on Arctic Oil Spills (February 2012)
Coastal Response Research Center - The Future of Dispersant Use in Oil Spill Response Initiative (March 2012)
Ultra-Deepwater Advisory Committee 2012 Plan: Comments, Findings and Recommendations (March 2012)
OESC Letter Recommendations to BSEE Department of the Interior (April 2012)
U.S. Government Accountability Office Oil Dispersants Report (May 2012)
Government and Industry Pipeline Forum (July 2012)
DOE 2012 Annual Plan Ultra-Deepwater and Unconventional Natural Gas and Other Petroleum Resources Research and Development Program, Report To Congress (August 2012)
OESC Letter Recommendations to BSEE Department of the Interior (August 2012)
U.S. Department of Energy - Ultra-Deepwater and Unconventional Natural Gas and Other Petroleum Resources R&D Program (August 2012)
Ultra-Deepwater Advisory Committee 2013 Draft Plan: Findings and Recommendations (November 2012)
Center for Spills in the Environment Alberta Oil Sands Workshop for Maine DEP and U.S. EPA Region 1 (December 2012)
Bureau of Safety and Environmental Enforcement - BAA Proposed Research on Oil Spill Response Operations (2012)
OESC Letter Recommendations to BSEE Department of the Interior (January 2013)

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Center for Spills in the Environment Oil Spill Dispersant Research Workshop Report (March 2013)
Oil Spill Simulants Materials: Workshop Proceedings (March 2013)
University of Washington Transporting Alberta Oil Sands Products: Defining the Issues and Assessing the Risks (March 2013)
Center for Spills in the Environment Alberta Oil Sands Workshop for Washington State Department of Ecology, the Regional Response Team 10 and the Pacific States/British Columbia Oil Spill Task Force (April 2013)
DOE 2013 Annual Plan Ultra-Deepwater and Unconventional Natural Gas and Other Petroleum Resources Research and Development Program, Report To Congress (June 2013)
NRC An Ecosystem Approach to Assessing the Impact of the Deepwater Horizon Spill in the Gulf of Mexico (2013)
TRB Effect of Diluted Bitumen on Crude Oil Transmission Pipelines Special Report 311 (2013)

During the Prioritization Process, the R&T Workgroup increased the number of SRAs to 25 by adding a new "Rail and Truck Transport" SRA and redefining the Onshore and Offshore facilities SRAs to create a new "Pipeline" SRA. The R&T Workgroup reviewed the new and revised SRAs and determined that additional review of sources for the Rail and Truck Transport SRA and the Onshore Facilities SRA were needed. The R&T Workgroup used experts at PHMSA and the EPA to obtain information on potential missing needs for these two SRAs. Table 6-2 lists the supplemental sources reviewed to determine additional Research Needs.

Table 6-2. List of Supplemental Sources Reviewed for Research Needs

Supplemental Sources Reviewed for the ICCOPR Research Needs (by date)
FRA Research Review Conference (2012)
USDOT Emergency Order on Transport of Bakken Crude Oil (2014)
Federal Railroad Administrator Prepared Remarks - 50th Meeting of the Railroad Safety Advisory Committee (2014)
Discussions with U.S. EPA Office of Solid Waste (2014)

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Discussions with PHMSA Office of Pipeline Safety (2014)

6.1.2 Extraction and Consolidation of R&D Needs

A searchable Excel database was created to record information on the source, the applicable environment and the frequency the Research Need was mentioned in the sources reviewed. Initially, more than 900 Research Needs were identified from the source material. After elimination of duplicated Research Needs, the final list consisted of 570 separate Research Needs. This list of 570 Research Needs is located in Appendix B. The original list of more than 900 Research Needs was archived for future use.

6.1.3 Assignment of Research Needs to an SRA

The last step in the Needs Identification Process involved assigning each of the 570 Research Needs to one of the 25 SRAs described in Chapter 4 of this based on the definition of each SRA. Some SRAs had a much larger number of Research Needs than others. SRAs with a large number of needs were further divided into SRA subcategories. The rationale for using subcategories is described in Section 6.2. Figure 6-2 shows an example of the column headings for a typical entry in the Research Needs database.

Figure 6-2 Sample from the Research Needs Database

Standing Research Area (SRA)	SRA Subcategory	Research Need and Key Research Concept	Sources	Physical Location	Sources
Dispersants	Behavior	Constituents - Study chemistry data for individual dispersant components in the oil droplets during the DWH spill.	CRRC - The Future of Dispersant Use in Oil Spill Response Initiative (2012)	Marine and Estuarine	1

6.2 Research Need Prioritization Process

The ICCOPR R&T Workgroup determined that the most effective Needs prioritization process for this OPRTP was to develop a survey (Figure 6-1) that could be distributed to Subject Matter Experts (SMEs) (e.g., scientists, policy makers) familiar with current oil spill research needs. In some areas, there was a need to include state agency, academic, or industry experts in order to find the right expertise to address the R&D Needs

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questions. The Workgroup determined, however, that in no SRA category or subgroup should non-federal employees exceed the number of Federal SMEs. The survey results helped ICCOPR identify and prioritize the most important Research Needs within each SRA.

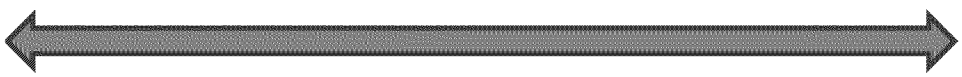
The R&T Workgroup created subcategories for 11 SRAs with a large number of Research Needs to reduce the number of Research Needs that each SME was required to evaluate. The decision to use this approach was based on the experience of UNH Survey Center experts (managers of the survey) who indicated that "survey fatigue" often occurs if a participant is asked to answer a large number of questions, thus affecting the validity of the results. Appendices D through F provide the survey technical report and examples of the survey instrument and results.

The Workgroup compiled a set of proposed priority research Needs for the SRAs and SRA subcategories and presented them to the whole ICCOPR for approval.

6.2.1 Development of Research Needs Survey

The R&T Workgroup developed and debated a series of key questions that reflected the various aspects of the research process and selected the following questions for the survey:

Question 1 - How important is this Research Need in improving any or all of the following: spill prevention, preparedness, response, and/or impact assessment/restoration? (Via sliding scale)



Low Medium High

Question 2 - Some research is designed to answer a small detail which refines our understanding of a research problem while other research answers key questions that become the building blocks for further advancements. Please estimate where this Research Need fits in this spectrum of oil pollution research (Via sliding scale)

Small Detail/Nuance Building Block/Key Question

Question 3 - What would be the estimated cost of the research to answer this Research Need? (Via text box)

Fill in blank text box

Example 50000000; no commas or dollar sign

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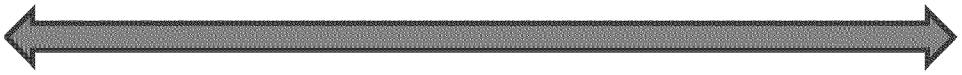
Question 4 - How soon would the results of this specific Research Need improve any or all of the following: spill prevention, preparedness, response, or impact assessment/restoration? (Via sliding scale)



Short (<2 year) 2-5 years Long (>5 years)

Question 5 - Solving research problems can require multiple steps. Some research projects take the initial steps while others will be the final step. Please estimate where this Research Need fits in the lifespan of solving a research problem. (Via sliding scale)

Initial Step Final Step

Questions 1-5 were designed to refer to a specific Research Need within the SRA or SRA subcategory that a SME was assigned. Questions 6 and 7 were designed to be asked at the end of the survey and refer to all of the Research Needs evaluated by an SME.

Question 6 - Of the research needs that you reviewed today, which rise to the top? For each, list (up to 3) impediments (other than cost or time to completion) for these top research Needs you identified. (Answers via text box)

Fill in blank text box

Question 7 - Are there any research needs related to this subject area that you feel need to be addressed, but were not on this list? (Answers via text box)

Fill in blank text box

In addition to the questions described above, the R&T Workgroup decided to ask each SME to provide a range of dollar values that they would expect for research projects associated with their assigned SRA or SRA subcategory. This information was intended to allow the R&T Workgroup to calibrate the difference in project costs between SMEs with different backgrounds and different types of research experience. Unfortunately, the number of responses to the inquiry on potential costs were limited and too variable to be

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of significant value to the decision making process.

The UNH Survey Center built and designed the survey instrument, in conjunction with the CRRC and the R&T Workgroup. A total of 46 separate surveys were developed, one for each SRA or SRA subcategory. Appendix E provides a sample of the survey for one of the Research Needs.

6.2.2 Administration of Survey to SMEs

The R&T Workgroup recruited 285 SMEs to provide at least five SMEs for each of the SRAs and SRA subcategories. These SMEs were selected for their knowledge and expertise in particular SRAs. Responses were received from 223 of these experts; 185 federal employees and 38 non-federal personnel. Survey groups were designed to include a majority of federal employees to avoid Federal Advisory Committee Act (FACA) issues. The UNH Survey Center administered the confidential survey and tabulated the scores.

6.2.3 Processing of Survey Results

In order to determine the highest priority Research Needs, the Survey Center calculated a mean and standard deviation for each of the questions using the answers provided by the SMEs. Questions #3 about costs could not be used in the final scoring because many SMEs did not answer it. The R&T Workgroup weighted the remaining questions based on its knowledge of their importance.

1. How important is this Research Need in improving any or all of the following: spill prevention, preparedness, response, and/or impact assessment/restoration? Weighting **55%**
2. Some research is designed to answer a small detail which refines our understanding of a research problem while other research answers key questions that become the building blocks for further advancements. Weighting **30%**
3. What would be the estimated cost of the research to answer this Research Need? Weighting **0%**
4. How soon would the results of this specific Research Need improve any or all of the following: spill prevention, preparedness, response, or impact assessment/restoration? Weighting **15%**

6.2.4 Identification of Top Priority Research Needs for Each SRA

The priority Research Needs were established based on a review and vote by ICCOPR on the recommended priorities selected by the R&T Workgroup during a series of working sessions during the summer of 2014. The R&T Workgroup's iterative process to select

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the recommended priorities consisted of the following steps:

- Evaluate statistical ranking and analysis of survey results. The UNH Survey Center provided a ranking of Research Needs by the raw and weighted scores and the standard deviations of both scores. The R&T Workgroup used these initial rankings as a starting point for discussions.

- Review missing Needs. Several SMEs identified potentially missing Research Needs in their responses to Question 7. The R&T Workgroup reviewed the suggestions to determine whether a different SRA or SRA subcategory included the Research Need. The R&T Workgroup added missing Research Needs to the appropriate SRA or SRA subcategory and assigned an appropriate rank based on the members' expert opinion.

- Consolidate research Needs. In many cases, an SRA or SRA subcategory listed similar Research Needs. The R&T Workgroup reviewed these similarities and consolidated them where appropriate. The draft ranking was adjusted to reflect the importance of the consolidated Research Need.

- Determine top three recommended priority Needs. The R&T Workgroup considered several factors in making its final recommendation on the three most important Research Needs for each SRA or SRA subcategory: 1) whether the impediments as listed by the SMEs in answer to Question 6 would prevent or severely limit the potential research to resolve the Need; 2) whether completed or ongoing research had already addressed the Research Need; and 3) did the results of Question 5 and 6 distinguish between similarly ranked Research Needs (however, this last factor was rarely necessary). The R&T Workgroup unanimously agreed upon the top three suggested priority Research Needs for each SRA or SRA subcategory before they were presented to the full ICCOPR.

- Develop the final description of each recommended priority Research Need. The R&T Workgroup reviewed the language of each SRA and the associated priority Research Needs to ensure each description was clearly articulated and consistent with the SRA definition.

- Obtain ICCOPR member feedback. The R&T Workgroup sent its draft list of priorities to the full ICCOPR membership for review and comment. The R&T Workgroup adjudicated the comments through discussions with commenting members and a meeting of the R&T Workgroup.

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- Finalize recommended priorities. The R&T Workgroup made its final edits to the recommendations based on the comment adjudication process and met on August 19, 2014 to formally vote on a final set of recommended priorities. The recommendations were sent to the full ICCOPR membership for consideration and adoption.

The full ICCOPR membership discussed the proposed SRA descriptions and the priority Research Needs at the Quarterly Meeting on September 17, 2014. Minor wording changes were made to two Research Needs based on the discussions, and by unanimous vote, ICCOPR adopted the top three priority Needs for each SRA and SRA subcategory as presented in Chapter 9.

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7. Noteworthy Oil Spill Incidents

This chapter provides a summary review of noteworthy oil spills since ICCOPR released the 1997 version of the OPRTP. The case studies describe the incidents, the significant causal factors, response issues, and the identified Research Needs. This section is organized chronologically by the type of incident as classified by the National Response Center:

- Vessel Spills (tank and non-tank),
- Offshore Drilling Operations,
- On-shore Pipeline Spills,
- Facility Spills, and
- Railroad Spills.

Information on the spill and response measures described in the case studies was acquired from various sources including: NOAA's Office of Response and Restoration's IncidentNews (www.incidentnews.noaa.gov) for open water spills; the EPA's OSC website (www.epaosc.gov) for inland spills; and State agency information and DOT reports. The Research Needs listed below the incident summaries were taken from Incident Specific Preparedness Reviews (ISPRs), NOAA OR&R reports; and contracted After Action Reviews (AARs) where available. In cases where specific no Research Needs were identified, the R&T Workgroup reviewed the case study information for applicable Research Needs.

7.1 Vessels Spills

Major spills from tankers have been declining globally for several decades according to ITOPF (2015). However, Spills from all vessels remain an on-going concern. The USCG (2012) reported that between 2001 and 2010 there were 20,710 spills from vessels responsible for more than 6.6 million gallons of oil. Tank barges accounted for more than 60 percent of the volume spilled.

TB Penn

In July 2000, the Tank Barge *Penn 460* ruptured and released ~12,600 gallons of No. 6 fuel oil into Narragansett Bay, Rhode Island, an active fishing and lobstering location. The spill oiled two miles of shoreline and numerous birds. Response measures included: the booming of heavily contaminated areas and surface skimming; low pressure flushing of shoreline and sediments; the use of sorbents and snares (passive collection) near the McAllister Hazardous Waste Landfill; a bird capture program for oiled birds;

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informational handouts on tar balls to the public; and fishery closures in the immediate area.

This incident is an example of a barge tank rupture that leaked heavy fuel oil into an estuary important for fishing and recreation. There were no specific research recommendations following the spill; however, the response action emphasized the need for further research in the following SRA areas:

- **In- and On-water Containment and Recovery (SRA 3400)** - improve boom and surface skimming equipment.
- **Shore Containment and Recovery (SRA 3500) -** develop improved methods for shoreline cleanup.
- **Environmental Impacts and Recovery (SRA 4100) -** develop improved methods of impact assessment and recovery (for fisheries and avian species).
- **Sociological and Human Impacts (SRA 4400) -** determine impacts to humans related to estuarine spills.

T/V Athos I

In November 2004, the single hull tanker *T/V Athos I* struck a submerged object and spilled approximately 264,000 gallons of heavy Venezuelan crude oil into the Delaware River creating a 20-mile slick that affected 214 miles of shoreline across four states (Pennsylvania, Delaware, New Jersey, and Maryland), with some of the oil submerged below the surface. The investigation by the USCG concluded that the vessel struck a submerged U-shaped pipeline while maneuvering en-route to its berth. The pipeline punctured the vessel's bottom plating in the ballast and cargo tanks.

Response included vessel stabilization and prevention of further discharge; facilitation of vessel traffic, as needed; deployment of protective booms and snares; skimming, collection and recovery of floating oil; enforcement of a safety zone; and collection and rehabilitation of injured wildlife. Economic losses were incurred due to delays in transportation on the Delaware River. The Salem Nuclear Power Plant shut down two reactors because submerged oil was identified in the sediment below some water intakes. The Plant shutdown affected regional electrical generation.

This incident was important for its identification of needed technology improvements including: subsurface object detection and the detection, tracking, mapping and recovery of subsurface and submerged oil. Although there were no specific recommendations for future research as a result of the spill and response actions, this spill highlighted the need for research in the following SRAs:

- **Vessel Design (SRA 1400)** - develop double hull designs.

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- **Structural Damage Assessment (SRA 3000) -** develop methods to determine vessel damage.
- **Environmental Impacts and Recovery (SRA 4100) -** develop better methods of wildlife rehabilitation.
- **Sociological and Economic Impacts (SRA 4400) -** study impacts related to primary and secondary economic impacts and costs.

M/V Selendang Ayu

During a large storm in December 2004, the *M/V Selendang Ayu*, carrying a cargo of soybeans, lost power and grounded on the west side of Unalaska Island, Alaska, where it broke into two and released 337,000 gallons of IFO-380 fuel oil, marine diesel, a small amount of lube oil as well as its soybean cargo. Most of the oil was carried onto the rocky shorelines of Makushin and Skan Bays. Half of the vessel sank, while the other half remained afloat, harboring fuel with the potential for additional releases.

Response measures included employing SCAT, an assessment process used for all spills where shorelines are impacted, and manual shoreline cleanup. The potential of an additional release from the floating half of the vessel triggered testing and approval for dispersants and *in situ* burning (ISB), which were not employed. After the initial response, cleanup was halted until April 2005 due to deteriorating winter weather conditions. In the spring, most shorelines were manually cleaned and dry mechanical tilling and berm relocation techniques were used where appropriate. Response actions continued during the weather-permitting seasons until June 2006.

This incident highlighted the difficulty of response operations in the Arctic environment and the availability of suitable response technologies in cold, icy conditions. The After Action Review for the *M/V Selendang Ayu* incident discussed the following specific R&D Needs (Wood & Associates, 2005):

- **Response Management Systems (SRA 2100) -** improve information sharing, including identification of response equipment and resource availability.
- **Chemical/Physical Modeling (SRA 3200) -** develop methods to determine the transportation and fate of oil in Arctic waters.
- **In and On-water Containment and Recovery (SRA 3400) -** develop measures of containment for application in Arctic conditions.
- **Shoreline Containment and Recovery (SRA 3500) -** develop technology improvements for Arctic shorelines and weather conditions.

T/V Bow Mariner

In February 2004, the *T/V Bow Mariner* crew was engaged in cleaning residual Methyl Tertiary Butyl Ether (MTBE) from a cargo tank while in transit. The MTBE caught fire

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and exploded and the ship sank about 45 nautical miles east of Virginia. Twenty-one men died in the incident and all the cargo was lost. The vessel was carrying 3,188,711 gallons of ethanol, 192,904 gallons of No. 6 fuel oil, and 48,266 gallons of diesel, which were all released during the incident. An ignition of a fuel/air mixture, either on deck or in the cargo tanks, caused this casualty; the precise source was not determined. The ethanol, which is miscible in water and diesel oil were dispersed rapidly. The fuel oil created an oil slick that required mechanical recovery. Response actions included fishery closures, and mechanical recovery using skimmers; the vessel was not salvaged. Corexit 9527 was tested for dispersants; however, it was not used due to the cold temperatures and the degree of oil weathering.

A significant contributing factor to this casualty was the failure of the operator, Ceres Hellenic Enterprises, Ltd., and the senior officers of the *Bow Mariner*, to properly implement the company and vessel Safety, Quality and Environmental Protection Management System (USCG, 2005). Although specific R&D Needs were not identified, this incident highlighted the need for research in key SRAs:

- **Human Error Factors (SRA 1000) -** study explosion hazards related to tank cleaning operations
- **Human Error Factors (SRA 1000) -** develop manuals for safe tank cleaning procedures.
- **Human Error Factors (SRA 1000) -** develop adequate training on tank cleaning procedures for crews of vessels carrying explosive materials.
- **Human Error Factors (SRA 1000) -** develop adequate training for multicultural crew cohesiveness.
- **In- and On-water Containment and Recovery (SRA 3400) -** study methods of containment and recovery of ethanol and alternative fuels.
- **Dispersants (SRA 3600) -** study the effectiveness of dispersants in cold water and with weathered oil.

M/V Cosco Busan

In November 2007, the container ship *M/V Cosco Busan* spilled 53,569 gallons of heavy fuel oil from its bunker tanks into San Francisco Bay after the vessel struck the San Francisco-Oakland Bay Bridge in thick fog. The source of the incident was not a tanker transporting crude oil as a component of the oil production and transportation system, but rather a non-tank vessel engaged in maritime commerce spilling oil used to fuel the ship. Investigators concluded that the vessel's pilot was impaired from his use of prescription pharmaceuticals, while piloting the container vessel, which rendered him unable to properly use the onboard radar and electronic navigation charts. The USCG Vessel Traffic Service (VTS) failed to warn the pilot that the vessel was headed for the bridge.

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The master of the *M/V Cosco Busan* did not implement several procedures found in the company safety management system related to safe vessel operations, which placed the vessel, crew and environment at risk.

The spill oiled about 200 miles of coastline. The near shore location, the type of oil, and proximity to sensitive and valuable coastal resources resulted in a substantial response. Response activities included: deployment of containment boom; mechanical collection and removal; natural attenuation; beach closures due to health and safety concerns with the fuel oil and; and oiled bird capture and cleaning programs.

This incident was an important driver for research needs involving human error, crew fitness, and waterways management because of the potential to prevent this incident and others like it had these needs been addressed. The ISPR for the *M/V Cosco Busan* (USCG, 2008a,b) noted these specific R&D Needs:

- **Human Error Factor (SRA 1000) -** develop protocols to report changes in crew fitness to the USCG, in a timely manner, including any substantive changes in their medical status or medications.
- **Waterways Management (SRA 1300) -** develop technology improvements to improve vessel traffic monitoring and communications.
- **Response Management Systems (SRA 2100) -** develop improvements to information management systems that provide timely and accurate information for the Federal On-scene Coordinator about the extent of the spill.
- **Environmental Impacts and Recovery (SRA 4100) -** develop improvements to aid in effective bird capture techniques and identify priorities and resources needed to provide the most effective wildlife rescue.
- **Environmental Impacts and Recovery (SRA 4100) -** develop a framework to make beach closure and reopening decisions and incorporate those into local government plans (coordinated through the Area Contingency Plan (ACP)).
- **Human Health and Safety (SRA 4300) -** develop protocols needed to close, open or restrict fisheries after a spill that are written into emergency plans and develop expedited tests to check whether impacted fish are a health risk.
- **Sociological and Economic Impacts (SRA 4400) -** evaluate proper use of and methods to monitor the use of social media during and after spills.

7.2 Offshore Drilling Operations

The explosion and collapse of the *Deepwater Horizon* drilling platform resulted in the largest marine oil spill in history and revealed several Research Needs associated with offshore drilling operations.

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***Deepwater Horizon (DWH)* Oil Spill**

In April 2010, an estimated 205.8 million gallons of oil began flowing from a subsea well blowout that followed an explosion and collapse of the *Deepwater Horizon* platform (also called the Macondo 252 well) during exploratory drilling. The platform was located approximately 50 miles south of the coast of Louisiana in waters about 5,000 ft. deep. The explosion on the drill rig killed 11 men and injured 17 others. For approximately three months, efforts to stop the flow at the source were unsuccessful until response operations temporarily capped the well on July 15, 2010. The complete well closure occurred on September 18, 2010. The resultant oil spill caused damage to deepwater and nearshore marine and wildlife habitats across the Gulf States and to the Gulf's fishing and tourism industries.

This spill was declared a Spill of National Significance (SONS). Response to the *Deepwater Horizon* spill was diverse and conducted on a larger scale than any previous efforts. Different response mechanisms were deployed depending on the day, the weather conditions, and the amount and location of oiled shoreline. This included: ISB, subsea and surface dispersant use, booming, and skimming. Application of 1.84 million gallons of dispersants, both aerially and sub-sea at the wellhead, was unprecedented, as was the use of controlled ISB (a global record of 411 individual burns were conducted). This spill was the first where dispersants were applied subsea at the wellhead. Existing options failed to satisfy the public expectations, which led to the testing and evaluation of more than 120,000 response technologies through the Alternative Response Technologies Evaluation System (ARTES) Program.

The magnitude and spatial extent of this spill resulted in the collection of a large amount of monitoring and experimental data. A substantial amount of research studying the effects of the spill and the response on the Gulf of Mexico are ongoing. The incident report (USCG, 2011) highlighted the following R&D Needs:

- **Pre-Baseline (SRA 2000)** - ensure minimum standards and consistency for Gulf of Mexico Area Contingency Plans (ACPs).
- **Pre-Baseline (SRA 2000) -** identify Environmentally Sensitive Areas (ESAs).
- **Source Control and Containment (SRA 3100) -** develop improved technology and response protocols for well blowouts.
- **Response Management Systems (SRA 2100) -** develop systems to better meet the needs of oil spill response organizations.
- **Response Management Systems (SRA 2100) -** establish standards and processes for rapid collection, processing, correlation, analysis and distribution of satellite imagery and oil thickness sensors to direct spill response operations with real-time data.

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- **Oil Spill Detection and Surveillance (SRA 3300) -** develop improvements for subsea oil detection.
- **Oil Spill Detection and Surveillance (SRA 3300) -** develop and use enhanced SMART monitoring technologies and protocols in offshore environments.
- **Oil Spill Detection and Surveillance (SRA 3300) -** develop technology to determine oil slick thickness.
- **In- and On-water Containment and Recovery (SRA 3400) -** develop improved and more efficient skimmers and mechanical recovery equipment.
- **In- and On-water Containment and Recovery (SRA 3400) -** use a fully operational Common Operating Picture (COP) available during drills, exercises, and actual events.
- **In- and On-water Containment and Recovery (SRA 3400) -** develop protocols for thorough, independent testing and evaluation of response technologies prior to being used on a spill.
- **Dispersants (SRA 3600) -** study the toxicity of dispersants as a function of oil and dispersant types, and different environments.
- **Dispersants (SRA 3600) -** study dispersant efficacy including volumetric limitations of applications.
- **Dispersants (SRA 3600) -** study dispersant efficacy in mitigation of environmental impacts.
- **Dispersants (SRA 3600) -** develop methods and programs to monitor and track large, dispersed oil plumes.
- **Dispersants (SRA 3600) -** conduct a case study analysis of all aspects of dispersant use including environmental effects of dispersants and dispersed oil.
- **Dispersants (SRA 3600) -** study the effectiveness of dispersants under different environmental conditions (e.g., subsea).
- **ISB (SRA 3700) -** study where ISB can be used as a response option and areas where it can be subject to expedited approval.
- **ISB (SRA 3700) -** study the performance of various fire boom designs and improve technologies for water-cooled and reusable booms.
- **Sociological and Economic Impacts (SRA 4400) -** develop outreach programs for, and incorporate state and local emergency managers into, spill preparedness and response.
- **Sociological and Economic Impacts (SRA 4400) -** Spill of National Significance (SONS) doctrine should be adapted to be more inclusive of state, local and tribal governments in a response.

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7.3 On-Shore Pipeline Spills

There are more than 300 oil and hazardous liquid spills annually along the more than 199,000 miles of hazardous liquid pipelines in the U.S. according to PHMSA statistics. Three such spills illustrate the types of Research Needs for pipeline spills.

Enbridge Pipeline

In July 2010, an Enbridge Energy Partners LLP pipeline (30-in. diameter) ruptured near Marshall, Michigan and spilled an estimated 843,000 gallons of crude oil produced from bitumen sands, also known as oil sands products (OSP). The rupture released the oil into Talmadge Creek and it then flowed into the Kalamazoo River, a Lake Michigan tributary. Heavy rains at the time of the incident affected spill behavior and transport causing the river to overtop existing dams and carry the OSP downstream contaminating 35 miles of the Kalamazoo River. The rains resulted during a 25-year flood event that also carried the OSP into the adjacent floodplain.

At the height of the response, more than 2,500 people were working along the impacted river and shoreline. Response measures for this spill included: fish advisories, river closure for dredging operations to remove sunken oil and oil in sediments, and deployment of sediment traps for oil that was not removed during dredging. A significant portion of the oil submerged in the river making detection and recovery difficult. Numerous methods were tried to recover the submerged oil because globules continued to rise from the bottom when bottom sediments were disturbed. Identification of submerged oil was determined by manually disturbing the sediments with a pole. Oil sheens would form where there was submerged oil. Vacuums or passive methods removed the oil. Passive methods of recovery in place continued for a long period after the spill.

Research Needs influenced by this spill included submerged oil detection and recovery for large areas, and cleanup methods for OSP in floodplains. Additional research needs identified by the NRDA team included:

- **Pipeline Systems (SRA 1700) -** develop new advanced technology for sensing pipeline leaks that will reduce leak detection false alarms for new construction and existing pipelines.
- **Pipeline Systems (SRA 1700) -** improve and develop in-line inspection (ILI) to locate and size defects in girth welds and for long seam defects including cracks in electric resistance welded pipe (ERW).
- **Chemical and Physical Modeling and Behavior (SRA 3200) -** study the behavior of OSP when spilled into rivers including weathering and interactions with sediments.

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- **Oil Spill Detection and Surveillance (SRA 3300) -** improve technology for detection of submerged oil in rivers.
- **Environmental Impacts and Recovery (SRA 4100) -** study the lethal and sublethal impacts of OSP on biota.
- **Environmental Impacts and Recovery (SRA 4100) -** study the impacts of cleanup activity on subtidal and floodplain habitats.
- **Human Health and Safety (SRA 4300) -** study the impacts of air quality on the community and responders from OSP spills.
- **Sociological and Economic Impacts (SRA 4400) -** study the impacts related to lost recreational opportunities from spills.

Yellowstone River Pipeline

On July 1, 2011, a break occurred in a 12 in. pipeline, owned by ExxonMobil Pipeline Company, under the Yellowstone River, 20 miles upstream from Billings, Montana. The ruptured pipeline leaked an estimated 63,000 gallons into the river before the pipeline was closed. USEPA led the response in close coordination with the State of Montana and other federal agencies. EPA's primary concern was protecting people's health and the environment. The river also is known for Yellowstone River cutthroat trout, a Montana fish of concern.

When the Yellowstone River dropped below pre-spill water levels, oil residue was visible in many areas, including some agricultural lands. Farmers were given instructions for crops and livestock. USEPA held ExxonMobil, the responsible party, accountable for assessment, cleanup and restoration. Cleanup crews recovered only about 420 gallons of crude.

As in the case of the Kalamazoo River, the amount of oil spilled was much higher than it might have been due to that lack of coordination and communication among the pipeline operators. In both cases, there was a substantial delay in closing the valves to shut off the flow. In the Yellowstone River incident, it was estimated two-thirds of the spill volume were attributable to the delay. Although there were no specific recommendations for R&D, this spill emphasized the need for:

- **Human Error Factor (SRA 1000) -** better training and coordination for operators.
- **Pipeline Systems (SRA 1700) -** research on methods of inspection of buried pipelines for erosion.
- **Pipeline Systems (SRA 1700) -** improve existing leak detection technology and health monitoring sensors that are miniaturized, automatic, and robust enough to withstand harsh environments.

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- **Environmental Impacts and Recovery (SRA 4100) -** research on the potential impacts of OSP on freshwater fisheries.
- **Environmental Impacts and Recovery (SRA 4100) -** research on the potential impacts and restoration of OSP on crops and livestock.

Pegasus Pipeline

ExxonMobil's Pegasus pipeline carries 3,990,000 gallons per day of crude oil a distance of 850 miles from Patoka, Illinois to Nederland, Texas. The spill occurred on March 29, 2013, when the pipeline carrying Canadian Wabasca heavy crude from the Athabasca oil sands ruptured in Mayflower, Arkansas, about 25 miles northwest of Little Rock. A reported 210,000 - 294,000 gallons of crude were spilled. Approximately 3,990,000 gallons of oil mixed with water were recovered by March 31. Twenty-two homes were evacuated. The EPA classified the leak as a major spill.

The crude oil entered a suburban neighborhood through a leak in the 20 in. pipeline, which was buried an average of two feet below ground. The oil flowed into storm drains leading to nearby Lake Conway, used for recreational fishing. First responders, including fire fighters, city employees, county road crews and police built dikes to block culverts and stop the crude from further fouling the lake. ExxonMobil deployed 3,600 feet of containment boom around the lake. By early morning on March 30, there was no more oil spilling from the pipeline.

The EPA and ExxonMobil conducted air quality monitoring. Overall, air emissions in the community were below levels likely to cause health effects to the public. The Arkansas Division of Environmental Quality (ADEQ) closely reviewed the cleanup, continued to monitor the surface water in the affected areas, and posted regular updates. Although reports identified no specific Research Needs, those that were evident from the Mayflower pipeline spill are similar to Research Needs from the Enbridge Kalamazoo OSP spill:

- **Pipeline Systems (SRA 1700) -** improve and develop in-line inspection (ILI) to locate and size defects in girth welds and long seam defects including cracks in electric resistance welded pipe (ERW).
- **Chemical and Physical Modeling and Behavior (SRA 3200) -** research on OSP weathering and interactions with sediments.
- **Environmental Impacts and Recovery (SRA 4100) -** more research on the impacts of cleanup on habitats.
- **Health and Safety (SRA 4300) -** research on air quality monitoring protocols for OSP spills.

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7.4 Facility Spills

Severe weather events, most notably hurricanes in the Gulf of Mexico and the East Coast, were responsible for several spills from facilities in the inland areas in recent years.

Hurricanes Katrina and Rita

Gulf of Mexico Hurricanes Katrina and Rita caused multi-state pollution events in 2005. In total, there were over 500 spills resulting from these storms. Storm damage caused above ground storage facilities to spill an estimated 8 million gallons of oil. The largest spill totaled 3.78 million gallons. It came from facilities operated by Bass Enterprises Production Company in Cox Bay, just east of Port Sulphur in Plaquemines Parish, LA. Another Bass Enterprises spill totaling 461,000 gallons occurred near Pointe a la Hache, LA. The second-largest spill, 1,050,000 gallons, was from a broken pipeline owned by Shell Pipeline Co. near Pilot Town, LA. Chevron Oil is believed to have spilled 991,000 gallons near Empire, LA and 53,000 gallons near Port Fourchon, LA, while Venice Energy Services Co. is believed responsible for the discharge of 840,000 gallons near Venice, LA. Shell also was responsible for 13,440 gallons discharged near Nairn, also in Plaquemines.

These incidents indicated a significant need to have more effective response plans for spills caused by natural disasters. In 2005, the National Response Plan (NRP) was revised into the National Response Framework (NRF), which established a single, comprehensive approach to domestic incident management to prevent, prepare for, respond to, and recover from all hazards including terrorist attacks, major natural disasters, and other emergencies.

The response actions during these storms although not specifically identified in reports, indicate the need for R&D in the following areas:

- **Pre-Spill Baseline (SRA 2000) -** research to identify ESA species and other sensitive or important resources near fixed petroleum facilities.
- **Response Management Systems (SRA 2100) -** develop systems that support response actions for multiple spills during natural disasters.
- **In- and On-water Containment and Recovery (SRA 3400) -** identify and pre-place equipment to support facility responses during natural disasters.

Super Storm Sandy

On October 29, 2012, Hurricane Sandy, also known as Super Storm Sandy, made landfall in New Jersey and caused severe damage in the New York and New Jersey metropolitan area. Official estimates indicate that 336,000 gallons of diesel fuel from the Motiva oil tank facility in Woodbridge, N.J spilled into the Arthur Kill, a tidal strait, after the Sandy

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storm surge lifted a storage tank and it ruptured. The USCG reported that a secondary containment tank caught most of the oil and that the liquid that escaped moved into the Arthur Kill where booms contained the oil. Two hundred responders were on scene to contain the spill. Initially, an acrid stench filled the air. Air samples collected by the USCG at Arthur Kill showed levels within acceptable thresholds within two days. On the adjacent land, a vacuum truck removed a diesel-and-water mixture next to a local park along the Arthur Kill. Although not specifically identified, the response to this type of storm reflected the research needs for:

- **Response Management Systems (SRA 2100) -** ability to rapidly respond to multiple spills during natural disasters.
- **In- and On-water Containment and Recovery (SRA 3400) -** establish pre-placed equipment to respond to onshore facility spills.

7.5 Railroad Spills

Increased oil production of Bakken crude and Canadian Tar Sands along with limitations on pipeline capacity has resulted in a four-fold increase in rail shipments of crude oil between 2010 and 2014. Two derailments illustrate the types of issues that arise with spills from railroad accidents.

Parkers Prairie Train Accident

On March 27, 2013, a mile-long train hauling oil from Canada derailed in western Minnesota and leaked its crude; the leak was the first major spill of the newly developed North American crude. Fourteen of the 94 cars of the Canadian Pacific mixed freight train left the tracks about 150 miles northwest of Minneapolis near the town of Parkers Prairie. The Minnesota Pollution Control Agency reported three tank cars ruptured and leaked an estimated 20,000 to 30,000 gallons. Cold weather made the crude thicker, hindering the ability to recover the oil.

This incident indicates the need for R&D in the following areas:

- **Rail and Truck Transportation (SRA 1600) -** evaluate accident and incident trends to identify ways to minimize the incident rate of leaks, spills, and damage to the environment due to oil spills.
- **Rail and Truck Transportation (SRA 1600) -** evaluate alternative tank car designs and modifications to minimize risk of oil spills during accidents.
- **In and On-water Containment and Recovery (SRA 3400)** - conduct field tests of cleanup techniques and create protocols for various habitats and conditions.

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Lac-Mégantic Train Accident

On July 5, 2013, a unit train with 72 cars of Bakken crude oil stopped at Nantes, Quebec. The engineer parked and left the train in accordance with an expected shift change. At approximately 00:56 hours on July 6, 2013, the train started to move down the track. It rolled down the approximately 1.2% grade into the center of the small tourist town of Lac-Mégantic, derailed and the locomotives detached from the rest of the train. Since there were no signals or track circuits, the rail traffic controller had no initial indication of the runaway train. Many of the derailed tank cars full of oil exploded and burned in the heart of the commercial district. The accident killed forty-seven people.

Canada's Transportation Safety Board investigated the incident and determined "the braking was insufficient to hold" the runaway train and that the crude was very volatile. The Board also found the tank cars were mislabeled and the crude was more flammable than originally thought. The deadly accident spurred USDOT's Federal Railroad Administration (FRA), to improve safety standards, specifically for the transport of hazardous materials. "No train or vehicles transporting specified hazardous materials can be left unattended on a mainline track or side track outside a yard or terminal, unless specifically authorized." New safety procedures are now in place in the U.S. to reduce the potential for any future incidents occurring. These procedures include requirements for notification prior to leaving an unattended train and mandatory safety inspections by first responders. FRA (2015) also proposed new regulations regarding rail cars carrying crude oil.

This incident indicates additional Research Needs for trains carrying oil in these SRAs:

- **Human Error Factor (SRA 1000) -** increase training in the areas of communication and safety for trainman and dispatchers.
- **Human Error Factors (SRA 1000) -** develop programs for vessel crews to improve their understanding of automated vessel functions.
- **Railway and Truck Transport (SRA 1600) -** analyze hazards and develop corresponding mitigation methods and technologies for headspace gases in tank cars.
- **Railway and Truck Transport (SRA 1600) -** evaluate and determine minimum crew size requirements for safe operations of unit trains.
- **Human Safety and Health (SRA 4300) -** develop protocols for first responders and railroad workers to improve safety and communications in locations where railroads are carrying hazardous cargos.
- **Human Safety and Health (SRA 4300) -** study the impacts of burning crude oil on first responders and residents.
- **Sociological and Economic Impacts (SRA 4400) -** study the economic impacts of a major train disaster on a small community.

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8. Current State of Oil Pollution Knowledge

The ICCOPR research and technology planning process involves continually assessing the current state of oil pollution knowledge. ICCOPR and its members continue to monitor and participate in a wide range of studies, workshops, and other events to gain insight into the state of knowledge regarding oil spill prevention, preparedness, response, and impact assessment and restoration. This chapter highlights some of the major sources of information since the 1997 version of the OPRTP was issued.

8.1 National Research Council - Oil Spill Dispersants: Efficacy and Effects

In 2005, the MMS, NOAA, USCG, and API funded the National Research Council (NRC) to convene a committee of experts to review the state of knowledge on the use of dispersants as a response technology for oil spills. They asked NRC to identify the adequacy of existing information and ongoing research regarding the efficacy and effects of dispersants. The study focused on: understanding the limitations imposed by the various methods used in previous studies; recommending steps to better understand the efficacy of dispersant use; and the effect of dispersed oil on freshwater, estuarine, and marine environments. The NRC completed the report well before the *Deepwater Horizon* oil spill and therefore did not envision the extensive use of dispersants during that response.

The NRC Committee emphasized the need to conduct bench-scale and meso-scale testing in order to be able to better control the environmental factors that are present in large-scale field experiments. They specifically recommended:

- Studies to better predict the effectiveness of dispersants for different oil types and environmental conditions;
- Bench-scale experiments to test effectiveness over a wide range of operating conditions;
- Investigations of the kinetics and transformation products of dispersed oil biodegradation at conditions that represent those that follow significant dilution of the dispersed oil plume;
- Toxicity studies to determine the mechanisms of acute and sublethal toxicity to key organisms from exposure to dispersed oil;
- Wave-tank studies that specifically address the chemical treatment of weathered oil emulsions; and
- Studies to quantify the weathering rates and final fate of chemically dispersed oil droplets compared with undispersed oil.

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8.2 The Coastal Response Research Center Workshops

The Coastal Response Research Center (CRRC) was established as a partnership between the NOAA OR&R, and the University of New Hampshire (UNH) in 2003. The CRRC's complementary organization is the Center for Spills in the Environment (CSE). CSE receives funding from sources other than NOAA.

The primary purpose of the CRRC and CSE is to bring together the resources of a research-oriented university and the expertise of governmental agencies, NGOs, academia and industry to conduct and oversee basic and applied research, conduct outreach, and encourage strategic partnerships in spill response, assessment and restoration. The CRRC and CSE hosted numerous workshops that brought together national and international oil spill experts to discuss future R&D Needs. The following workshops identified Research Needs that are important to the improvement of oil spill response and the understanding of potential effects:

- Research & Development Priorities: An Oil Spill Workshop (November 2003)
- Research & Development Needs For Making Decisions Regarding Dispersing Oil (September 2005)
- R&D Needs for Addressing the Human Dimensions of Oil Spills (June 2006)
- Submerged Oil Workshop Report (December 2006)
- R&D Priorities: Oil Spill Workshop (March 2009)
- Coordinating R&D on Oil Spill Response In the Wake of *Deepwater Horizon* (July 2011)
- A Forum – Oil Spill Research (January 2012)
- The Future of Dispersant Use in Oil Spill Response Initiative (March 2012)
- Oil Spill Dispersant Research Forum (March 2013)
- Alberta Oil Sands Workshop (April 2013) Washington State Department of Ecology, the Regional Response Team 10 and Pacific States/British Columbia Oil Spill Task Force (April 2013)
- Environmental Disaster Data Management Workshop (September 2014)

Research and Development Priorities: An Oil Spill Workshop (November 2003)

This CRRC workshop provided a foundation for a NOAA R&D strategic plan and a road map for funding decisions for five years. The participants considered Research Needs and then prioritized them in terms of short- and long-term research objectives, cost effectiveness, and applicability to response and restoration actions.

The topics were grouped into themes because many overlapped or were similar:

- Physical Transport Forecasting;
- Oil Weathering: Data Development and Modeling;

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- Ecosystem Services: Identification and Valuation;
- Communication: Public and Stakeholder Participation in Response and Restoration;
- Restoration Review;
- Chronic Effects of Oil at Individual and Habitat Levels;
- Methods and Techniques; and
- New Tools for Restoration and Recovery.

Research & Development Needs For Making Decisions Regarding Dispersing Oil (September 2005)

This CRRC workshop used the major topic recommendations from the 2005 NRC study on dispersant efficacy and effects to serve as the basis for the workshop discussion. The NRC report provided recommendations for major research topic areas within six R&D categories:

- chemical effectiveness of dispersant formulations;
- operational effectiveness parameters;
- hydrodynamics and integration of data needed to develop modeling capabilities to predict and evaluate dispersant effectiveness;
- short- and long-term toxicity of dispersants and dispersed oil;
- long-term fate of dispersants and dispersed oil, including biodegradation; and
- development of relevant exposure regimes.

R&D Needs for Addressing the Human Dimensions of Oil Spills (June 2006)

The goal of the CRRC Human Dimensions of Oil Spills Workshop was to bring together a broad spectrum of human dimensions researchers and oil spill practitioners, including industry representatives and regulators, to develop a list of research needs on human dimensions that the Center could use in Request for Proposals (RFPs) and announcements from other funding entities. CRRC specifically designed the workshop to gather holistic perspectives and feedback from all stakeholder groups involved in oil spill response and restoration.

Six research topics were noted as critical components to incorporate into NRDA and other spill response processes. They were:

- Human Use Dimensions;
- Risk Communication;
- Valuing Natural Resources;
- Social Impacts;
- Subsistence;

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- Coordination in Response and Restoration; and
- Environmental Ethics.

Submerged Oil Workshop (December 2006)

The overall goal of this CRRC workshop was to identify Research Needs information on submerged oil pertaining to the following response and restoration topics:

- Detection and Monitoring;
- Fate and Transport;
- Containment and Recovery (including Protection of Water Intakes); and
- Effects and Restoration.

R&D Priorities: Oil Spill Workshop (March 2009)

This CRRC workshop focused on areas where significant Research Needs still existed. This was a follow-up to the 2003 CRRC five-year R&D Needs Workshop. Participants were asked to discuss the needs in the areas of:

- **Spill Response During Disasters** - This area addressed issues that are encountered during natural (e.g., earthquakes, hurricanes, floods) or anthropogenic (e.g., accidents) disasters resulting in nearshore and offshore oil spills. Planning and implementation gaps and health and safety issues were the primary focus.

- **Response Technologies** - This research area addressed planning, implementation, technology and effectiveness issues for response (i.e., bioremediation, surface washing agents, solidifiers, sorbents, dispersants, and ISB).

- **Acquisition, Synthesis and Management of Information** - This research topic focused on practices and methodologies for accessing and using remote-sensing data, real-time observational data systems, electronic data collection via field surveys, and geographic information systems (GIS).

- **Human Dimensions** - This research topic addressed the human dimension as part of a response, including: 1) minimizing social impacts and subsequent response activities; 2) developing strategies to address the long-term socioeconomic effects oil spills have on a region's culture and vitality; 3) translating and incorporating social science research, methodologies, and initiatives into individual and collective response plans; and 4) assessing where social science research "fits" into the spill management structure.

- **Ecological Monitoring and Recovery Following Spills** – This research area focused on: 1) understanding long-term ecological recovery to make informed

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decisions from response to restoration; 2) understanding the ecological factors affecting recovery rates; 3) developing ecological 'metrics' that can be applied by resource managers to develop restoration projects that best compensate for lost resources.

- **Biofuels** – This topic addressed research on first generation biofuel blends in terms of spill response technologies and determination of fate and effects after a spill.
- **Ecological Effects of Oil Spills** – This topic addressed issues around the long-term effects of residual oil in the environment, including the levels and types of adverse effects resulting when oil remains, and the effects of an oil spill that may be magnified by the clean-up technologies.
- **Environmental Forensics** - This topic focused on chemical fingerprinting methods to determine the source and extent of oil resulting from an incident. This information can be important for clean-up, assessment, recovery, monitoring, and associated liability issues.

Coordinating R&D on Oil Spill Response in the Wake of Deepwater Horizon (April 2011)

The CSE organized this workshop to bring together experts from across a broad spectrum of organizations to address the state of future oil spill response research and practices. The overarching goals were to: (1) develop an updated list of Research Needs for response related to dispersant efficacy and effects, spill trajectory modeling, detection of surface and subsurface oil, human dimensions in spill response, seafood safety monitoring and information management; and (2) create a dialogue between researchers and responders in order to ensure translation of research results into practice.

A Forum –Oil Spill Research (January 2012)

The goal of this forum is to encourage dialogue among Principal investigators (PI's) of current research related to oil spill response (e.g., GoMRI, NSF) and industry and government representatives in order to coordinate R&D activities regarding future oil spill response in the wake of the *Deepwater Horizon*.

The objectives of this forum were to review previous and on-going R&D conducted by academic, governmental agencies and industry; present newly funded projects so that everyone is aware of what types of research are being conducted; and evaluate mechanisms for scientific exchange and coordination of oil spill response R&D efforts going forward.

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As defined for this forum, oil spill response R&D encompassed any of the following topics:

- Physical, Chemical and Biological Fate and Transport;
- Biological Effects - Resources at Risk;
- Response Technologies;
- Oil Spill Modeling;
- Monitoring and Detection of Surface, Subsurface and Dispersed Oil;
- Human Dimensions and Risk Communication.

The Future of Dispersant Use in Oil Spill Response Initiative (March 2012)

CRRC convened this workshop with the goal of bringing together federal and state representatives, academic scientists, responders, and other stakeholders to discuss the future of dispersant use in spill response in the United States. The overall goals for the workshop were to:

- Build a fact-based consensus on the trade-offs associated with dispersant use;
- Evaluate the current state-of-knowledge on the monitoring, behavior, effects, and fate of dispersants;
- Identify information gaps; and
- Recommend R&D topics to help inform dispersant use in future spill response.

Oil Spill Dispersant Research Forum (March 2013)

Coordination with research, technology, application, and response is needed to optimize dispersant efficacy and effectiveness. After the *Deepwater Horizon* oil spill, there was an increase of research on dispersants and dispersed oil, with a large amount of research coming from the Gulf of Mexico Research Initiative (GoMRI), BSEE, and industry.

This workshop focuses on enhancing communication about dispersant related research and its application, use, and transition to spill response efforts. It was convened with the goal of encouraging, opening, and continuing dialogue among principal investigators (PIs) of research related to dispersant use and response practitioners. The overall objective was to review prior and current research and development (R&D) conducted by academia, government agencies and industry and evaluate mechanisms for scientific exchange and coordination of these efforts. Specific objectives were to:

- Learn about on-going and newly funded R&D on dispersants and dispersed oil (DDO);
- Determine how on-going and new R&D on DDO can improve dispersant use (assuming that dispersants will continue to be a tool in some spill responses);

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- Develop mechanisms for information exchange/interaction among researchers, practitioners and public/nongovernmental organizations regarding DDO;
- Explore data needs, tradeoffs, and decisions of practitioners regarding DDO before, during and after spills; and
- Identify potential R&D efforts on DDO that could improve dispersant use during future spills offshore. Other goals were to (1) encourage and continue dialogue on DDO among researchers, spill practitioners and NGO's; and 2) foster mechanisms to enhance public understanding;
- Common themes across breakout groups at the meeting included: enhancing and continuing communication between researchers and responders regarding DDO; increasing public outreach and education; and improving comprehensive and transparent transition of research from laboratory to field application. Modeling is a tool that could act as a potential bridge between laboratory research and field application.

Alberta Oil Sands Workshop (April 2013)

The Washington Department of Ecology contacted the University of New Hampshire's CSE to conduct a workshop for relevant state and Federal agencies on the important issues related to OSP characteristics, transportation and response planning. A similar training was conducted for the State of Maine related to transport of OSP and Bakken crude through that State.

The first day of the workshop was an open forum, which provided information to a broad group of stakeholders from the region. The second day was a working session for response practitioners to focus on issues related to potential OSP spill scenarios. Task groups were given four potential scenarios to test the current understanding of OSP and identify future information and other needs. The breakout groups identified actions that could be taken to improve both near- and longer-term OSP spill response.

Environmental Disaster Data Management Workshop (September 2014)

In the wake of the *Deepwater Horizon* oil spill, the significant body of information, including new research, has highlighted the need for improved coordination of data management. It is common for multiple organizations to collect data that vary significantly in quality, collection methods, access, and other factors that affect use by others. These differences result in limitations for use of the data including comparing results or making inferences.

The Environmental Disasters Data Management (EDDM) Workshop, organized by NOAA's OR&R with assistance from CRRC, was the beginning of a project to foster communication between collectors, managers, and users of with a goal to identify and

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establish best practices for orderly collection, storage, and retrieval of data. The objectives of the EDDM project are to:

- Engage the community of data users, data managers, and data collectors to foster a culture of applying consistent terms and concepts, data flow, and quality assurance and control;
- Provide oversight in the establishment and integration of foundational, baseline data collected prior to an environmental event;
- Provide best-practice guidance for data and metadata management
- Suggest infrastructure design elements to facilitate quick and efficient search, discovery, and retrieval of data; and
- Define the characteristics of a "gold standard" data management plan for appropriate data sampling, formatting, reliability, and retrievability.

8.3 Department of Energy (DOE) Programs

DOE's ongoing research within the Office of Fossil Energy is focused on the prudent development of domestic oil and gas resources. Onshore research is coordinated with the USEPA and the Department of the Interior (DOI)/US Geological Survey (USGS). The three agencies jointly developed a framework for Federal research that addresses how to safely and prudently develop the Nation's unconventional oil and gas resources. The unique and specific core research competencies of each agency underpin the synergy of this research effort. This multiagency research strategy includes key research questions the agencies will address in a coordinated fashion. These research questions focus on protecting groundwater and air quality, reducing, reusing, and recycling water used in upstream exploration and production operations, reducing the surface and subsurface impacts of oil and gas exploration and production activities, and improve the understanding for the purpose of mitigating induced seismicity.

Offshore research is coordinated with the DOI/Bureau of Safety and Environmental Enforcement (BSEE). Prior to the BP Deepwater Horizon oil spill, DOE's offshore research had been directed at maximizing the value of the Nation's offshore oil and gas resources while protecting the environment. A recommendation of the President's National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling was that DOE should refocus its offshore research activities. In working with the DOI/BSEE Ocean Energy Safety Advisory Committee, DOE refocused its offshore research program on oil spill prevention. DOE's focus has since been on assessment and mitigation of the risk of loss of well control so as to prevent oil spills. Research pathways include: identification of geologic hazards, well control during the drilling and completion process, integrity of the surface facilities and umbilicals, and subsea reliability and automation.

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8.4 Ultra-Deepwater Advisory Committee Annual Plan Reviews

The Ultra-Deepwater Advisory Committee (UDAC) was formed in 2007 to advise the Secretary of Energy on the development and implementation of programs related to ultra-deepwater (UDW). The Committee, sunset in 2013, provided recommendations for incorporation into DOE's annual plan of research.

In 2011, the UDAC suggested that, because of the *Deepwater Horizon* accident, there should be projects aimed at placing additional measuring instruments in the well and/or at the wellhead to determine the nature of the well fluids, pressures, and their flow status in real time. They recommended that this work be combined with development of secure methods for transmitting the data to the surface and providing timely interpretation. Analysis of the *Deepwater Horizon* incident indicated that a lack of reliable information hampered control efforts from the initial blowout to the final capping of the well. The UDAC also recommended conducting studies of current subsea containment and capture technologies (hardware), including gap analyses and needs for future technologies with emphasis on subsea capture systems that are independent of surface facilities. Because a number of behavioral factors associated with operations, maintenance, and training contributed to the *Deepwater Horizon* incident, the UDAC recommended research aimed at discovering the fundamental attitudes of rig personnel and associated groups to health and safety issues.

In the 2012 review of the DOE offshore research plan, the UDAC indicated that there was a strong emphasis on the engineering aspects of increasing safety, but little attention was given to the aspects of human behavior regarding safety. However, given the causal factors in the *Deepwater Horizon* incident, research into how to conduct the human aspect of operations safety and how to use advanced decision support and backup systems is not only prudent, but also mandatory.

The UDAC indicated that information is limited regarding methods to prevent and respond to catastrophic events, and mitigate the negative impacts of spills in remote, harsh and sensitive environments. Environmental protection and personnel health and safety working in harsh, unique and sensitive marine habitats, such as Arctic waters and tropical coral reef areas, requires additional focus. To accomplish this, the UDAC recommended that a gap analysis be conducted to catalog and characterize the salient differences between operations in the Gulf of Mexico and those environments encountered in drilling and completion in unique and sensitive marine habitats, such as Arctic waters and tropical coral reef environments, to assess the risks that demand more research.

Finally to further improve safety, the UDAC recommended the present scope of expert (case-based) systems be determined, and then benefits and limitations be identified, as

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well as other applications (e.g., cementing, completions, wellbore design), that would reduce the risk when operating in deepwater.

8.5 Deepwater Horizon Oil Spill Principal Investigator Conferences

The *Deepwater Horizon* oil spill focused unprecedented attention on the Gulf of Mexico ecosystem. During the response to the *Deepwater Horizon* event, resource managers and researchers from across the country collaborated to conduct science, monitoring, and response activities to understand impacts from the spill. The data and information collected from those efforts have since been used to make progress towards the long-term goal of protecting and restoring public health and natural resources in the Gulf of Mexico.

In 2010 and 2011, the National Science and Technology Council's Joint Subcommittee on Ocean Science and Technology (NSTC JSOST) convened two major workshops in St. Petersburg, Florida of Principal Investigators (PIs) actively involved in research, sampling, and monitoring activities in response to the *Deepwater Horizon* incident. Each of the workshops was an opportunity for PIs to foster new collaborations, compare initial results, interact with federal agencies, and discuss recommendations for longer-term research activities.

> The October 2010 Conference had six breakout groups. Five groups addressed oil/dispersant: fate and extent; impacts and mitigation in the offshore; impacts and mitigation in coastal areas; impacts and mitigation on living marine resources; and impacts and mitigation on human health and socio-economic systems. The sixth group addressed the use of *in situ* and remote sensors, sampling, and systems for assessing the extent, fate, impacts, and mitigation of oil/dispersant.

The follow-on workshop in October 2011 was an opportunity for researchers to present results of studies that were in progress during the first conference in October 2010. The second conference provided a significant amount of information regarding the spill impacts, early recovery, and the scientific efforts to capture that information. Researchers presented numerous potential research needs going forward. As in the initial 2010 conference, the participants identified a series of overall recommendations and observations about gaps and needs for continued research and ways to improve scientific understanding of Gulf of Mexico science issues.

8.6 Deepwater Horizon Incident Specific Preparedness Review

In January 2011, the USCG Commandant chartered the Incident Specific Preparedness Review (ISPR) for the response to the *Deepwater Horizon* oil spill in 2010 to examine the implementation and effectiveness of the preparedness and response to the incident as

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it related to the National Contingency Plan, Area Contingency Plans, and other oil spill response plans. The report was divided into three main chapters: Planning and Plan Execution, Organization, and Resources and Readiness. The ISRP also provided a list of lessons learned and recommendations.

- **Planning and Preparedness** - There was a general weakness in the USCG's ability to respond to this type of large spill. The problems were the result of budget reductions organizational structure. The agency needs to reassess its readiness programmatically and reinvest to the extent that Marine Environmental Response (MER) is, once again, firmly established as one of the USCG's core competencies.
- **Area Contingency Plans** - The ISPR found these plans to be inadequate for this size of incident. The USCG needs to provide service-wide direction to all Area Committees, develop minimum standards for contingency plans, and establish an oversight, review, and compliance program.
- **Environmentally Sensitive Areas** - In some planning areas, the ESAs were not identified. In some plans where the areas were listed, they were not prioritized. In a few instances, ESAs did have protection strategies for the heavily affected areas. There must be a national planning process that identifies ESAs and ensures that there are trained personnel, equipment, and strategies adequate to protect these resources.
- **Alternative Response Technologies** - The use of two alternative response technologies, dispersants and ISB, proved critical to preventing wholesale impacts to ESAs. This was possible because the spill characteristics, location, and distribution of ESAs were favorable to the use of these technologies. However, important concerns and questions remain about their impacts on the environment, and more research is necessary before bringing them into the mainstream of spill response options. The use of dispersants during the *Deepwater Horizon* incident identified a need for a thorough review of this response option, its efficacy in minimizing environmental impacts, its overall effect on the environment, and conditions under which they are most effective. Dispersant protocols and authorization procedures should be established and articulated in ACPs. The National Response Team should require that all RRTs establish ISB guidelines as a viable response option in their area of responsibility, consistent with public health and safety issues.
- **Effective Daily Recovery Capacity (EDRC)** - EDRC is the planning standard used to estimate the rate at which mechanical means (e.g., skimmers) can recover an amount of oil and rate capabilities of oil spill removal organizations (OSROs). Revised EDRC requirements could stimulate OSROs to invest in response research and development, with the goal of developing skimmers and other recovery equipment that are more efficient.

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- **Funding** - Many of the recommendations provided in the report require additional or new funding. The *Deepwater Horizon* incident showed the response community and the public that a "business as usual" approach to funding would not work.
- **National Response Framework (NRF)** - The USCG should fully implement its policy on connectivity with the NRF, including an expanded outreach program to state and local emergency managers through sector participation with Local Emergency Planning Committees, and District participation with Regional Interagency Steering Committees.
- **Crisis Leadership** - The *Deepwater Horizon* incident placed individuals into crisis management roles, and not all were able to demonstrate the required leadership. The National Incident Command concept worked very well during this incident, and it provides a model for selecting individuals with the necessary crisis management skills to lead response efforts and to manage effectively future national incidents.
- **Lessons Learned** - The USCG needs to formally address lessons learned, institutionalize them through programmatic changes, and in some cases, through cultural changes.

8.7 National Commission on BP Deepwater Horizon - Final Report

In January 2011, the National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling (Commission) issued their Report to the President – Deepwater: The Gulf Oil Disaster and the Future of Offshore Drilling. The Commission's complete recommendations in the report reflect the government's sweeping sovereign authority as owner of the seabed and water column and, as the regulator of activities there, with the overriding responsibility to manage and protect the valuable resources of the outer continental shelf (OCS) on behalf of current and future generations. The Commission's report grouped recommendations in nine distinct areas:

- Improving the safety of offshore operations through greater government oversight and control including a new regulatory organizational structure;
- Improving the safety of offshore operations by industry through greater emphasis on a more risk based approach to operations and safety;
- Safeguarding the environment;
- Strengthening oil spill response, planning, and capacity;
- Advancing well-containment capabilities;
- Overcoming the impacts of the *Deepwater Horizon* spill and restoring the Gulf;
- Ensuring financial responsibility;
- Promoting Congressional engagement to ensure responsible offshore drilling; and

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- Developing approaches for frontier regions to incorporate lessons learned during the *Deepwater Horizon* oil spill.

Within each of the major categories, the Commission had additional specific actions and recommendations to improve offshore drilling prevention, preparedness, response and environmental protection and restoration.

The Commission Staff Working Paper No. 7, "Response/Clean-up Technology Research & Development and the BP Deepwater Horizon Oil Spill," documented the state of research and development by the private sector and federal government specific to containment and well-control technology. The paper was provided to the full Commission for consideration as it deliberated it report to the President. The paper discussed three basic questions:

- Does the private sector invest less than the socially optimal amount in response/cleanup technology?
- Do federal agencies lack adequate long-term funding to maintain response/cleanup preparedness?
- Can the federal government and industry create a set of incentive for private companies and government agencies that would optimize levels of investment in response/cleanup technology?

The paper concluded that there was a response R&D gap. The paper suggested that the National Commission consider:

- Recommending language in OPA 90 to guarantee the full oil spill research authorization provided in the Act as originally intended.
- Recommending OPA 90 be amended to guarantee sustained and additional funding for Ohmsett.
- Recommending ways to stimulate the cleanup technology market and incentivize related R&D,
- Recommending that the EDRC regulations be revised to give an incentive for response companies to employ the most efficient recovery equipment.
- Recommending that EPA streamline the permitting process for open-water testing and that EPA loosen its oiled-water discharge requirements for technology testing purposes.

8.8 Public Meetings, Letters, and Reports Submitted to ICCOPR

As part of the R&T planning process, ICCOPR held three public meetings in 2010 to solicit input on future oil pollution research needs. ICOCPR advertised the public meetings in the Federal Register and conducted them on the West, East, and Gulf Coasts to obtain different regional interests and perspectives.

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In addition to the public meetings, ICCOPR also received letters from the Pacific States/British Columbia Oil Spill Task Force, the U.S. Arctic Research Commission, and the Marine Mammal Commission and a report entitled "Assessing the Long-term Effects of the BP Deepwater Horizon Oil Spill on Marine Mammals in the Gulf of Mexico: A Statement of Research Needs."

8.9 National Research Council: Responding to Oil Spills in the U.S. Arctic Marine Environment

A group of organizations requested that the National Research Council of the National Academy of Sciences conduct a study of the current capabilities to respond to oil spills in the Arctic. ICCOPR sponsors included the USCG, BSEE, BOEM, NOAA, and USARC. Other sponsors included API, Marine Mammal Commission, and OSRI. The report had four main sections: 1) Environmental Conditions and Natural Resources in the U.S. Arctic; 2) Arctic Oil Spill Response Research; 3) Operations, Logistics, and Coordination in an Arctic Oil Spill; and, 4) Strategies for Response and Mitigation. Each section described the current state of knowledge or capabilities of the U.S. response organizations and made recommendations for an effective prevention, preparedness, and response system.

NRC released the report after ICCOPR had completed the Research Needs Identification Process (see section 6.1) and was in the Needs Prioritization Process (see section 6.2). The R&T Plan Workgroup reviewed the NRC report and determined that the recommendations were consistent with the Research Needs already under consideration. The Workgroup used the NRC recommendations as a factor in selecting priority Research Needs.

8.10 National Petroleum Council: Arctic Potential – Realizing the Promise of U.S. Arctic Oil and Gas Resources

In 2013, the Secretary of Energy commissioned the National Petroleum Council (NPC) to conduct a comprehensive study considering the research and technology opportunities to enable prudent development of U.S. Arctic oil and gas resources. The study included an in-depth assessment of available offshore oil and gas technology, ongoing research, and research opportunities, in six areas:

- Ice characterization
- Oil and gas exploration and development
- Logistics and infrastructure
- Oil spill prevention and response
- Ecology, and
- Human environment.

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The report includes extensive information on the state of knowledge on Arctic technologies and operations, spill prevention and response capabilities, and the ecological and human environment. The NPC issued the Executive Summary of the report in March 2015 after ICCOPR had completed the prioritization process and was in the final stages of developing the text of this OPRTP. As such, the NPC report was issued too late for ICCOPR to consider it in developing this version of the Plan. However, ICCOPR will continue to review the NPC report and use it as a source of information.

8.11 Industry Reports

The oil and gas industry convened the Joint Industry Oil Spill Preparedness and Response (OSPR) Task Force (JITF) in June 2010 to evaluate procedures and lessons learned during the *Deepwater Horizon* oil spill response. The initial focus of the JITF was to identify potential opportunities for improvement to oil spill response systems in the areas of planning and coordination, optimization of each response tool, R&D, technology advancement, and training/education of all parties preparing for or responding to an oil spill. The JITF spent several months developing and prioritizing project plans to address each preliminary recommendation, and subsequently received approval and Industry funding for a multi-year work program. The JITF divided its recommendations into seven categories, or work streams:

- Planning;
- Dispersants;
- Shoreline protection and cleanup;
- Oil sensing and tracking;
- *In-situ* burning;
- Mechanical recovery; and
- Alternative technologies.

Nine oil and gas companies established the Arctic Oil Spill Response Technology Oil Joint Industry Programme (JIP) to further build on existing research and improve the technologies and methodologies for Arctic oil spill response. The goal of the JIP was to advance Arctic oil spill response strategies, improve equipment and increase understanding of potential impacts of oil on the Arctic marine environment. There were seven key areas of research addressed by the JIP specifically for the Arctic:

- Dispersants;
- Environmental effects;
- Trajectory modeling;
- Remote sensing;

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- Mechanical recovery;
- *In-situ burning*; and
- Field research.

8.12 Prince William Sound Oil Spill Recovery Institute (OSRI) Research Plan 2011-2015 (February 2010)

The Prince William Sound (PWS) Oil Spill Recovery Institute (OSRI) was authorized in 1990 by the United States Congress to "identify and develop the best available techniques, equipment, and materials for dealing with oil spills in the Arctic and sub-Arctic marine environments" (Title V, Section 5001, Oil Pollution Act of 1990). OPA 90 amendments in 1996 and 2005expanded the area of emphasis and extended the life of OSRI programs until one year after the completion of oil exploration and development efforts in Alaska.

OSRI sponsors research programs on physical oceanography and meteorology designed to improve the ability to forecast weather and ocean conditions. OSRI works with a wide array of industry and agency organizations to sponsor technological improvements for oil spill response. This includes contributing to the testing of new skimmer technologies, sensitivity index maps, and sponsoring workshops to identify best practices and research needs. It supports K-12 classroom programs and recently worked to include more technology in the education programs. With the increased desire by industry to develop offshore regions of the Arctic, there is greater emphasis on improving technologies for oil spill response in ice-laden waters.

OSRI's 2011-2015 Research Plan outlines the priority research areas that it will be funding:

- Interdisciplinary approaches to understanding the fate and effects of an oil spill in the Arctic and the recovery of that oil;
- Development of response tools to assist responders to mitigate the impact of spills in the Arctic; and
- Communication and education of the public on the issues related to oil spills in the Arctic.

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9. Oil Spill Research and Technology Priorities

ICCOPR selected 150 priority oil pollution Research Needs to address the 25 SRAs and SRA subcategories using the deliberative process described in Chapter 6. These priorities represent the federal opinion on where federal research programs should focus in order to make the most progress to addressing the overall Research Needs. Each federal agency should consider these priorities as they make their research investments. ICCOPR encourages non-federal research programs to use these priorities as well. ICCOPR will track progress toward addressing these priorities during the next planning cycle and establish a new set of priorities at that time.

ICCOPR organized the priority Research Needs by the four major Classes of research: Prevention, Preparedness, Response, and Injury Assessment and Restoration (Figure 9-1)

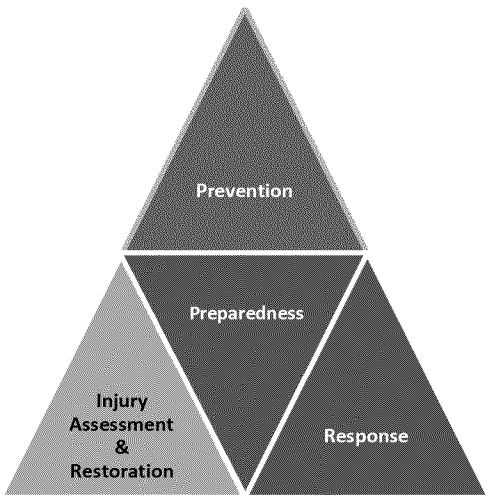

Figure 9-1 - The Oil Spill Research Categorization Framework

As discussed in Section 4.1, this framework embodies the concept that the research in each Class can inform and support the research from other classes; and that the Preparedness class plays a central role in supporting them all. Member organizations may conduct or support research in a single Class or multiple Classes depending on their specific mission, regulatory responsibilities, and/or expertise.

Table 9-1 lists the Classes and the SRAs they encompass. The following sections present the top priority Research Needs by Class and SRA or SRA subcategory. The order of the three priorities listed within an SRA or SRA subcategory is not indicative of their relative importance. All three are of equal importance. The Classes are:

Prevention Class - Research that supports the development of practices and technologies designed to reduce the likelihood of releases or minimize the volume of oil released into the environment.

Preparedness Class - Research that determines baseline conditions or supports the activities, programs, and systems typically developed prior to an oil spill to improve the

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planning, decision-making, and management processes needed for responding to and recovering from oil spills.

Response Class - Research that supports techniques and technologies that address the immediate and short-term effects of an oil spill and encompasses all activities involved in containing, cleaning up and treating oil in order to: 1) maintain safety of human life; 2) stabilize a situation to preclude it from worsening, and 3) minimize adverse environmental and socioeconomic effects.

Injury Assessment and Restoration Class - Research that involves the collection and analysis of information to evaluate the nature and extent of environmental, human health, and socioeconomic injuries resulting from an incident, and determine and refine the restoration actions needed to bring injured natural resources and services back to pre-spill conditions and make the environment and public whole after interim losses.

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Table 9-1 Standing Research Areas (SRAs) by Research Class

Prevention	Preparedness	Response	Injury Assessment & Restoration
• Human Error Factors • Offshore Facility and Systems • Onshore Facilities and Systems • Waterways Management • Vessel Design • Drilling • Rail & Truck Transportation • Pipeline Systems	• Pre-spill Baseline Studies • Response Management Systems	• Structural Damage Assessment and Salvage • At Source Control and Containment • Chemical and Physical Behavior Modeling • Oil Spill Detection and Surveillance • In- and On-water Containment and Recovery • Shore Containment and Recovery • Dispersants • In-situ Burning • Alternative Countermeasures • Oily and Oil Waste Disposal • Bioremediation	• Environmental Impacts and Ecosystem Recovery • Environmental Restoration Methods and Technologies • Human Safety and Health • Sociological and Economic Impacts

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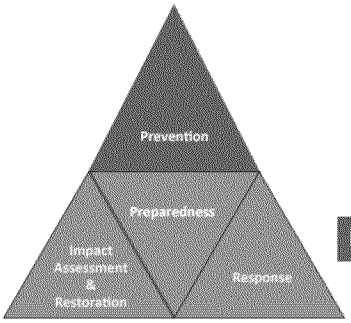
9.1 Prevention Priority Research Needs



PREVENTION

9.1.1 Human Error Factors Priorities (Section 4.3.1.1)

This SRA focuses on how human performance and factors contribute to accidents in the oil production/transportation system. It includes the development of advanced methods and systems for training operational personnel, basic research on operating personnel performance in preventing oil spills (safe navigation on vessels, proper oil transfer practices, analysis/evaluation of equipment monitoring systems, decision-making processes), and the development of methods and technologies to evaluate the ability and knowledge of operating personnel in performing their duties. This may extend to evaluation of the overall management culture and its ability to foster the appropriate organizational safety, preparedness and response operating environment.

The priorities selected focus on improving the performance of individuals to reduce potential spills through better technology and improved training methods. ICCOPR selected Research Needs that emphasized development of innovative training methods by using simulations and gaming. At the operational level, improvements in instrumentation and data interpretation technology are essential to allow better decisions to be made on vessels, in ports, and on railway and pipeline transportation systems.

☐ Improve performance and decision-making by developing innovative training methods including readiness evaluations, gaming and simulators.
☐ Conduct research to determine current level of expertise for operators within modern transportation systems including marine, rail, truck, and pipeline.
☐ Improve and develop sensors; instrumentation; command electronics; and advanced data interpretation technologies and alert systems, including data analysis and expert systems to enhance decision-making capabilities.

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9.1.2 Offshore Facilities and Systems Priorities (Section 4.3.1.2)

This SRA includes: offshore exploration and development wells, platforms, and well control systems; the methods, techniques, and equipment for system reliability inspections; systems to detect, prevent, and mitigate oil and gas discharges; and equipment to regain control of a well blowout or any other accidental discharge. It also includes transfer equipment, storage units, and piping used to transfer oil within the offshore system and connect the system to transfer pipelines. This technology is relevant for the multiple operating environments of exploration and production activities (e.g., Arctic, shallow, deep and ultra-deep waters).

One of the selected priorities acknowledges the special conditions that occur in the Arctic. Another priority recognizes the need to address material integrity in deepwater, the Arctic and other frontier drilling locations.

☐ Evaluate corrosion and corrosion mitigation processes at the splash zone for offshore platforms.
☐ Study effects of ice forces, scour and gouging with respect to prevention of oil spills from offshore facilities.
☐ Conduct studies related to the longevity and integrity of metallic materials used under extreme conditions in relation to new surface treatments and alloys.

9.1.3 Onshore Facilities and Systems Priorities (Section 4.3.1.3)

This SRA includes designs, techniques, operational procedures and equipment for fixed onshore facilities including wells. It covers inspections and systems to detect, prevent, and mitigate oil and gas discharges from the facilities and their systems, including transfer equipment, storage, and piping.

The priorities for this SRA emphasize the need to improve the integrity and operations of onshore facilities. As in other SRAs, the priorities for Onshore Facilities recognize the need to address the effects of emerging crude and Arctic environments on facility infrastructure. There are two subcategories under this SRA: 1) Tank and Piping Inspection, Operations, Design, and Data; and, 2) Emerging Issues.

TANK AND PIPING INSPECTION, OPERATIONS, DESIGN, AND DATA
☐ Analyze upstream and/or downstream causes and magnitude of discharges from tanks, appurtenances, and associated piping.
☐ Develop improved methods and protocols used to determine the imperviousness of secondary containment structures.
☐ Evaluate the efficacy of sorbent and similar technologies used as oil spill control measures for storm water filtration and secondary containment shut-off drains.

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EMERGING ISSUES
Identify the effects of an aging oil storage infrastructure (tanks, appurtenances, and piping systems) and develop methodologies/protocols to predict/minimize failures.
Assess the effects of emerging crude oils and alternative fuels on tanks, appurtenances and piping.
Assess the effects of Arctic and cold weather environments on the operation and maintenance of tanks, appurtenances, and associated piping.

9.1.4 Waterways Management Priorities (Section 4.3.1.4)

This SRA includes methods, equipment, and integrated systems designed to improve navigation at sea and in ports, rivers, and inland waterways. It includes on-board navigation systems, such as integrated navigation and bridge systems and collision avoidance systems. It also includes systems external to the vessel, such as vessel traffic and tracking systems, navigational aids and piloting systems, as well as includes general research into navigation risks, the effects of navigational safety programs, and the development of decision support tools for waterways management efforts. This SRA includes development of navigational channel maintenance programs and analysis of voyage pre-planning processes.

The priorities selected recognize the special nature of operations and navigation in ice-infested waters of the Arctic. They also focus on the need to improve technology on ships and in ports for traffic control.

Improve navigation through enhanced piloting systems, electronic charts and information systems.
Improve systems and protocols needed for traffic control in ports.
Improve Arctic waterways management/vessel accident prevention, including improvements in (a) Arctic communications, (b) emergency response paradigms for vessel accidents (e.g., vessel foundering), (c) ice piloting requirements/qualifications, (d) Arctic weather, and (e) ice forecasting.

9.1.5 Vessel Design Priorities (Section 4.3.1.5)

This SRA includes the development, physical and numerical modeling, and testing of advanced tanker and barge designs to make these vessels less susceptible to damage and less likely to spill their cargoes into the waterways if an accidental grounding, collision or structural failure occurs. This SRA also includes research on non-tank vessel designs

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(e.g., double-hulled fuel and lube oil tanks) to minimize the possibility of spillage from collisions, allisions, and groundings.

The selection of priorities recognizes the significant progress made because of the double hull tanker design mandated by OPA '90. The priorities in this SRA emphasize the design of vessels for survivability during accidents and the tools and models necessary to assess the effectiveness of ship structures to estimate spill potential. ICCOPR recognizes the need for design improvements for operating in the extreme environments of the Arctic.

- Develop designs and methods to improve survivability of ships and structures in damaged condition.
- Develop improved analytical tools (procedures, computer models, and software) to evaluate performance of structures in collisions, allisions, and groundings, so that estimates of damage extent and loss of oil-tight boundaries are available.
- Develop improved designs and analytical tools (procedures, computer models, and software) for design and operation of ships and marine structures in extreme environments.

9.1.6 Drilling Priorities (Section 4.3.1.6)

This SRA focuses on: the design, construction, and placement of wells (deepwater and ultra-deepwater, and onshore); materials, sensors, and systems needed for offshore drilling and production platforms, and well heads/risers; and techniques and equipment for well and facility monitoring and inspection under extreme pressure and temperature environments. Also included are efforts aimed at understanding the chemical and physical characteristics for the full range of petroleum oils under varying conditions of pressure and temperature; predicting their phase/state, behavior and their physical interaction with other materials in the environment (e.g., rock and sediments); and their impact on engineered systems. Example issues include: early kick detection; systems for communicating and responding to changes in downhole parameters; strategies and methods for training operational personnel on the use of advanced technology; systems to detect and prevent oil and gas discharges; and well-head systems and equipment to control wild wells and cap well blowouts.

ICCOPR again recognizes the need to prioritize research that focuses on operational differences in the Arctic. Other research priorities focus on improving drilling systems and the knowledge of complex reservoir conditions to better assess potential incidents related to stratigraphy and hydrocarbon pathways. There are two subcategories to this SRA: Deepwater Drilling and Technology and Reservoir Characterization.

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DEEPWATER DRILLING AND TECHNOLOGY
☐ Evaluate subsea blowout preventer control pod batteries including assessments of battery design, life expectancy, performance, and reliability with respect to different manufacturers.
☐ Conduct a gap analysis on current managed pressure drilling (MPD) techniques to identify future critical needs.
☐ Study the interaction and potential for failure at the interface of each system (formation - cement - instrumentation) and develop advanced downhole tools to assess the integrity of the system *in situ*.
RESERVOIR CHARACTERIZATION
☐ Conduct research, including improved modeling, on the conditions (e.g., *in-situ* stress, sediment rheology, fluid pressure, flow rate, and blowout duration) where hydrocarbon pathways to the sea floor are established through hydraulic fractures and reactivated natural faults.
☐ Characterize reservoirs to identify geologic conditions, such as bounding strata weaknesses that need special engineering considerations to ensure hydrocarbon containment.
☐ Characterize reservoir conditions associated with offshore Arctic oil and gas provinces to identify potential issues in areas of offshore clathrates, sea ice, and other effects.

9.1.7 Rail and Truck Transportation Priorities (Section 4.3.1.7)

This SRA includes the development and testing of rail and truck transport system designs, operations, and infrastructure to make oil tanks less susceptible to damage and loss of cargo during normal operations, train accidents and derailments, or truck accidents. This SRA includes evaluation of vehicle designs, construction materials, spill prevention devices, and loading/unloading systems and equipment. It also includes evaluations of: the physical and chemical characteristics and behavior of the crude oils being shipped, the effects of those characteristics on the tanks during operations and under accident conditions, and systems to control these characteristics. This SRA also includes evaluations of safety systems and processes to: manage the movement and composition of trains and trucks carrying crude oil, prevent accidents and derailments, select preferred shipping routes, and respond safely to an oil spill emergency.

The selection of priorities under this SRA recognizes the increased volume of crude oil transported by rail and truck in response to the energy renaissance in the U.S. and

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Canada. ICCOPR also recognizes the unique characteristics of the crude oils transported by rail and trucks and the hazards they pose under accident conditions.

☐ Analyze hazards and develop corresponding mitigation methods/technologies for head space gases in tank cars.
☐ Evaluate accident and incident trends to identify ways to minimize the incident rate of leaks, spills, and damage to the environment due to oil spills.
☐ Evaluate alternative designs and modifications to minimize risk of oil spills during accidents.

9.1.8 Pipeline Systems Priorities (4.3.1.8)

This SRA includes the development, operation, monitoring, and inspection of offshore and onshore pipeline systems used to transport oil between facilities. It covers the pipeline system design, procedures, and equipment for pipeline operations and inspection protocols to prevent, detect, and mitigate oil discharges. Pipeline research under this SRA also includes technologies to prevent (detection/characterization and repair of anomalies before failure) and detect failures, as well as monitor/control systems that can rapidly isolate and shut down operations in order to minimize spillage when failures occur.

ICCOPR in the selection of priorities recognized the need for better detection technology to prevent incidents and protect human health. In the area of ensuring pipeline integrity, ICCOPR recognized the need to develop technology that will detect potential anomalies and failures in pipeline materials. There are two subcategories for this SRA: Materials and Integrity.

MATERIALS
☐ Develop new advanced technology for sensing pipeline leaks that will reduce leak detection false alarms for new construction and existing pipelines.
☐ Improve existing leak detection technology and health monitoring sensors so that they are miniaturized, automatic, robust and withstand harsh environments.
☐ Evaluate the performance, reliability and failure mechanisms of the use of composites technology for pipelines.
INTEGRITY
☐ Develop technology that detects the presence, location and separation between multiple utilities (underground, through various soil conditions) in a common corridor.

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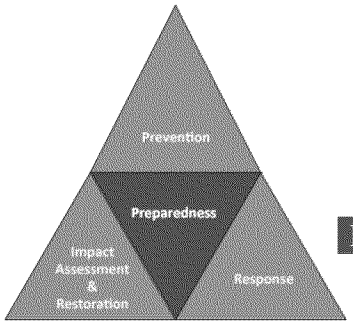
- Improve and develop in-line inspection (ILI) to locate and size defects in girth welds and long seam defects including cracks in electric resistance welded (ERW) pipe.
- Assess the remaining integrity of pipelines that have multiple different anomalies in proximity.

9.2 Preparedness Priority Research Needs



PREPAREDNESS

9.2.1 Pre-spill Baseline Studies Priorities (4.3.2.1)

This SRA includes research to characterize and analyze baseline data on the natural environment, human health, and socio-economic characteristics in areas at risk for oil spills. Research includes risk assessments conducted in areas involved in the oil production and transportation systems to identify locations most at risk from pollution events and therefore priority candidates for baseline studies. Baseline information and studies may include: location and population data on species and their habitats, especially ecologically sensitive species; the epidemiology/human health characteristics of people in potential impact areas; and potential community and economic impacts in these areas (e.g., tourism, commercial/recreational fishing, and seafood industry).

ICCOPR divided this SRA into three subcategories: Habitat and Species Baselines; Oceanographic and Geological Baselines; and Environmental Baseline Planning. In the area of habitat and species planning, there is an emphasis on the need to understand more about important Arctic species, intertidal habitats and species that are often impacted by oil spills, and the deepwater and ultra-deepwater habitats and microbiological assemblages (about which little is known). Some of these environments are or soon will be subject to drilling operations (e.g., Arctic, ultra-deepwater). ICCOPR also identified research needs related to understanding currents and coastal processes in areas where oil and gas extraction occurs to aid in future oil spill response or coastal protection should an incident occur. Research on the amount of variability that exists in baseline data is extremely important in order to document change, identify potential Natural Resource Damages, and establish restoration goals.

HABITATS AND SPECIES BASELINES
☐ Study ecological structure and population of key Arctic indicator species and protected species (including those with subsistence and ecosystem importance) particularly in areas that are likely to be explored/developed for oil and gas extraction in the near to mid- term.

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☐ Study and synthesize existing information for intertidal habitats (i.e., sand beaches, rocky and cobble habitats) regarding productivity, species diversity, community structure, and the effects of oil on these parameters, including recovery time, with consideration for regional variation.
☐ Study ecological structure and population of key indicator and protected species in deepwater and ultra-deepwater (including those with subsistence and ecosystem importance), particularly in areas that are likely to be explored/developed for oil and gas extraction in the near to mid-term.
OCEANOGRAPHIC AND GEOLOGICAL BASELINES
☐ Conduct a series of large-scale Arctic studies of oceanographic exchanges, shelf-basin exchanges via wind and eddies, coastal boundaries, under-ice river plumes, and sea-ice boundaries to better inform pre- and post-spill modeling and response.
☐ Develop a better understanding of coastal processes unique to the Gulf of Mexico (i.e., changing shorelines due to erosion, deposition from the Mississippi River) to help inform protection and recovery strategies for oil spills.
☐ Develop methodologies for using baseline flow characteristic data (such as tidal energy mapping and other energy sources) to support shallow water inlet protection strategies during oil spills.
ENVIRONMENTAL BASELINE PLANNING
☐ Develop models of background variability relative to habitat and species data in various environments where oil is transported or extracted so that the impacts from oil or other stressor(s) can be delineated from those of natural variation.
☐ Evaluate the adequacy of existing ecosystem-based scientific studies for legal defense of Natural Resource Damage Assessment (NRDA) injury assessments for Outer Continental Shelf areas that are currently in production or likely to be explored/developed.
☐ Conduct baseline studies of microbial communities in a variety of areas where oil is transported or extracted (e.g., Great Lakes, rivers, ports, offshore) and their potential for hydrocarbon degradation in the event of a spill.

9.2.2 Response Management Systems Priorities (Section 4.3.2.2)

This SRA includes analysis and development of systems to manage how data and information are collected, analyzed, documented, and shared between and among, the planning/preparedness and response communities, the Incident Command System (ICS), and the public. These systems are used to integrate diverse sets of narrative, graphic, and

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video information and many sets and types of raw and analyzed data. Examples of oil spill information systems include: ICS forms; computer systems; data management software and databases; Geographic Information Systems (GIS); routing, spill and incident management tracking systems; electronic mail and web content; documents, photographs, and video management and archiving systems; communication systems; public information messages and protocols; and graphical displays.

ICCOPR priorities under this SRA recognize the need to upgrade information management systems, develop more rapid methods of incorporating data prior to and during a spill, and improve spill response planning tools. Improved pre-spill planning, development of information management tools, and incorporation of baseline data from current oil and gas extraction areas and potential frontier areas will greatly enhance response should an incident occur.

☐ Develop techniques and/or software for automatically translating data collected from different sources into common, usable formats.
☐ Develop spill planning and response tools based on gap analysis of the availability of countermeasures in different Arctic locations and seasons.
☐ Develop improved information systems for decision-making, including the use of data from coastal mapping, baseline data, and other data related to the environmental effects of oil discharges and cleanup technologies.

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9.3 Response Priority Research Needs

9.3.1 Structural Damage Assessment and Salvage Priorities (Section 4.3.3.1)

This SRA includes the development of methodologies and equipment to assess the extent of damage to a stricken vessel caused by collision, allision, grounding, or improper hull stresses during cargo transfers or explosion. This area also includes development of methods and technology to graphically present the implications of various measures that can be implemented to stabilize the vessel's condition, reduce the potential for further pollution, and allow it to be moved safely for repairs or disposal.

The priorities in this SRA include the need to improve technology to determine the oil and water interface in tanks and develop remote vehicles capable of assessing external integrity of vessel hulls. Another important priority is to evaluate existing wrecks that have the potential to leak petroleum products into marine water.

- Study methods for remotely and rapidly determining whether a cargo tank contains sea water and the extent of the water bottom (height of the oil/water interface from the bottom of the tank).
- Develop technologies and techniques to better determine the presence of oil and the probability of its release from specific sunken vessels.
- Develop improved use of remotely operated vehicles (ROVs) and emerging technologies for underwater assessment of vessel and marine structure integrity.

9.3.2 At-Source Control and Containment Priorities (Section 4.3.3.2)

This SRA includes the development of methods, systems, and equipment for containing and recovering the oil at or from the source and for mitigating oil flow from a damaged vessel, onshore/offshore pipeline, and an exploration or production platform, temporarily abandoned (plugged) well, or well head once the spill has begun. Such technologies include well-head capping systems, remotely operated vehicles (ROVs) for subsea

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containment activities, and patching, plugging and sealing systems. This technology is applicable to all geographic/environmental areas (Arctic, terrestrial, water surface, subsurface shallow, and deep and ultra-deep water).

ICCOPR selected priorities that reflect the difficulties in containing the well during the *Deepwater Horizon* oil spill. The priorities also reflect an anticipated need to provide at source containment in more extreme environments.

- ☐ Study the range of failure states and flow rates for which subsea containment may be required.
- ☐ Develop subsea containment equipment for integration into spill response operations, including relevant procedures and standards for training personnel.
- ☐ Determine how extreme environmental conditions affect at-source containment and control (including Arctic, ultra-deep and other extreme conditions).

9.3.3 Chemical and Physical Modeling and Behavior Priorities (4.3.3.3)

This SRA includes laboratory and theoretical research and field studies aimed at understanding the behavior and characteristics of the full range of petroleum oils including: behavior and transport in the environment, partitioning of hydrocarbon constituents, and physical interaction with other materials in the environment (rock, sediments, and ice). It includes studies of oil behavior and changes throughout the water column from deepwater blowouts. There is particular interest in non-conventional oils such as those produced in the Bakken and Canadian Tars sands (diluted bitumen (dilbit) and synthetic bitumen (synbit)). It also includes the development and verification of numerical models to predict the surface and subsurface movement and weathering (i.e., spreading, evaporation, dispersion, and dissolution) of oil spills. This SRA also includes methodologies to provide accurate model input data to verify model outputs. This SRA includes development of user-friendly programs to enhance contingency planning and to serve as training aides for spill response teams. Models should be available for various spill scenarios at specific locations for different tidal, current, and weather conditions to pre-plan potential boom deployment strategies and estimate response resource needs.

ICCOPR recognized the importance of addressing research needs related to understanding how oil behaves under differing conditions in both fresh and saltwater, and developing models to use during oil spills. ICCOPR specifically identified priority Research Needs to improve the understanding of how oil behaves in the Arctic and how new emerging oils such as oil sands products and Bakken crude oils behave in the environment. There are five subcategories for this SRA: 1) Arctic Behavior and

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Modeling; 2) Oil Behavior Models; 3) Transport Models; 4) Oceanographic Models; and, 5) Emerging Crudes.

ARCTIC BEHAVIOR AND MODELING
☐ Develop improved modeling tools and trajectory models in order to predict spreading of oil in different weather and ice conditions in the Arctic.
☐ Study the fate of oil in Arctic conditions; including open water, ice infested water and oil trapped in ice, particularly as it relates to the effectiveness of spill response countermeasures and the potential for ecosystem exposure.
☐ Study Arctic-based indigenous microbial populations in the water column and benthic sediment, and define rates of microbial processes to determine the role such communities have in the oil weathering process.
OIL BEHAVIOR MODELS
☐ Study the oil droplet size from deepwater blowouts, the thickness of surfacing oil and the behavior of dissolvable components.
☐ Study bottom substrate dynamics that might affect submerged oil fate and behavior.
☐ Study how oil degrades in intertidal and shallow subtidal habitats (e.g., cobble, pebble, sand, mud, mussel beds, mangrove, and marsh).
TRANSPORT MODELS
☐ Use best available scientific data on oil weathering and fate to develop and improve transport model parameters (e.g., volatilization, solubilization, emulsification, biodegradation).
☐ Develop/improve oil trajectory and fate models that can be used during spill response to predict the behavior and transport of dispersed oil and verify/validate them in an appropriately designed experimental setting or during actual spills.
☐ Develop a decision template or conceptual model of the conditions under which oil might become submerged that considers oil properties and environmental characteristics.
OCEANOGRAPHIC MODELS
☐ Link ocean circulation models to observations (e.g., ocean observing systems) to better incorporate real-time data.
☐ Increase development and availability of high resolution nearshore models.

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☐ Integrate upper sea-surface turbulence, with particular emphasis on quantifying horizontal and vertical diffusivities and the rate of energy dissipation, to improve 3D and 4D spill transport models.
EMERGING CRUDE (including oil sands products (OSP) and Bakken, etc.)
☐ Conduct research on the fate and transport of oil sands products in freshwater and marine environments.
☐ Study the persistence of oil sands products in marine and freshwater environments.
☐ Conduct research on the chemical and physical characteristics of various crudes (including blends of dilbit, synbit and Bakken crude) to better understand how to address spills.

9.3.4 Oil Spill Detection and Surveillance Priorities (Section 4.3.3.4)

This SRA principally refers to methods and equipment for characterizing and monitoring oil pre- and post-implementation of response options, and the detection of unknown discharges. This SRA includes surface and subsurface oil spill surveillance including devices, sensors, and systems for detecting and tracking oil spills, determining the area and thickness of the oil slick, and measuring the physical properties of the oil. Examples of equipment considered in this area are: surface oil spill tracking buoys; airborne remote sensors and data analysis systems; fluorometers and light-scattering sensors; and satellite remote sensing data and on/in-water oil detection devices with the ability to conduct nighttime and low light recovery operations. It includes research that provides information to support development of monitoring protocols for subsea and surface responses or improvements to existing ones such as the NRT Atypical guidance or the SMART guidance, as applicable. This SRA also includes evaluation of techniques for autonomous sensing operations and reporting from remote locations where logistical challenges limit human accessibility.

The priorities for this SRA focus on the development of improved technologies that can more rapidly and effectively identify the presence and the characteristics of oil in the water column and on the seafloor. These priorities would address some of the issues that arose from the *Deepwater Horizon* spill and may assist responders to react more effectively to future incidents. There are three subcategories for this SRA: Remote Detection, Monitoring, and Submerged Oil Detection.

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REMOTE DETECTION
☐ Develop technologies that enable remote oil spill detection and mapping in low visibility conditions (e.g., night, fog).
☐ Develop enhanced technology for detecting oil under ice, encapsulated in ice, and floating within broken ice fields.
☐ Identify specific characteristics of crude oil exposed to the full microwave radiation spectrum (at hyperspectral intervals) and develop high resolution sensors for oil spill visualization, detection and quantification.
MONITORING
☐ Develop a refined SMART or equivalent protocol and operational procedures for use during subsea and surface responses based on recent experiences.
☐ Develop technology to rapidly analyze physio-chemical properties of spilled oil to improve decision-making regarding dispersant use and *in situ* burning (ISB).
☐ Develop new technologies to improve oil, dispersant, and oil/dispersant detection in the water column and on the seafloor, and for monitoring dispersant effectiveness in the field.
SUBMERGED OIL DETECTION
☐ Study the potential of acoustic systems and Light Detection and Ranging (LiDAR), both individually and as packaged suites, to detect submerged oil on the seafloor and in the water column.
☐ Develop new or improve existing chemical sensors for detecting submerged oil.
☐ Develop methods to calibrate the degree of oiling on snare sampling systems with the amount of oil on the seafloor or in the water column.

9.3.5 In- and On-water Containment and Recovery Priorities (Section 4.3.3.5)

This SRA includes the development of methods, equipment, and materials for physically containing and removing oil from the surface of the water, the water column, or on the bottom of the sea/river bed. This SRA focuses on improving traditional equipment such as booms, skimmers, and sorbent materials, as well as developing new approaches to surface containment, and equipment and systems specific to containment and recovery of subsurface oils.

The priority Research Needs in this SRA focus on the Arctic and other northern areas where cold water and ice will require innovative methods and technologies. There was

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also recognition of the need for better technologies to control and recover submerged oil given the greater emphasis on deep and ultra-deep water drilling. ICCOPR acknowledged the need for better testing protocols for new technologies and methods and identified research priorities that could improve laboratory and field testing. ICCOPR identified priorities in two subcategories: Control and Recovery Technology, and Recovery Operations and Testing.

CONTROL AND RECOVERY TECHNOLOGY
☐ Develop new mechanical recovery methods/technologies for logistically challenging (e.g., cold water, ice, broken ice) Arctic conditions.
☐ Develop new tools to control and recover oil that is submerged, suspended in the water column, or on the seafloor.
☐ Develop control and recovery capabilities for oil in river conditions with pack ice and ice flows.
RECOVERY OPERATIONS AND TESTING
☐ Develop/improve standardized testing protocols (especially for wave tanks) that yield cross-comparability of results and establish practical oil recovery limits that are achievable during response operations.
☐ Conduct field tests of cleanup techniques and create protocols for various habitats and conditions, including Arctic conditions.
☐ Develop surrogates for different types of oil to be used for training and for research and development testing.

9.3.6 Shore Containment and Recovery Priorities (Section 4.3.3.6)

This SRA covers new methods, treating agents, and equipment for removing oil from shorelines, as well as mitigating the environmental impact of oil that cannot be removed. Specifically, this SRA includes water washing and flooding techniques, the use of chemical treating agents, and novel applications of mechanical removal techniques and equipment. It also includes analysis, evaluation and decision-making (risk and benefits) for the use of active shoreline oil removal techniques versus passive naturally-occurring processes.

ICCOPR recognizes the difficulty of relying solely on physical recovery on shorelines. Therefore, priorities in this SRA focus on developing chemicals that prevent shoreline contact.

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- Study the effectiveness of a range of technologies for shoreline or nearshore cleanup; including dispersants, bioremediation agents, shoreline cleaners, and mechanical methods.
- Study the effectiveness of surface washing for shoreline cleanup and develop standards for surface washing.
- Conduct research to assess the ability of chemicals to prevent oil from reaching or sticking to shorelines.

9.3.7 Dispersants Priorities (Section 4.3.3.7)

This SRA addresses the use of chemical products designed to interact with marine oil slicks by reducing the oil/water interfacial tension and breaking up the slick into tiny droplets with the aid of wave or other energy sources. Research areas for dispersants include: developing appropriate dispersant applications for cold weather and deep sea environments; increasing dispersant effectiveness for water surface and subsurface applications (e.g., effective on a wider viscosity and emulsification range, and calm sea conditions); reducing ecological effects of individual dispersant components and combined components in the water column; refining vessel, aircraft, and subsurface application methodologies and equipment; developing enhanced monitoring methods and systems for determining the effectiveness of surface and subsurface application of dispersants; determining how to distinguish physically versus chemically dispersed oil; studying the distribution and impact of the chemicals and dispersed oil in the environment; and understanding regional variations in dispersant performance and environmental effects. This SRA may include characterization to enhance the ability to predict dispersant effectiveness on various oil types and at varying application rates, including the effectiveness of dispersants on weathered/emulsified oils and in a range of water salinities. This SRA also encompasses studies to determine the suitability of subsea application of dispersants in the Arctic region where the unique conditions (e.g., shallow depths, water salinity, ice-infested water, under-ice discharges) could influence their fate and effects. An important supporting activity is the development of an information database on dispersant product effectiveness, application procedures, and effects. Since dispersants shift the risk from the surface to the water column, additional research is needed to address questions about the potential acute and chronic effects of dispersants on water column organisms and populations at various depths.

The *Deepwater Horizon* spill resulted in a very widespread use of dispersants and the first application of subsurface dispersants near the well head. This use of dispersants resulted in a significant interest in the effectiveness of dispersant use and its potential impacts. The importance of this SRA to future oil response is demonstrated by the large

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number of research needs identified. It is important to understand how dispersants behave in the environment and what their potential impacts are when applied. Specifically, ICCOPR identified Research Needs such as: dispersant use in Arctic conditions; the behavior of dispersants and dispersed oil in the environment; the toxicity of dispersants and dispersed oil; efficacy and effectiveness of dispersants; fate of dispersants and dispersed oil; and the application of subsurface dispersants.

This SRA includes six subcategories: Cold Weather and Ice Conditions, Behavior, Impacts, Efficacy and Effectiveness, Fate, and Subsurface. The Research Needs for this SRA include formulations appropriate for dispersant applications in cold weather and deep sea environments, and increasing dispersion effectiveness for water surface and subsurface applications.

COLD WEATHER AND ICE CONDITIONS
☐ Understand the "window of opportunity" for potential deployment of all dispersants in the Arctic and sub-Arctic.
☐ Study the best dispersants for different types of crude oil over a range of environmental conditions, including ice infested waters.
☐ Study the fate and effects of subsea application of dispersants in Arctic waters, including in ice infested water and under ice.
BEHAVIOR
☐ Study the transport and detection of oil, dispersants, and oil/dispersants in surface and subsurface environments, including deepwater.
☐ Study the impact of natural processes such as flocculation and hydrate encapsulation on oil and dispersed oil.
☐ Quantify degradation rates of chemically dispersed, physically dispersed, and undispersed oil, including biodegradation kinetics.
IMPACTS
☐ Improve protocols for testing toxicity of dispersants and other chemical agents to better represent real world exposure scenarios.
☐ Study and evaluate dispersant and dispersed oil chronic and sub-lethal effects on key species, and subsequent long-term ecological effects for varying real world exposure scenarios and durations.
☐ Collect existing dispersed oil toxicity data and studies to aid in risk-based decision-making regarding use of dispersants at spills.

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EFFICACY AND EFFECTIVENESS
☐ Study the relative effectiveness of various surface dispersant delivery techniques/systems.
☐ Study the effects of subsea dispersant application on subsequent mechanical recovery of oil.
☐ Develop methods and quantify the factors needed to scale results of laboratory and wave tank experiments so that they become more accurate indicators of real world effectiveness.
FATE
☐ Develop studies to quantify the weathering rates and final fate of chemically dispersed vs. physically-dispersed oil droplets under different scenarios.
☐ Study the differences in the effects of photolysis on undispersed, chemically dispersed, and physically dispersed oil droplets.
☐ Study the adhesiveness of physically and chemically dispersed oil on organisms and habitats, including how adhesion changes over time and with oil type.
SUBSURFACE
☐ Study the relationship between subsurface application of dispersants, the characteristics of oil at the surface, and the fate of oil constituents, including Volatile Organic Compounds (VOCs), in the water column and at the surface.
☐ Develop conditions of operability for dispersant use in the subsea, including the characteristics of the most effective dispersant, application methods, and dispersant to oil ratios.
☐ Conduct research involving the application of dispersants at high pressure and low temperatures including quantifying the mixing energy at the wellhead.

9.3.8 *In Situ* Burning (ISB) Priorities (Section 4.3.3.8)

This SRA includes equipment and techniques required to ignite and sustain combustion of oil spills on the water, along shorelines, and on land. A source of ignition must be present for the mix of fuel (e.g., oil) and oxidant (e.g. oxygen) in a slick to burn. Because slick thickness is a key variable in determining whether the oil will burn, this research area includes development of equipment such as fire-resistant booms and herders to concentrate the slick thickness, and improved ignition devices. This SRA also includes developing knowledge of the conditions under which this equipment and technique can

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be applied effectively, including evaluation of use in frigid (i.e., Arctic) environments, where cold conditions and ice limit operational effectiveness of mechanical containment and recovery of spilled oil. This SRA also includes research to develop new methods to enhance burn efficiency and burn weathered, emulsified, and more viscous oils. Research into the production of residuals including soot and other ISB residues, and the techniques and equipment to recover these residues is also included in this SRA.

The priorities for this SRA address issues related to potential public health and environmental health from the burning of oil. The ICCOPR priorities also emphasize the need for improved technology to address containment, sustain burning and understand the potential for application of ISB in Arctic and other special environments. There are two subcategories: 1) Effectiveness and 2) Impacts and Planning and Technology.

EFFECTIVENESS AND IMPACTS
☐ Develop improved pre- and post-spill plume modeling to determine whether an *in situ* burn should be conducted and facilitate decisions on measures to protect local populations, including the potential effect of "fall-out" from a smoke plume that goes over land-based subsistence resources.
☐ Study *in situ* burning residues, especially toxicity, physical properties, and bioavailability of contaminants contained within the residue matrix, especially regarding potential benthic community effects.
☐ Conduct additional research to improve *in situ* burning effectiveness in the Arctic and better define its applicability under various conditions.
PLANNING AND TECHNOLOGY
☐ Conduct a comparative study of *in situ* burning vs. mechanical, chemical and natural attenuation methods in cleanup of wetlands or marshy areas.
☐ Develop enhanced designs for containment of burning oil, such as reusable and high seas capable booms.
☐ Develop methods to improve and sustain combustion of emulsions.

9.3.9 Alternative Chemical Countermeasures Priorities (Section 4.3.3.9)

This SRA includes the development and use of various spill response chemicals to treat oil slicks on the surface of the water making the oil more amenable to other recovery techniques, such as mechanical recovery and ISB. These chemicals include solidifiers, herding agents, elasticity modifiers, shoreline pre-treatment agents, and emulsion treating agents (demulsifiers). Development activities include improving chemical formulations,

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refining application techniques, and conducting studies of effectiveness and environmental effects.

ICCOPR priorities in this SRA recognize the potential of alternate chemical treatments to break emulsions and herd oil slicks to enhance other response techniques.

☐ Study the potential use of chemical herders to enhance response capabilities of *in situ* burning, recovery of oil-in-ice, or recovery of oil in confined/covered spaces.
☐ Study the value and impact of chemical herders with respect to the timing for deployment of various countermeasures, particularly with respect to a second-stage recovery effort during ice melt to target oil that had previously been entrained in sea ice.
☐ Conduct laboratory and field tests of chemical agents for breaking or inhibiting emulsions.

9.3.10 Oily and Oil Waste Disposal Priorities (Section 4.3.3.10)

This SRA includes study and development of analytical methods, procedures, equipment and techniques to manage and dispose of oil, oily water, oiled soils, and oiled debris recovered during both on-water and on land oil pollution incidents. Specific technologies include, but are not limited to, waste segregation, temporary storage, solidification and stabilization prior to landfill disposal or recycling, oil reclamation, incineration, and biological treatment (i.e., land farming and composting). It also includes techniques and equipment for onsite oil-water separation, filtration, and decanting operations that would reduce the volumes of oil/water material that would need to be handled, transported, and disposed.

ICCOPR priorities for this SRA focus on storage, waste issues and recycling.

☐ Develop innovative techniques for oil/water separation decanting systems for various oil types.
☐ Develop methods to recycle sorbents and reduce the waste created by using sorbents as a recovery option.
☐ Develop methods to temporarily store or dispose of recovered oil/pollutants in remote or harsh environments.

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9.3.11 Bioremediation and Biodegradation Priorities (Section 4.3.3.11)

This SRA includes research and technology to exploit the capabilities of microorganisms and plants to accelerate the rate of degradation of oil typically through aerobic degradation, but also through anaerobic degradation processes. Bioremediation is largely an *in-situ* technology as *ex-situ* use requires excavation and further manipulations that may have a greater potential for environmental harm. Research and development opportunities include the development of methodologies for the use of nutrient enrichment and possibly microbes to accelerate the biodegradation process on land, a process called bio-augmentation. This topic area also covers research to understand the conditions needed for effective bioremediation in the presence or absence of dispersants, herders, and other chemical agents. In areas such as coastal wetlands, where stranded oil may have penetrated into the anaerobic subsurface, this research area would include studies to wick the oil up to the surface where aerobic conditions and nutrient enrichment may result in enhanced biodegradation. This SRA also includes development of methodologies to apply bioremediation for more effective response and restoration efforts. For purposes of this OPRTP, bioremediation includes phytoremediation (remediation using plants), a longer-term restoration technique.

ICOCPR priorities under this SRA focus on gaining a better understanding of the bioremediation process and the factors associated with its use in oil spill remediation.

☐ Study the relative effectiveness and environmental impacts of bioremediation technologies.
☐ Develop an improved understanding of bioremediation processes with a wider range of conditions/environments (e.g., cold water), multiple types of oil, nutrient enrichment, toxicity and eutrophication.
☐ Study the factors controlling bioavailability of petroleum hydrocarbons in estuarine and freshwater sediments.

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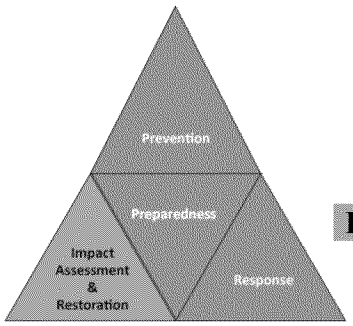
9.4 Injury Assessment and Restoration Priority Research Needs



INJURY ASSESSMENT AND RESTORATION

9.4.1 Environmental Impacts and Ecosystem Recovery Priorities (Section 4.3.4.1)

This SRA includes laboratory research, field studies, and modeling efforts to better understand and predict the short- and long-term effects of oil spills at the ecosystem level. It includes research into the short- and long-term recovery of various types of environments and the chronic effects of oil spills on habitat, species, recovery and rehabilitation of wildlife, and community structures. This SRA includes the effects of the oil and the countermeasures and cleanup techniques used to remove the oil. It also includes research to determine the rate of ecosystem recovery both with and without countermeasures and cleanup.

The priorities selected by ICCOPR reflect the continued need to assess the short- and long-term effects of the *Deepwater Horizon* oil spill through the NRDA process. ICCOIPR identified priorities within six subcategories for this SRA due to the large number of identified Research Needs: 1) Species Impacts; 2) Toxicological and Sub-lethal Impacts; 3) Submerged and Submerged Oil Impacts; 4) Ecosystem and Habitat Impacts; 5) Recovery; and 6) Risk Assessment and Impact Metrics.

SPECIES IMPACTS
☐ Study the effect of exposure to oil on: physiological functions of organisms (immune, reproductive, and other vital systems); potential impacts on individual fitness; and population vitality rates, abundance and trends.
☐ Develop an increased understanding of the environmental effects of *in situ* burning, chemical dispersants and herding agents on Arctic ecology.
☐ Conduct research that examines the state of knowledge of specific NRDA metrics that would help identify specific population, physiological, habitat, and exposure data to support future NRDA activities in Arctic areas that are likely to be explored/developed for oil and gas extraction in the near to mid-term.

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TOXICOLOGICAL AND SUB-LETHAL IMPACTS
☐ Develop relevant biological markers of exposure and guidelines for their use.
☐ Conduct research on key species to determine the long-term, sub-lethal effects of short-term exposure to oil.
☐ Study the bioavailability and toxicity of oil sands products in freshwater and marine environments.
SUNKEN AND SUBMERGED OIL IMPACTS
☐ Develop an understanding of the pathways of exposure and mechanisms of chronic toxicity of submerged oil to benthic communities.
☐ Develop approaches for long-term monitoring of the impacts of submerged oil spills after termination of cleanup efforts.
☐ Develop an understanding of the potential threats of chronic releases from sediments containing oil and oily residues.
ECOSYSTEM AND HABITAT IMPACTS
☐ Develop relevant exposure conditions (spatially and temporally) and examine connections between exposure and ecological effects.
☐ Develop an understanding of trophic and habitat linkages among organisms to incorporate into models predicting cascading effects.
☐ Develop an understanding of the difference between oil effects and natural stressors by assessing community structure and function for different habitats.
RECOVERY
☐ Study recovery rates of injured habitats using different types of oils and methods (e.g., previous spills, mesocosm, field studies).
☐ Develop conceptual models of service loss and recovery from key habitats, and gather the information necessary to parameterize recovery models.
☐ Conduct a study comparing environmental injury footprints and ecosystem recovery times after implementation of various response technologies and techniques.

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RISK ASSESSMENT AND IMPACT METRICS
☐ Develop models to estimate injury to natural resources encompassing a range of exposure scenarios to biota at different life stages.
☐ Conduct research to determine the best metrics for assessing injury and damages to natural resources.
☐ Conduct single species toxicity research to assess population effects and help risk-based decision-making during an event.

9.4.2 Environmental Restoration Methods and Technologies Priorities (Section 4.3.4.2)

This SRA includes development of methods and technologies to facilitate and accelerate the recovery of resources following an oil spill. It includes research into the effectiveness of approaches for environmental restoration. It also includes evaluations and comparisons of the factors affecting success of the restoration methods and technologies. It also involves studying previous restoration efforts, as well as natural recovery, to better understand ways to improve or enhance future recovery from oil spills.

ICCOPR recognized that the *Deepwater Horizon* oil spill, as well as other marine and onshore spills, offer opportunities to assess restoration techniques and improve the state of the art.

☐ Develop methods for restoration assessment (including establishing indicators and applying performance metrics) and estimation of restoration cost.
☐ Conduct comparative analysis of restoration vs. natural attenuation.
☐ Study the factors associated with long-term restoration success.

9.4.3 Human Safety and Health Priorities (Section 4.3.4.3)

This SRA includes studies on the effects of spilled oil and oil spill response activities on human health and safety for both workers and the public. It includes the study of oil weathering throughout the water column and the potential concerns relative to worker health and safety. It focuses on the development of monitoring instruments, procedures, and processes to inform personnel engaged in oil spill response activities, as well as the general public, who could be affected by the oil spill and response options. It also includes studies of the safety of fish and shellfish in a spill area to determine if they are safe to market and consume. Research on seafood safety may include petrochemical

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toxicology and profiling, risk analysis, sampling and testing methodology development, and risk communications.

The research priorities focus on worker safety and human exposure, as well as on seafood safety. The *Deepwater Horizon* spill has provided opportunities for short- and long-term monitoring of workers and the public related to these topics. There are two subcategories to this SRA: Safety and Human Exposure.

SAFETY
☐ Develop technologies, methods, and standards for protecting on-scene personnel, including the incorporation of training, adequate supervision, information databases, protective equipment, maximum exposure limits, and decontamination procedures.
☐ Study the levels of oil constituents, including Volatile Organic Compounds (VOCs), throughout the water column under different dispersant application scenarios (e.g., subsea, surface) and establish their contribution to potential worker health and safety issues.
☐ Conduct research on the short- and long-term safety of seafood following a spill or fisheries closure and develop methods to communicate these to the public.
HUMAN EXPOSURE
☐ Develop the framework needed to conduct rapid research response on human exposure during oil spills.
☐ Study the short- and long-term impacts to humans from exposure to contaminants from oil spills (e.g., dermal, oral (through seafood), and respiratory).
☐ Study the toxicological effects and the causal or correlative relationships between chemical (i.e., oil and dispersants) exposure and human health.

9.4.4 Sociological and Economic Impacts Priorities (Section 4.3.4.4)

This SRA includes studies on how oil spills and the response to oil spills affect the sociological fabric of communities and their economies. Disciplines encompassed in this research area include sociology, economics, behavioral sciences, political science, and law. It also involves studies on risk communication and community resilience.

The priorities in this SRA identify the need for improving communication methods and understanding the human and community impacts of a spill, particularly by improving

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research frameworks and studying previous spills. There are two subcategories in this SRA: Community and Economic Impacts, and Human Impacts.

COMMUNITY AND ECONOMIC IMPACTS
☐ Develop more effective models/frameworks for community/stakeholder involvement in oil spill planning, response and restoration.
☐ Develop improved methods for communicating risks and tradeoffs to various audiences, including tradeoffs of mechanical recovery, dispersant use, and other technologies.
☐ Study cumulative community vulnerability and resilience to past spills, including social impacts.
HUMAN IMPACTS
☐ Study the resilience of social-ecological systems to environmental disasters, including the degree of impact on human well-being from ecosystem services losses.
☐ Determine human/community impacts associated with a spill, including subsistence losses and culturally-significant natural resource injuries.
☐ Study the effects of media and community groups in shaping individual and public perceptions of a spill's impact.

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From: Vocke, William CIV
Sent: Wed 9/30/2015 6:56:54 PM
Subject: Approved ICCOPR Oil Pollution Research & Technology Plan
Approved 2015 ICCOPR R&T Plan - PrePrinting Version.pdf

ICCOPR members and friends,

Attached is the ICCOPR Oil Pollution Research & Technology Plan for FY2015-2021, which was approved at the ICCOPR FY15 Fourth Quarter Meeting on September 29, 2015. Thank you for your input and reviews of draft versions as we worked through this first update to the plan since 1997. As one of our senior managers commented when I explained the purpose of the plan, "This is a big deal!"

The plan is available for public release. I will add it to the ICCOPR website in a few days. A technical editor is cleaning up any formatting issues and getting it set up for printing.

I look forward to working with you as we all use this plan as we make research decisions.

Bill Vocke
ICCOPR Executive Director
(202) 372-2019

OIL POLLUTION RESEARCH AND TECHNOLOGY PLAN

Fiscal Years 2015-2021

INTERAGENCY COORDINATING COMMITEE
ON OIL POLLUTION RESEARCH (ICCOPR)

September 2015

DISCLAIMER

This Oil Pollution Research and Technology Plan (OPRTP) presents the collective opinion of the 15 departments and agencies that constitute the members of Interagency Coordinating Committee on Oil Pollution Research (ICCOPR), regarding the status and current focus of the federal oil pollution research, development, and demonstration program (established pursuant to section 7001(c) of the Oil Pollution Act of 1990 (33 U.S.C. 2761(c))). The statements, positions, and research priorities contained in this OPRTP may not necessarily reflect the views or policies of an individual department or agency, including any component of a department or agency that is a member of ICCOPR. This OPRTP does not establish any regulatory requirement or interpretation, nor implies the need to establish a new regulatory requirement or modify an existing regulatory requirement.

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LIST OF ACRONYMS

A-CORE	Arctic Center for Oil-Spill Research & Education
AAR	After Action Review
AC	Area Committee
ACP	Area Committee Plan
ADEC	Alaska Department of Environmental Conservation
ADEQ	Arkansas Division of Environmental Quality
AESC	Arctic Executive Steering Committee
AIP	Australian Institute of Petroleum
AMOSC	Australian Marine Oil Spill Centre
AMSA	Australian Maritime Safety Authority
API	American Petroleum Institute
APICOM	Association of Petroleum Industry Co-op Managers
ARTES	Alternative Response Technologies Evaluation System
BAST	Best Available and Safest Technology
bbl (s)	Barrel (equals 42 U.S. Gallons)
BIO COOGER	DFO Canada's Bedford Institute of Oceanography Center for Offshore Oil, Gas and Energy Research
BOEM	Bureau of Ocean Energy Management
BOEMRE	[former] Bureau of Ocean Energy Management, Regulation and Enforcement
BP	British Petroleum
Bpd	Barrels per day
BSEE	Bureau of Safety & Environmental Enforcement
CAOSPR	California Office of Oil Spill Prevention and Response
CASP	Center for Arctic Study & Policy
CEC	CEDRE Experimentation Column
CEDRE	Centre of Documentation, Research and Experimentation on Accidental Water Pollution
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Resource, Compensation, and Liability Act
CFR	Code of Federal Regulations
CGHQ	Coast Guard Headquarters
CIRCAC	Cook Inlet Regional Citizen's Advisory Committee
CMR	Center of Excellence for Maritime Research
COP	Common Operating Picture
CPF	Coastal Protection Fund
CRADA	Cooperative Research and Development Agreement
CRRC	Coastal Response Research Center
CRREL	Cold Regions Research and Engineering Laboratory

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CSE	Center for Spills in the Environment
CSIRO	Commonwealth Scientific and Industrial Research Organization
CWA	Clean Water Act
DDO	Dispersants and dispersed oil
DECC	Department of Energy and Climate Change
DFO	Department of Fisheries and Oceans Canada
DHHS	Department of Health and Human Services
DOC	Department of Commerce
DOD	Department of Defense
DOE	Department of Energy
DOI	Department of the Interior
DOR	Dispersant to Oil Ratio
DOT	Department of Transportation
DWH	*Deepwater Horizon*
E&P	Exploration & Production
EC	Environment Canada; European Union
EDDM	Environmental Disasters Data Management
EDRC	Effective Daily Recovery Capacity
EDRP	Emergency Disaster Recovery Program
EEZ	Exclusive Economic Zone
EIA	U.S. Energy Information Administration
EMERCOM	Russian Ministry of Civil Defense, Emergencies and Disaster Response
EMSA	European Maritime Safety Agency
EOI	Expression of Interest
EOP	Executive Office of the President
EPA	Environmental Protection Agency
EPAct	Energy Policy Act of 2005
EPPR	Emergency Prevention, Preparedness and Response Working Group
ERA	Environmental Risk Assessments
ERDC	U.S. Army Engineer Research and Development Center
ERRC	European Response Coordination Center
ERT	Environmental Response Team
ERW	Electric resistance welded pipe
ESA	Endangered Species Act
ESB	Environmental Specimen Bank
ESI	Environmental Sensitivity Index
ESP	Environmental Studies Program
EU	European Union
FACA	Federal Advisory Committee Act
FMSAS	Florida Marine Spill Analysis System

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FEMA	Federal Emergency Management Agency
FIO	Florida Institute of Oceanography
FOSC	Federal-On Scene Coordinator
FOSTERRS	Federal Oil Spill Team for Emergency Response Remote Sensing
FWPCA	Federal Water Pollution Control Administration
GIRG	Global Industry Response Group
GIS	Geographic Information Systems
GMFMC	Gulf of Mexico Fishery Management Council
GOMA	Gulf of Mexico Alliance
GoMRI	Gulf of Mexico Research Initiative
GOMURC	Gulf of Mexico University Research Collaborative
GRP	[National Academy of Science] Gulf Research Program
GSMFC	Gulf States Marine Fisheries Commission
HAZMAT	Hazardous Material
HML	Hollings Marine Laboratory
HMTA	Hazardous Materials Transportation Act
ICCOPR	Interagency Coordinating Committee on Oil Pollution Research
ICS	Incident Command System
ILI	In-Line Inspection
IMO	International Maritime Organization
IOM	Institute of Medicine
IOOS	Integrated Ocean Observing System
IOSC	International Oil Spill Conference
IPIECA	International Petroleum Industry Environmental Conservation Association
ISB	In-situ Burn
ISCO	International Spill Control Organization
ISPR	Incident Specific Preparedness Reviews
ITAC	Industry Technical Advisory Committee
ITOPF	International Tanker Owners Pollution Federation Limited
JITF	Joint Industry Oil Spill Preparedness and Response Task Force
JIP	Joint Industry Programme; Joint Industry Program
LEGEEPA	General Law of Ecological Equilibrium and Environmental Protection
LiDAR	Light Detection and Ranging
LNG	Liquefied Natural Gas
MARAD	Maritime Administration
MARPOL	Marine Pollution (International convention for the Prevention of Pollution from Ships)
MCA	Maritime and Coastguard Agency
MER	Marine Environmental Response
META	Maritime Environmental and Technical Assistance
MMC	U.S. Marine Mammal Commission

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MMPA	Marine Mammal Protection Act
MMS	[former] Minerals Management Service
MOC-A	Marine Operations Center, Atlantic
MOC-P	Marine Operations Center, Pacific
MOC-PI	Marine Operations Center, Pacific Islands
MODU	Mobile Offshore Drilling Units
MPCSA	State Marine Pollution Control, Salvage and Rescue Administration
MPD	Managed pressure drilling
MRCC	Marine Rescue Coordination Centres
MSA	China Maritime Safety Administration
MSL	USCG Marine Safety Laboratory
MTBE	Methyl Tertiary Butyl Ether
NAS	National Academy of Sciences
NASA	National Aeronautics & Space Administration
NAVSEA	Naval Sea Systems Command
NAWCA	North American Wetlands Conservation Act
NDRF	National Defense Reserve Fleet
NEBA	Net Environmental Benefit Analysis
NEPA	National Environmental Policy Act
NCP	National Contingency Plan
NETL	DOE's National Energy Technology Laboratory
NFWF	National Fish and Wildlife Federation
NGO	Non-governmental Organization
NIEHS	National Institute of Environmental Health Sciences
NIH	National Institutes of Health
NIST	National Institute of Standards and Technology
NOAA	National Oceanic and Atmospheric Administration
NPC	National Petroleum Council
NPFC	U.S. Coast Guard's National Pollution Funds Center
NRC	National Response Center; National Research Council
NRDA	Natural Resource Damage Assessment
NRDAR	Natural Resource Damage Assessment and Restoration
NRF	National Response Framework
NRL	U.S. Naval Research Laboratory
NRMR	U.S. EPA National Risk Management Research Laboratory
NRP	National Response Plan
NRT	National Response Team
S&T	National Response Team Science & Technology Committee
NSAR	National Strategy for the Arctic Region
NSCS	National Spill Control School

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NSF	National Science Foundation
NSTC	National Science and Technology Council
NTIS	National Technical Information Service
NTNU	Norwegian University of Science and Technology
NTSB	National Transportation Safety Board
NURail	National University Rail (NURail) Center
OCRE	Ocean Coastal Research Engineering
OCS	Outer Continental Shelf
ODRP	Oil Disaster Recovery Program
OESI	Ocean Energy Safety Institute
OGP	Oil and Gas Producers
OMAO	NOAA's Office of Marine and Aviation Operations
OPA 90	Oil Pollution Act of 1990
OPRTP	Oil Pollution Research & Technology Plan
OR&R	NOAA Office of Response & Restoration
OSC	On Scene Coordinator
OSHA	Occupational Safety & Health Administration
OSPR	Oil Spill Preparedness and Response
OSRADP	Oil Spill Research and Development Program
OSRI	Oil Spill Recovery Institute
OSRO	Oil Spill Removal Organization
OSP	Oil Sands Products
OSLTF	Oil Spill Liability Trust Fund
OST	[Executive Office of the President] Office of Science & Technology
OSV	Ocean Survey Vessel
OSWG	Oil Spill Working Group
PAJ	Petroleum Association of Japan
PCT	Pew Charitable Trusts
PEMEX	Petróleos Mexicanos
PERF	Petroleum Environmental Research Forum
PHMSA	Pipeline & Hazardous Materials Safety Administration
PI	Principal investigators
P.L.	Public Law
PNNL	Pacific Northwest National Laboratory
PRCI	Pipeline Research Council International
PRI	Paleontological Research Institution
PROMAM	Navy's Marine Environment Protection Division
PSBCOSTF	Pacific States/British Columbia Oil Spill Task Force
PTSA	Port and Tanker Safety Act of 1978
PWS	Prince William Sound

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PWSA	Ports and Waterways Safety Act of 1972
PWSRCAC	Prince William Sound Regional Citizen's Advisory Committee
RAPID	Rapid Response Research
RAR	Resources at Risk
RDC	Coast Guard Research & Development Center
RDT&E	Research, Development, Test, and Evaluation
R&D	Research & Development
R&T	Research & Technology
RESTORE	Resources and Ecosystem Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act
RFP	Request for Proposal
ROV	Remotely Operated Vehicle
ROW	Right of Way
RP	Responsible Party
RRT	Regional Response Team
RSPA	[former] Research and Special Projects Administration
S&T	Science and Technology
SCAA	Spill Control Association of America
SCAT	Shoreline Cleanup Assessment Technique
SETAC	Society of Environmental Toxicology and Chemistry
SIO	Scripps Institution of Oceanography
SIT	Stevens Institute of Technology
SMART	Special Monitoring of Applied Response Technologies
SME	Subject Matter Expert
SONS	Spill of National Significance
SPCC	Spill Prevention, Control & Countermeasures
SRA	Standing Research Areas
SRM	Standard Reference Materials
SSC	NOAA Scientific Support Coordinator
SUPSALV	NAVSEA Supervisor of Salvage and Diving
SwRI	Southwest Research Institute
TCEQ	Texas Commission on Environmental Quality
TDC	Technology Development Center
TPWD	Texas Parks and Wildlife Department
TRB	Transportation Research Board
TXGLO	Texas General Land Office
UAA	University of Alaska Anchorage
UAF	University of Alaska Fairbanks
UDAC	Ultra-Deepwater Advisory Committee
UDW	Ultra-Deepwater

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UIUC	University of Illinois Urbana
UNEP	United Nations Environment Programme
UNH	University of New Hampshire
USACE	United States Army Corps of Engineers
USARC	United States Arctic Research Commission
USCG	United States Coast Guard
USGS	United States Geological Survey
USFA	United States Fire Administration
USFWS	United States Fish and Wildlife Service
USN	United States Navy
UTC	University Transportation Center
VOC	Volatile Organic Compound
VTS	Vessel Traffic Service
VTSS	Vessel Traffic Service / Separation
WADOE	Washington Department of Ecology
WHOI	Woods Hole Oceanographic Institution

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DEFINITIONS

ICCOPR uses the following definitions solely for purposes of this Oil Pollution Research and Technology Plan (OPRTP). These definitions do not reflect all existing/relevant statutory and/or regulatory definitions and do not supersede any statutory or regulatory requirements.

Allision is the running of one vessel against another vessel or structure that is stationary. An allision is different from a collision in that a collision is the running of two moving vessels against each other.

Applied Research is any systematic study to gain knowledge or understanding necessary to determine the means by which a recognized and specific need may be met, in this case related to advancing knowledge about oil spill prevention, preparedness, response, mitigation, and restoration/recovery.

Basic Research is any systematic study directed toward fuller knowledge or understanding of the fundamental aspects of phenomena and of observable facts without specific applications towards processes or products in mind.

Baseline Study refers to studies conducted to gather a set of critical observations or data that provide a basis for comparing conditions before and after an action or event. Baseline studies document the ecological and socioeconomic conditions of an area before an oil system activity or potential spill occurs. These studies provide a basis for assessing changes or damages that occur as a result of the activities or a spill.

Collision means the running of two vessels against each other (both under power). A collision is different from an allision where only a single vessel is underway and strikes a stationary vessel or structure.

Damages means injury to natural resources, to real or personal property, loss of subsistence use of natural resources, loss of governmental revenues, loss of profits or earning capacity, and increased cost of additional public services. Damages also include the cost of assessing these injuries. Removal costs and damages covered by OPA 90 are defined in 33 U.S.C § 2702(b)(2).

Demonstration refers to activities that are part of research or development (i.e., that are intended to prove or to test whether a technology or method does, in fact, work). Demonstrations intended primarily to make information available about new technologies or methods should not be included in this definition (NSF, 2009).

Development is any systematic application of knowledge or understanding, directed toward the production of useful materials, devices, and systems or methods,

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including design, development, and improvement of prototypes and new processes to meet specific requirements.

Discharge means any emission (other than natural seepage), intentional or unintentional, and includes, but is not limited to spilling, leaking, pumping, pouring, emitting, or dumping of oil that is not permitted.

Dispersants means those chemical agents that emulsify, disperse, or solubilize oil into the water column or promote the surface spreading of oil slicks to facilitate dispersal of the oil into the water column

Facility means any structure, group of structures, equipment, or device (other than a vessel) that is used for one or more of the following purposes: exploring for, drilling for, producing, storing, handling, transferring, processing, or transporting oil. This term includes any motor vehicle, rolling stock, or pipeline used for one or more of these purposes. The OPA 90 definition of a facility is codified at 33 U.S.C § 2702(b)(2).

National Contingency Plan (NCP) refers to the National Oil and Hazardous Substances Pollution Contingency Plan (40 CFR Part 300), the federal government's blueprint for responding to both oil spills and hazardous substance releases. The NCP is the result of efforts to develop a national response capability and promote coordination among the hierarchy of responders and contingency plans.

Natural Resource Damage Assessment (or assessment) means the process of collecting and analyzing information to evaluate the nature and extent of injuries resulting from an incident, and determine the restoration actions needed to bring injured natural resources and services back to baseline and make the environment and public whole for interim losses.

Natural Resources, for purposes of injury assessment and restoration, refers to land, fish, wildlife, biota, air, water, ground water, drinking water supplies, and other such resources belonging to, managed by, held in trust by, appertaining to, or otherwise controlled by the United States (including the resources of the exclusive economic zone), any State or local government or Indian tribe, or any foreign government. Natural resources, for other purposes, may include minerals such as oil and gas.

Oil refers to oil of any kind or in any form, including, but not limited to, petroleum, fuel oil, sludge, oil refuse, and oil mixed with wastes other than dredged spoil. It may also refer to: fats, oils, or greases of animal, fish, or marine mammal origin; vegetable oils, including oils from seeds, nuts, fruits, or kernels; and, other oils and greases, including synthetic and mineral oils. The CWA definition of oil is codified at 33 U.S.C. § 1251 *et seq.*; the OPA definition of oil is codified at 33 U.S.C. § 2701 *et seq.*

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The ***Oil Pollution Act of 1990*** (OPA 90), codified at 33 U.S.C § 2701 *et seq.*, is a law that amended the Clean Water Act (CWA) and addressed the wide range of problems associated with preventing, responding to, and paying for oil pollution incidents in navigable waters of the United States. Title VII of OPA 90 established ICCOPR.

An ***Oil Spill*** is a non-permitted occurrence or series of occurrences having the same origin, involving one or more vessels, facilities, or any combination thereof, resulting in the discharge or substantial threat of discharge of oil into or upon navigable waters of the United States, adjoining shorelines, or the exclusive economic zone (e.g., oil spill in coastal waters from a tanker). This term also includes discharges of oil on land with the potential to reach any waters of the United States.

Oil Spill Response Organizations (OSROs) are companies that specialize in cleaning up oil spills. They often serve as contractors or subcontractors for spill response efforts.

An ***On-Scene Coordinator*** (OSC) is the federal official pre-designated by EPA or the USCG to coordinate and direct responses under Subpart D of the NCP. It also refers to a designated representative of a lead Federal agency to coordinate and direct removal actions under Subpart E of the NCP. General responsibilities of OSCs are found in 40 CFR 300.120. OSCs are sometimes referred to as Federal On-Scene Coordinators (FOSCs).

The ***Ports and Waterways Safety Act*** (PWSA) 1972, as amended by the Port and Tanker Safety Act of 1978 (PTSA), and the Oil Pollution Act of 1990 (OPA), is designed to promote navigation, vessel safety, and protection of the marine environment. The PWSA authorizes the U.S. Coast Guard (USCG) to establish vessel traffic service/separation (VTSS) schemes for ports, harbors, and other waters subject to congested vessel traffic.

The ***Ports and Tanker Safety Act*** (PTSA) of 1978 amended the PWSA. Under the PTSA, Congress found that navigation and vessel safety and protection of the marine environment are matters of major national importance and that increased vessel traffic in the nation's ports and waterways creates substantial hazard to life, property or the marine environment. In addition, increased supervision of vessel and port operations was deemed necessary.

Preparedness is an activity, program, or system developed prior to an oil spill to support and enhance the ability of personnel and organizations to prevent, respond to, and recover from an oil spill or other adverse event.

Prevention is an on-going activity to minimize the likelihood of discharges of oil into the environment. Prevention may be a long-term approach to looking at the

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fundamentals of minimizing the potential of oil spills with the goal to identify, minimize, and mitigate risks.

Release means any spilling, leaking, pumping, pouring, emptying, discharging, injecting, escaping, leaching, dumping, or disposing of oil into the environment.

Research is the systematic study directed toward fuller scientific knowledge or understanding of the subject studied. (NSF, 2009)

Response includes all activities involved in containing and cleaning up oil in order to: 1: maintain safety of human life; 2: stabilize a situation to preclude it from worsening, and; 3: minimize adverse environmental and socioeconomic impacts by coordinating all containment and removal activities to carry out a timely, effective response.

The ***Responsible Party*** (RP) of an incident is the person, business, or entity that has been identified as owning or operating a vessel or facility that caused an oil spill. The OPA definition of responsible party is codified at 33 U.S.C. § 2701 *et seq*.

Restoration is the process of restoring an affected area or resource to its pre-incident state. Restoration can take several months to many years and may require technical and financial assistance from a variety of sources. Restoration efforts are primarily concerned with actions that involve rebuilding destroyed property, re-employment of effected stakeholders, rehabilitating, replacing, or acquiring the equivalent of injured natural resources and the services they provided prior to the damage being inflicted and the repair of other essential infrastructure.

Submerged and subsurface oil refers to oil that is not floating on the water surface.

Surface Washing Agent is any product that removes oil from solid surfaces, such as beaches and rocks, through a detergency mechanism and does not involve dispersing or solubilizing the oil into the water column.

Technology is the study, development, and application of devices, machines and techniques for manufacturing and productive processes. Technology also includes tools, equipment, and methods or methodologies that apply scientific knowledge or tools. For purposes of this plan, technology represents the application of knowledge or widgets to the development and/or usage of equipment, systems and organizational capabilities for oil spill prevention, preparedness, response, and restoration.

Vessel means every description of watercraft or other artificial contrivance used, or capable of being used, as a means of transportation on water.

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EXECUTIVE SUMMARY

Title VII of the Oil Pollution Act of 1990 (OPA 90) established the Interagency Coordinating Committee on Oil Pollution Research (ICCOPR) to coordinate a comprehensive program of oil pollution research, technology development, and demonstration. Pursuant to Section 7001(b) of OPA 90, ICCOPR developed the Oil Pollution Research and Technology Plan (OPRTP) to implement the Federal research and development program.

ICCOPR published its first version of the OPRTP in 1992 and published a revised version in 1997. These two versions provided an initial baseline assessment and analysis of: agency roles and responsibilities; status of knowledge of oil pollution prevention, response, and mitigation technologies; priority research and development needs; and an estimate of resources and time needed to implement the program.

The purpose of the FY 2015-2021 version of the OPRTP, and subsequent revisions, is to provide current assessments of the oil pollution research needs and priorities. ICCOPR intends to update this OPRTP every six years to reflect advancements in oil pollution technology and changing research needs. This ongoing planning process will capitalize on the unique roles and responsibilities of member agencies to address oil pollution research and development needs and maintain awareness of research needs.

This version of the OPRTP includes two parts. Part One, Oil Pollution Research, explains why oil pollution research is needed, the parties that are involved in the research, and presents ICCOPR's Oil Pollution Research Categorization Framework for tracking research activities and successes. Part Two, Establishing Research Priorities, presents ICCOPR's priority Research Needs. It also explains the process that ICCOPR used to identify the research gaps and priorities, noteworthy oil spill events, and the current state of oil pollution knowledge. In future versions, Part One will remain relatively static; however, Part Two is expected to change significantly as research advances the state of knowledge and priority Research Needs are successfully addressed.

The Introduction and Chapter 1, The Need for Oil Pollution Research, describes the historical basis for oil pollution research and reviews trends in oil spills from different sources. ICCOPR member agencies share responsibilities to monitor changes in the oil spill system and find opportunities to improve technologies to meet changing needs. ICCOPR recognizes that activities in the Arctic and Alaska, the Gulf of Mexico, inland areas, and the Atlantic Outer Continental Shelf are all of high importance at this time.

Chapter 2, Federal Oil Pollution Research, describes the Federal entities involved in oil pollution research including the ICCOPR member agencies, other Federal research organizations and facilities. Similarly, Chapter 3, Non-Federal Oil Pollution Research Entities, describes state, industry, independent organizations, academia, and international oil pollution research entities.

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Chapter 4, Structuring Oil Pollution Research, presents ICCOPR's Oil Pollution Research Categorization Framework, which provides a common language and planning framework that would enable researchers and interested parties to identify and track research in each topic area. The Framework groups research into four broad Classes: Prevention, Preparedness, Response, and Injury Assessment and Restoration. ICCOPR further classified research within each Class into 25 Standing Research Areas (SRAs), which represent the most common research themes encountered for oil spills.

Chapter 5, Knowledge Transfer and Advancement, describes ICCOPR's efforts to promote continuous improvement in the nation's ability to address oil pollution by monitoring the state of knowledge and adjusting the program to meet changing needs. The R&T planning process emphasizes and strengthens the roles and responsibilities of the member agencies to assure that research advances the capabilities to reduce oil pollution.

Chapter 6, Oil Pollution Research Needs Identification and Prioritization Process, documents the process ICCOPR employed to establish the research priorities. ICCOPR established an R&T Working Group that identified more than 900 research gaps, consolidated them into 570 unique Research Needs, and evaluated them with the assistance of the results from a survey of 280 subject matter experts.

Chapter 7, Noteworthy Oil Spill Incidents, describes important oil spill events and lists the oil pollution research gaps that they illuminated. Spills associated with vessels, drilling operations, on-shore pipelines, facilities, and railroads are included.

Chapter 8, Current State of Oil Pollution Knowledge, describes the sources and mechanisms that ICCOPR uses to obtain and share information on research needs and accomplishments.

Chapter 9, Oil Spill Research and Technology Research Priorities, presents ICCOPR's priority Research Needs. ICCOPR identified three top priorities for each SRA. For SRAs with a large number of Research Needs (i.e., Dispersants), ICCOPR established subcategories of similar research. Three priority Research Needs were assigned to each subcategory.

There are eight SRAs and 33 priorities within the Prevention Class. Two SRAs and 12 priorities are in the Preparedness Class. The Response Class has the largest number of priorities with 72 in 11 SRAs. The four SRAs in the Injury Assessment and Restoration Class have 33 priorities.

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INTRODUCTION

Title VII of the Oil Pollution Act of 1990 (OPA 90) established the Interagency Coordinating Committee on Oil Pollution Research (ICCOPR) to "… coordinate a comprehensive program of oil pollution research, technology development, and demonstration among the Federal agencies, in cooperation and coordination with industry, universities, research institutions, State governments, and other nations, as appropriate, and shall foster cost-effective research mechanisms, including the joint funding of research." Section 7001(c) of OPA 90 required ICCOPR to establish a Federal oil pollution research and development (R&D) program. Pursuant to Section 7001(b) of OPA 90, ICCOPR developed the Oil Pollution Research and Technology Plan (OPRTP) to implement the Federal research and development program.

Background

Federal oil pollution research efforts began to take shape in the late 1960s following the *Torrey Canyon* oil spill off the coast of England. At that time, the U.S. had neither the technical or operational capacity to deal with a large oil spill in the marine environment (EOP-OST, 1969). The Federal government developed the first National Contingency Plan (FWPCA, 1968) to address oil spills and began extensive oil pollution research over the next 20 years. Coordination of the Federal research efforts was informal and on an ad hoc basis through conferences, workshops, and committees of researchers scheduling their projects at the Ohmsett facility. The challenges posed by the response to the *Exxon Valdez* oil spill in 1989 revealed the need for Federal agencies to better coordinate their research. Efforts to coordinate the research resulted in Title VII of OPA 90 and the first requirement for a comprehensive and coordinated research and technology plan.

ICCOPR submitted the original OPRTP to Congress in April 1992. As directed by OPA 90, ICCOPR provided the OPRTP to the National Research Council's (NRC's) Committee on Oil Spill Research and Development for review. Using input from the NRC's Marine Board, ICCOPR started a revision of the plan in May 1993 to include topics related to spill prevention, human factors, and the field testing/demonstration of developed response technologies. ICCOPR released a revised version in April 1997, which identified 21 research areas divided into three levels of priority and served as a strategic planning document for ICCOPR to communicate and coordinate research needs.

This version of the OPRTP is the first in a new series of revisions covering six-year planning cycles, and presents ICCOPR's coordinated research and technology plan for FY 2015-2021. This ongoing planning process will capitalize on the unique roles and responsibilities of member agencies to address oil pollution research and development needs and maintain awareness of research needs.

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Purpose of the Plan

The 1992 version of the OPRTP provided Congress with an implementation plan for the new research and development program established by OPA 90. That version, and the 1997 revisions, provided an initial baseline assessment and analysis of: agency roles and responsibilities; status of knowledge of oil pollution prevention, response, and mitigation technologies; priority research and development needs; and an estimate of resources and time needed to implement the program. The purpose of the FY 2015-2021 version, and subsequent revisions, is to provide current assessments of the oil pollution research needs and priorities. To that end, the principal objectives of the OPRTP are to:

1. define common research themes related to oil pollution research;
2. identify on a regular basis the knowledge gaps associated with common research themes and recommend what gaps should be considered as high research priorities within them;
3. act as an umbrella or connecting document with other strategic Federal research plans (or accomplishment reports) that also address research support for oil pollution topics;
4. document the interagency research coordination process, as well as the feedback processes developed by Federal research, management and regulatory agencies; and
5. promote research information transfer between the government, the public and other stakeholders.
6. encourage and track efforts to implement improvements and technological change within agency roles and responsibilities via updates in the biennial reports to Congress.

Scope and Use of the Plan

This OPRTP provides a basis for coordinating research to address oil pollution issues in the U.S. It is primarily directed at Federal agencies with responsibilities for conducting or funding oil pollution research, but can serve as a research planning guide for industry, academia, State governments, research institutions, and other nations.

Research, in the context of the OPRTP, includes both basic and applied studies that are considered as peer-reviewed and published as well as studies reported in the "grey literature," which is publically available scientific literature that has not been peer reviewed. The following National Science Foundation definitions apply with respect to the OPRTP:

- **Basic research** is any systematic study directed toward fuller knowledge or understanding of the fundamental aspects of phenomena and of observable facts without specific applications towards processes or products in mind.
- **Applied research** is any systematic study to gain knowledge or understanding necessary to determine the means by which a recognized and specific need may be met. ICCOPR

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interprets this to mean studies to advance knowledge about oil spill prevention, preparedness, response, mitigation, and restoration/recovery.

- **Development** is any systematic application of knowledge or understanding, directed toward the production of useful materials, devices, and systems or methods, including design, development, and improvement of prototypes and new processes to meet specific requirements.
- **Technology** is defined as making, usage, and knowledge of tools, machines, techniques, crafts, systems or methods of organization in order to solve a problem or perform a specific function. ICCOPR believes this definition represents the application of knowledge as well as the development and usage of the equipment, systems and organizational capabilities concerning oil spill prevention, preparedness, response, mitigation, and restoration/recovery.

At the federal level, this OPRTP provides information that can be used as a basis to conduct interagency coordination and track progress toward addressing the nation's research needs. It can also help Federal agencies:

1. identify high-priority research emphasis areas;
2. promote needed research based on priorities; and
3. synchronize and collaborate research activities to avoid overlapping research efforts.
4. track progress of key efforts to aid implementation of needed improvements.

ICCOPR recognizes that there are a large number of oil pollution research programs conducted by non-Federal organizations and the private sector. This OPRTP provides these entities with ICCOPR's recommendations on research areas that will best address the nation's oil pollution research needs.

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PART ONE – OIL POLLUTION RESEARCH

1. The Need for Oil Pollution Research

Oil is a dominant source of energy in the United States, supplying the nation with approximately 40 percent of its energy needs (Ramseur, 2012). Oil provides fuel for the transportation, industrial, and residential sectors and serves as a primary feedstock for making plastics. Oil is expected to remain a major source of energy in the U.S. for at least the next several decades. With historical, current and projected use and constant movement, it is inevitable that spills will occur.

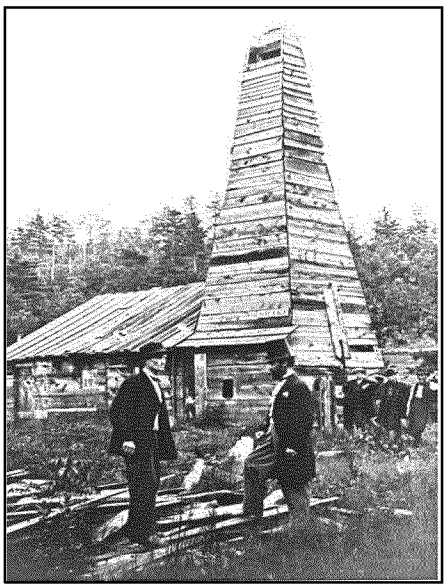

Figure 1-1: The start of the commercial oil industry in the U.S. – Oil Creek, PA, 1859 (Source: Drake Wells Museum)

Spills of oil in the U.S. accompanied the inception of early commercial efforts for petroleum drilling in the early 19th century in the United States and continue to this day. The first oil discovery was on land at Oil Creek, Pennsylvania in 1859 by George Bissel and Edwin Drake (Figure 1-1) (Pees, 2004). This success quickly led to additional commercial investments in oil drilling refining and marketing in the western Appalachian Mountains, where oil seeps were common. Commercial drilling projects rapidly spread to include areas in Southern California, Kansas, Oklahoma, Arkansas, North Louisiana and Texas by the late 1890's.

In 1910, the largest onshore blowout in the U.S. and the world occurred at the Lakeview No. 1 well in the San Joaquin Valley, CA (Figure 1-2). The initial flow estimates ranged from 125,000 barrels per day (bpd) at the start to 90,000 bpd after a month. The well remained uncontrolled for 544 days with an estimated 9.4 million bbl of crude being released into the environment (one barrel = 42 U.S. gallons).

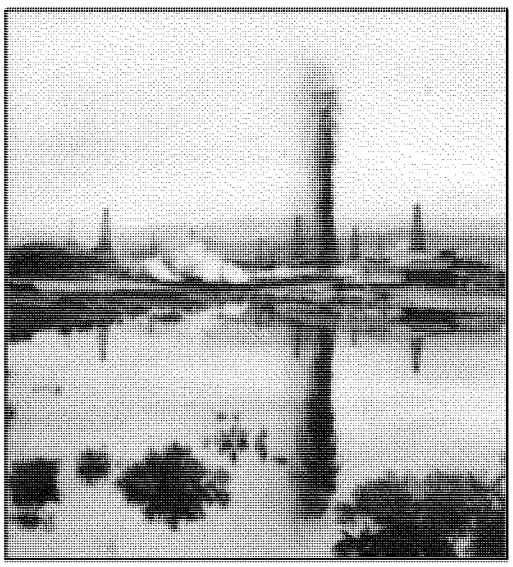

Figure 1-2: The Lakeview Gusher, CA; the US's single largest well blowout, 1910. (Source: San Joaquin Valley Geology)

Oil spills continued to occur but it wasn't until the late 1960s that the national attention focused on the need to address the problems associated with oil spills. In 1967, reaction in the U.S. to the *Torrey Canyon* oil spill off the coast of England resulted in the creation of the original National Multiagency Oil and Hazardous Materials Contingency Plan in 1968 (FWPCA, 1968). That Plan was superseded in 1970 when the Council on Environmental Quality (CEQ) published the National Oil and Hazardous Materials Pollution

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Contingency Plan in the Federal Register at 35 FR 8508 (CEQ, 1970). In 1969, a well blowout and undersea faults spilled an estimated 42 million gallons of oil into the Santa Barbara Channel, one of the largest environmental disasters in the U.S. (NOAA, 2014). This spill increased awareness of oil pollution problems and contributed to creation of the U.S. Environmental Protection Agency, the National Environmental Policy Act, and the National Marine Sanctuaries system. It also prompted several federal agencies to begin oil pollution research programs.

Oil pollution research must continually evolve to keep pace with new oil spill risks and environments where they occur. The process by which oil is produced, processed, and delivered to consumers is ever evolving. The oil industry opens new areas for exploration and production as technological advances make the ventures profitable. In turn, the location and methods of transporting that oil to markets shifts, affecting the potential locations and types of oil spills. For example, the opening of the Alaska North Slope and the Trans-Alaska Pipeline necessitated transportation of crude oil by tanker through Prince William Sound, site of the *Exxon Valdez* oil spill. Similarly, the technological advances that allow deep water oil exploration and production also pose new hazards and risks as evidenced by the British Petroleum (BP) *Deepwater Horizon* oil spill. Those spills posed new response challenges and revealed the need for additional oil pollution research.

There will continue to be a need for oil pollution research as long as there is a demand for oil-based products. Human errors, mechanical failures, natural events, and accidents all have the potential to cause spills. This chapter examines the oil production system and patterns of oil spills that affect the oil pollution research needs addressed in this OPRTP.

1.1 U.S. Oil Production

Figure 1-3 shows the U.S. Energy Information Administration (EIA) Annual Energy Review 2015 (EIA, 2015) and provides a review on the production, import and consumption for petroleum and other liquids for the last 60 years (from 1949 to 2014). The U.S. has experienced a steadily increasing consumption rate that quickly outstripped the U.S. petroleum production capabilities, resulting in a regular increase in net imports of petroleum products to address the shortfall beginning in 1970. Domestic production of oil continued to decrease until 2008 when new finds and improved drilling capabilities began to increase U.S. field production.

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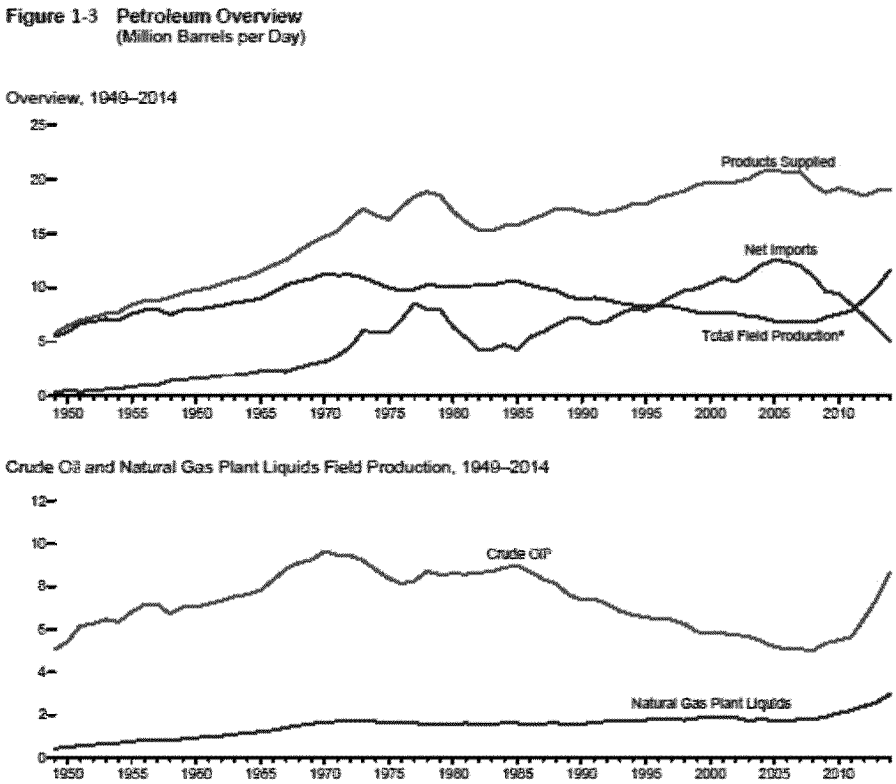

Figure 1-3. Petroleum and other Liquid Estimated Consumption, Production and Net Imports (in million bpd) for 1949 – 2014 in the U.S. Source: EIA. 2015.

Of particular note was the discovery of the Bakken field in North Dakota, Montana and in Canada (Figure 1-4). Significant increases in domestic production from these discoveries resulted in a decrease in net oil imports as shown in Figure 1-3. The increase in production of natural gas has also led to a decrease in net imports. The application of hydraulic fracturing and horizontal drilling technologies caused a significant increase in Bakken production since 2000. By the end of 2010, oil production rates had reached 458,000 bbls per day, outstripping the pipeline capacity to ship oil out of the Bakken. The result was an expansion of rail transportation to move the crude oil to refineries or ports for export.

Shale oil and natural gas resources are found in shale formations that contain significant accumulations of natural gas and/or oil (Figure 1-4). The Barnett Shale in Texas has been producing natural gas for more than a decade. Information gained from developing the Barnett Shale provided the initial technology template for developing other shale plays in the U. S. Another important shale gas play is the Marcellus Shale in the eastern U. S. While the Barnett and Marcellus formations are well-known shale gas plays in the United States, more than 30 U.S. states overlie shale formations. The Marcellus natural gas trend, which encompasses 104,000 square miles and stretches across Pennsylvania and West Virginia, and into southeast Ohio and upstate New York, is the largest source of natural gas in the United States, and production was still growing rapidly as of 2014.

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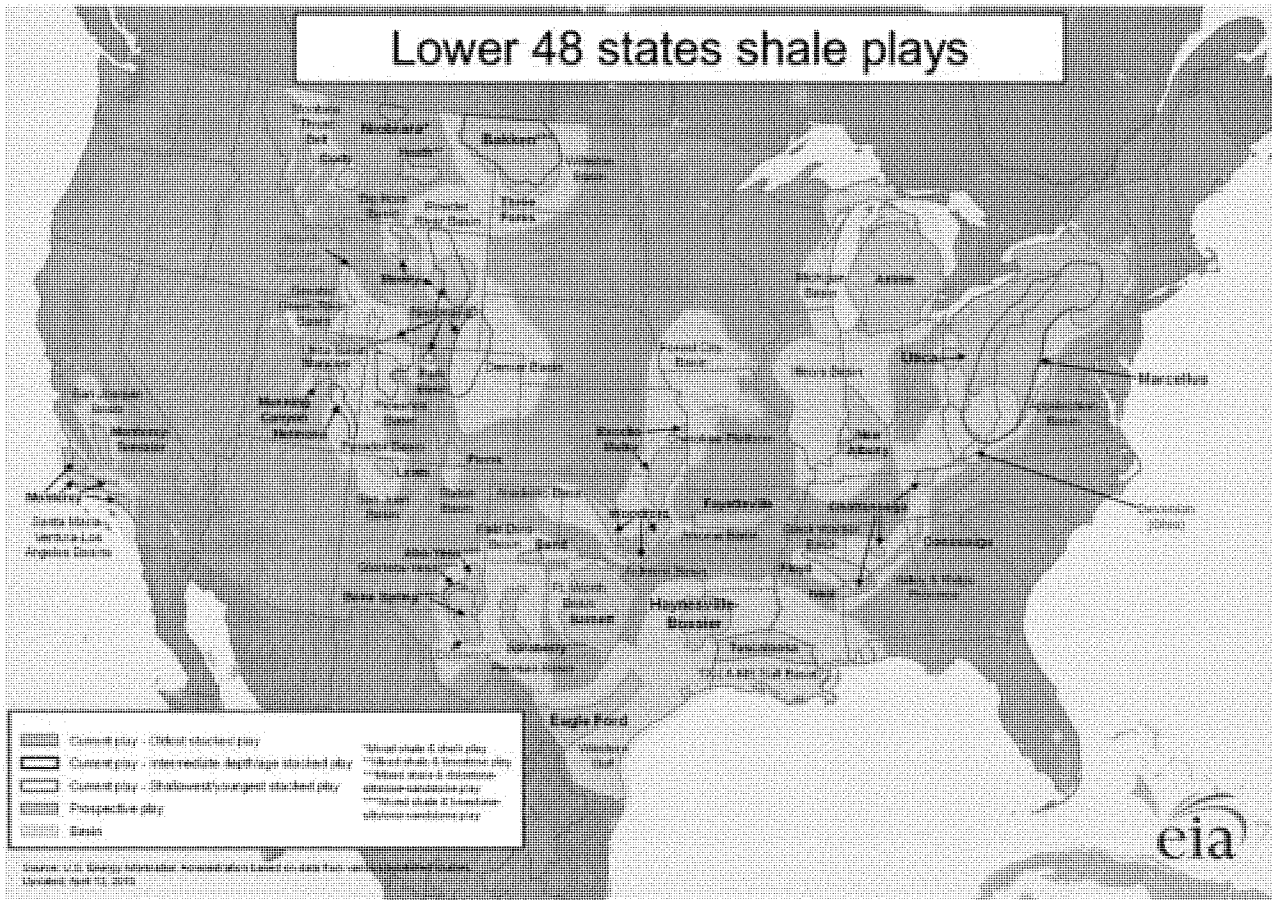

Figure 1-4 Domestic Shale gas plays. Source: EIA 2015

Figure 1-5 shows the location of refineries in the U.S. Figure 1-6 shows the substantial increase in transportation of petroleum from the Midwest to other parts of the country where the refinery capacity exists. The greatest overall volumes were transported to the Gulf coast. The 2010 to 2014 period reflects the increase in U.S. production in the shale-producing locations.

The significant increase in petroleum being transported within the U.S. has taxed the available pipeline capacity significantly. In order to meet some of the increased demand, there has been a significant increase in rail transportation of crude oil.

The large increase in U.S. and North American petroleum production has resulted in a significant change in the transportation patterns. The production from the Bakken field and the Canadian oil sands products (OSP) areas have resulted in a significant change in the number trains and tank cars carrying petroleum. The Association of American Railroads (2015) reports that the number of rail tankers carrying crude oil and petroleum products in the U.S. increased from just under 19,000 carloads in 2008 to more than 1,033,000 carloads in 2014. Figure 1-7 shows the change in the number of rail cars and the change in train movements between 2010 and 2014; this represents the time period when the development of Bakken oil began to be significant.

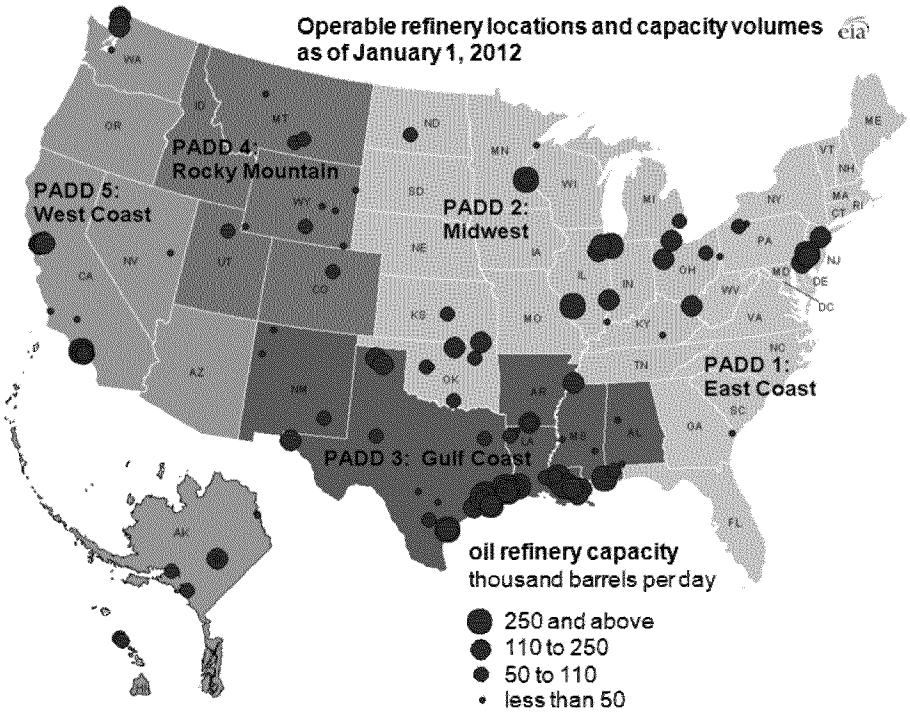

Figure 1-5: Location of U.S. Refineries and Refining Capacity. EIA 2015.

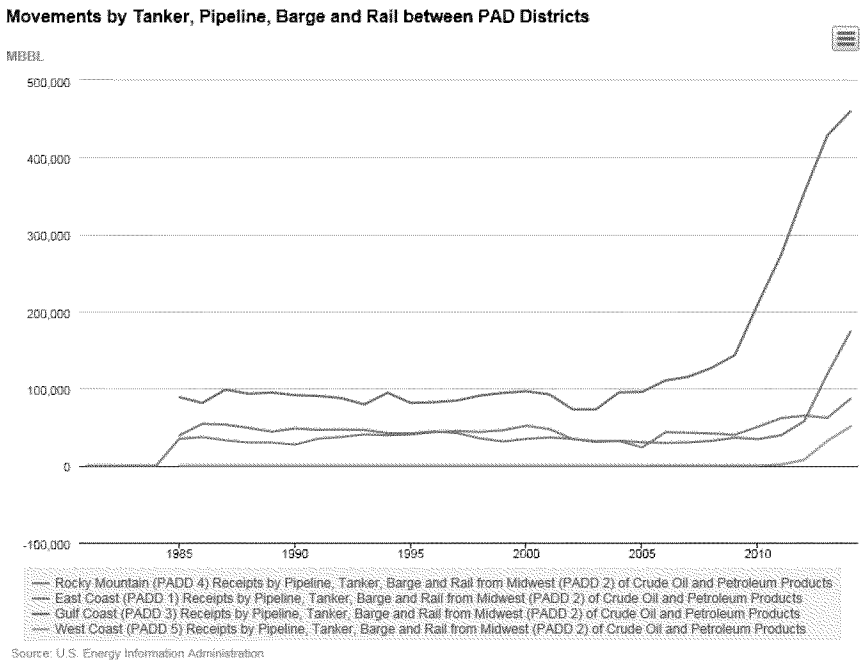

Figure 1-6 Movement of crude oil (MBBL) by pipeline, tanker barge and rail tor refinery areas. Source: EIA 2015.

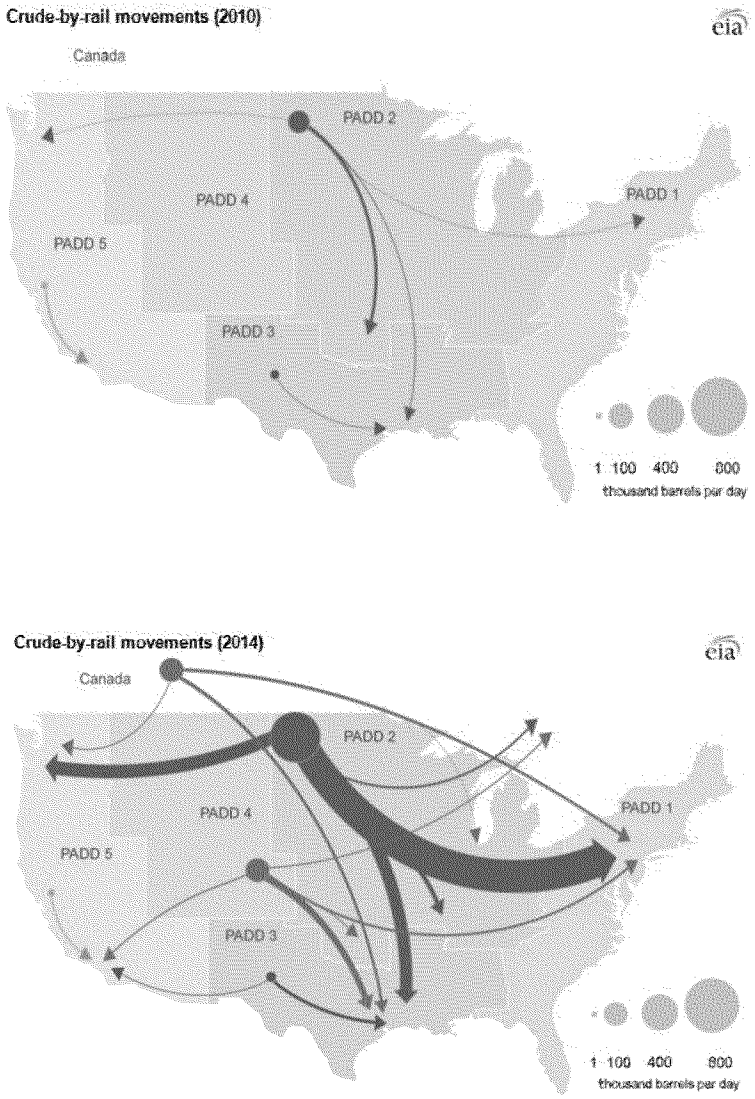

Figure 1-7 A comparison of crude oil movements by rail from 2010 and 2014. Source EIA 2015.

1.2 History of Oil Spills in the U.S.

From 1973 to 1990, an average of 2.8 million bbl of oil was spilled every year. Since 1990, that number has reduced to 35,700 bbl a year. Based on data between 1973 and 2009, the annual number and volume of oil spills declined, and in some cases dramatically (Etkin, 2009). Total petroleum industry spillage has decreased consistently over the last 40 years through 2007 (Figure 1-8). Table 1-1 summarizes the average annual oil spillage from petroleum industry

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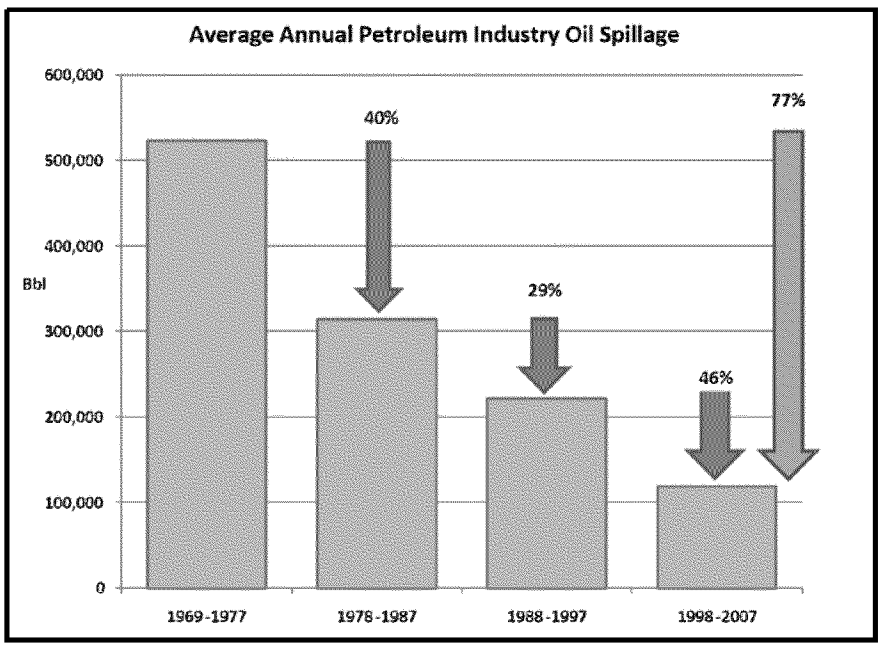
sources, including: spillage related to oil exploration and production platforms and offshore pipelines; spillage from coastal and inland pipelines, tank vessels, railroads, and tanker trucks; spillage from oil refineries; and spillage at gas stations. By multiplying the average annual spill volumes for each decade by 10, the total volume spilled (as recorded) from 1969 to 2007 would approximately equal 17.5 million bbls. (See Table 1-1.)



*NOTE: The average annual oil spillage volumes represented here are gathered from petroleum industry spillage sources, including: spillage related to oil exploration and production, platforms and offshore pipelines; spillage from coastal and inland pipelines; spillage from oil transport by tank vessels, railroads, and tanker trucks; spillage from oil refineries; and spillage from gas stations.

Figure 1-8: Average Annual Oil Spillage from Petroleum Industry Sources by Decade. Etkin, 2009.

These figures do not address any other significant spillage events in the U.S. after 2007, which would include the 2010 Macondo/*Deepwater Horizon* (DWH) well blowout and oil spill and the 2010 Enbridge Pipeline release in the Kalamazoo River in Michigan or any other significant spillage events in the U.S. after 2007. The 4.9 million bbls spilled during the *Deepwater Horizon* oil spill (USCG, 2011b) would reverse this downward trend and increase the total volume spilled between 1969 and 2007 by nearly 1400 percent; this incident represents nearly 95% of the total volume spilled from all oil platforms in the last 42 years. In general, the very largest spills, which constitute only 0.4% of the total spills, comprise 90.6% of the total volume spilled in the U.S. for the period 1988 – 2007.

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Average Annual Oil Spillage from Petroleum Industry Sources, bbls. Modified From Etkin, 2009				
Source	1969-1977	1978-1987	1988-1997	1998-2007
PRODUCTION	31,435	8,701	15,183	9,938
Offshore Platform Spills	25,858	1,344	1,814	1,273
Offshore Pipelines	4,48	3,462	8,127	2,614
Offshore Supply Vessels	95	245	48	10
Inland Production Wells	1,000	3,650	5,194	6,041
REFINING	3,000	3,512	15,015	12,136
Refinery Spills	3,000	3,512	15,015	12,136
TRANSPORT	488,662	301,645	190,753	96,393
Inland Pipelines	259,340	181,196	118,297	76,754
Tanker Trucks	3,000	4,888	5,213	9,181
Railroads	2,000	2,322	2,164	1,431
Tank Ships	192,492	60,250	42,197	3,598
Tank Barges	31,830	52,989	22,882	5,429
STORAGE AND CONSUMPTION	118,523	97,206	278,525	77,613
Non-Tank Vessels (Cargo Ships)*	5,000	6,786	2,817	1,602
Other Vessels*	14,858	6,574	6,301	4,167
Gas Stations and Truck Stops	1,195	1,195	1,564	814
Residential*	150	179	518	498
Aircraft*	3,700	3,714	3,862	4,044
Inland EPA-Regulated Facilities*	30,000	34,740	245,017	59,676
Coastal Facilities (Non-refining)*	62,220	42,781	15,059	4,230
Inland Unknown*	900	967	2,198	516
Motor Vehicles*	500	270	1,189	2,066
AVERAGE ANNUAL TOTALS	641,620	411,064	499,476	196,080
ESTIMATED DECADE TOTAL	6,416,200	4,110,640	4,994,760	1,960,800
ESTIMATED GRAND TOTAL SPILLAGE for 1969 – 2007	17,482,400 bbls (734,560,800 gallons)			
*Additional storage and consumption data for the 1969-1977 period was provided by Dagmar Schmidt Etkin, 2011, personal communications.				

Table 1-1: Average Annual Oil Spillage from Petroleum Industry Sources, bbl. (Modified from Etkin, 2009).

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1.3 Analysis of the Oil Spill System

In their Congressionally-mandated review of the 1992 OPRTP, the National Research Council (NRC) Marine Board recommended "…an analysis of the marine oil spill system, which consists of a variety of subsystems beginning with drilling for oil and ending at delivery of the product to the consumer." The oil spill system described by the NRC consists of all components and nodes of the oil supply chain (see Figure 1-9) including all aspects of the oil handling and transport processes, succeeding environments affected as a spill spreads, and intervention techniques for preventing or minimizing environmental damage (Marine Board, 1993; 1994). The NRC advocated that such an approach would identify critical nodes of potential failure within the system where ICCOPR could focus its research planning efforts.

ICCOPR agreed with the NRC on the value of a systems analysis approach in research planning but full implementation of the approach has been beyond the funding capabilities of the ICCOPR membership. In 2007, the USCG Research & Development Center (RDC) completed a system analysis of the response system and used the results to identify and evaluate research opportunities as part of strategic planning to improve spill response (VanHaverbeke, 2012). ICCOPR member agencies also have expertise on specific components of the oil spill system. This base of knowledge on the system components provides a general framework from which ICCOPR plans its research coordination, funding allocations, and measures of effectiveness. The oil spill research categorization scheme discussed in Chapter 4 reflects how ICCOPR used its understanding of the oil supply chain and oil spill response system to focus research planning as envisioned by the NRC.

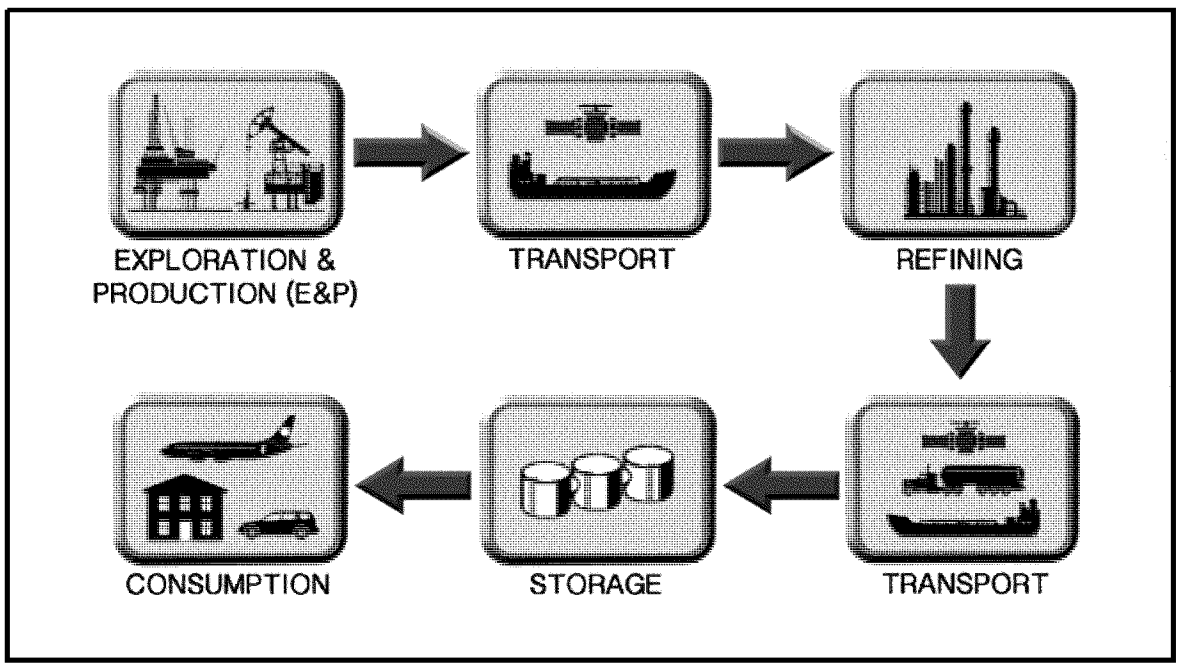

Figure 1-9: Oil Supply Chain.

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For planning R&D activities, the oil supply chain for petroleum oils consists of five subsystems (Figure 1-9):

- **Subsystem 1-Exploration and Production Facilities** - This is the origination point of crude oil and includes onshore and offshore exploration and production facilities.
- **Subsystem 2-Transportation** - This is the transportation of foreign and domestic oil products (generally crude oil) to refineries in the U.S. either by tank vessel (ship and barge), pipeline (offshore and onshore), tank railcar (unit trains), or tanker trucks.
- **Subsystem 3- Refining** - Refining of crude oil into petroleum products including the storage of crude oil, actual refining operations, storage of refined products, and the loading of refined products on tank vessels (ship and barge), tank railcars, and tanker trucks. In addition, refining would also encompass those activities that produce biofuels or vegetable oils. The latter products present many common and novel challenges compared to their traditional petroleum counterparts.
- **Subsystem 4- Transport / Storage/Distribution** - This subsystem involves the transportation of refined products to a bulk distribution storage facility by various modes of transportation, (e.g., product pipeline, tank vessel (ship and barge), tanker truck, tank railcars). Imported refined products would enter the U.S. system, as well as exported refined products would leave the U.S. system at this point. Tanker trucks may also deliver direct from refinery storage to the end user, e.g., residence or retail gas station.
- **Subsystem 5-Consumption/Consumer/Retail/Industrial** - This subsystem includes the retail gas station and the residential home heating oil segments of the oil system as well as industrial users (e.g. electric generation facilities).

There are available historic data to support claims that the improved safety and operating procedures implemented have generally reduced the risk of a spill at any point along the system. However, because accidents cannot be completely eliminated, efforts to improve pollution prevention and response must be sustained. In the following section, five potential high risk spill sources (exploration & production, vessels, onshore and offshore pipelines, railroads and refineries / bulk terminals) are examined to highlight existing weaknesses and concerns, and the efforts being made to address them.

1.4 Exploration and Production Facilities

The spill record for domestic drilling and production over the past 30 years suggested that technology and procedures for preventing oil spills were being employed effectively. However, that trend was interrupted in 2010 when the DWH drilling rig experienced an uncontrollable well blowout and oil spill. Even with modern equipment and modern safety measures, spills are a part of the oil and gas industry. The DWH blowout occurred when human errors circumvented the modern technological safeguards designed to prevent such an accident.

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> "Current technology enables drilling in water twice as deep as Macondo. Drilling at such depths requires all parties to set their standards still higher for difficult issues such as remote containment systems in water depths with extreme pressures and very limited human access, as well as different geological pressures and formations and mixes of hydrocarbons. Desire to tap resources in deeper waters should be accompanied by equivalent investments in subsea equipment, operator training, research and development for containment and response technologies, demonstrated financial capacity, and continuous improvement in and communication of industry practices devoted to safety." *(National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling, 2011)*

Due to the rising energy demands in developed economies and dramatically rising levels of consumption in emerging economies, the world's appetite for oil and other fuels will continue growing for the foreseeable future. This demand will increase pressure for continued and new oil and gas exploration in challenging environments including in the Arctic and in deep and ultra-deep waters. It will also encourage exploration and production of unconventional resources (e.g., oil sands) and the increased use of advanced technologies (e.g., hydraulic fracturing and horizontal drilling).

1.5 Onshore and Offshore Pipelines

Approximately 2.6 million miles of pipelines provide an efficient and fundamentally safe means of transporting gases and liquids. They are an integral part of the U.S. energy supply and provide vital links to other critical infrastructure such as power plants, airports, and military bases. Currently, there are 199,157 miles of pipelines that carry volatile, flammable, or toxic materials with the potential to cause public injury and environmental damage.

Canadian oil exports to the U.S. have been increasing rapidly, primarily due to growing extraction from the oil sands in Western Canada. Oil sands are a mixture of clay, sand, water, and heavy black viscous oil known as bitumen. After extraction, the bitumen is converted into an oil sands product (OSP) suitable for pipeline transport. Canada's OSPs are exported as either light, upgraded synthetic crude ("syncrude") or a heavy crude oil that is a blend of bitumen diluted with lighter hydrocarbons ("dilbit") to ease transport. The bulk of oil sands' supply growth is expected to be in the form of dilbit.

The expansion of petroleum pipelines from Canada has generated considerable controversy in the U.S. One specific area of concern was the potential new risks of the OSPs to pipeline integrity. An NRC panel (TRB, 2013) concluded, however, that diluted bitumen does not have any unique properties that make it more likely to cause internal failure of pipelines than other types of crude oil. However, additional research is needed to understand the fate and transport of unconventional oils, relative to that of traditional crude oils and refined products.

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In the 49 year period between 1964 and 2012, there were 79 oil spills from pipelines on the Outer Continental Shelf according to BSEE (2015) statistics, or about 1.6 per year. However, 25 of those spills were caused by damage from a series of hurricanes in the Gulf of Mexico in 2004, 2005, and 2008. Otherwise, spills from offshore pipelines occur at a rate of about one per year.

Both government and industry have taken numerous steps to improve pipeline safety over the last 10 years such as improved corrosion resistance, integrity testing, and requirements to identify pipelines before digging. According to PHMSA, pipelines are extremely safe when compared to other modes of energy transportation relative to the volumes of products transported (PHMSA, 2007). The trend is down, however, major pipeline incidents in 2010 and 2011 suggest that more work is needed. Figure 1-10 and Table 1-2 provide information from PHMSA on pipeline oil spills over the past 20 years.

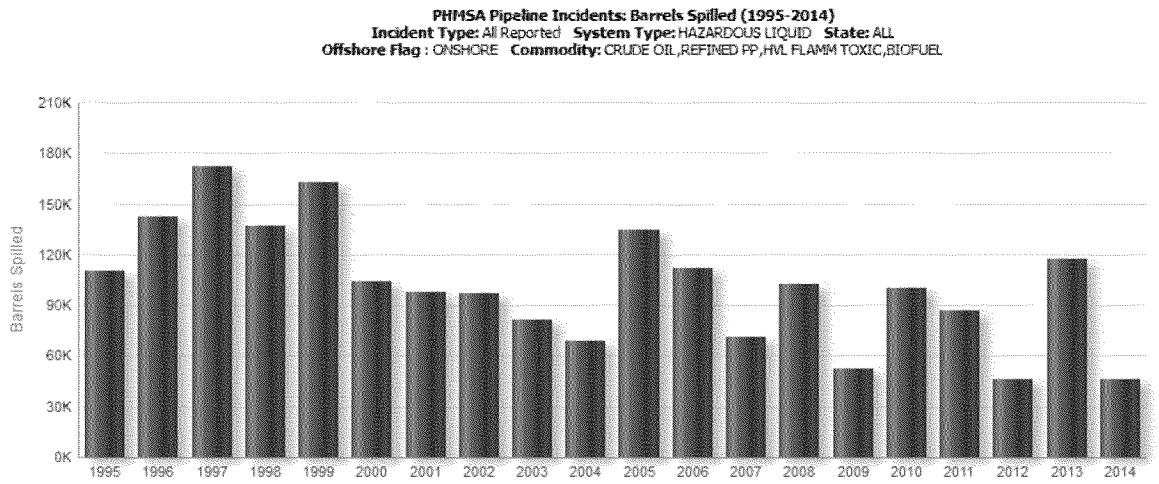

Figure 1-10 Barrels of Oil Spilled by Pipelines (1995-2014)

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PHMSA Pipeline Incidents: (1995-2014)
Incident Type: All Reported **System Type:** HAZARDOUS LIQUID **State:** ALL
Offshore Flag : ONSHORE **Commodity:** CRUDE OIL,REFINED PP,HVL FLAMM TOXIC,BIOFUEL

Calendar Year	Number	Fatalities	Injuries	Property Damage As Reported	Barrels Spilled	Net Barrels Lost
1995	176	0	9	$31,575,189	109,865	0
1996	180	3	7	$74,543,311	141,994	0
1997	155	0	2	$40,836,392	171,988	0
1998	133	1	5	$52,048,979	136,760	0
1999	151	4	17	$81,722,760	162,637	0
2000	131	1	4	$130,605,839	103,806	0
2001	121	0	9	$24,684,499	97,852	0
2002	442	1	0	$49,258,448	96,809	0
2003	421	0	0	$67,314,774	81,292	0
2004	355	5	16	$83,996,433	68,840	0
2005	340	2	2	$275,460,922	134,614	0
2006	326	0	2	$52,848,585	112,029	0
2007	321	4	9	$59,509,192	71,032	0
2008	360	2	2	$136,858,894	101,940	0
2009	325	0	1	$58,112,827	52,437	0
2010	340	1	4	$1,066,323,312	100,223	49,116
2011	339	1	2	$268,056,467	86,490	54,832
2012	359	3	4	$143,694,837	45,861	29,315
2013	392	1	5	$276,271,799	117,415	85,799
2014	438	0	0	$101,402,847	45,975	20,612
Grand Total	**5,805**	**29**	**100**	**$3,075,126,306**	**2,039,859**	**239,675**

Table 1-2, PHMSA Pipeline Spill Statistics (1995-2014)

1.6 Railroads

New technologies and high global oil prices have made it economical for energy companies to develop shale oil and oil sands petroleum reserves in the United States and Canada. The challenge is getting the oil from the oil fields to the appropriate refineries across North America so they can process the oil. That has created an opportunity for railroads to fulfill the transportation demand. In 2011, railroads and other facility and transportation businesses began building loading facilities and adding tank cars to compete with pipelines for a piece of this transportation demand.

The movement of Bakken oil and OSP occurs via unit trains, which can be composed of more than 100 tank cars, all carrying the same cargo. Tank cars are typically double-lined and made of hardened steel to survive a derailment. With the increased use of unit trains there has been an increase in the number of significant spills from derailments.

The American Petroleum Institute's Analysis of U.S. Oil Spillage (Etkin, 2009), which tracks oil spill statistics up through 2007 data, stated that railroads spilled 1,400 bbl of oil annually as cargo in tank cars and as fuel. This was a 34% reduction from the previous decade (1990s). The Association of American Railroads (2015a,b) reports that the number of rail tankers carrying

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crude oil and petroleum products in the U.S. increased from just under 19,000 carloads in 2008 to more than 1,033,000 carloads in 2014. The Federal Railroad Administration (FRA) statistics indicate number of train accidents has continued to decrease from 2005-2014 (Table 1-3). The number of hazmat releases has decreased also over this time period, although the level of damages over $1 million dollars has remained constant. However, the increased transportation of crude oil resulted in a number of significant rail accidents that resulted in damages and deaths. (See section 7.1.5)

In 2014, the U.S. Department of Transportation (DOT) began a comprehensive rulemaking proposal to improve the safe transportation of large quantities of flammable materials by rail - particularly crude oil, denatured alcohol, and ethanol/gasoline mixtures - because of the concern for the quantity of Bakken crude transported by rail and the increase in number of accidents. DOT proposed enhanced tank car standards, a classification and testing program for mined gases and liquids, and new operational requirements for high-hazard flammable trains that include braking controls and speed restrictions. Within two years it proposes the phase out of the use of older DOT 111 tank cars for the shipment of packing group I flammable liquids, including most Bakken crude oil, unless the tank cars are retrofitted to comply with new tank car design standards.

Category(1)	CY05	CY06	CY07	CY08	CY09	CY10	CY11	CY12	CY13	CY14
Freight Train Accidents(2)	3266	2998	2693	2481	1912	1902	2022	1760	1822	1736
Hazmat cars Damaged or Derailed (3)	915	1041	1056	750	743	708	665	671	822	779
Hazmat Releases(4)	39	30	46	21	22	21	21	26	18	15
Cars Releasing	52	71	76	37	44	40	66	50	78	26
Damages >100k	526	571	540	481	385	423	407	347	406	381
Damages >1mil.	57	59	69	52	52	57	53	43	66	58
Deaths	33	6	9	27	4	8	6	9	11	2

(1) Calendar years
(2) Not including crossing collisions and other accidents with death
(3) Total hazard material cars damaged
(4) Accidents with hazard material releases

Table 1-3: Number of Train Accidents and Hazmat Releases 2005-2014. (FRA 2015)

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1.7 Refining and Storage Operations

Potentially damaging discharges of crude oil or petroleum products in a refinery or at a bulk storage terminal can and do occur at every point in this system (offloading, storage, loading), and the factors that can influence the occurrence of these accidental discharges includes: the design, construction, maintenance, and operational activities; and human factors (e.g. training).

Despite a decrease in the number of domestic refineries between 1982 and 2010, the U.S. combined daily throughputs have slowly increased from about 12 million up to approximately 15 million bbl/day (Table 1-4). Increased throughput has occurred in spite of decreased numbers of refineries, because remaining refineries operate at increased capacities/efficiencies to compensate for the lack of production at decommissioned older refineries.

U.S. Gross Inputs to Refineries (Thousands of Barrels per Day)										
Decade	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9
1980s						12,165	12,826	13,003	13,447	13,551
1990s	13,610	13,508	13,600	13,851	14,032	14,119	14,337	14,838	15,113	15,080
2000s	15,299	15,352	15,180	15,508	15,783	15,578	15,602	15,450	15,027	14,659
2010s	15,177	15,289								
Source: U.S. Energy Information Administration (EIA), 2012.										

Table 1-4: U.S. Gross Inputs to Refineries (Thousands of Barrels per Day)

Thousands of above ground crude oil and refined product storage tanks are in service at refineries and other oil/product handling/storage facilities. Buried pipelines within refinery boundaries represent another source of leaks. Aging domestic refinery infrastructure increases the risk of spillage and better systems are needed to detect potential problems. Another possible source of leakage is the refinery process line.

On June 19, 2006, a violent rain storm compromised a waste oil tank at the CITGO Refinery on the Calcasieu River, near Sulfur, Louisiana. Oil booms initially contained the spilled oil but subsequently failed and oil spread down the Calcasieu River and into Calcasieu Lake. The spill released up to an estimated 71,000 bbls (approximately 3 million gallons) of waste oil into the environment. The exact amount of oil spilled and the amount reaching the water is still unknown. Hurricane Katrina also caused considerable damage and oil spills from the refineries and bulk storage terminals in the storm's path (Table 1-5).

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Spill Events that Occurred in the Path of Hurricane Katrina (2005)	
Spill Location	Quantity (bbls)
Bass Enterprises (Cox Bay)	90,000
Shell (Pilot Town)	25,000
Chevron (Empire)	23,600
Murphy Oil (Meraux and Chalmette)	19,500
Bass Enterprises (Pointe à la Hache)	10,980
Chevron (Port Fourchon)	1,260
Venice Energy Services (Venice)	595
Shell Pipeline Oil (Naim)	320
Sundown Energy (West Potash)	310
Source: Pine, 2006	

Table 1-5: Spill Events that Occurred in the Path of Hurricane Katrina (2005).

1.8 Maritime and Riverine Transport - Tank Vessels (Ships & Barges) and Non-Tank Vessels

A combination of Federal, State, and international authorities are responsible for regulating oil spills from vessels in the U.S. They are collectively responsible for creating and implementing legislation to prevent oil spills and handling the decisions and procedures that follow in the aftermath.

There has been a reduction of operational and accidental oil spillage in the U.S. that can largely be attributed to the domestic and international regulations that have improved shipping safety and increased limits of liability for oil spills. These regulations required the phase-out of single hull tank vessels (ships and barges) and development of new tank vessels designs for double hulls to reduce accidental discharges in the event of grounding, collision, and allisions. Operational preventative measures including mandatory tug escorts for tank ships transiting through environmentally-sensitive areas in ports may also have contributed to the downward spillage trend by ensuring immediate assistance to a vessel experiencing a loss of propulsion or steerage.

Section 703 of the Coast Guard Authorization Act of 2010 directed the USCG to conduct a study of oil spills involving commercial vessel sources between 2001 through 2010 (Table 1-6). The Coast Guard released the study in May 2012 and reported that a small number of vessel casualties resulted in the greatest percentage of the overall spill volume. The data also show that most spills do not involve vessel casualties. These non-casualty spills are termed "operational"

spills. The report addressed casualty and non-casualty groupings separately in order to identify their respective causal factors. The report defined a non-casualty spill as one in which the only reported occurrence is an oil spill (i.e., the incident did not involve an allision or collision).

U.S. Oil Spills from Vessels – 2001 - 2010. From: USCG, 2012		
Vessel Type	Spills	Barrels
MODU*	259	9,842
Tank Barge	1,318	75,044
Tank Ship	426	30,070
Freight Ship	893	17,284
Fishing Vessel	3,619	8,746
Tow / Tugboat	2,965	6,956
Public Vessel	486	3,077
OSV / Oil Recovery	883	2,334
Recreational	5,058	1,696
Unclassified Vessel	2,479	1,511
Passenger	1,100	8,66
Industrial Vessel	604	675
Freight Barge	407	408
Research Vessel	162	107
Other	51	11
TOTALS	**20,710**	**158,633**

*MODU- Mobile Offshore Drilling Units

Table 1-6: U.S. Oil spills from vessels 2001-2010. (USCG, 2012)

The study concluded that the most frequently reported human factors were inattention, procedural errors and situational awareness. However, while the study focused on human factors, it found that more than half of all discharges were the result of material failure. Vessel casualty statistics showed that the combination of material failure and loss of vessel control led to some of the largest oil spill volumes from 2001 through 2010. Material failure was a significant factor for propulsion and steering problems. The potential for damage due to allision, collision, or grounding is significant when such failures occur on large vessels, (e.g. tank ships, freight ships). According to industry feedback, material failures are also a significant factor in near-miss incidents.

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1.9 Oil Tankers

Stricter regulations and improved operations of oil tankers has reduced the number of large (> 5,000 bbls, or 7 tonnes) and medium (50 – 5,000 bbls) oil spills from tankers globally, as well as in the U.S. despite an increase in marine transportation of oil. Following the grounding of the single-hull tank vessel *Exxon Valdez*, OPA 90 mandated that all newly built tank vessels have double hulls and that single-hull tank vessels be phased out and replaced by double-hulled vessels by January 1, 2015 for operations in the U.S. waters. Similarly, requirements stemming from the International Convention for the Prevention of Pollution from Ships (MARPOL) have increased the safety of tanker transport.

The International Tanker Owners Pollution Federation Limited (ITOPF), which tracks oil spills from tankers, reports that 19 of the 20 largest spills from tankers occurred before 1970 (ITOPF, 2015). Figure 1–11 shows the trend in oil tanker transport and the number of spills. Figure 1-12 shows the downward trend in oil spills from tankers since 1970 according to ITOPF.

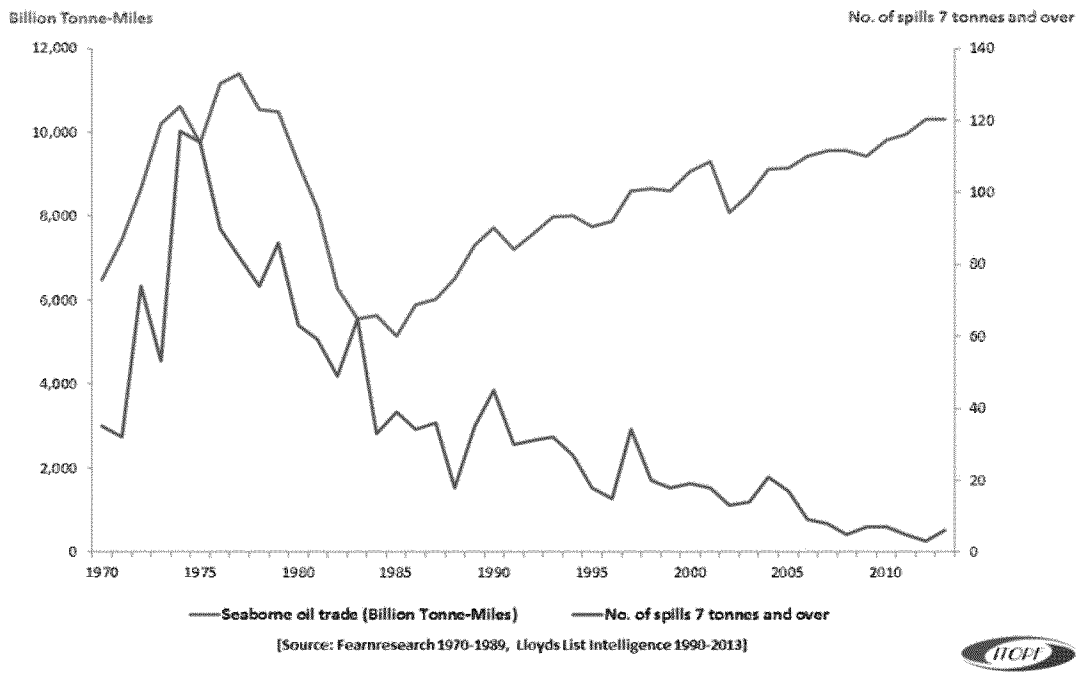

Figure 1-11: Seaborne oil trade and oil spill trends

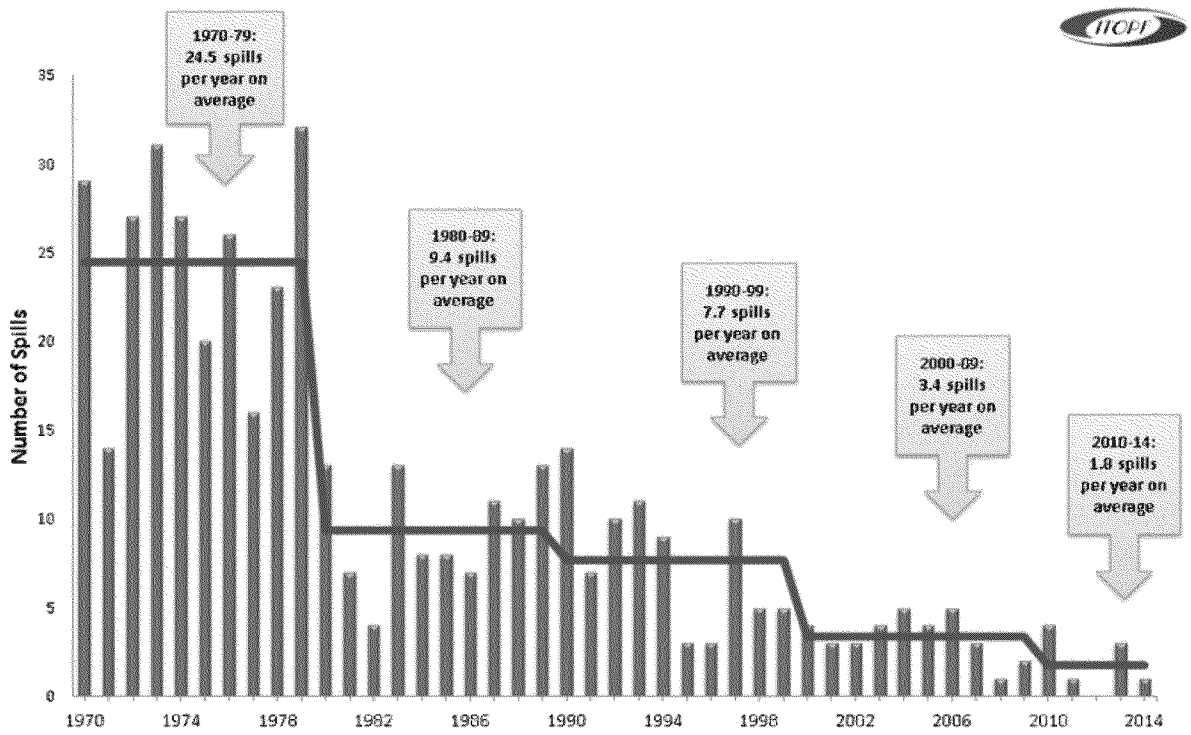

Figure 1-12: Number of Large Spills (>5,000 bbls) from 1970-2014 (ITOPF, 2014)

1.10 Regional and Geographic Areas of Interest

ICCOPR considers regional issues an important element in executing an effective oil pollution R&T program. The applicability of research results can vary significantly between geographic regions due to their unique environmental characteristics. Regional issues are prevalent in the Arctic with its potential for new oil exploitation and related activity, and in the Gulf of Mexico where ultra-deepwater drilling and injury assessment and restoration activity from the *Deepwater Horizon* spill continues. Inland regions, likewise, have evolving issues related to onshore shale oil, oil sand products development, and pipeline and rail transportation safety. Development of other OCS regions will raise their own geographically-specific issues. In its research planning efforts, ICCOPR maintains visibility of regional issues by coordinating with RRTs, states, and regional research groups.

ICCOPR considers the following regional and geographic areas to be of high importance at this time or during the next six-year planning cycle:

The Arctic and Alaska – The extent of sea ice in the Arctic and Alaskan waters has diminished in recent years, a trend that is expected to continue for the foreseeable future. The oil industry is expanding exploration and production operations into the Arctic region as conditions change to make operations feasible in the region. One oil company is drilling in the Arctic Ocean during the 2015 summer season. Understanding and overcoming the operational and logistical

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challenges of responding to an oil spill in the Arctic region is a major focus of ICCOPR member research planning. This focus is reflected in the number of research priorities (see Chapter 9) that apply directly to Arctic conditions.

Gulf of Mexico – The Gulf of Mexico has abundant oil and gas resources, which results in extensive exploration and production activity. Advances in drilling technology have enabled industry to expand operations into progressively deeper areas of the Gulf. It is also the site of two of the largest oil spills from well blowouts, Macondo/*Deepwater Horizon* and *Ixtoc*, as well as numerous other spills. Federal and state agencies are continuing to conduct studies to determine the short- and long-term effects of the *Deepwater Horizon* oil spill. Both Federal and non-Federal Gulf of Mexico research programs established because of the *Deepwater Horizon* oil spill will continue through the next several years.

Inland Areas – As discussed in Section 1.1, the production of oil and gas from the shale plays in the U.S. and tar sand regions in Canada has dramatically increased over the past five years. The resulting increase in oil shipments by rail and pipeline has elevated the importance of research to prevent and prepare for oil spills from train accidents or pipeline breaks. In addition, the potential for these spills to affect freshwater rivers and lakes necessitates greater emphasis on research into non-marine response techniques.

Atlantic Outer Continental Shelf (OCS) – At present, there are no active oil and gas leases in any of the four Atlantic OCS planning areas. However, the Bureau of Ocean Energy Management (BOEM) Draft Proposed Plan for 2017-2022 proposes one lease sale in the Atlantic in 2021. Preparation for leasing in the Atlantic will involve pre-spill baseline studies to document environmental conditions prior to exploration and drilling.

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2. Federal Oil Pollution Research

ICCOPR serves to coordinate research by its member federal agencies and other federal research entities to promote a coordinated approach to addressing oil pollution issues. This section describes ICCOPR and the other federal research entities.

2.1 ICCOPR

2.1.1. Origin

Congress created ICCOPR in the Oil Pollution Act of 1990 (OPA 90). The Committee's membership, roles, and responsibilities are outlined in the original Public Law (P.L.) that mandated its creation, as amended and codified in the United States Code. Consequently, when referencing ICCOPR, it is generally cited with: *Oil Pollution Act of 1990, § 7001, 104 Stat. 484, 559-564 (1990) (33 U.S.C. 2761).*

ICCOPR is charged with two general responsibilities: (1) to prepare a comprehensive, coordinated federal oil pollution research and development plan; and (2) to promote cooperation with industry, universities, research institutions, state governments, and other nations through information sharing, coordinated planning, and joint funding of projects. ICCOPR reports on its activities to Congress every two years.

2.1.2. ICCOPR Membership

ICCOPR is comprised of fifteen federal independent agencies, departments, and department components. The U.S. Coast Guard (USCG) chairs ICCOPR. The National Oceanic and Atmospheric Administration (NOAA), the Bureau of Safety and Environmental Enforcement (BSEE), and the Environmental Protection Agency (EPA) rotate as the vice-chair every two years.

OPA 90 originally stipulated that ICCOPR include representatives from: the Department of Commerce, including NOAA and the National Institute of Standards and Technology (NIST); the Department of Energy (DOE): the Department of the Interior (DOI), including the Minerals Management Service (MMS) and the US Fish and Wildlife Service (USFWS); the Department of Transportation (DOT), including the USCG, the Maritime Administration (MARAD), and the Research and Special Projects Administration (RSPA); the Department of Defense, including the U.S. Army Corps of Engineers (USACE) and the Navy; the EPA; the National Aeronautics and Space Administration; and the US Fire Administration (USFA) in the Federal Emergency Management Agency (FEMA).

Today ICCOPR's original membership remains mostly intact but with some recent changes (Table 2.1). In 2012, the DOI reorganized MMS to form BSEE and the Bureau of Ocean Energy Management (BOEM) – both of which are now members of ICCOPR. Additionally, the USCG and FEMA reorganized under the DHS and DOT re-designated the RSPA as the Pipeline and

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Hazardous Materials Safety Administration (PHMSA). In 2013, ICCOPR welcomed its newest member, the U.S. Arctic Research Commission (USARC), to help address emerging issues associated with the Arctic and cold weather environments.

Table 2.1 - ICCOPR Membership

Member	Current Department	Notes
USCG	Homeland Security	Transferred from Transportation
FEMA/USFA	Homeland Security	Originally Independent
MARAD	Transportation	
PHMSA	Transportation	Agency renamed from RSPA
USFWS	Interior	
BSEE	Interior	Formerly part of MMS
BOEM	Interior	Formerly part of MMS
NOAA	Commerce	
NIST	Commerce	
Navy	Defense	
USACE	Defense	
DOE	Energy	
EPA	Independent	
NASA	Independent	
USARC	Independent	Added in 2013

ICCOPR membership may continue to evolve to fully address new research challenges when agency missions change or there are changes in patterns of oil exploration, production, and transportation. OPA 90 provides that the President may designate other agencies as members of ICCOPR. The President delegated this power to the Secretary of the "Department in which the Coast Guard (USCG) operates" through Executive Order 12777 (October 18, 1991) Section 8 (h) and as amended by Executive Order 13286 (March 5, 2003). The Secretary of Homeland Security delegated this power to the USCG Commandant in DHS Delegation No. 0170.1, II.80. ICCOPR may also invite other federal agencies to participate in a non-voting observer role. Currently the U.S. Geological Survey (USGS) is participating in ICCOPR as a non-voting observer.

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The diversity of ICCOPR's membership reflects Congress' intent to adequately address the full spectrum of oil spill preparedness, response, and restoration research. Each organization in ICCOPR bears unique regulatory responsibilities, research capabilities, and/or technical expertise that collectively give ICCOPR its knowledge and networks for tackling varying oil pollution research and technology issues. The following sections briefly discuss each of ICCOPR's member organizations and their connections to oil pollution research. Some organizations directly oversee oil pollution research programs while others provide guidance and resource support or specialized expertise.

2.1.2.1 U.S. Coast Guard (USCG)

The USCG serves as the Chair of ICCOPR in accordance with OPA 90. It also serves as the vice-chair of the National Response Team (NRT) and a co-chair of Regional Response Teams (RRTs). The USCG, together with the EPA, has the primary responsibility for federal oil spill response activities. In accordance with the National Contingency Plan (NCP), the USCG is the lead agency for response to spills in the U.S. coastal zone as defined in 40 CFR 300.5.

The USCG provides pre-designated Federal On-Scene Coordinators (FOSCs) for spills in the coastal zone (all United States waters). In addition to spill response, the Coast Guard also has statutory and operational responsibility for oversight of ship design and construction, periodic vessel inspections, investigation of marine casualties, waterway management and port safety and security (including the regulation of hazardous cargoes). These activities all help the USCG improve pollution prevention and response capabilities.

Since 1969, the USCG Research & Development Center (RDC) in New London, Connecticut, has been the Coast Guard's sole facility performing applied oil pollution research, development, test, and evaluation (RDT&E) experimentation and demonstrations.

The USCG also hosts the National Response Center (NRC), which serves as the NRT communications center and the official federal point of contact for pollution incident reports. The National Contingency Plan (40 CFR Part 300) requires that the NRC be notified in the event of an oil spill into navigable water. The U.S. Coast Guard's National Pollution Funds Center (NPFC) administers the Oil Spill Liability Trust Fund (OSLTF) and provides funding from the OSLTF Emergency Fund for responses, compensates claimants for cleanup costs and damages, and takes action to recover costs from responsible parties. The NPFC also provides funding from the OSLTF Principal Fund for operations and for research and development.

2.1.2.2 National Oceanic and Atmospheric Administration (NOAA)

NOAA serves as a rotating Vice Chair of ICCOPR. NOAA provides science, service and stewardship for the oceans and atmosphere; with a goal of healthy ecosystems, communities and economies that are resilient in the face of change. Many components of NOAA may support response to a major oil spill (including the National Ocean Service, National Weather Service;

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the National Marine Fisheries Service; the National Environmental Satellite, Data and Information Service; and the Office of Marine and Aviation Operations). A core component of the support is NOAA's Office of Response and Restoration (OR&R) and its network of Scientific Support Coordinators (SSCs) who respond to approximately 120 oil spills annually, primarily in the coastal zone. These SSCs serve as the primary scientific advisors to Federal On-Scene Coordinators (FOSCs), coordinating scientific expertise from federal and State agencies, academia, industry and the local community (40 CFR 300.145). NOAA support includes assessments of hazards, predictions of fate and behavior (trajectories), recommendations on cleanup and mitigation methods and endpoints, emergency consultations on protected resources, environmental information and data management, wildlife operations, meteorological, hydrological and oceanographic observations and forecasts and satellite imagery access and analysis.

NOAA supports the NRT and RRTs as delegated Department of Commerce representatives and serves on workgroups and area committees on activities associated with preparedness, assessment and restoration. NOAA applies and develops tools for emergency response support, transitioning research into operations. In coordination with states and other federal agencies, NOAA produces environmental sensitivity maps, which rank coastal areas by sensitivity to oil and identify priority locations to be protected in a spill. Federal, State and local agencies use these maps to plan and respond to oil spills.

As a Federal Natural Resource Trustee for living marine resources and their habitat, NOAA is required to assess the injuries that result from an oil spill, to determine and recover monetary compensation and, using those sums, to restore, rehabilitate or recover the equivalent of the damaged resources. NOAA is also responsible for the issuance and implementation of regulations governing oil spill damage assessment.

2.1.2.3 National Institute of Standards and Technology (NIST)

Founded in 1901, NIST is a non-regulatory federal agency within the U.S. Department of Commerce. NIST's mission is to promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve our quality of life. NIST has a long history of scientific, technical and measurement support to other federal agencies and U.S. industry on a reimbursable basis.

NIST maintains unique measurement facilities and has an experienced technical staff able to assist with oil spill response and oil pollution research providing a wide variety of scientific and measurement services. NIST's most recent activities relating to oil spills include developing protocols for sampling of protected species, providing for archival for marine animal specimens associated with oil spills, conducting interlaboratory comparison exercises for laboratories involved in assessing oil contamination, providing measurements of contamination in archived marine mammals and seabirds, and assisting with measuring oil flow from well blow-outs. NIST develops Standard Reference Materials (SRMs) for crude oil and other fossil-fuel materials

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and additionally has groups involved with research in Fire and Pipeline Safety. NIST maintains and manages the Marine Environmental Specimen Bank (ESB) that contains marine mammal samples dating back as far as the Exxon Valdez oil spill damage assessment and includes marine organism samples from the Pacific Islands, Alaska, and coastal regions of the lower 48 states. NIST has worked more than 30 years developing environmental specimen banking technology so that samples can be used to understand environmental exposure and effects from oil and other contaminants. Because samples have been collected continuously from many locations they provide a resource in the event of a spill to establish pre-spill baseline conditions.

2.1.2.4 U.S. Department of Energy (DOE)

The DOE works to ensure America's energy security and prosperity by addressing energy and environmental challenges with research and technology solutions. This includes ensuring the prudent development of America's oil and natural gas resources through R&D that improves the safety and environmental performance of oil and natural gas exploration and production.

In its offshore research program, DOE works toward mitigating the risks and challenges associated with drilling and production operations through a research portfolio dedicated to oil spill prevention. Completed and ongoing research focus on the following areas: geologic uncertainty; drilling and completions; surface systems and umbilicals; and subsea systems reliability/automated safety systems.

Onshore DOE focuses on prudent development of unconventional oil and gas resources with emphasis on resource characterization, protecting water quality, increasing water availability, protecting air quality, and reducing induced seismicity associated with waste water injection. The advent of shale gas development also brings a host of safety and environmental issues, including: 1) demand for water for use in hydraulic fracturing; 2) protection of drinking water aquifers; 3) evaluation of the safety of chemicals used in fracturing; 4) environmental impacts resulting from the treatment and/or disposal of produced or fracturing flowback water; 5) air quality impacts; and 6) community safety issues.

DOE's National Energy Technology Laboratory (NETL) conducts laboratory, field, and modeling-based research on offshore oil spill prevention, focusing on reducing the risk and mitigating the risk of a loss of well control that leads to spills. Onshore modeling includes life cycle analysis of natural gas, and modeling of methane emissions.

2.1.2.5 Bureau of Safety and Environmental Enforcement (BSEE)

The DOI's BSEE serves as a rotating Vice Chair of ICCOPR. The Bureau works to promote safety, protect the environment, and conserve energy resources offshore through vigorous regulatory oversight and enforcement. The BSEE develops standards and regulations to enhance operational safety and environmental protection in connection with the exploration and development of offshore oil, natural gas, and renewable energy sources on the U.S. Outer

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Continental Shelf (OCS); and undertakes actions to ensure compliance with those standards and regulations. BSEE has two research programs that support its mission. The Technology Assessment Program supports research regarding operational safety and pollution prevention related to offshore oil and natural gas and renewable energy exploration and development. The Oil Spill Response Research Program is dedicated to improving oil spill response options. The major focus of the program is to support BSEE's mission of ensuring offshore operators are prepared to respond to any potential oil spill. Research is conducted to improve the methods and technologies used for oil spill detection, containment, treatment, recovery and cleanup.

As part of ensuring that offshore operators are prepared to respond to an oil spill BSEE conducts oil spill response plan reviews, government-initiated unannounced exercises, equipment inspections, and audits of oil spill removal organizations and spill management training. Risks identified through these activities are mitigated by directed changes to plans, training programs, equipment, response strategies, and BSEE-funded research projects.

The BSEE also manages the operation of the national Oil Spill Response Research & Renewable Energy Test Facility (Ohmsett), the only facility where full-scale oil spill response equipment testing, research, and training can be conducted in a marine environment with oil under controlled environmental conditions (waves and oil types). OPA 90 mandated continued operation of Ohmsett. (See Section 2.3.1.)

2.1.2.6 Bureau of Ocean Energy Management (BOEM)

The DOI's BOEM manages the exploration and development of the nation's offshore resources on the U.S. Outer Continental Shelf (OCS). It seeks to appropriately balance economic development, energy independence, and environmental protection through oil and gas leases, renewable energy development and environmental reviews and studies. BOEM conducts studies to improve pre-spill baseline information and estimates of oil-spill transport, fate, and impacts to the environment. BOEM manages an Environmental Studies Program (ESP), which, since 1973, has included: development and use of oil transport and weathering models; measurement of oil effects in laboratory and field conditions on marine organisms including birds, fish, and mammals; identification of sensitive biological resources; and assessment of the social and economic impacts of oil development. While some of the ESP consists of in-house investigations, BOEM manages a substantially larger program that is conducted by contractors, industry, universities, and other federal agencies. Interagency coordination of this program is overseen by the National Ocean Pollution Policy Board and the Interagency Arctic Research Policy Committee, in addition to review provided by the OCS Scientific Committee.

2.1.2.7 U.S. Fish and Wildlife Service (USFWS)

The DOI's USFWS has trustee responsibility for migratory birds, threatened and endangered species, certain marine mammals, anadromous and catadromous fish, and national wildlife refuge lands. The USFWS is the primary DOI Bureau that responds to oil spills, provides

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information and advice on safeguarding sensitive habitats and protected species (including advice on use of dispersants and other chemicals), and oversees the rescue and the rehabilitation of oiled birds and certain marine mammals. It works closely with state fish and wildlife agencies to ensure the protection of potentially affected fish and wildlife and takes an active role in protecting USFWS lands, such as national wildlife refuges. USFWS, in its role as trustee, is also the most active DOI bureau in natural resource damage assessment and restorations (NRDAR). In addition to civil actions, USFWS may also pursue criminal violations of the Migratory Bird Treaty Act, Marine Mammal Protection Act, and the Endangered Species Act.

The USFWS R&D efforts are focused on identifying chemical pollutants and their metabolites in biological tissues; defining and mapping wetlands, other critical habitats and natural resources; inventorying species of particular concern, including threatened and endangered species; developing biological indicators and economic tools for damage assessment; and determining biological requirements for sustaining viable populations and habitats and identifying factors contributing to their demise. The USFWS R&D efforts support the needs of the DOI in meeting the operational needs and the requirements of OPA 90.

2.1.2.8 Maritime Administration (MARAD)

The DOT's MARAD is tasked with promoting the use of waterborne transportation and its seamless integration with other segments of the transportation system, and the viability of the U.S. merchant marine. MARAD's role in maritime transportation spans many areas involving ships and shipping, shipbuilding, port operations, vessel operations, national security, environment, and safety. MARAD supports the Maritime Environmental and Technical Assistance (META) program, which focuses on environmental research and demonstration projects. The Maritime Administration collaborates extensively with stakeholders from all transportation sectors and modes in order to accomplish its mission to improve and strengthen the U.S. marine transportation system. Through long range planning and analysis, the Maritime Administration's Office of Policy and Plans looks ahead and develops plans for integrating the Maritime Administration's activities with those of other appropriate government agencies, as well as private sector marine transportation stakeholders.

2.1.2.9 Pipeline & Hazardous Materials Safety Administration (PHMSA)

The mission of DOT's PHMSA is to protect people and the environment from the risks of hazardous materials transportation by establishing national policy, setting and enforcing standards, providing education, and conducting research to prevent oil spills and hazardous materials incidents. PHMSA's Office of Pipeline Safety promulgates and enforces regulations addressing the design, construction, operation and maintenance of pipeline systems. PHMSA's Pipeline Safety Research Program supports the PHMSA mission by: 1) funding technology development research; and 2) generating and sharing new technical knowledge with decision makers in support of planning, evaluating, and implementing pipeline safety programs. This

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research focus is providing near-term solutions that will increase the safety, reduce environmental impact and improve reliability of the Nation's pipeline system.

PHMSA, via its Office of Hazardous Materials Safety, also provides support to federal agencies in oil spill related areas such as logistics management, transportation infrastructure, telecommunications, command and control systems, expert computer systems, facilities maintenance management, mobilization preparedness and hazardous materials transportation by any mode.

2.1.2.10 US Army Corps of Engineers (USACE)

The USACE has specialized equipment and personnel that can be used in oil spill response activities. The Corps has responsibilities for maintaining navigation channels, removing obstructions, performing structural repairs, and maintaining hydropower electric generating equipment. Their Engineer Research and Development Center (ERDC) conducts research and development (R&D) in support of the Soldier, military installations and civil works projects (water resources, environmental missions, etc.) as well as for other federal agencies, state and municipal authorities, and with U.S. industry through innovative work agreements. USACE ERDC has seven laboratories in four states: Construction and Engineering Research laboratory in Champaign, Illinois; Cold Regions Research and Engineering Laboratory (CRREL) in Hanover, New Hampshire; Geospatial Research Laboratory in Alexandria, Virginia; and the Coastal and Hydraulics, Geotechnical and Structures, Environmental, and Information Technology Laboratories in Vicksburg, Mississippi. CRREL, maintains unique cold facilities to conduct research on oil spill detection and response in Arctic and other ice covered waters. Other USACE research with applicability to oil pollution issues include providing technical support on wind and wave effects, diffusion, remote sensing, satellite imaging, image enhancement systems, alternative methods for removing oil, shoreline cleanup and environmental evaluation, effects and mitigation.

The Corps also assists in design and construction and, on a reimbursable basis, provides technical manpower and support for any federal agency involved in any aspect of research and development described in this Plan. Special note should be made of USACE capabilities for assisting in the engineering aspects of conducting various research projects. As the nation's environmental engineer, the USACE manages one of the largest federal environmental missions: restoring degraded ecosystems; constructing sustainable facilities; regulating waterways; managing natural resources; and cleaning up contaminated sites from past military activities.

2.1.2.11 U.S. Navy (USN)

NAVSEA's Directorate of Ocean Engineering, Supervisor of Salvage and Diving (SUPSALV) experts provided technical, operational, and emergency capabilities in marine salvage, pollution abatement, diving, diving system certification, and underwater ship husbandry to improve Fleet readiness and capability across the globe. SUPSALV has been the Navy's oil pollution experts

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since the 1970s, as required by the Federal Water Pollution Control Act. The USN has expertise in preventing and responding to oil spills from ships. Upon the request of an On-Scene Coordinator, the USN may provide technical assistance in the ocean engineering disciplines of marine salvage, shipboard damage control, pollution abatement, diving, diving system certification, and underwater ship husbandry. The USN also owns specialized containment, collection, and removal equipment designed for salvage-related and near shore to open-sea pollution incidents. The equipment design and systems make it transportable and sustainable in the field. The USN has successfully deployed and operated its equipment at almost every major oil spill in the past 35 years.

2.1.2.12 U.S. Fire Administration (USFA)

As an entity of FEMA, USFA provides national leadership to foster a solid foundation for fire and emergency services stakeholders in prevention, preparedness, and response. The Agency was established by Public Law 93-498, the Federal Fire Prevention and Control Act of 1974, which called for: 1) the establishment of a National Fire Academy to advance the professional development of the fire service personnel and of other persons engaged in fire prevention and control activities; 2) a technology program of development, testing, and evaluation of equipment for use by the Nation's fire, rescue, and civil defense services; and 3) the operation of a National Fire Data Center for the selection, analysis, publication, and dissemination of information related to the prevention, occurrence, control and results of fires of all types; and ; 4) education of the public to overcome public indifference toward fire and fire prevention. USFA focuses on supplementing, not duplicating, existing programs of training, technology and research, data collection and analysis, and public education. While USFA does not directly conduct oil spill pollution research, it provides valuable emergency service expertise and connectivity to a number of emergency management programs.

2.1.2.13 U.S. Environmental Protection Agency (EPA)

The EPA serves as the Chair of the National Response Team (NRT), as co-chair of all the Regional Response Teams (RRTs), and as a rotating Vice Chair for ICCOPR. EPA works closely with the USCG in coastal spill response activities. In accordance with the National Contingency Plan (NCP), the EPA is the lead agency for response to spills in the U.S. inland zone. The EPA provides pre-designated On-Scene Coordinators (OSCs) for the inland zone, and maintains assets that can be used for command, control, and surveillance of oil spills. EPA also provides legal expertise on the interpretation of applicable environmental statutes.

The EPA issues and implements federal regulations regarding oil spills under the Clean Water Act, including the NCP. It implements spill prevention regulations for non-transportation-related facilities. Also, through Subpart J of the NCP, EPA maintains a Product Schedule of dispersants and other oil spill mitigating substances and regulates their use during spill response.

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The EPA provides expertise on cleanup technologies and the environmental effects of oil spills. Its Environmental Response Team (ERT) is a group of highly trained scientists and engineers whose capabilities include multimedia sampling and analysis, hazard evaluation, contamination monitoring, cleanup techniques, and overall technical support to the OSCs. The EPA's R&D activities include the development of test protocols to evaluate the efficacy and toxicity of spill mitigating agents (e.g., dispersants), and research to determine the fate and effects of oil following a spill.

2.1.2.14 National Aeronautics and Space Administration (NASA)

NASA develops and maintains several technologically advanced airborne and satellite systems suitable for spill observation and mapping. The agency's multi-disciplinary team of scientists, engineers and computer modelers also analyzes vast archives of data for insights into Earth's interconnected systems -- atmosphere, ocean, ice, land, and biosphere; and openly provides that data to the global community. They design and deploy airborne, ground-based and ocean-going field campaigns to study the earth from the heights of the stratosphere to the depths of the ocean to the remote ice caps at the poles. NASA also works with other government agencies and partner organizations to apply NASA data and computer models to improve decision-making and problem solving.

2.1.2.15 U.S. Arctic Research Commission (USARC)

The USARC is an independent federal agency created by the Arctic Research and Policy Act of 1984, as amended. It consists of a nonpartisan advisory body of scientists, physicians, indigenous leaders, and industry representatives appointed by the President of the U.S. and supported by staff located in Washington, D.C. and Anchorage, AK. The Commission sets U.S. Arctic research policy and builds cooperative links in Arctic research including: 1) the U.S. Arctic research program; 2) to international research partners, and; 3) Alaska. The law requires the Commission to comment to Congress on the progress of the executive branch in reaching goals set by the Commission and on their adoption by the Interagency Arctic Research and Policy Committee. The Commission plays an active role in the work of several interagency committees, including the Arctic Policy Group, chaired by the U.S. Department of State, which oversees U.S. participation in the eight-nation Arctic Council. The Commission is a statutory member of: the North Pacific Research Board and the North Slope Science Initiative. USARC is also a member of: various committees of the National Ocean Governance Structure; the interagency Extended Continental Shelf Task Force; the Scientific Ice Expeditions Interagency Committee, involving U.S. Navy nuclear submarines in the Arctic; the Alaska Ocean Observing System; the International Permafrost Association; and the Consortium for Ocean Leadership.

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2.2. Other Federal Stakeholders and Entities

Several Federal stakeholders and organizations also conduct research or affect oil pollution research. These include Federal independent organizations (i.e., committees, councils), agencies not currently members of ICCOPR, and ICCOPR member components that do not actively participate within ICCOPR. Other entities set Federal policies that guide or focus research initiatives on specific topics. ICCOPR maintains awareness of these stakeholders and works with them to coordinate research efforts.

2.2.1 Arctic Executive Steering Committee (AESC)

The AESC was formed in 2015 by Executive Order to provide guidance to executive departments and agencies (agencies) and enhance coordination of Federal Arctic policies across agencies and offices, and, where applicable, with State, local, and Alaska Native tribal governments and similar Alaska Native organizations, academic and research institutions, and the private and nonprofit sectors. The AESC provides guidance and coordinate efforts to implement the priorities, objectives, activities, and responsibilities identified in National Security Presidential Directive 66/Homeland Security Presidential Directive 25, Arctic Region Policy, the National Strategy for the Arctic Region (NSAR), the NSAR Implementation Plan (NSAR-IP), and related agency plans. The AESC does not conduct oil pollution research but can influence the policies guiding research in the Arctic.

2.2.2 Federal Oil Spill Team for Emergency Response Remote Sensing (FOSTERRS)

The Federal Oil Spill Team for Emergency Response Remote Sensing (FOSTERRS) is an interagency working group organized in 2015 to facilitate the sharing of remote sensing capabilities and to discuss improvements in disaster response using remote sensing. Specifically, FOSTERRS seeks to connect agency information on airborne and space borne asset's availability, limitations, capabilities and performance, and ancillary data needs to stake holders and responders. FOSTERRS includes members from agencies (NOAA, NASA, and USGS) with remote sensing assets and key end users. It also reaches out to the larger community involved in marine disaster response and the development and implementation of remote sensing best practices.

2.2.3 Federal Rail Administration (FRA)

The Department of Transportation Act of 1966 created the FRA with a mission to enable the safe, reliable, and efficient movement of people and goods for a strong America, now and in the future. It is one of ten agencies within the DOT concerned with intermodal transportation.

FRA's Office of Railroad Safety promotes and regulates safety throughout the Nation's railroad industry. The office executes its regulatory and inspection responsibilities through a diverse staff

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of railroad safety experts who are responsible for five safety disciplines focusing on compliance and enforcement in:

- Hazardous Materials;
- Motive Power and Equipment;
- Operating Practices;
- Signal and Train Control; and
- Track.

2.2.4 U.S. Geologic Survey (USGS)

The USGS supports an array of scientific capabilities and assets that address many elements of oil pollution research. As a science agency for DOI, the USGS provides science leadership and collaborations with other federal agencies during oil spill response. USGS research capabilities related to oil pollution include the development of objective and reliable scientific information needed to inform policies and practices that help avoid exposure to toxic substances, mitigate environmental deterioration from contaminants, provide cost-effective cleanup and waste-disposal strategies, and reduce future risk of contamination. USGS science primarily focuses on inland area but also includes near-shore and off-shore environments.

USGS oil pollution related capabilities include long-term monitoring of the Exxon Valdez, Deepwater Horizon, and inland oil spills. Also, the USGS Patuxent Wildlife Research Center has been studying the effects of crude oil and petroleum products on birds since the late 1970's. The USGS Coastal and Marine Program develops 3-D hydrodynamic models that can predict the nearshore sources, transport, and fate of oil. The USGS Energy Program provides capabilities to characterize chemical fingerprints of oil to identify sources of tar balls and support post-spill shoreline assessments.

2.2.5 Gulf Coast Ecosystem Restoration Council

The RESTORE Act established a Gulf Coast Ecosystem Restoration Council (the Council), which is comprised of governors from the five affected Gulf States, the Secretaries from the U.S. Departments of the Interior, Commerce, Agriculture, and Homeland Security as well as the Secretary of the Army and the Administrator of the U.S. Environmental Protection Agency. The Gulf States recommended and President Obama appointed the Secretary of Commerce as the Council's Chair.

2.2.6 Gulf of Mexico Fishery Management Council (GMFMC)

The GMFMC is one of eight regional Fishery Management Councils established by the Fishery Conservation and Management Act of 1976. The Council prepares fishery management plans designed to manage fishery resources from where state waters end, out to the 200-mile limit of the Gulf of Mexico. These waters are also known as the Exclusive Economic Zone (EEZ). The

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Council consists of voting members from the NMFS, the five Gulf state marine resource management agencies, and nominees by the State governors. In addition, there are four nonvoting members representing the USCG, U.S. Fish and Wildlife Service, Department of State, and the Gulf States Marine Fisheries Commission. The GMFMC provides an advisory role in directing scientists on where to focus their research. Current priorities include research on species recovering from the Deepwater Horizon oil spill and broad research on long-term fisheries data.

2.2.7 U.S. Marine Mammal Commission (MMC)

The MMC is an independent agency of the U.S. government established under Title II of the Marine Mammal Protection Act (MMPA). The Commission provides independent oversight of the marine mammal conservation policies and programs of federal agencies. The Commission's main roles with respect to oil spills are oversight of the agencies charged with response, assessment, and restoration activities, and convening of interagency working groups to coordinate those activities.

The Commission, in consultation with its Committee of Scientific Advisors on Marine Mammals, has prepared a report "Assessing the Long-term Effects of the BP Deepwater Horizon Oil Spill on Marine Mammals in the Gulf of Mexico: A Statement of Research Needs" (2011). The objectives of the report were to (1) guide assessment of the long-term effects of the Gulf spill and associated risk factors on marine mammals, (2) guide mitigation and restoration efforts for Gulf marine mammal populations, (3) help track the changes in the Gulf ecosystem, including recovery and restoration, and (4) help guide assessment of future spills in the Gulf and elsewhere.

The Commission administers a small annual grant program that supports projects aimed at meeting the conservation and protection goals of the MMPA. In addition, the Commission has initiated an annual survey of federally funded research on marine mammals to determine the nature of research conducted or supported by each agency. Information from the survey is used to assess ways to target and enhance specific marine mammal research and conservation activities.

2.2.8 National Institute of Environmental Health Sciences (NIEHS)

NIEHS is one of 27 research institutes and centers that comprise the National Institutes of Health (NIH) of the Department of Health and Human Services (DHHS). The mission of the NIEHS is to reduce the burden of human illness and disability by understanding how the environment influences the development and progression of human disease. The NIEHS, part of the NIH, activated programs throughout the institute to provide timely and responsive services following the DWH oil spill.

In June 2010, NIEHS initiated the GuLF STUDY to conduct research on the health of the workers and volunteers most directly involved in responding to the Deepwater Horizon oil spill.

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The GuLF STUDY will help determine if oil spills and the exposure to crude oil and dispersants, affects physical and mental health. Almost 33,000 cleanup workers are enrolled in the 10-year health study, making a significant contribution to their communities and to answering important public health questions.

2.2.9 U.S. National Response Team (NRT) - Science and Technology (S&T) Committee

The NRT is an organization of 15 federal departments and agencies responsible for coordinating emergency preparedness and response to oil and hazardous substance pollution incidents. The EPA and the USCG serve as Chair and Vice Chair respectively. The NCP and the Code of Federal Regulations (40 CFR part 300) outline the role of the NRT and Regional Response Teams (RRTs). Various federal statutes cite the NRT and RRTs including the Superfund Amendments and Reauthorization Act - Title III and the Hazardous Materials Transportation Act (HMTA).

The NRT's S&T Committee provides a forum to fulfill the NRT's NCP delegated responsibilities in R&D. Specifically, NCP regulation 40 CFR 300.110(h)(6) lists as one of the NRT's responsibilities "Monitoring response-related research and development, testing, and evaluation activities of NRT agencies to enhance coordination, avoid duplication of effort, and facilitate research in support of response activities." Additionally, 40 CFR 300.110(g) states, "the NRT may consider and make recommendations to appropriate agencies on ... necessary research, development, demonstration, and evaluation to improve response capabilities."

2.2.10 National Science Foundation (NSF)

The NSF is an independent federal agency created by Congress in 1950 "to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense…" The NSF is the funding source for approximately 24 percent of all federally supported basic research conducted by America's colleges and universities. NSF fulfills their mission chiefly by issuing limited-term grants to fund specific research proposals judged to be the most promising by a rigorous and objective merit-review system. Currently, they issue about 11,000 new awards per year, with an average duration of three years. NSF-funded research addresses a number of scientific areas with applications to oil pollution research including engineering, materials science, biology, and the Arctic. NSF also has a Rapid Response Research (RAPID) mechanism that enables research on unanticipated events such as the *Deepwater Horizon* oil spill.

2.2.11 NOAA RESTORE Act Science Program

In 2012, the U.S. Congress passed (P.L. 112-141) the "Resources and Ecosystem Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act" (RESTORE Act). The RESTORE Act transfers 80% of all administrative and civil penalties paid by responsible parties in connection with the Deepwater Horizon incident to a Gulf Coast Restoration Trust

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Fund. The RESTORE Act also establishes several programs, funded by the Trust Fund, to aid in the ecological and economic recovery of the Gulf Coast states. Under Section 1604 of the RESTORE Act directed NOAA to establish a Gulf Coast Ecosystem Restoration Science, Observation, Monitoring, and Technology Program (NOAA RESTORE Act Science Program). This program is to be funded by 2.5 percent of the Gulf Coast Ecosystem Restoration Trust Fund plus 25 percent of the Trust Fund accrued interest. The Program can expend funds for marine and estuarine research; marine and estuarine ecosystem monitoring and ocean observation; data collection and stock assessments; pilot programs for fishery independent data and reduction of exploitation of spawning aggregations; and cooperative research.

2.2.12 North American Wetlands Conservation Act (NAWCA) Gulf of Mexico Funds

The NAWCA provides matching grants from the North American Wetlands Conservation Fund to organizations and individuals who have developed partnerships to carry out wetlands conservation projects in the United States, Canada, and Mexico for the benefit of wetlands-associated migratory birds and other wildlife. As part of their criminal settlement agreement, BP paid $100 million to the Fund for the purpose of wetlands restoration and conservation located in states bordering the Gulf of Mexico or otherwise designed to benefit migratory bird species and other wildlife affected by the Macondo oil spill. The USFWS administers the Fund. The restoration projects include research to monitor and evaluate restoration success.

2.3 Federal Research Laboratories and Testing Facilities

Several federal facilities and locations provide opportunities for both federal and non-federal oil pollution research.

2.3.1 Ohmsett

Ohmsett, located at the Naval Weapons Station Earle Waterfront in Leonardo, New Jersey, is managed by BSEE. The facility includes an above ground concrete test tank that is one of the largest of its kind, measuring 203 meters long by 20 meters wide by 3.4 meters deep. The tank holds with 2.6 million gallons of crystal clear saltwater.

The Ohmsett test tank allows testing of full-scale oil pollution response equipment. The tank includes a wave generator that creates realistic sea environments, while state-of-the-art data collection and video systems record test results. The facility has proven to be ideal for testing equipment, evaluating acquisition options, and validating research findings.

Government agencies, academia, public and private companies use Ohmsett as a research center to test oil spill containment/clean-up equipment and techniques, to test new designs in response equipment, and to conduct training with actual oil spill response technologies.

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2.3.2 USCG Research & Development Center (RDC)

The RDC, located in New London, Conn. is the USCG's sole facility performing research, development, and test and evaluation in support of the service's major missions. The RDC is responsible for evaluating the feasibility and affordability of mission execution solutions and providing operational and risk-management analysis at all stages of the acquisition process.

At any given time, the RDT&E program is working on more than 80 projects that support USCG requirements across all mission areas. The program also provides Coast Guard leadership with knowledge necessary for making strategic decisions. The RDT&E program leverages partnerships with academia and other government agencies. The RDC also leverages Cooperative Research and Development Agreements (CRADAs) under the Technology Transfer Act to work with private industry to anticipate and research solutions to current and future technological challenges.

2.3.3 USCG RDC Joint Maritime Test Facility

The USCG RDC's Joint Maritime Test Facility *In Situ* Burn Pan is working in conjunction with the Naval Research Laboratory and the BSEE to refurbish its *in-situ* burn test pan located on Little Sand Island in Mobile, Alabama. The burn pan is the nation's only permitted open air *in-situ* burn pan for fire boom research. Once refurbished, this burn pan will help the RDC's Joint Maritime Test Facility meet its mission to support the maritime safety efforts by providing full-scale tests and evaluation under close to actual operating and environmental conditions.

2.3.4 USCG Marine Safety Laboratory

The USCG Marine Safety Laboratory (MSL) provides forensic oil analysis and expert testimony in support of the oil pollution law enforcement efforts for Marine Investigators, Districts, Hearing Officers, National Pollution Funds Center, Department of Justice, and other federal agencies. The MSL is the USCG's sole facility for performing forensic oil analysis.

2.3.5 U.S. EPA National Risk Management Research Laboratory (NRMRL)

The NRMRL is EPA's premiere laboratory for risk management research. It conducts research at the basic level, as well as bench-scale and pilot-scale levels, to explore innovative solutions to pollution problems. Environmental risk management seeks to determine what environmental risks exist and how to manage those risk in a way best suited to protect human health and the environment. Its mission is to advance scientific and engineering solutions to manage current and future environmental risk.

NRMRL's research directly supports efforts to manage chemical risks, clean up hazardous waste sites, protect water, reduce greenhouse gas emissions, and improve air quality.

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2.3.6 Cold Regions Research and Engineering Laboratory (CRREL)

CRREL, located in Hanover, New Hampshire is one of seven US Army Corps of Engineers (USACE) Engineering Research and Development Center (ERDC) laboratories. The laboratory's mission is to solve interdisciplinary and strategically important problems by advancing and applying science and engineering to complex environments, materials and processes in all seasons and climates, with unique core competencies related to the Earth's cold regions. CRREL maintains several unique and specialized research facilities at its Hanover, New Hampshire location, to include: 26 low-temperature research cold rooms; a refrigerated Ice Engineering Facility comprised of a 12,800 square foot research area, a 3,600 square foot by 8 foot deep test basin, and a 120 foot long water flume with tilting bed; a 1,320 square foot by 7 foot deep outdoor Geophysical Research Facility; a 40 foot working length portable wave tank that can be located indoors within a cold facility for year round cold research or outdoors to support in situ burn tests; and a 29,000 square foot environmentally controlled Frost Effects Research Facility. CRREL also maintains a research permafrost tunnel in Fox, Alaska, a 135-acre permafrost research site near Fairbanks, Alaska, and has project offices in Anchorage and Fairbanks, Alaska. CRREL works with partners from industry, government agencies, and educational institutions, to develop scientific tools that can aid in effective oil spill response, and provides unique facilities and cold region expertise to stake-holders to create effective spill response techniques for ice covered environments.

2.3.7 U.S. Army Engineer Research and Development Center (ERDC)

The ERDC is the world's largest laboratory primarily devoted to civil engineering and environmental sciences research, development, test, and evaluation. The ERDC, which includes seven laboratories located in four geographic locations, provides a broad array of services ranging from basic research to test and evaluation. The ERDC Laboratories maintain state of the art modeling and experimentation facilities which support a broad array of capabilities in oil spill response from modeling impacts to remediation techniques.

ERDC capabilities to support Oil Spill efforts are categorized into three phases. Phase 1, Emergency Response/Mitigation, includes those activities that that enhance the ability to conduct emergency response and mitigation. Phase 2, Remediation, includes activities designed to support tasks such as active intervention to ameliorate the oil contamination. Phase 3, Recovery/Long Term Monitoring/Assessment, includes activities supporting the monitoring and assessment of long term environmental impacts associate with the spill.

2.3.8 Hollings Marine Laboratory (HML)

The Hollings Marine Laboratory is located in Charleston, SC and was established as a joint facility combining partners from NOAA, NIST, the Medical University of South Carolina, the College of Charleston, and the South Carolina Department of Natural Resources. The laboratory is operated by the NOAA National Ocean Service and houses NIST's Environmental Specimen

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Bank, NIST and NOAA environmental chemistry laboratories, as well as NOAA personnel and facilities for assessing the health of living marine resources. Immediately after the Deepwater Horizon oil spill, the co-location of NOAA and NIST personnel was instrumental in planning and mounting NOAA's response to the event with regard to, sample archival, monitoring protected species and evaluating data quality being produced by different laboratories providing chemistry data related to the spill. Oil spill-related research continues at the HML with projects including aiming to understand biomarkers of oil exposure in protected species and exploring the effects of dispersants on marine organisms and humans.

2.2.9 U.S. Naval Research Laboratory (NRL) Stennis Space Center

The NRL detachment at Stennis Space Center focuses on marine geosciences, oceanography, and underwater acoustics. The Oceanography Division and the Marine Geosciences Division conduct studies applicable to oil pollution research.

The Oceanography Division is known for its combination of theoretical, numerical, and experimental approaches to oceanographic problems. The Division numerically models the ocean on the world's most powerful supercomputers and operates a number of highly sophisticated graphics systems to visualize ocean model results. The Division maintains two satellite receiving systems, a computer network with automated processing capabilities for ocean color and advanced optical instrumentation and calibration facilities.

The Marine Geosciences Division conducts a broadly-based, multidisciplinary program of scientific research and advanced technology development directed towards maritime and other national applications of geosciences, geospatial information and related technologies. Research includes investigations of basic processes within ocean basins and littoral regions. The Division develops models, sensors, techniques and systems to exploit this knowledge for applications to enhance Navy and Marine Corps systems, plans and operations

2.3.10 Pacific Northwest National Laboratory (PNNL)

The PNNL's Marine Sciences Laboratory (MSL), located in Sequim, Washington on the Strait of Juan de Fuca, provides a platform for marine and freshwater ecological research, instrument and method development, and biotechnology research. The laboratory has regional access to oceans and rivers that have experienced human impacts ranging from the uninhabited and protected coastlines of Olympic National Park to heavily developed shores around Seattle and Tacoma. The Marine Research Operations' Wet Laboratory provides a large space in which to perform innovative, water-oriented research. A variety of indoor and outdoor tank configurations provide capacity for bench-scale tests through large-scale outdoor mesocosm systems and for other studies using aquatic plants and animals.

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2.3.11 Coastal and Ocean Research Vessels

2.3.10.1 USCG Cutter Healy

The USCG's cutter *Healy* is designed to conduct a wide range of research activities, providing more than 4,200 square feet of scientific laboratory space, numerous electronic sensor systems, and accommodations for up to 50 scientists. HEALY is designed to break 4½ feet of ice continuously at three knots and can operate in temperatures as low as -50 °F. *Healy* substantially enhances the U.S. Arctic research capability. It serves as a platform for research activities as part of the Arctic Shield demonstrations where components of an Arctic oil spill response are tested. *Healy* is also a capable platform for supporting other potential missions in the polar regions, including logistics, search and rescue, ship escort, environmental protection, and enforcement of laws and treaties.

2.3.11.2 EPA Vessels

The EPA operates two ships that monitor and assess impacts from ecological disturbances and ocean-based human activities on the ocean, Great Lakes, and coastal waters. EPA's Ocean Survey Vessel (OSV) *Bold* operates under the statutory requirement to monitor the deposition of dredged materials under the Marine Protection, Research, and Sanctuaries Act of 1972. This Act regulates intentional ocean disposal of materials, authorizes any related research and provides for the designation and regulation of marine sanctuaries. OSV *Bold* operates in the Atlantic and Pacific Oceans and the Caribbean Sea to monitor water quality, effects of dredged material, coral reef health, and other special assessments.

EPA's Great Lakes National Program Office based in Chicago, Illinois operates R/V *Lake Guardian*, which conducts monitoring programs that sample the water, aquatic life, sediments, and air in order to assess the health of the Great Lakes ecosystem.

2.3.11.3 MARAD Vessels

MARAD operates the National Defense Reserve Fleet (NDRF) of 100 ships that are available for use during oil spill exercises, providing housing during a spill response, or for education and training. The NDRF is available to support emergency shipping operations during war and national emergencies. The fleet has anchorages in Fort Eustis, Virginia; Beaumont, Texas; Suisun Bay in Benicia, California; and at designated port facility berths.

2.3.11.4 NOAA Vessels

NOAA's Office of Marine and Aviation Operations (OMAO) operates a wide assortment of hydrographic survey, oceanographic research, and fisheries survey vessels. Five ships located in the Pacific are managed by the Marine Operations Center, Pacific (MOC-P) in Newport, Oregon. Nine ships located in the Atlantic are managed by the Marine Operations Center,

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Atlantic (MOC-A) in Norfolk, Virginia. Two ships located in Hawaii are managed by the Marine Operations Center, Pacific Islands (MOC-PI).

NOAA's research and survey ships compose the largest fleet of federal research ships in the nation. The fleet ranges from large oceanographic research vessels capable of exploring the world's deepest ocean, to smaller ships responsible for charting the shallow bays and inlets of the United States. The fleet supports a wide range of marine activities including fisheries research, nautical charting, and ocean and climate studies.

The OMAO's aircrafts operate throughout the world providing a wide range of capabilities including hurricane reconnaissance and research, marine mammal and fisheries assessment, and coastal mapping.

2.3.12 Oil Spill Field Research

Federal oil pollution research is not limited to research facilities and laboratories. Oil spills can provide opportunities for federal agencies to conduct research on the fate, effects, and physical and chemical behavior of the spilled oil and the responses to the spills in the natural environment. NOAA and USGS have ongoing research projects to study the long-term fate and effects of the *Exxon Valdez* oil spill. The *Deepwater Horizon* oil spill is also providing many opportunities to study both the near-term and long-term effects of the spill and response. Other potential research locations include the Santa Barbara oil seeps off the California coast and the submerged Taylor Energy platform in the Gulf of Mexico, which is a continuing source of sheens.

Intentional releases have been used by many countries, most notably Norway, to demonstrate the effectiveness of spill control equipment or processes. Under controlled circumstances, these releases may provide an opportunity to conduct tests under actual spill conditions.

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3. Non-Federal Oil Pollution Research Entities

Consistent with the mandates of OPA 90, ICCOPR cooperates with research programs of state governments, industry, academia, non-government organizations/institutions, and other nations. The cooperation of federal and non-federal entities provides whole community approach to oil pollution research. The following sections describe non-federal entities that conduct or sponsor oil pollution research.

3.1 State Organizations

Several coastal states have established oil pollution research programs. These programs are in states affected by previous oil spills or where there are active oil exploration and production activities. Increasing shale oil production has prompted other states to study the risks of hydraulic fracturing and transporting oil by rail and pipeline. This section describes on-going state research programs.

3.1.1 Alaska Department of Environmental Conservation (ADEC)

Judgments entered in the criminal cases for the *Exxon Valdez* oil spill resulted in appropriation of funds to the State of Alaska to enhance the ability of the State and industry to respond to oil spills. A total of $2,500,000 was made available to ADEC for projects under this program. The funds are used for research programs directed toward the prevention, containment, cleanup and amelioration of oil spills in Alaska. In cooperation with other stakeholders, ADEC has developed a list of more than 30 R&D projects dealing with such subjects as cleanup technology, non-mechanical response techniques, the fate and effects of spilled oil, oil-spill contingency planning and preparedness, spill response training, incident-management systems and spill prevention. Alaskan oil-spill response cooperatives, private consultants, universities, and other state and federal agencies have conducted research under the program.

3.1.2 California Office of Oil Spill Prevention and Response (CAOSPR)

As both a prevention and response organization, CAOSPR has the Department of Fish and Game's public trustee and custodial responsibilities for protecting, managing and restoring the state's fish, wildlife, and plants. It is one of the few state agencies in the nation with both major pollution response authority and public trustee authority for wildlife and habitat. This mandate ensures that prevention, preparedness, restoration and response will provide the best protection for California's natural resources.

In 2014 California expanded the CAOSPR program to cover all state surface waters at risk of oil spills from any source, including pipelines, production facilities, and the increasing shipments of oil transported by railroads. This expansion provided critical administrative funding for industry preparedness, spill response, and continued coordination with local, state and federal government along with industry and non-governmental organizations.

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3.1.3 Florida

The Oil Spill Academic Task Force (OSATF) is a consortium of scientists and scholars from institutions in the State University System as well as from five of Florida's private universities and two marine laboratories working in collaboration with the Florida Department of Environmental Protection (DEP). The OSATF brings together expertise and resources to assist the state of Florida and the Gulf region in responding to and studying the Deepwater Horizon oil spill.

The Fish and Wildlife Research Institute's work includes assessment and restoration of ecosystems and studies of freshwater and marine fisheries, aquatic and terrestrial wildlife, imperiled species, and red tides. The institute develops the information science required to analyze and disseminate research products, and engages in outreach activities to complement all programs.

The Florida Marine Spill Analysis System (FMSAS) is a powerful geographic information system (GIS) application that allows users to conduct oil spill planning activities and manage response and mitigation efforts during an actual spill. Spill planning and response activities have always relied on maps and charts to display information. From simple notes on nautical charts to specialized maps showing the location of sensitive resources or the location of an oil slick, many of the essential information components of planning and response actions require geospatial data. The FMSAS is designed to address five aspects of oil spill management:

- Contingency planning;
- On-scene spill tracking and "Resources At Risk" (RAR) analysis;
- Long-term monitoring;
- Damage assessment; and
- General oil spill GIS data management.

3.1.4 Louisiana Applied and Educational Oil Spill Research and Development Program (OSRADP)

The Louisiana OSRADP provided oil spill planners and response personnel with practical, scientifically-sound and cost effective spill prevention, management and mitigation tools for two decades until 2011 when OSRADP became part of the Center for Energy Studies.

3.1.5 Gulf States Marine Fisheries Commission (GSMFC)

The Gulf States Marine Fisheries Commission was established by an act of Congress (P.L. 81-66) in 1949 as a compact of the five Gulf States with a charge to: "to promote better utilization of the fisheries, marine, shell and anadromous, of the seaboard of the Gulf of Mexico, by the development of a joint program for the promotion and protection of such fisheries and the prevention of the physical waste of the fisheries from any cause."

The GSMFC Oil Disaster Recovery Program (ODRP) evolved from the receipt of $15 million dollars in October of 2010 and aims to improve the public perception and confidence in Gulf of

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Mexico seafood following the 2010 *Deepwater Horizon* oil disaster. Funding for this program, like that of the post-Katrina Emergency Disaster Recovery Program (EDRP), came from the U.S. Congress following fishery disaster declarations by the U.S. Secretary of Commerce. Scheduled to be completed in September of 2015, the activities under the program are identified through an ad-hoc advisory committee consisting of the marine resource directors from each of the five Gulf of Mexico states. Under this component, multiple post-disaster recovery elements were executed to address issues relative to improving both the perception of and confidence in Gulf of Mexico seafood products.

3.1.6 Minnesota National Crude Oil Spill Fate and Natural Attenuation Site

The Minnesota National Crude Oil Spill Fate and Natural Attenuation Site dates back to 1979, when a dramatic pipeline rupture released 10,000 bbl of crude petroleum to the land surface and shallow subsurface. In 1983, research began at the site through the support of the USGS' Toxic Substances Hydrology Program. Continuing USGS support has allowed hundreds of scientists from across the globe to visit this "underground observatory" and study the effects of a terrestrial crude oil spill including the physical, chemical and biological processes driving the degradation and transport of crude petroleum. Research from the site has been included in more than 200 scientific papers.

In 2008 and 2009, the Minnesota Pollution Control Agency, Enbridge Energy LLC, the USGS and Beltrami County created several agreements to formally establish the "National Crude Oil Spill Research Site in Bemidji, Minn." The objective of these agreements is to create a self-sustaining research facility that brings academic researchers and practitioners (e.g., consultants, petroleum and pipeline industry representatives and pollution control officials) together thereby linking novel ideas to practical, on-the-ground applications.

3.1.7 Pacific States/British Columbia Oil Spill Task Force (PSBCOSTF)

In 1989, following the *Nestucca* and *Exxon Valdez* oil spills, the Governors of Alaska, Washington, Oregon, and California, and the Premier of British Columbia, signed a Memorandum of Agreement that authorized PSBCOSTF. These events highlighted their common concerns regarding oil spill risks and the need for cooperation across shared borders. In June 2001, a revised Memorandum of Cooperation was adopted to include the State of Hawaii and expand the focus to spill preparedness and prevention needs of the 21st century. Now in its third decade, the PSBCOSTF provides a forum where its members can work with stakeholders from the Western US and Canada to implement regional initiatives that protect 56,660 miles of coastline from Alaska to California and the Hawaiian archipelago.

3.1.8 Texas General Land Office (TXGLO)

The TXGLO is a national leader in oil spill research. The TXGLO R&D program has funded groundbreaking work on oil dispersants, shoreline cleaners, bioremediation and high-frequency

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radar. The R&D program is improving response technology and developing alternative methods for removing oil from coastal waters.

Over the years, the TXGLO has coordinated with other state agencies, the state's higher education institutions and private industry to establish viable research projects for oil spill prevention and response. Funded projects have involved preventive technologies, spill detection, environmental data collection, chemical countermeasures, recovered materials management and in situ burning

The TXGLO, as a NRDA Trustee, acts on behalf of the public to identify the injured natural resources and determine the extent of the impact. They also recover damages from the responsible party to plan and carry out restoration activities. In addition to the TXGLO, two other state agencies are designated as NRDA trustees: the Texas Parks and Wildlife Department (TPWD) and the Texas Commission on Environmental Quality (TCEQ).

3.1.9 Washington Department of Ecology (WADOE)

The WADOE has program offices for oil pollution prevention, preparedness, and response, which include resource damage assessments and recovery. The Department conducts studies on the risks of oil transportation through the state and provides guidance to industry and the public on oil pollution issues. WADOE also manages a Coastal Protection Fund (CPF) that collects monies from oil and hazardous materials spill damage assessments and penalties. The CPF uses the money to fund projects to: restore or enhance public natural resources; investigate long-term effects of oil spills; and develop and implement aquatic land geographic information systems. Funds may also be allocated for R&D on the causes, effects, and removal of pollution caused by the discharge of oil.

3.2 Industry

The oil industry plays an important part in oil pollution research. Industry approaches to exploration, production, transportation, and spill prevention evolve as new techniques are identified or new resources are found. Industry has several research programs to improve their practices to prevent oil spills and to better respond to spills when they occur.

3.2.1 American Petroleum Institute Joint Industry Task Force (API JITF)

In the wake of the *Deepwater Horizon* oil spill of 2010, the petroleum industry launched four JITFs to critically assess capabilities and performance. Each JITF used subject matter experts to identify best practices in offshore drilling operations and oil spill response and to share that knowledge across industry with the goal of ensuring environmental protection through enhanced safety.

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The Oil Spill Preparedness and Response JITF examined industry's ability to respond to a "Spill of National Significance (SONS)" and the actual response to the *Deepwater Horizon* oil spill. This program covers:

- Spill Response Planning
- Oils Sensing and Tracking
- Dispersant
- In Situ Burning
- Mechanical recovery
- Shoreline protection
- Alternate response technologies

The industry has also has also begun to improve public outreach in a number of focus areas including:

- Oil spill preparedness and response framework;
- Net environmental benefit analysis (NEBA);
- Role of dispersants in oil spill response;
- Tiered preparedness and response framework;
- Incident management system; and
- Regulatory approval and use of dispersants.

The JITF also initiated subcommittees to address response issues related to inland spills including railroad spills and pipeline emergency response.

3.2.2 American Salvage Association (ASA)

The ASA was created in 2000 as an association of professional salvors dedicated to improving marine casualty response in North American coastal and inland waters. The ASA promotes cooperation among its members and works with Federal and state agencies to identify ways to improve salvage and firefighting response capabilities. The ASA encourages research to identify risks from sunken vessels and uses its members' experience to identify areas for additional research or technology development.

3.2.3 Association of Petroleum Industry Co-op Managers (APICOM)

APICOM, founded in 1972, is an association of unaffiliated petroleum industry oil spill cooperative managers. APICOM exists for the purpose of exchanging information related to the management of an oil spill response cooperative. It also serves as a forum for the exchange of ideas related to oil spill response technologies, operations, regulations and other issues of common interest to its members.

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3.2.4 Industry Technical Advisory Committee (ITAC)

The ITAC includes members from the oil spill response community within the oil industry, and other organizations that have oil pollution preparedness and response as their principal goal. ITAC acts as a focal point for technical issues and as a forum for exchanging information on preparedness, oil spill response operations, response technology and response training.

3.2.5 International Maritime Organization (IMO)

The IMO is a specialized agency of the United Nations, which is responsible for measures to improve the safety and security of international shipping and to prevent marine pollution from ships. It is also involved in legal matters, including liability and compensation issues and the facilitation of international maritime traffic. IMO's governing body is the assembly, made up of all 170 Member States, which meets once every two years. The Maritime Safety, Marine Environment Protection, Legal, Technical Co-operation and Facilitation Committees, and a number of sub-committees carry out the main technical work. Since 1967, the IMO has adopted a series of conventions covering prevention of marine pollution by ships, preparedness and response to incidents involving oil and hazardous and noxious substances, prevention of use of harmful anti-fouling systems and the international convention on ballast water management to prevent the spread of harmful aquatic organisms in ballast water.

3.2.6 International Petroleum Industry Environmental Conservation Association (IPIECA)

IPIECA is the global oil and gas industry association for environmental and social issues. It develops, shares, and promotes good practices and knowledge to help the industry improve its environmental and social performance. It is the industry's principal channel of communication with the United Nations.

IPIECA's Oil Spill Working Group (OSWG) was established in 1987 and serves as a key international industry forum to help improve oil spill contingency planning and response around the world. The OSWG aims to improve oil spill preparedness and response around the world by:

- Enabling members to exchange information and best practices
- Supporting industry and government cooperation at all levels
- Encouraging ratification and implementation of relevant international conventions
- Promoting the principle of 'Net Environmental Benefit Analysis' and the 'Tiered Response' approach to designing response strategies; and
- Developing and communicating the industry's views and activities to external audiences'

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3.2.7 International Spill Control Organization (ISCO)

The International Spill Control Organization (ISCO) is a not-for-profit organization incorporated in London in 1984 with membership in 36 countries around the world. ISCO aims to raise worldwide preparedness and co-operation in response to oil and chemical spills, to promote technical development and professional competency, and to provide a focus for making the knowledge and experience of spill control professionals available to IMO, United Nations Environment Programme (UNEP), European Commission (EC) and other organizations. ISCO provides organizations with information on experiences, problems solved, and lessons learned by spill responders. They also keep the spill response community informed of new developments and news through their website and newsletters.

3.2.8 International Tanker Owners Pollution Federation (ITOPF)

ITOPF is a not-for-profit organization established on behalf of the world's ship owners and their insurers to promote effective response to marine spills of oil, chemicals, and other hazardous substances. ITOPF provides a range of technical services including emergency response, advice on clean up techniques, pollution damage assessment, assistance with spill response planning, and training. It is recognized and respected globally as a source of objective technical expertise in the area of accidental spills of oil and chemicals from ships and ITOPF is a source of comprehensive information on marine pollution. Investing in R&D is one way ITOPF meets this objective. ITOPF invests in R&D to help fulfill their mission of promoting effective response to marine spills of oil, chemicals and other substances.

3.2.9 Oil Spill Response (OSR) Joint Industry Program (JIP)

The OSR JIP is an initiative of the Oil and Gas Producers (OGP) to address issues related to the Macondo well blowout. In response to the incident, the OGP formed the Global Industry Response Group (GIRG), which was tasked to identify the key issues that could prevent recurrence of such an incident and identify learning opportunities on both the causation, and the subsequent response to the incident. The OSR JIP has initiated discreet projects or supported projects of other groups in many oil spill related subject areas resulting from the OGP GIRG-OSR studies.

3.2.10 Petroleum Environmental Research Forum (PERF)

The PERF is a research and development joint venture, formed to provide a stimulus to and forum for the collection, exchange, and analysis of research information relating to the development of technology for health, environment and safety, waste reduction and system security in the petroleum industry. PERF is a non-profit organization of member corporations in the petroleum industry. PERF does not itself participate in research projects but provides a forum for members to collect, exchange, and research information relating to practical and

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theoretical science and technology concerning the petroleum industry and a mechanism to establish joint research projects in the field.

3.2.11 Pipeline Research Council International (PRCI)

The PRCI was established in 1952 as the Pipeline Research Committee of the American Gas Association to address the problem of long-running brittle fractures in natural gas transmission pipelines. In substantially solving that problem within two years, the committee demonstrated the benefit of industry collaboration and leveraging voluntary industry funding. Unique among all pipeline research organizations, the mission of PRCI is to be the global leader in collaborative energy pipeline research that provides safe, reliable, environmentally conscious and efficient means of energy delivery. The committee will be used to improve current inspection and integrity assessment technologies, and to promote the development of new technologies for pipeline integrity management.

Some of PRCI's recent research has addressed:

- Corrosion — location and assessment;
- Mechanical damage — location and assessment;
- Right of Way (ROW) monitoring;
- Growth of construction defects;
- Compressor and pump station; and
- Measurement.

3.2.12 Spill Control Association of America (SCAA)

SCAA organized in 1973 to actively promote the interests of all groups within the spill response community. They represent spill response contractors, manufacturers, distributors, consultants, instructors, government and training institutions and corporations working in the industry. SCAA partners with the USCG and the Association of Petroleum Industry Co-op Managers (APICOM) in the quality partnership for marine safety and environmental protection, which was created to improve the effectiveness of spill response and to promote sound risk management among/between private and governmental response organizations.

3.3 Independent Research Interests

Several independent organizations conduct or manage oil pollution research programs. These include non-governmental organizations, non-profit organizations, and committees with a mix of memberships including citizens, industry, and government organizations.

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3.3.1 Cook Inlet Regional Citizen's Advisory Committee (CIRCAC)

OPA 90 established CIRCAC to create an avenue for public participation in the oversight of the Cook Inlet oil industry. Since its inception, the CIRCAC has formed environmental monitoring and oil spill prevention programs to promote safe production and transportation of oil in Cook Inlet. These programs seek to develop an understanding of efficacy, fate, transport, and effects of oil and oil treated by various response methods likely to be used on oil spills in the area of concern. It also monitors the biological and chemical environment in Cook Inlet and nearby areas to detect effects of oil industry operations. The CIRCAC also has a Coastal Habitat Mapping Program to assess coastal habitats with an oil spill prevention and response tool that incorporates detailed coastal habitat data.

3.3.2 Gulf of Mexico Alliance (GOMA)

The Gulf State Governors established the Gulf of Mexico Alliance (GOMA) in 2004 in response to the President's Ocean Action Plan. GOMA's mission is to enhance the ecological and economic health of the Gulf region by encouraging collaboration among government agencies, businesses, education providers and non-governmental organizations. It is a state-led network of partners working together on projects related to the priority issues identified by the Governors in early discussions. The GOMA structure allows federal and state agency partners to focus funding priorities on the needs of the Gulf, and it provides a forum to share knowledge, expertise, and collaborate to reduce duplication of efforts.

3.3.3 Gulf of Mexico Research Initiative (GoMRI)

On May 24, 2010, shortly after the *Deepwater Horizon* oil spill, BP announced a $500 million commitment to fund a Gulf of Mexico Research Initiative (GoMRI), a 10-year independent research program designed to study the effects of the oil spill and its associated response on the environment and public health in the Gulf of Mexico. GoMRI awards funds competitively for scientists to investigate the impacts of the oil, dispersed oil, and dispersants on the ecosystems of the Gulf of Mexico and affected coastal States in a broad context of improving fundamental understanding of the dynamics of such events and their environmental stresses and public health implications. GoMRI also seeks to develop improved spill mitigation, oil and gas detection, characterization and remediation technologies.

As directed by an independent 20-member Research Board, GoMRI issues grants for independent scientific research conducted primarily at academic institutions in the U.S. Gulf Coast States. However, institutions from outside the Gulf region, as well as for-profit entities, can participate. The funds are distributed using peer evaluations (National Science Board Process) and are used strictly for research activities such as sampling, modeling and studies, but not acquisition of infrastructure. Researchers are required to publish their results in peer-reviewed scientific journals with no requirement for BP approval.

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The ultimate goal of GoMRI is to improve society's ability to understand, respond to and mitigate the impacts of petroleum pollution and related stressors of the marine and coastal ecosystems, with an emphasis on conditions found in the Gulf of Mexico. Knowledge accrued will be applied to restoration and to improving the long-term environmental health of the Gulf of Mexico.

3.3.4 Gulf Restoration Science Programs Ad Hoc Coordination Forum

The Gulf Restoration Science Programs Ad Hoc Coordination Forum serves to provide regular communication and coordination on Gulf of Mexico restoration related science between the ecological sciences programs funded from criminal penalties, settlement agreements, and programs funded due to the Deepwater Horizon oil spill.

3.3.5 National Academy of Sciences Gulf Research Program (GRP)

As part of the criminal settlement agreements following the *Deepwater Horizon* Oil Spill, the federal government asked the National Academy of Sciences (NAS) to establish a new program to fund and conduct activities to enhance oil system safety, human health, and environmental resources in the Gulf of Mexico and other U.S. outer continental shelf regions that support oil and gas production. The settlement agreements provide a total of $500 million over the first five years of the 30-year program. The Gulf Research Program works to enhance oil system safety and the protection of human health and the environment in the Gulf of Mexico and other U.S. outer continental shelf areas by seeking to improve understanding of the region's interconnecting human, environmental, and energy systems and fostering application of these insights to benefit Gulf communities, ecosystems, and the Nation. Initial funding of projects began in 2015.

3.3.6 National Fish and Wildlife Federation (NFWF)

Congress created NFWF in 1984. They serve as a non-profit agency to aid in the protection and restoration of fish and wildlife and their habitats. The BP and Transocean Settlement Agreements with the United States established NFWF's Gulf Environmental Benefit Fund to support projects that remedy harm to natural resources (habitats, species) where there has been injury to, or destruction of, loss of, or loss of use of those resources resulting from the *Deepwater Horizon* oil spill. The Fund will distribute $2.544 billion for projects that contribute significantly to restoring and maintaining the ecological functions of landscape-scale coastal habitats, ensuring long-term viability and resilience of habitats, restoring and maintaining the ecological integrity of priority coastal bays and estuaries, and replenishing and protecting living resources.

3.3.7 Ocean Energy Safety Institute (OESI)

The OESI was established under BSEE sponsorship to facilitate research and development, training of Federal workers to remain current on state-of the art technology associated with oil and gas development. It provides recommendations and technical assistance on the

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determination of Best Available and Safest Technology (BAST), and implementation of operational improvements in the areas of offshore drilling safety and environmental protection, blowout containment and oil spill response. The OESI is a collaborative initiative involving government, academia and scientific experts.

The Texas A&M Engineering Experiment Station's (TEES) Mary Kay O'Connor Process Safety Center manages the OESI, in partnership with the University of Texas at Austin and the University of Houston. The OESI provides a forum for dialogue, shared learning and cooperative research among academia, government, industry, and other non-governmental organizations, in offshore energy-related technologies and activities that ensure safe and environmentally responsible offshore operations.

Specific objectives of OESI are:

- Develop a program of research, technical assistance, and education that serves as a center of expertise in offshore oil and gas exploration, development, and production technology, including technology specific to deepwater and Arctic exploration and development;
- Provide recommendations and technical assistance to the Bureau of Safety and Environmental Enforcement (BSEE) and the Bureau of Ocean Energy Management (BOEM) related to emerging technologies and the determination of BAST, and environmentally sound oil and gas development practices on the Outer Continental Shelf (OCS);
- Provide recommendations and technical assistance related to geological and geophysical sciences relevant to understanding the technical challenges of exploration and development, such as reservoir characteristics, geohazards, and worst case discharge analyses;
- Develop and maintain a domestic and international equipment failure reporting system and database of critical equipment failures related to control of the well that will allow the Institute to identify reliability issues and industry trends. This system should engage both the user and manufacturer of the equipment;
- Engage employees of the Federal agencies to participate in research and training to remain current on state-of-the-art technology associated with offshore oil and gas development;
- Promote collaboration among Federal agencies, industry, standards organizations, academia, and the National Academy of Sciences.

3.3.8 Oil Spill Recovery Institute (OSRI)

OPA 90 established OSRI (http://pws-osri.org/) in response to the 1989 *Exxon Valdez* oil spill. The Prince William Sound Science Center, a non-profit research and education organization located in Cordova, Alaska, administers and houses OSRI. The Congressional mandate given to OSRI is to: 1) identify and develop the best available techniques, equipment and materials for dealing with oil spills in the Arctic and sub-Arctic marine environment; 2) complement federal

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and state damage assessment efforts and determine, document, assess and understand the long-range effects of Arctic and sub-Arctic oil spills on the natural resources of Prince William Sound; and, 3) understand and document the effects to the environment, the economy and the lifestyle and well-being of the people who are dependent on those resources. Subsequent legislation has provided OSRI with a funding mechanism to assure the research continues as long as oil exploration and development occurs in Alaska. Since 1998, OSRI has awarded approximately one million dollars a year to support a wide range of projects.

3.3.9 Pew Charitable Trusts (PCT) Arctic Science Program

The PCT's Arctic Science Program engages in numerous scientific activities to support conservation campaigns throughout the Arctic. These efforts include original fieldwork, analyses of existing data, and the sharing of scientific findings with a range of audiences. Scientists provide expertise on marine conservation-related issues to the U.S., Canada, Greenland, and elsewhere.

3.3.10 Prince William Sound Regional Citizen's Advisory Committee (PWSRCAC)

OPA 90 established the PWSRCAC to promote partnership and cooperation among local citizens, industry and government. The PWSRCAC conducts long-term environmental monitoring program and oil spill prevention programs to promote safe production and transportation of oil in Prince William Sound. Its programs include a hydrocarbon toxicity project to study and address the gaps in knowledge regarding chronic toxic effects of oil, dispersed oil, and *in-situ* burn residue under study conditions similar to the cold marine Alaskan waters.

3.3.11 Ship Structure Committee

Since its inception in 1943, the Ship Structure Committee has sponsored and coordinated R&D projects to improve ship design, construction, operation, inspection, maintenance, and repair methodologies. The Committee's mission is to enhance the safety of life at sea, promote technology and education advancements in marine transportation, and to protect the marine environment. This is done through advocating, participating in, and supporting cooperative R&D in structural design, life cycle risk management of marine structures, and production technologies. The Committee includes representatives from the USCG, Navy, MARAD, American Bureau of Shipping, Transport Canada, Defense Research and Development Canada Atlantic, and the Society of Naval Architects and Engineers.

3.4 Academia

Extensive oil pollution research is conducted at academic institutions, either individually or as part of university consortia. These entities provide opportunities to explore basic and applied scientific concepts to address oil pollution issues.

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3.4.1 Gulf of Mexico Research Consortia

Several university research consortia have been created to study the effects of the Deepwater Horizon oil spill. These consortia bring together researchers from universities, research institutes and other academic entities to collaborate on scientific studies in the Gulf of Mexico. The consortia activities combine research with scientific knowledge of the ecosystems of the Gulf of Mexico to advance the understanding of interactions that occurred and continue to occur among the marine and coastal ecosystems, oil, and dispersants produced by the oil spill.

GoMRI (see Section 3.3.3) provides funding for these consortia or their individual studies. To date, GoMRI issued four one-year block grants in 2010 followed by a series of Request for Proposals (RFPs) for academic consortia and individual investigators to propose research ideas. To date, GoMRI funded 15 different consortia in two rounds of grants, as shown on Table 3-1. In their funding decisions, GoMRI emphasizes: interdisciplinary science and technology involving experts in physical, chemical, geological, and biological oceanography; marine biology; coastal and reef ecosystems, fisheries and wildlife ecology; public health; and associated development of physical, chemical, and biological instrumentation, advanced modeling, and informatics. The activities combine research with scientific knowledge of the ecosystems of the Gulf of Mexico to advance the understanding of interactions that occurred and continue to occur among the marine and coastal ecosystems, oil, and dispersants produced by the oil spill.

Table 4-1: GoMRI-funded Consortia 2010-2014

Consortia	2010 Block Grants	2011 Consortia	2014 Consortia
Florida Inst. of Oceanography	X		
Louisiana State University (LSU)	X		
Marine Environmental Science Consortium	X		
Northern Gulf Institute	X		
Center for Integrated Modeling and Analysis of Gulf Ecosystems (C-IMAGE)		X	X
Consortium for Advanced Research on Transport of Hydrocarbon in the Environment (CARTHE)		X	X
Consortium for the Molecular Engineering of Dispersant Systems (C-MEDS)		X	
Coastal Waters Consortium (CWC)		X	X
Gulf of Mexico Integrated Spill Response Consortium		X	

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(GISR)		
Deepsea to Coast Connectivity in the Eastern Gulf of Mexico (DEEP-C)	X	
Dispersion Research on Oil: Physics and Plankton Studies (DROPPS)	X	X
Ecosystem Impacts of Oil and Gas Inputs to the Gulf (ECOGIG)	X	X
Aggregation and Degradation of Dispersants and Oil by Microbial Exopolymers (ADDOMEx)		X
Alabama Center for Ecological Resilience (ACER)		X
Consortium for Oil Spill Exposure Pathways in Coastal River-Dominated Ecosystems (CONCORDE)		X
Consortium for Resilient Gulf Communities (CRGC)		X
Deep-Pelagic Nekton Dynamics of the Gulf of Mexico (DEEPEND)		X
Littoral Acoustic Demonstration Center - Gulf Ecological Monitoring and Modeling (LADC-GEMM)		X
Relationship of Effects of Cardiac Outcomes in Fish for Validation of Ecological Risk (RECOVER)		X

3.4.2 Gulf of Mexico University Research Collaborative (GOMURC)

Universities across five U.S. Gulf of Mexico states initiated several marine research consortia over the past decades. GOMURC's region-wide alliance of these consortia promotes large-scale, long-term research initiatives required to address Gulf ecosystem-wide stressors such as oil spills, hurricanes, and climate change. GOMURC's mission goals and objectives include advocating for science and education activities that support science-based policies to restore and sustain Gulf natural resources and economy. The following five university consortia members of GOMURC represent 80 universities in the Gulf States:

- Alabama Marine Environmental Sciences Consortium, led by Dauphin Island Sea Lab;
- Florida Institute of Oceanography (FIO), led by University of South Florida;
- Louisiana Universities Gulf Research Collaborative, led by Louisiana State University;
- Mississippi Research Consortium, led by University of Southern Mississippi; and
- Texas Research Consortium, led by the Texas A&M University-Corpus Christi

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3.4.3 Harte Research Institute for Gulf of Mexico Studies

The Harte Research Institute, an endowed research component of Texas A&M University-Corpus Christi, is dedicated to advancing the long-term sustainable use and conservation of the Gulf of Mexico. The Institute serves as a research center of excellence in generating and disseminating knowledge about the Gulf of Mexico ecosystem and its critical role in the economies of the North American region. The Institute's ecosystems group focuses on environmental flows and the effects of deep sea oil and gas activities.

3.4.4 NOAA's Sea Grant Program

NOAA's National Sea Grant College Program is a network of 33 individual programs located in universities in every coastal and Great Lakes state, Puerto Rico, Lake Champlain and Guam. These programs serve as the core of a dynamic, national university-based network of over 300 institutions involving more than 3,000 scientists, engineers, educators, students and outreach experts. The network engages the power of academia and a wide variety of partners to address issues such as coastal hazards, sustainable coastal development, and seafood safety.

3.4.5 National University Rail (NURail) Center

In January 2012, the U.S. Department of Transportation awarded a grant of $3.5 million to a multi-university consortium led by University of Illinois Urbana (UIUC) to establish a rail transportation and engineering research center. Headquartered within the Department of Civil and Environmental Engineering at UICC, NURail is a consortium of seven partner colleges and universities with a combination of strengths in railway transportation engineering research and education in North America. The NURail is the first University Transportation Center (UTC) focused solely on rail and concentrates on rail education and research to improve railroad safety, efficiency and reliability. Particular focus is on challenges associated with rail corridors in which higher-speed passenger trains share infrastructure with freight trains.

The NURail has identified six thematic research topics that will be the subject of strategic development planning and ongoing technical research:

- Integrated railroad vehicle/track interaction and dynamic;
- Railroad safety and risk;
- Rail network capacity analysis and planning,
- Urban, regional and high-speed passenger rail implementation
- Multimodal freight transportation; and
- Funding, finance, community and economic development.

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3.4.6 Oil Spill Academic Task Force (OSATF)

The Oil Spill Academic Task Force (OSATF) is a consortium of scientists and scholars from institutions in Florida's State University System as well as from five of Florida's private universities and two marine laboratories working in collaboration with the Florida Department of Environmental Protection (DEP). The OSATF brings together expertise and resources to assist the state of Florida and the Gulf region in responding to and studying the Deepwater Horizon oil spill.

3.4.7 Scripps Institution of Oceanography (SIO)

SIO, a department of the University of California San Diego, is one of the oldest and largest centers for ocean, earth and atmospheric science research, education, and public service in the world. Research at Scripps encompasses physical, chemical, biological, geological, and geophysical studies of the oceans, earth, and planets. Researchers at SIO engage in basic research to expand our knowledge and understanding of natural hazards, including earthquakes, volcanoes, tsunamis, storm waves, floods, erosion, hurricanes, tornadoes, wildfires, and harmful algal blooms, as well as their impacts.

Some important programs include: the Southern California Coastal Ocean Observing System's real-time surface current mapping network for tracking and mitigating response to oil spills and improving search and rescue operations and safe boating; and the ANZA Seismic Network, providing real-time seismic information for Southern California.

3.4.8 UAA/SIT Center of Excellence for Maritime Research (CMR)

The DHS Science and Technology (S&T) Directorate selected the University of Alaska Anchorage (UAA) and the Stevens Institute of Technology (SIT) as co-leads for a Center of Excellence for Maritime Research (CMR). The CMR will provide research to identify better ways to create transparency in the maritime domain along coastal regions and inland waterways, while integrating information and intelligence among stakeholders. DHS charged the CMR to develop new ideas to address these challenges, provide a scientific basis, and develop new approaches for USCG and other DHS maritime missions.

3.4.9 UAF Arctic Center for Oil-Spill Research & Education (A-CORE)

The University of Alaska-Fairbanks (UAF) A-CORE is a leading academic institution in Arctic research that focuses on research applicable to Arctic oil spills. A-CORE partners with state and federal agencies, industry, and other academic institutions to support wise decision-making concerning Arctic oil spill response and prevention by working to fill gaps in existing knowledge.

In March 2015, UAF began operating the *Sikuliaq*, a new 261-foot oceanographic research vessel owned by the National Science Foundation. The *Sikuliaq* can cut through 2.5 feet of first-

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year sea ice and is the only ice-capable vessel in the U.S. academic research fleet. The ship is outfitted with state-of-the-art equipment to bring scientists to previously inaccessible ice-choked polar regions of the globe. The *Sikuliaq* will advance polar and sub-polar research. *Sikuliaq* can accommodate up to 24 scientists and students, including those with disabilities.

3.4.10 U.S. Coast Guard Academy

The United States Coast Guard Academy is the Department of Homeland Security's only institution of higher education. Academy cadets as well as faculty continue to undertake academic research in oil spill science, policy, and in marine engineering. The Academy also provides education to cadets in these fields.

The United States Coast Guard established a Center for Arctic Study & Policy (CASP) at the Academy to promote academic research on Arctic policy and strategy by facilitating collaboration, partnerships, and dialogue among specialists from academia, government, tribal organizations, non-governmental organizations (NGOs), industry, and the USCG. CASP serves as an operationally-focused academic think tank to promote research, broaden partnerships, and educate future leaders about the complexities of this unique region. Through collaborative efforts, the Center will promote effective solutions to address present and future Arctic maritime challenges as the Coast Guard increases its Arctic presence.

3.4.11 University of New Hampshire (UNH) Oil Spill Centers

UNH in Durham, NH, administers the Coastal Response Research Center (CRRC) and the Center for Spills in the Environment (CSE). CRRC was established in 2004 as a partnership between the NOAA Office of Response and Restoration (OR&R) and UNH. The CRRC partnership stimulates innovation in spill preparedness, response, assessment, and recovery strategies. The primary purpose of the CRRC is to bring together the resources of non-governmental scientists and the field expertise of OR&R to conduct and oversee basic and applied research, conduct outreach, and encourage strategic partnerships in spill response, assessment and restoration.

The CSE expands the scope of interaction and cooperation with the private sector, other governmental agencies and universities. The CSE involves individuals and institutions, public and private, at local, regional, national and international levels in identifying needs, evaluating and demonstrating promising technologies, and fostering their use as part of new, integrative approaches to response and restoration.

3.4.12 Woods Hole Oceanographic Institution (WHOI)

WHOI is a non-profit oceanographic research organization with a mission to explore and understand the ocean and to educate scientists, students, decision-makers, and the public. WHOI scientists and engineers maintain expertise across a range of oceanographic research areas. They work collaboratively within and across six research departments to advance knowledge of the

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global ocean and its fundamental importance to other planetary systems. WHOI research provides information of value to a wide range of ICCOPR research areas including pre-spill baseline studies, injury assessment and restoration, and multiple response research areas.

3.5 International Efforts

Oil pollution is a global issue and requires international cooperation and research to address. ICCOPR and its members work cooperatively with other nations and international entities to conduct research and to better respond to oil spills.

3.5.1 Arctic Council

The Ottawa Declaration of 1996 formally established the Arctic Council as a high level intergovernmental forum to provide a means for promoting cooperation, coordination and interaction among the Arctic States, with the involvement of the Arctic indigenous communities and other Arctic inhabitants on common issues, in particular issues of sustainable development and environmental protection. Arctic Council member states are: Canada, Denmark (including Greenland and the Faroe Islands), Finland, Iceland, Norway, Russian Federation, Sweden, and the United States.

The Council established a series of guidelines intended to define a set of recommended practices and outline strategic actions for consideration by those responsible for regulation of offshore oil and gas activities (including transportation and related onshore activities) in the Arctic. The goal is for regulators to identify the key aspects related to protection of human health and safety and protection of the environment for the management of offshore activities, remaining sufficiently flexible in the application of these regimes to permit alternative regulatory approaches. In May, 2013, all member agencies of the Arctic Council signed the "Agreement on Cooperation on Marine Oil Pollution Preparedness and Response in the Arctic," providing support for interactions between all eight parties relative to response and preparedness. The eight Arctic nations have different systems with different emphases on the division of responsibility between the operator and the regulator. The Council's goal is to assist regulators in developing standards that are consistently applied and enforced for all offshore Arctic oil and gas operators.

The Council established an Emergency Prevention, Preparedness and Response Working Group (EPPR) to addresses various aspects of prevention, preparedness and response to environmental emergencies in the Arctic. The goal of the EPPR Working Group is to contribute to the protection of the Arctic environment from the threat or impact that may result from an accidental release of pollutants or radionuclides. In addition, the Working Group considers questions related to the consequences of natural disasters.

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3.5.2 Australia

Australia's Commonwealth Scientific and Industrial Research Organization (CSIRO) helps to unlock Australia's offshore oil and gas resources through research focused on the safe, efficient and sustainable use of their marine natural resources. CSIRO works with industry, government agencies, and academia to provide scientific knowledge and advice for offshore oil and gas; it conducts research and provides advice on the environmental, economic and social factors associated with the entire oil and gas value chain (CSIRO 2015).

The primary objective for Australia is to develop the knowledge and technology to prevent marine incidents and understand pre-spill ecosystems so should an incident occur Australia is prepared to respond effectively. CSIRO has conducted a significant amount of research in a wide variety of areas that support a broad array of prevention and response initiatives. Recent research projects include:

- BLUElink ocean forecasting technology;
- Hydrocarbon sensor arrays to monitor the movement of hydrocarbons during an oil spill;
- Hydrocarbon fingerprinting technique;
- The Hydrates flow loop simulation techniques to help to prevent pipeline blockages;
- Microbial degradation research;
- Biomarker research;
- Dispersant assessments; and
- Ecotoxicology assessments.

The Australian Maritime Safety Authority (AMSA), a federal government self-funded maritime safety agency established in 1990, is responsible for providing a national response capability for marine pollution. The AMSA administers the "National Plan to Combat Pollution of the Sea by Oil and other Noxious and Hazardous Substances", a cooperative arrangement between the federal, state and northern territory (NT) Governments and the shipping, oil exploration and chemical industries, emergency services, and fire brigades.

The oil industry maintains resources for spills occurring at their facilities. For incidents that may require beyond individual company capabilities, the Australian Institute of Petroleum (AIP) through its Australian Marine Oil Spill Centre (AMOSC) subsidiary has established the AMOS Plan formalizing mutual aid arrangements among member companies.

3.5.3 Canada

Environment Canada (EC) is a diverse science-based organization that implements the Government of Canada's environmental agenda. It provides science and technology to support decisions about the environment. The EC conducts and publishes 80 percent of its research in collaboration with external researchers. The EC operates 15 research institutes and laboratories,

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seven storm prediction centers, and 32 water survey offices. The EC has worked with EPA, MMS (now BSEE), and the Navy to conduct oil pollution research at the Ohmsett facility since the early 1970s.

The Department of Fisheries and Oceans Canada (DFO) has Canada's most complex and comprehensive science programs, in terms of function and geography. Its program areas applicable to oil pollution research address ecosystem effects of energy production and operational oceanography. The DFO's research on ecosystem effects addresses expanded energy development in Canada, mainly offshore oil and gas, hydroelectricity, and oil sands. The DFO's operational oceanography programs study oceanic processes and circulation patterns to predict the ocean's present and future state, and include ocean modeling, ecosystem modeling, and near-shore processes.

3.5.4 Centre of Documentation, Research and Experimentation on Accidental Water Pollution (CEDRE)

CEDRE is a not-for-profit association created as part of the measures taken in the aftermath of the Amoco Cadiz oil spill. CEDRE's headquarters, technical facilities and the majority of its personnel are based in Brest, Brittany, France. It provides advice and expertise to the authorities responsible for oil spill response for marine waters and inland surface waters. CEDRE's advice and expertise is available to foreign authorities or private companies. CEDRE conducts its own research projects and contributes to French and international research programs. Their main research and development activities focus on themes of: enhancing knowledge in the field of spill response; fate of oil and chemicals on the surface and in the water column; response equipment and product assessments; and spill impact and post-spill monitoring.

3.5.5 China

The China Maritime Safety Administration (MSA), part of the Ministry of Transport, has the mandate to investigate and respond to marine pollution incidents in Chinese waters. The China MSA headquarters in Beijing provides central control with 14 subordinate bureaus and about 100 local branches along the coast and the Yangtze River. In recent years, China promulgated a series of new pollution regulations relating to ships, which progressively came into force in the period 2010-12. These cover a wide range of issues, including oil pollution response planning, pre-spill clean-up arrangements, and the emergency handling of pollution accidents. Regulations have also introduced a domestic ship-source oil pollution compensation fund.

3.5.6 European Union (EU)

Since 1978, the EU has played a vital role in the response to marine pollution and today its role has become even greater with the response coordination ensured by its European Response

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Coordination Center (ERRC) and with marine pollution preparedness and response services provided by the European Maritime Safety Agency (EMSA).

EMSA assumes the leading role in ensuring a uniform and effective level of maritime safety, maritime security, prevention of and response to pollution caused by ships as well as response to marine pollution caused by oil and gas installations, and provide technical and scientific assistance to the European Commission and member states. EMSA manages a network of standby at-sea oil spill recovery vessels based in all the regional seas of Europe. These normally commercial vessels that cease their normal activities and quickly move to the scene of the oil spill upon request. The agency also provides satellite imagery for detection and monitoring of oil spills, pollution response experts to give operational and technical assistance, and information service for chemical spills at sea.

In September 2008, the European Commission, the EU's executive body, issued their Communication on 'A European Strategy for Marine and Maritime Research' delineated an action plan for better integration of research between the maritime and marine communities in order to address the problems of marine degradation caused by human activities and develop new technologies for sustainable development of maritime activities.

The European Commission is currently funding projects aimed at developing new technologies to mitigate the effects of pollution in the seas and oceans. The 'Argomarine' project ('Automatic oil spill recognition and geopositioning integrated in a marine monitoring network') is one example.

3.5.7 France

Oil represents approximately one-third of France's total primary energy consumption and that share has been falling over the past 10 years. France imports crude oil through three major sea ports (Marseille, Le Havre, and Saint-Nazaire). France has very little domestic natural gas production, and since the French government banned the use of hydraulic fracturing, France imports natural gas through a variety of cross-border pipelines from the Netherlands, Norway, and Russia. France also imports liquefied natural gas (LNG) from countries around the world, notably Algeria , Nigeria, Qatar, and Egypt.

Response arrangements are governed by the "at sea pollution response" section of ORSEC MARITIME (Organisation de la Réponse de SÉcurité Civile), France's civil defense plan. Responsibility for preparing for and conducting clean-up operations at sea lies with one of three Maritime Préfets (one for the Mediterranean Sea, one for the Atlantic and one for the North Sea/Channel). The Maritime Préfet will work in cooperation with the Secrétariat Général de la Mer who has the authority to access the various stockpiles of equipment. Coordination of sea and shoreline clean-up would be supervised locally by a permanent conference with representatives of the Maritime Préfet and the Préfet of the particular Department concerned.

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3.5.8 Kill-Spill

Kill-Spill is an EU-funded research program with the mission to develop highly efficient, economically- and environmentally-viable biotechnological solutions for the clean-up of oil spills caused by maritime transport or offshore oil exploration and related processes. The program will deliver innovative biotechnological tools for oil spills remediation.

These new developments include biosensors to monitor hydrocarbon degradation, new environmentally-friendly dispersants and adsorbents, combined microbial and additives formulations, multifunctional bioremediation agents, and tools for sediments decontamination. The impact and toxicity of these newly developed products will be evaluated; and they will be validated in mesocosms and on actual oil spills.

3.5.9 Mexico

A National Contingency Plan was developed in 1981 by a sub-committee of the Mexican Inter-Departmental Commission for Environmental Health. It aims to establish a national response network and provide overall coordination of resources in the event of a spill. The Mexican navy maintains a regional and local organizational structure to implement the National Plan at these levels. Under the General Law of Ecological Equilibrium and Environmental Protection (LEGEEPA), overall responsibility for oil pollution matters in Mexican ports and territorial waters rests with the Mexican navy. Response to a spill is likely to be initiated through the Navy's Marine Environment Protection Division (PROMAM). Assistance is also likely to be sought from the national oil company, Petróleos Mexicanos (PEMEX).

3.5.10 Norway

As a major energy nation, Norway has a particular responsibility to ensure an adequate energy supply and to develop knowledge and technology for efficient and sustainable energy systems. Norway has significant expertise in petroleum and hydropower science and engineering. In addition, Norway is conducting important research efforts in the field of environment and climate research. Despite extensive recovery of petroleum resources during the past 30 years, the petroleum industry still represents a large potential for future value creation in Norway. Research and technological innovation, combined with strict environmental regulations and other policy instruments, are needed to make the environmental impact of the exploration and production of oil and gas as small as possible.

The Norwegian Government's goal is to be a pioneer in developing an integrated, ecosystem-based management regime for marine areas. The purpose of this management plan is to provide a framework for the sustainable use of natural resources and ecosystem services derived from the North Sea and Skagerrak and at the same time maintain the structure, functioning, productivity

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and diversity of the area's ecosystems. Norway utilizes its major universities to conduct major research programs with respect to oil and gas.

3.5.11 Russia

The Federal Agency of Maritime and River Transport, part of the Ministry of Transport, is the federal executive body with responsibility for preparedness and response for oil spill incidents in Russia. Oil pollution response is assigned to the State Marine Pollution Control, Salvage and Rescue Administration (MPCSA). The MPCSA is responsible for the Marine Rescue Coordination Centres (MRCC), which serves as the focal point for communication during marine spill incidents at the regional level. The "Federal Contingency Plan on Oil Spill Prevention and Response at Sea" was adopted by the Ministry of Transport, the Ministry of Natural Resources and the Ministry of Civil Defense, Emergencies and Disaster Response (EMERCOM) in July 2003. The Plan complies with IMO Guidelines on contingency planning. There are three levels of planning: local, regional and federal. Ports, oil terminals, and harbors have local contingency plans and capabilities which, if exceeded, can be supplemented by regional plans and resources.

3.5.12 SINTEF

SINTEF is the largest independent research organization in Scandinavia, which operates in partnership with the Norwegian University of Science and Technology (NTNU) in Trondheim. NTNU personnel work on SINTEF projects, and many SINTEF staff members teach at NTNU. SINTEF is known worldwide for its work on oil spills, dispersants, and is one of the world's largest independent research organizations within the oil spill research community and offers expertise in many areas, including:

- Studies of oil weathering;
- Characterization of oil spills including thickness and chemistry;
- Oil spill identification - "fingerprinting";
- Marine environmental technology development;
- Surface water chemistry;
- Net Environmental Benefit Analysis (NEBA) oil spills in the Arctic; and
- Subsea and deepwater releases.

3.5.13 United Kingdom (UK)

The Department of Energy and Climate Change (DECC) works to insure that the UK has secure, clean, affordable energy supplies and promotes international action to mitigate climate change.

DECC is a ministerial department, supported by nine agencies and public bodies. The Oil and Gas Authority, an executive office of the DECC, works with government and industry to make sure that the UK gets the maximum economic benefit from its oil and gas reserves. The Oil and

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Gas Authority is responsible for regulating offshore and onshore oil and gas operations in the UK including:

- Oil and gas licensing;
- Oil and gas exploration and production;
- Oil and gas fields and wells;
- Oil and gas infrastructure; and
- Carbon capture and storage (CCS) licensing.

The Maritime and Coastguard Agency (MCA) is the UK's authority responsible for the provision of response procedures designed to deal with any emergency at sea that threatens or causes actual pollution. The national contingency plan for marine pollution from shipping and offshore installations sets out revised procedures for incident response. The national contingency plan ("National Contingency Plan for Marine Pollution from Shipping and Offshore Installations") underwent a major review in 2000, was revised again in 2006 to take advantage of lessons learned during actual incidents and major exercises, and is currently under review. MCA develops and participates in maritime exercises designed to maintain the operational readiness of its staff and equipment. The Counter Pollution and Response Branch also organizes training courses for local authorities to prepare their staff when responding to shoreline pollution.

3.6 Non-Federal Oil Pollution Testing Facilities

Several non-federal facilities provide opportunities for oil pollution testing.

3.6.1 Bedford Institute of Oceanography Center for Offshore Oil, Gas and Energy Research (BIO COOGER)

The DFO Canada's BIO COOGER, located in Dartmouth, Nova Scotia, maintains a wave tank facility for oil pollution research. Each tank measures 32 m long, 0.6 m wide, and 2 m high (1.5 m water depth; 28,800 L volume). Water from the Bedford Basin of Halifax Harbor is pumped into the tanks through a coarse (25 μm pore size) and fine (5 μm pore size) serial filtration system. The tanks are capable of generating various types of wave energies in either static or flow-through mode. Breaking and non-breaking waves (computer-controlled flat-type wave maker) provide mixing energies to achieve dispersant effectiveness similar to that of field conditions. The tanks are equipped with subsea injection systems from pressurized, heated canisters. Experiments benefit from the ability of the tanks to be drained and cleaned (tank walls, bottom, wave maker and absorbers) after each experiment to remove all oil and surfactants.

3.6.2 CEDRE Technical Facilities

CEDRE's technical facilities cover 300 acres and constitute a completely watertight area, which includes a man-made beach, water body, and a deep-water basin. These facilities allow full scale

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simulation of real life spills in an environmentally friendly manner. The CEDRE Experimentation Column (CEC) is a tool to study the behavior of a substance as it rises up or settles through the water column. The facilities include a flume tank, or Polludrome, that is designed to simulate offshore, shoreline and river conditions on a pilot scale. The facilities also include a greenhouse for experimentation on living organisms.

3.6.3 Churchill Marine Observatory.

A multi-government, multi-university research centre is being developed in Churchill, Manitoba, Canada. The Churchill Marine Observatory will be a multidisciplinary research facility where researchers will study the detection, impact and mitigation of oil spills in sea ice and investigate issues facing Arctic marine transportation. The research will help address technological, scientific and economic issues pertaining to Arctic marine transportation and oil and gas exploration and development throughout the Arctic. The facility is scheduled to open in 2017.

3.6.4 Ocean Coastal Research Engineering (OCRE)

The National Research Council of Canada's OCRE assists industry and government to develop solutions to engineering challenges within ocean, coastal and river environments with a particular focus on harsh and extreme conditions. The approach includes physical and numerical modeling, engineering analysis, technology development, as well as full scale experiments and field work conducted with the support of a comprehensive suite of world-class model test basins and tanks capable of reproducing a wide range of ice, wave, current and wind conditions. OCRE provides technology and facilities to support problems related to: the Arctic; marine infrastructure, and; marine vehicles. OCRE maintains several testing facilities that provide real world conditions:

- Coastal wave basin;
- Offshore engineering basin;
- Multidirectional wave basin;
- Large area basin;
- Ice tank;
- Coastal wave basin; and
- Multidirectional wave basin.

3.6.5 PRCI Technology Development Center

The Pipeline Research Council International (PRCI) opened its new Technology Development Center (TDC) in Houston, Texas in July 2015. The TDC covers eight acres, including a state-of-the-art pull test facility, an over 20,000 sq. ft. workshop, and test facility with an additional 9,000 sq. ft. of office and meeting space. The TDC will provide the industry with an independent third

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party site to fully understand the capabilities of current pipeline tools and to guide the development of new technologies needed to push toward that goal.

3.6.6 SINTEF Sealab

SINTEF Sealab is a cooperative effort of SINTEF Fisheries and Aquaculture and the Norwegian University of Science and Technology (NTNU) and offers a variety of experimental facilities covering the key elements of marine food webs. The emphasis is on developing experimental systems that simulate natural processes and mimic the fate, behavior and effects of pollutants in the recipient.

The SINTEF Sealab provides:

- Cold climate laboratories with basin facilities;
- Chemical and microbiological laboratories;
- Ecotoxicological laboratories;
- Oil spill research facilities;
    - Shoreline basins;
    - Simulated seabed basin;
    - Dynamic and static test basins/systems; and
    - Tank facilities for subsea studies.

3.6.7 Southwest Research Institute (SwRI)

The Chemical Engineering Department at SwRI specializes in finding solutions to difficult problems and providing exacting services. Staff expertise and world-class facilities provide services such as wastewater cleanup, catalyst screening, pilot plant design and operation, reaction kinetics and enthalpy analyses. Typical services include;

- Analytical testing;
- Personal safety equipment testing;
- Waste disposal characterization; and
- Waste cleanup.

An Ocean Simulation Lab at SwRI provides government and commercial clients with quality facilities and experienced staff to conduct testing and performance evaluation services in more than 10,500 square feet of air conditioned laboratory space and 12 ocean simulation test chambers that range in pressures to 30,000 psig and sizes to 90-inch diameter. Capabilities are available for the complete evaluation of your marine products including: development of testing procedures; test design; test setup; and static and cyclic structural/pressure/thermal testing.

3.6.8 Texas A&M Corpus Christi Center for Coastal Studies (CCS)

The CCS comprises 10,000 square feet of office and laboratory space within the Carlos F. Truan

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Natural Resources Center. The CCS facilities include:

- Plankton laboratory;
- Marine ecotoxicology laboratory;
- Marine invertebrate environmental physiology laboratory; and
- Benthic ecology laboratory.

The National Spill Control School (NSCS) was established in 1977 and was named as a consulting, training, and research resource for the National Response Team in OPA 90. The NSCS offers specialized hands-on OSHA mandated training for professionals and workers in the oil spill, hazardous material (HAZMAT), and emergency management industries as well as others in exploration, production, and transportation who deal with spill prevention, planning, and response.

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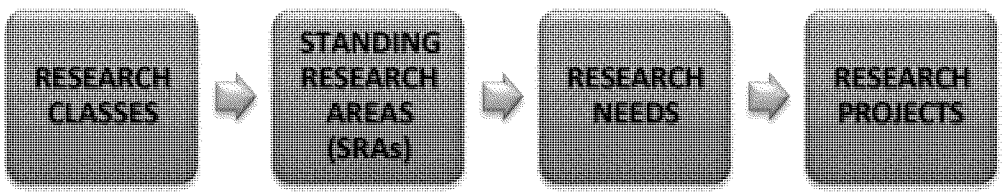
4. Structuring Oil Pollution Research

The field of oil pollution research covers an array of subjects depending on the interests and needs of researcher or the research funding institution. The focus of oil pollution research extends well beyond removing or mitigating spilled oil from the environment to involve other themes such as developing new means for preventing oil discharges, assessing impacts on the natural and human environment, and restoring an affected ecosystem as best as possible to pre-spill conditions. Each of these areas includes a broad spectrum of subjects and topics for oil pollution research, which creates challenges for tracking research activities.

ICCOPR established a new Oil Pollution Research Categorization Framework to provide a common language and planning framework that would enable researchers and interested parties to identify and track research in each topic area. This new approach will be used by ICCOPR to better facilitate communication with Congress, Federal partners, industry, academia, and the general public. It provides a basis for the 15 member organizations to translate their different research needs and perspectives into one federal voice through ICCOPR.

4.1 Introduction to the Oil Spill Research Framework

The Categorization Framework provides a hierarchy of terms to classify, discuss, and prioritize oil pollution research. It is analogous to the taxonomic classification of organisms (i.e., Kingdom, Phylum, Class, Order, Family, Genus, and Species). ICCOPR's oil pollution research classification scheme contains four elements:



Research Classes and Standing Research Areas (SRAs) are generally fixed while the Research Needs and Projects assigned to the SRAs will vary over time. Each of these categorization terms is defined later in this chapter. The following example shows how this new classification scheme works for one project:

Class: Prevention
SRA: Pipeline Systems
Need: Develop advanced pipeline break sensing technologies
Project: Smart Pipeline Network – Seal Sensor System (PHMSA DTRT57-12-C-10050)

Chapter 9 of this OPRTP provides a prioritized list of current Research Needs suggested for 2015-2012 for each SRA. Throughout the six-year life of this Plan, ICCOPR will monitor relevant planned, ongoing, and completed Projects to gauge how government, NGOs, industry,

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and academia are addressing the published priority Research Needs. ICCOPR will use this information to provide updates on research progress in the Biennial Reports to Congress and to modify or replace existing Research Needs. At the end of the 6-year cycle, ICCOPR will revise the OPRTP for the next 6-year cycle and include a summary of the previous version's accomplishments and a new set of prioritized Research Needs.

4.2 Classes

The overarching Oil Pollution Research Categorization Framework includes four Classes that represent the general groupings of oil spill research: Preparedness, Prevention, Response, and Injury Assessment and Restoration. Figure 4-1 depicts this framework of Classes. It shows that the research in each Class can inform and support the research from other Classes and that the Preparedness Class plays a central role in supporting the others. ICCOPR's member organizations may conduct or support research across one or multiple Classes depending on their specific mission, regulatory responsibilities, and/or expertise.

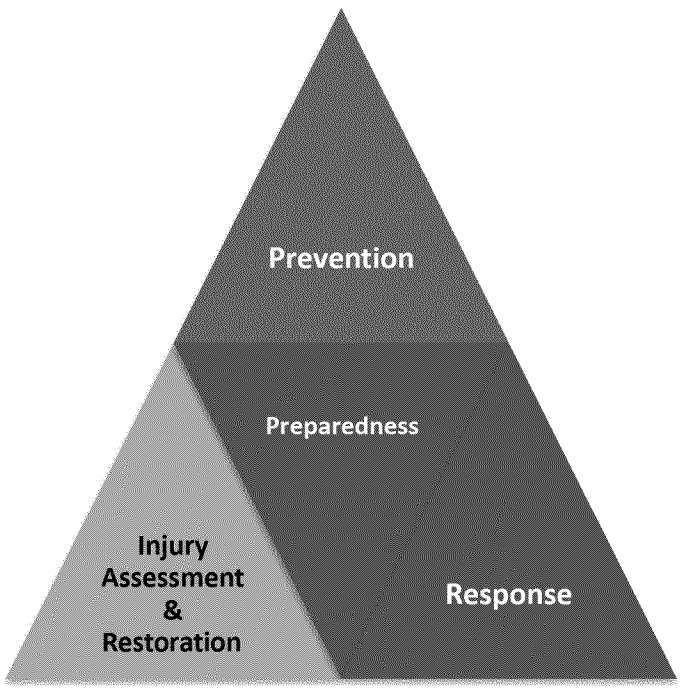

Figure 4.1. The Oil Pollution Research Categorization Framework Classes

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The following section describes the research pertinent to each Class.

Prevention Class

Research that supports the development of practices and technologies designed to predict, reduce, or eliminate the likelihood of discharges, or minimize the volume of oil discharges into the environment.

Preparedness Class

Research that supports the activities, programs, and systems developed prior to an oil spill to improve the planning, decision-making and management processes needed for responding to and recovering from oil spills.

Response Class

Research that supports techniques and technologies that address the immediate and short-term effects of an oil spill and encompasses all activities involved in containing, cleaning up, treating, and disposing oil in order to: 1) maintain safety of human life; 2) stabilize a situation to preclude further damage; and, 3) minimize adverse environmental and socioeconomic effects.

Injury Assessment and Restoration Class

Research that involves the collection and analysis of information to: 1) evaluate the nature and extent of environmental, human health, and socioeconomic injuries resulting from an incident; 2) determine the restoration actions needed to restore natural resources and their services to pre-spill conditions; and, 3) make the environment and public whole after interim losses.

4.3 Standing Research Areas (SRAs)

The backbone of ICCOPR's oil pollution research categorization scheme is the SRAs that exist within the four Classes. The SRAs represent the most common research themes encountered for oil spills – many of which have been studied over several decades. Their topical content supports the themes of the Classes for which they are assigned. For this OPRTP, ICCOPR identified 25 SRAs within the four Classes. The number of SRAs will, for the most part, remain consistent; however, changes may occur based on emerging research themes. Specifically, ICCOPR is monitoring on-going activities to determine whether the current SRA structure adequately addresses worker exposure and hydraulic fracturing issues. If not, ICCOPR may add additional SRAs.

Table 4.1 lists the current SRAs by Research Class. ICCOPR uses a numbering scheme to facilitate tracking of research within each SRA (1000 – 4400). The numbering series associated with each SRA is included in the SRA descriptions in the subsections below and in Appendix A.

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Table 4-1. Standing Research Areas assigned within the four research Classes.

Prevention	Preparedness	Response	Injury Assessment & Restoration
• Human Error Factors • Offshore Facilities and Systems • Onshore Facilities and Systems • Waterways Management • Vessel Design • Drilling • Rail & Truck Transportation • Pipeline Systems	• Pre-spill Baseline Studies • Response Management Systems	• Structural Damage Assessment and Salvage • At Source Control and Containment • Chemical and Physical Behavior Modeling • Oil Spill Detection and Surveillance • In- and On-water Containment and Recovery • Shore Containment and Recovery • Dispersants • In-situ Burning • Alternative Countermeasures • Oily and Oil Waste Disposal • Bioremediation	• Environmental Impacts and Ecosystem Recovery • Environmental Restoration Methods and Technologies • Human Safety and Health • Sociological and Economic Impacts

4.3.1 Prevention SRAs

ICCOPR has identified eight SRAs that address development of practices and technologies designed to reduce or eliminate the likelihood of oil discharges into the environment and to reduce the potential for consequences of any oil discharges on life, property, and the environment.

4.3.1.1 Human Error Factors [1000 series]

Description: This SRA focuses on how human performance and factors contribute to accidents in the oil production/transportation system. It includes the development of advanced methods and systems for training operational personnel, basic research on operating personnel performance in preventing oil spills (safe navigation on vessels, proper oil transfer practices, analysis/evaluation of equipment monitoring systems, decision-making processes), and the

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development of methods and technologies to evaluate the ability and knowledge of operating personnel in performing their duties. This may extend to evaluation of the overall management culture and its ability to foster the appropriate organizational safety, preparedness and response operating environment.

Importance: A significant proportion of accidents in oil production/transportation and related industries are attributed to "human errors." A Coast Guard analysis of oil spill causes found that human error factors were responsible for more than one third of non-casualty discharges from ships (USCG, 2012). Non-casualty spills typically include spills from actions such as overfilling of tanks and equipment failures not related to a vessel accident. More than half of these human errors were due to inattention, but also resulted from inadequate training, management and organizational culture. Identifying and solving various human error factors can significantly reduce oil spills at far less cost than more expensive technology-based solutions once the oil is discharged into the environment.

4.3.1.2 Offshore Facilities and Systems [1100 series]

Description: This SRA includes: offshore exploration and development wells, platforms, and well control systems; the methods, techniques, and equipment for system reliability inspections; systems to detect, prevent, and mitigate oil and gas discharges; and equipment to regain control of a well blowout or any other accidental discharge. It also includes transfer equipment, storage units, and piping used to transfer oil within the offshore system and connect the system to transfer pipelines. This technology is relevant for the multiple operating environments of exploration and production activities (e.g., Arctic, shallow, deep and ultra-deep waters).

Importance: Offshore oil and gas facilities are responsible for a significant percentage of oil and natural gas production in the U.S. Globally, three of the ten largest oil spills came from offshore facilities, including the *Deepwater Horizon* oil spill, the largest marine oil spill in U.S. history. (Oil & Gas IQ, 2015) Important new and potential offshore discoveries will continue to be made in frontier environments of increasingly deeper waters and arctic conditions, creating new technical challenges. Research is needed to determine the effects of deepwater conditions, ice forces, and increasingly severe weather conditions (hurricanes, blizzards, etc.) on offshore structures built in these environments. Research is also needed to address issues due to the aging of existing offshore facility infrastructure. Older well spills result from both internal damage (chemical/mechanical corrosion) and external damage (e.g., electrochemical corrosion, mechanical damage, and structural failures). Advanced system designs and the effective application of improved inspection technologies have the potential to detect problems before failures occur, while improved leak detection and well control systems have the ability to identify leaks when they are still small and can be quickly isolated and mitigated to minimize spillage.

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4.3.1.3 Onshore Facilities and Systems [1200 series]

Description: This SRA includes designs, techniques, operational procedures and equipment for fixed onshore facilities including wells. It covers inspections and systems to detect, prevent, and mitigate oil and gas discharges from the facilities and their systems, including transfer equipment, storage, and piping.

Importance: A significant number of discharges occur from onshore facilities, coastal bunkering facilities, and cargo transfer operations. Studies conducted by industry estimate that almost a third of oil discharges between 1998 and 2007 occurred at inland facilities subject to EPA's Spill Prevention, Control, and Countermeasures (SPCC) program (API, 2009). Advanced system designs and the effective application of improved inspection technology have the potential to detect, or predict the likelihood of potential failures before they occur. Improved leak detection systems have the ability to identify leaks quickly, potentially reducing the size and impacts of the discharge. It is also important to understand the ability of onshore structures to withstand changes in soil bearing capacity caused by changes in the climate and other factors.

4.3.1.4 Waterways Management [1300 series]

Description: This SRA includes methods, equipment, and integrated systems designed to improve navigation at sea and in ports, rivers, and inland waterways. It includes on-board navigation systems, such as integrated navigation and bridge systems and collision avoidance systems. It also includes systems external to the vessel, such as vessel traffic and tracking systems, navigational aids and piloting systems, as well as includes general research into navigation risks, the effects of navigational safety programs, and the development of decision support tools for waterways management efforts. This SRA includes development of navigational channel maintenance programs and analysis of voyage pre-planning processes.

Importance: A navigation-related marine casualty, such as a collision, allision, or grounding, causes most major spills from vessels underway. Collisions are when two moving vessels run into each other. Allisions are when a moving vessel strikes a stationary object such as a bridge abutment or an anchored ship. Groundings occur when a vessel runs ashore or strikes the bottom. According to ITOPF (2015), these causes accounted for 59 percent of large tanker spills in open waters and about 99 percent of tanker spills in restricted or inland waters. Improving navigation and waterways management, particularly in congested port areas and the approaches to ports, can prevent many of these accidents. In addition, improved waterways management can facilitate safe navigation through the Arctic and other ice-infested waterways as shipping increases in these areas.

4.3.1.5 Vessel Design [1400 series]

Description: This SRA includes the development, physical and numerical modeling, and testing of advanced tanker and barge designs to make these vessels less susceptible to damage and less

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likely to spill their cargoes into the waterways if an accidental grounding, collision or structural failure occurs. This SRA also includes research on non-tank vessel designs (e.g., double-hulled fuel and lube oil tanks) to minimize the possibility of spillage from collisions, allisions, and groundings.

Importance: OPA 90 required a phased in double-hull program for all tank vessels entering U.S. ports with all remaining tank barges having double hulls by January 1, 2014. Additional research and development is needed to verify these design approaches and investigate other measures to reduce oil spillage from tank vessel damage. IMO Regulation 12A established double-hull fuel tank construction for certain vessels. Congress has likewise considered double-hull fuel tank requirements for non-tank vessels to minimize the possibility of discharges from groundings, collisions, and allisions. In addition, the anticipated increase in shipping in the Arctic seas has created a need to evaluate and develop new vessel designs to ensure safe operations under arctic conditions where ice filled waters and icing conditions around ships and structures create additional structural stresses and corrosion hazards.

4.3.1.6 Drilling [1500 series]

Description: This SRA focuses on: the design, construction, and placement of wells (shallow, deepwater and ultra-deepwater, and onshore); materials, sensors, and systems needed for offshore drilling and production platforms, and well heads/risers; and techniques and equipment for well and facility monitoring and inspection under extreme pressure and temperature environments. Also included are efforts aimed at understanding the chemical and physical characteristics for the full range of petroleum oils under varying conditions of pressure and temperature; predicting their phase/state, behavior and their physical interaction with other materials in the environment (e.g., rock and sediments); and their impact on engineered systems. Example issues include: early kick detection; systems for communicating and responding to changes in downhole parameters; strategies and methods for training operational personnel on the use of advanced technology; systems to detect and prevent oil and gas discharges; and well-head systems and equipment to control wild wells and cap well blowouts.

Importance: The trend toward drilling in deep- and ultra-deepwater and Arctic conditions increases the difficulty in responding to a well blowout and oil spill. Systems to improve safe drilling operations and prevent loss of well control need to adjust as drilling operations advance into deeper waters and the Arctic. Of key importance is the ability to detect changes in rock and fluid properties at the bit-rock interface or even in the rock and fluids ahead of the bit so that measures can be taken to bring the well under control. Advanced system designs and materials, and the effective application of improved sensors, monitoring systems, and more in depth inspection technology have the potential to detect and measure well integrity and prevent failures, while improved leak detection and other systems have the ability to identify leaks while they are still small and can be quickly isolated and mitigated to prevent or minimize spillage. A fundamental understanding of the chemical and phase behavior, especially under extreme

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conditions of pressure and temperature and effects on engineered systems is critical to effective well construction planning, long-term monitoring, and long-term well integrity.

4.3.1.7 Rail & Truck Transportation [1600 series]

Description: This SRA includes the development and testing of rail and truck transport system designs, operations, and infrastructure to make oil tanks less susceptible to damage and loss of cargo during normal operations, train accidents and derailments, or truck accidents. This SRA includes evaluation of vehicle designs, construction materials, spill prevention devices, and loading/unloading systems and equipment. It also includes evaluations of: the physical and chemical characteristics and behavior of the crude oils being shipped, the effects of those characteristics on the tanks during operations and under accident conditions, and systems to control these characteristics. This SRA also includes evaluations of safety systems and processes to: manage the movement and composition of trains and trucks carrying crude oil, prevent accidents and derailments, select preferred shipping routes, and respond safely to an oil spill emergency.

Importance: North America has experienced a rapid expansion in crude oil supply due to the growing non-conventional oil production activities such as the oil sands products (OSP) from Canada and shale oil from the Bakken fields in North Dakota and Montana as well as the Eagle Ford and Permian Basins in Texas. This expansion in supply resulted in a four-fold increase in the number of crude oil rail car shipments in the past five years. Similarly, crude oil imports from Canada have increased more than 20-fold since 2011. A series of major US crude oil unit train accidents and the Lac Mégantic, Quebec disaster, which resulted in 47 deaths and destroyed much of the town, have underscored the need for safe rail transport of crude oil. The DOT has issued a safety warning that the crude oils being shipped by rail from the Bakken region may be more flammable than traditional heavy crude oil. In May 2015, the DOT issued a final rule to strengthen safety of tank cars transporting flammable liquids.

4.3.1.8 Pipeline Systems [1700 series]

Description: This SRA includes the development, operation, monitoring, and inspection of offshore and onshore pipeline systems used to transport oil between facilities. It covers the pipeline system design, procedures, and equipment for pipeline operations and inspection protocols to prevent, detect, and mitigate oil discharges. Pipeline research under this SRA also includes technologies to prevent (detection/characterization and repair of anomalies before failure) and detect failures, as well as monitor/control systems that can rapidly isolate and shut down operations in order to minimize spillage when failures occur.

Importance: A significant number of oil discharges occur from the more than 182,000 miles of hazardous liquid pipelines in the U.S. PHMSA (2015) pipeline spill statistics document that between 1995 and 2014, there were 2,694 significant hazardous liquid pipeline incidents, 2,614 (97 percent) were onshore. These incidents accounted for the discharge of about 2.2 million

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barrels and more than three billion dollars in property damages. Several major pipeline spills have occurred causing significant damage to aquatic environments and residential areas. Other pipeline spills in remote areas have gone undetected for long periods of time. Advanced system designs and the effective application of improved inspection technology have the potential to detect potential failures before they occur, while improved detection systems have the ability to identify leaks quickly, potentially reducing the size and effects of the discharge.

4.3.2 Preparedness SRAs

The two SRAs under the Preparedness Class cover research that: 1) supports the collection of baseline data needed to assess the effects of oil spills under the Injury Assessment and Restoration Class, and 2) develops information management tools and systems to improve the ability of response organizations and responders to collect and analyze information during an incident.

4.3.2.1 Pre-spill Baseline Studies [2000 series]

Description: This SRA includes research to characterize and analyze baseline data on the natural environment, human health, and socio-economic characteristics in areas at risk for oil spills. Research includes risk assessments conducted in areas involved in the oil production and transportation systems to identify locations most at risk from pollution events and therefore priority candidates for baseline studies. Baseline information and studies may include: location and population data on species and their habitats, especially ecologically sensitive species; the epidemiology/human health characteristics of people in potential impact areas; and potential community and economic impacts in these areas (e.g., tourism, commercial/recreational fishing, and seafood industry).

Importance: Having baseline information and data enables scientists to compare pre-and post-oil spill changes in natural, human health, and socio-economic systems to support response decision-making and post-spill damage assessments and restoration activities. It is common to conduct a credible post-spill environmental and economic damage assessment without pre-spill baseline information, using reference sites that were not contaminated for comparative studies. However, the availability of pre-spill baseline information makes the post-spill natural and socio-economic damage assessment task much easier, accurate, and more defensible. Essentially, the better environmental and economic systems are understood before a pollution event, the easier it will be to assess changes to those systems, estimate damage and develop appropriate restoration strategies afterward.

4.3.2.2 Response Management Systems [2100 series]

Description: This SRA includes analysis and development of systems to manage how data and information are collected, analyzed, documented, and shared between and among, the planning/preparedness and response communities, the Incident Command System (ICS), and the

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public. These systems are used to integrate diverse sets of narrative, graphic, and video information and many sets and types of raw and analyzed data. Examples of oil spill information systems include: ICS forms; computer systems; data management software and databases; Geographic Information Systems (GIS); routing, spill and incident management tracking systems; electronic mail and web content; documents, photographs, and video management and archiving systems; communication systems; public information messages and protocols; and graphical displays.

Importance: Information management and decision-making tools are critical to successfully planning for and managing a response and meeting external demands for information about an incident. These systems provide a tool for the incident command to obtain a common operating picture of an incident, to make resource management decisions, and to share appropriate information with all relevant parties. Improving the accuracy and timeliness of the data increases the ability of the incident command to stay abreast of changing situations. Efficient information systems also provide personnel with timely information to give to the public and media, which have a high demand for information to support the 24-hour news cycle.

4.3.3 Response SRAs

The Response Class of research includes 11 SRAs that support improvements to the activities, technologies, techniques, and equipment used during response operations. These SRAs cover all areas from oil detection, behavior modeling, cleanup, and waste disposal.

4.3.3.1 Structural Damage Assessment and Salvage [3000 series]

Description: This SRA includes the development of methodologies and equipment to assess the extent of damage to a stricken vessel caused by collision, allision, grounding, or improper hull stresses during cargo transfers or explosion. This area also includes development of methods and technology to graphically present the implications of various measures that can be implemented to stabilize the vessel's condition, reduce the potential for further pollution, and allow it to be moved safely for repairs or disposal.

Importance: A critical consideration in responding to a casualty is stabilizing the condition of the vessel to prevent loss of life, minimize loss of property, and prevent or minimize discharges of oil. To accomplish this, on-scene personnel must be able to rapidly assess the overall structural integrity and hydrodynamic stability of the vessel to determine the appropriate response measures.

4.3.3.2 At Source Control and Containment [3100 series]

Description: This SRA includes the development of methods, systems, and equipment for containing and recovering the oil at or from the source and for mitigating oil flow from a damaged vessel, onshore/offshore pipeline, and an exploration or production platform,

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temporarily abandoned (plugged) well, or well head once the spill has begun. Such technologies include well-head capping systems, remotely operated vehicles (ROVs) for subsea containment activities, and patching, plugging and sealing systems. This technology is applicable to all geographic/environmental areas (Arctic, terrestrial, water surface, subsurface shallow, and deep and ultra-deep water).

Importance: The logistical difficulties, enormous costs, and limited success experienced during on-water and shoreline cleanup operations make clear the advantages of containing or recovering oil within, or at least near, the source of the oil flow. Recent technological breakthroughs arose from experiences acquired during the 2010 *Deepwater Horizon* oil spill incident. Additional advances in this area could provide substantial return on R&D investment to contain/recover oil at the source and thereby reduce the extent of contamination and ecological and socio-economic impacts if a spill occurs.

4.3.3.3 Chemical and Physical Behavior Modeling [3200 series]

Description: This SRA includes laboratory and theoretical research and field studies aimed at understanding the behavior and characteristics of the full range of petroleum oils including: behavior and transport in the environment, partitioning of hydrocarbon constituents, and physical interaction with other materials in the environment (rock, sediments, and ice). It includes studies of oil behavior and changes throughout the water column from deepwater blowouts. There is particular interest in non-conventional oils such as those produced in the Bakken and Canadian Tars sands (diluted bitumen (dilbit) and synthetic bitumen (synbit)). It also includes the development and verification of numerical models to predict the surface and subsurface movement and weathering (i.e., spreading, evaporation, dispersion, and dissolution) of oil spills. This SRA also includes methodologies to provide accurate model input data to verify model outputs. This SRA includes development of user-friendly programs to enhance contingency planning and to serve as training aides for spill response teams. Models should be available for various spill scenarios at specific locations for different tidal, current, and weather conditions to pre-plan potential boom deployment strategies and estimate response resource needs.

Importance: Predicting the trajectory (movement) and the weathering of spilled oil, its resultant physical properties and behavior in the water, and the extent of contamination are all critical to identifying the appropriate mix of spill response equipment and countermeasures. A fundamental understanding of the fate (chemical behavior and transport) and effects of oil in the environment is critical to effective contingency planning, response operations management, long-term monitoring, and restoration. In addition, knowledge of longer-term fractionation and transport of hydrocarbons, coupled with potential effects on aquatic resources, provide valuable information to help focus monitoring efforts and develop environmentally-relevant restoration plans.

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4.3.3.4 Oil Spill Detection and Surveillance [3300 series]

Description: This SRA principally refers to methods and equipment for characterizing and monitoring oil pre- and post-implementation of response options, and the detection of unknown discharges. This SRA includes surface and subsurface oil spill surveillance including devices, sensors, and systems for detecting and tracking oil spills, determining the area and thickness of the oil slick, and measuring the physical properties of the oil. Examples of equipment considered in this area are: surface oil spill tracking buoys; airborne remote sensors and data analysis systems; fluorometers and light-scattering sensors; and satellite remote sensing data and on/in-water oil detection devices with the ability to conduct nighttime and low light recovery operations. It includes research that provides information to support development of monitoring protocols for subsea and surface responses or improvements to existing ones such as the NRT Atypical guidance or the SMART guidance, as applicable. This SRA also includes evaluation of techniques for autonomous sensing operations and reporting from remote locations where logistical challenges limit human accessibility.

Importance: Finding and characterizing areas of subsurface or submerged oil in onshore (inland) and offshore waters remains a significant research and technology need. Surveillance technologies provide opportunities to locate spills and their source, determine their extent and volume, provide important data to support response operations, and determine the effectiveness of response. The ability to locate concentrations of oil and track slick movements for countermeasures and cleanup planning supports response operations. Thickness and physical properties measurement allow responders to determine the feasibility of mechanical recovery, *in situ* burning and dispersant use. The data obtained from the surveillance can facilitate the efficient deployment of resources for response operations. Surveillance data from response operations can also be useful for improving and validating spill behavior models.

4.3.3.5 In- and On-water Containment and Recovery [3400 series]

Description: This SRA includes the development of methods, equipment, and materials for physically containing and removing oil from the surface of the water, the water column, or on the bottom of the sea/river bed. This SRA focuses on improving traditional equipment such as booms, skimmers, and sorbent materials, as well as developing new approaches to surface containment, and equipment and systems specific to containment and recovery of subsurface oils.

Importance: Mechanical recovery is often the preferred option to physically remove oil from the environment because the use of these devices to respond to oil spills generally does not pose the potential for additional environmental harm. Containment booms are subject to entrainment and splash over when they encounter certain current velocities or wave heights, thereby reducing their containment effectiveness. Developing new boom designs could improve oil containment across a wider range of environmental conditions, including ice-infested and brash-ice infested

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waters. Mechanical recovery is often the most viable recovery option since it is not subject to agency pre-approval requirements (as are the use of dispersant and *in situ* burning (ISB)). The total average on-water recovery effectiveness for larger spills ranges from 5-30 percent of the oil spilled depending upon the type of oil spilled, ambient conditions, and available equipment. Improvements in the speed of skimmer advance and encounter rates, onboard separation/decanting, and enhanced skimming abilities at higher speeds and wave heights, and rapid systems for temporary oil storage of skimmers could significantly improve mechanical recovery efficiencies. Existing technologies have limited success in recovering oil suspended in the water column or located on the sea/river bed.

4.3.3.6 Shoreline Containment and Recovery [3500 series]

Description: This SRA covers new methods, treating agents, and equipment for removing oil from shorelines, as well as mitigating the environmental impact of oil that cannot be removed. Specifically, this SRA includes water washing and flooding techniques, the use of chemical treating agents, and novel applications of mechanical removal techniques and equipment. It also includes analysis, evaluation and decision-making (risk and benefits) for the use of active shoreline oil removal techniques versus passive naturally-occurring processes.

Importance: Oil spills that impact shorelines often result in oiling of natural resources (e.g., beaches, marshes, coral reefs, mangroves) and man-made structures (e.g., breakwaters, seawalls, piers, vessels). Removing the oil or mitigating the impacts of the oil requires a range of viable technologies that can remove/mitigate the oil while minimizing environmental damage from the technology. Implementing technologies also requires knowledge of the relative benefits of foregoing cleanup activities and allowing natural processes to remove the oil.

4.3.3.7 Dispersants [3600 series]

Description: This SRA addresses the use of chemical products designed to interact with marine oil slicks by reducing the oil/water interfacial tension and breaking up the slick into tiny droplets with the aid of wave or other energy sources. Research areas for dispersants include: developing appropriate dispersant applications for cold weather and deep sea environments; increasing dispersant effectiveness for water surface and subsurface applications (e.g., effective on a wider viscosity and emulsification range, and calm sea conditions); reducing ecological effects of individual dispersant components and combined components in the water column; refining vessel, aircraft, and subsurface application methodologies and equipment; developing enhanced monitoring methods and systems for determining the effectiveness of surface and subsurface application of dispersants; determining how to distinguish physically versus chemically dispersed oil; studying the distribution and impact of the chemicals and dispersed oil in the environment; and understanding regional variations in dispersant performance and environmental effects. This SRA may include characterization to enhance the ability to predict dispersant effectiveness on various oil types and at varying application rates, including the

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effectiveness of dispersants on weathered/emulsified oils and in a range of water salinities. This SRA also encompasses studies to determine the suitability of subsea application of dispersants in the Arctic region where the unique conditions (e.g., shallow depths, water salinity, ice-infested water, under-ice discharges) could influence their fate and effects. An important supporting activity is the development of an information database on dispersant product effectiveness, application procedures, and effects. Since dispersants shift the risk from the surface to the water column, additional research is needed to address questions about the potential acute and chronic effects of dispersants on water column organisms and populations at various depths.

Importance: Dispersants are an important tool in spill response when it is critical to mitigate oil slicks, especially those that are large and offshore. Refinements in dispersant formulations to improve their effectiveness, reduce environmental effects, and/or increase understanding about their potential benefits and risks, can allow dispersants to remain a viable option, especially for large offshore spills and other areas where mechanical techniques can fall short in reaching desired levels of effectiveness to remediate spilled oil. Research is needed to address environmental tradeoffs, worker and public health exposures and provide the conditions under which they may be used appropriately.

4.3.3.8 In-situ Burning [3700 series]

Description: This SRA includes equipment and techniques required to ignite and sustain combustion of oil spills on the water, along shorelines, and on land. A source of ignition must be present for the mix of fuel (e.g., oil) and oxidant (e.g. oxygen) in a slick to burn. Because slick thickness is a key variable in determining whether the oil will burn, this research area includes development of equipment such as fire-resistant booms and herders to concentrate the slick thickness, and improved ignition devices. This SRA also includes developing knowledge of the conditions under which this equipment and technique can be applied effectively, including evaluation of use in frigid (i.e., Arctic) environments, where cold conditions and ice limit operational effectiveness of mechanical containment and recovery of spilled oil. This SRA also includes research to develop new methods to enhance burn efficiency and burn weathered, emulsified, and more viscous oils. Research into the production of residuals including soot and other ISB residues, and the techniques and equipment to recover these residues is also included in this SRA.

Importance: The *Deepwater Horizon* incident demonstrated that ISB is a very promising technique for removing large amounts of oil from the surface of the water. For example, on a single day (on June 18, 2010), 16 on-water ISBs resulted in removal of approximately 60,000 barrels of oil from the Gulf of Mexico (USCG, 2011). Another benefit of this technology is that it also reduces the extent of onshore disposal of recovered oil. In addition it can be an effective method of mitigating spills on land and in coastal areas by removing the spilled oil from the surface in lieu of the potential for damage caused by certain mechanical removal techniques or

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longer-term, passive natural degradation processes. An important consideration in Arctic regions is how soot deposition affects the thickness of snow and ice.

4.3.3.9 Alternative Countermeasures [3800 series]

Description: This SRA includes the development and use of various spill response chemicals to treat oil slicks on the surface of the water making the oil more amenable to other recovery techniques, such as mechanical recovery and ISB. These chemicals include solidifiers, herding agents, elasticity modifiers, shoreline pre-treatment agents, and emulsion treating agents (demulsifiers). Development activities include improving chemical formulations, refining application techniques, and conducting studies of effectiveness and environmental effects.

Importance: Alternative countermeasure employing chemicals to treat oil slicks are not frequently used but, in certain cases, can be very effective in improving oil recovery and oil impact mitigation. At present, the countermeasures included in this SRA would typically be used on smaller spills close to shore due to the logistics involved in using them. Their use for larger spills is currently limited. However, development of new formulations of these agents has the potential to increase their utility. Emulsion breakers used on recovered oil could decrease the amount of material for disposal.

4.3.3.10 Oily and Oil Waste Disposal [3900 series]

Description: This SRA includes study and development of analytical methods, procedures, equipment and techniques to manage and dispose of oil, oily water, oiled soils, and oiled debris recovered during both on-water and on land oil pollution incidents. Specific technologies include, but are not limited to, waste segregation, temporary storage, solidification and stabilization prior to landfill disposal or recycling, oil reclamation, incineration, and biological treatment (i.e., land farming and composting). It also includes techniques and equipment for onsite oil-water separation, filtration, and decanting operations that would reduce the volumes of oil/water material that would need to be handled, transported, and disposed.

Importance: Disposal of oil and oiled debris can be a significant problem during major spills, particularly in remote areas. Oil in water tends to emulsify (wave action results in water becoming incorporated into the oil forming "mousse"). Emulsified oil generally occupies a larger volume than the same amount of fresh oil, making waste disposal a significant issue during spill response. In addition to waste recovered during the active response, waste is also generated by decontamination activities, such as cleaning of oiled vessels, hard booms and skimmers, and mechanical shoreline cleanup equipment. Disposal of decontamination waste will likely include the oil, water, and cleaning agents, which further complicates waste disposal options. Research is needed to advance recycling opportunities and disposal treatment technologies for recovered oil waste and reduce the overall waste following a significant oil spill.

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4.3.3.11 Bioremediation [4000 series]

Description: This SRA includes research and technology to exploit the capabilities of microorganisms and plants to accelerate the rate of degradation of oil typically through aerobic degradation, but also through anaerobic degradation processes. Bioremediation is largely an *in-situ* technology as *ex-situ* use requires excavation and further manipulations that may have a greater potential for environmental harm. Research and development opportunities include the development of methodologies for the use of nutrient enrichment and possibly microbes to accelerate the biodegradation process on land, a process called bio-augmentation. This topic area also covers research to understand the conditions needed for effective bioremediation in the presence or absence of dispersants, herders, and other chemical agents. In areas such as coastal wetlands, where stranded oil may have penetrated into the anaerobic subsurface, this research area would include studies to wick the oil up to the surface where aerobic conditions and nutrient enrichment may result in enhanced biodegradation. This SRA also includes development of methodologies to apply bioremediation for more effective response and restoration efforts. For purposes of this OPRTP, bioremediation includes phytoremediation (remediation using plants), a longer-term restoration technique.

Importance: Bioremediation in many cases is used as a polishing step to follow mechanical recovery or other ex-situ treatment strategies. Bioremediation is a less-intrusive alternative to mechanical recovery techniques. This is especially important in environmental habitats and sensitive areas that could be seriously damaged by the use of mechanical recovery techniques

4.3.4 Injury Assessment and Restoration SRAs

The four SRAs in the Injury Assessment and Restoration Class address the development of strategies to recovery from the effects of an oil spill by determining the level of effects and the implications of those effects on the environmental and sociological resources of the affected area. These SRAs primarily support the Natural Resource Damage Assessment (NRDA) process as well as the need to improve restoration techniques and determine ways to minimize the adverse effects of response activities.

4.3.4.1 Environmental Impacts and Ecosystem Recovery [4100 series]

Description: This SRA includes laboratory research, field studies, and modeling efforts to better understand and predict the short- and long-term effects of oil spills at the ecosystem level. It includes research into the short- and long-term recovery of various types of environments and the chronic effects of oil spills on habitat, species, recovery and rehabilitation of wildlife, and community structures. This SRA includes the effects of the oil and the countermeasures and cleanup techniques used to remove the oil. It also includes research to determine the rate of ecosystem recovery both with and without countermeasures and cleanup.

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Importance: This research provides important feedback on the effectiveness of past responses, forms the basis for future decision-making during spill response, and provides input for damage assessment, restoration planning, and development of decision support tools. Knowledge of the environmental and ecosystem effects of different response measures provides decision-makers the opportunity to identify and select methods that maximize recovery and reduce the adverse effects of response.

4.3.4.2 Environmental Restoration Methods and Technologies [4200 series]

Description: This SRA includes development of methods and technologies to facilitate and accelerate the recovery of resources following an oil spill. It includes research into the effectiveness of approaches for environmental restoration. It also includes evaluations and comparisons of the factors affecting success of the restoration methods and technologies. It also involves studying previous restoration efforts, as well as natural recovery, to better understand ways to improve or enhance future recovery from oil spills.

Importance: OPA 90 mandated restoration activities and specifically required that funds obtained through damage assessment and compensation litigation be expended on restoration activities. However, very few proven methods, technologies, or monitoring protocols exist to support restoration activities. Knowing the conditions affecting the success of the methods and technologies provides decision makers with tools for selecting the approaches that would enhance the chance for successful restoration.

4.3.4.3 Human Safety and Health [4300 series]

Description: This SRA includes studies on the effects of spilled oil and oil spill response activities on human health and safety for both workers and the public. It includes the study of oil weathering throughout the water column and the potential concerns relative to worker health and safety. It focuses on the development of monitoring instruments, procedures, and processes to inform personnel engaged in oil spill response activities, as well as the general public, who could be affected by the oil spill and response options. It also includes studies of the safety of fish and shellfish in a spill area to determine if they are safe to market and consume. Research on seafood safety may include petrochemical toxicology and profiling, risk analysis, sampling and testing methodology development, and risk communications.

Importance: Protecting the health and safety of responders and the public is the highest priority during a response. Potential hazards in dealing with oil include fire and explosion, vapor toxicity, and danger from dermal exposure. Physical health hazards can be acute or chronic. There are processes and procedures that can be implemented to reduce these potential hazards. However, some hazards require a further understanding of how oil behaves to inform the potential concerns relative to worker health and safety. Benzene, for example, can present a potential for chronic health hazards such as leukemia, for which an understanding of oil weathering would inform the needed levels of protection. Response operations conducted on the water or shoreline present

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inherent dangers to personnel health and safety ranging from trips, falls, and cuts; injuries from equipment accidents; working in extreme weather conditions (e.g., heat stroke and freezing); and working around environmental hazards. Some response options present additional health concerns such as: the chemicals in dispersants and oil, other chemical countermeasures; bioremediation; and ISB fires. An additional aspect of human health and safety is seafood safety, which is a complex topic involving sampling and analytical plans, equipment and methods, and data interpretation to assess the potential effects on the health of consumers. Development of health and safety techniques and equipment to mitigate these hazards helps the incident command meet its fundamental responsibility to safeguard both responders and the public.

4.3.4.4 Sociological and Economic Impacts [4400 series]

Description: This SRA includes studies on how oil spills and the response to oil spills affect the sociological fabric of communities and their economies. Disciplines encompassed in this research area include sociology, economics, behavioral sciences, political science, and law. It also involves studies on risk communication and community resilience.

Importance: Research is needed to improve communication of risk, decrease scientific uncertainty, and address socioeconomic concerns associated with oil spills. Oil spills and spill response may cause high levels of stress and psychological trauma, including post-traumatic stress. These effects may begin at the individual level and frequently spread to other members of families, and communities whose culture and livelihood are dependent upon the waters and shorelines near an oil spill. Unemployment and loss of income are additional stressors on peoples' lives. Oil spills can also adversely affect social relationships and have disastrous effects on specific individuals and communities in areas where livelihoods depend on use of renewable resources (e.g., fishing). An oil spill can affect the economic livelihood and aspirations of a family as well as an entire community. Typically, the commercial and recreational fisheries and tourism industries experience the greatest economic effects, although a significant number of other economic sectors also may be affected. Research that supplies a broad understanding of the human dimensions of oil spill hazards and identifies better ways to engage and share information using risk communication principles could enhance future decisions concerning sociological and economic effects on community stakeholders and assist those communities in successfully overcoming these obstacles.

4.4 Research Needs

This category represents the research gaps that ICCOPR identified within the SRAs. ICCOPR identifies oil pollution Research Needs during the OPRTP planning cycle through a number of means, including:

- Reports on research programs and results;

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- Analyses of lessons learned from recent oil spill incidents;
- Data and information shared at various workshops, conferences, and technical and policy meetings;
- Development or enactment of new regulations;
- Input shared and collected from correspondence, quarterly meetings, or scheduled public meetings;
- Numbers and types of research projects conducted/managed by industry, academia, and non-governmental organizations; and
- Forecasts of issues or problems associated with changes or expansion in any aspect of the energy distribution system.

For this FY2015-2021 version of the OPRTP, ICCOPR compiled a new baseline list of Research Needs that incorporates those needs identified in previous versions and new ones identified since 1997 as described in Chapter 9. Future versions of the OPRTP will: 1) update the needs to remove those already addressed; and, 2) add new needs that ICCOPR identifies through the needs identification process.

4.5 Projects

Projects are the specific research experiments and studies conducted by a primary investigator that addresses a Research Need. Projects involve a methodological study or technology development with assigned budgets, resources, and personnel. ICCOPR tracks projects conducted by any entity, not just those conducted specifically by ICCOPR member organizations. ICCOPR recognizes the value of research projects by other entities and encourages its partners from industry, NGOs, state research programs, research institutions, academia, and international organizations to identify and pursue projects that address the needs.

ICCOPR will monitor oil pollution research projects from any identified source and classify identified needs within the Research Categorization Framework by SRA. ICCOPR will use the lists of projects and information on the research results as a basis for assessing how well the Research Needs were addressed.

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5. Knowledge Transfer and Advancement

ICCOPR's ultimate goal for the research and technology (R&T) program is to advance information, technologies and regulations that increase the effectiveness of oil spill prevention, preparedness, response, and injury assessment and restoration efforts. The R&T planning process emphasizes and strengthens the roles and responsibilities of the member agencies to assure that research advances the capabilities to reduce oil pollution. The degree to which practitioners implement the results of the R&T program will depend upon the success of the research and how well results are communicated to the oil spill response community. As part of the program, ICCOPR promotes continuous improvement by monitoring the state of knowledge and adjusting the program to meet changing needs.

5.1 Factors Affecting Research and Technology Program Success

The success of the federal oil pollution R&T program depends on several factors: 1) funding; 2) continuity of research; 3) field testing; 4) regional issues; 5) development of new researchers; and, 6) public perception. The importance of these factors to the success of the federal program is discussed below.

5.1.1 Funding

A steady funding stream at appropriate levels is a primary factor to support a successful R&T program. Funding for oil pollution research has been a recognized challenge since the passage of OPA 90. In their review of the 1992 OPRTP, the NAS Marine Board (1993) acknowledged the need for steady funding:

> "An important unresolved issue is funding. The continued evolution and effectiveness of the (OPRTP) plan is in doubt because the additional funding authorized by Congress has not been appropriated. Moreover, little funding under OPA 90 is expected. This short term funding approach poses a significant barrier to most multi-year research. For example, scientists cannot undertake basic research dealing with the nature of oil and sea water mixtures and their response to mechanical and chemical treatment, oceanic environments, and time, because several years of laboratory work and additional time for field testing would be required." *(NAS, Marine Board Commission on Engineering Technical Systems, 1993)*

The Marine Board also noted the problems caused by the boom and bust cycle of research and funding efforts for oil spill cleanup technology:

> "Research and development (R&D) related to oil spills follows a boom-and-bust cycle. After catastrophic spills, when the acute effects of oiled beaches, polluted waterways, and dying wildlife are featured in all the media, there is public outcry and political interest, accompanied by calls for action, for more research, and for better prevention and control measures. Later, as acute effects fade, but longer term and less obvious

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> problems may continue, public interest-and with it political interest-fade. By the time the calls for action are translated into R&D plans, the interest is gone, and the plans typically are neither supported nor funded. When the next catastrophe occurs, everyone wonders why no one has learned more about how to deal with the problem since the last spill. The phenomenon of cyclical attention and lack of sustained interest and resources, coupled with the natural distribution of research assignments among a group of agencies with different underlying responsibilities, has made it difficult to create a coherently planned R&D program." *(NAS, Marine Board Commission on Engineering Technical Systems, 1993)*

Similarly, the National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling (2011) discussed the continued need for funding at an appropriate level:

> "The technology available for cleaning up oil spills has improved only incrementally since 1990. Federal research and development programs in this area are underfunded: In fact, Congress has never appropriated even half the full amount authorized by the Oil Pollution Act of 1990 for oil spill research and development. In addition, the major oil companies have committed minimal resources to in-house research and development related to spill response technology. Oil spill removal organizations are underfunded in general and dedicate few if any resources to research and development..."
>
> "Recommendation: Congress should provide mandatory funding for oil spill response research and development and provide incentives for private-sector research and development." *(National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling, 2011)*

The oil production and distribution system is constantly changing, posing new challenges to managing oil pollution. Wells are being drilled at increasingly greater water depths and in more challenging environments. A warming Arctic Ocean is expected to lead to greater activity there, both in exploration and transportation. Exploration of onshore shale oils and oil sands products, along with transportation by rail and pipeline is also increasing. The ability of research and technology efforts to keep pace with the challenges will be affected by long-term funding levels.

ICCOPR does not receive funding for research. Instead, ICCOPR members fund research using their agency's annual budget appropriations or the Oil Spill Liability Trust Fund (OSLTF) R&T funds. At this time, ICCOPR agencies with access to the OSLTF R&T funds are the USCG, EPA, BSEE, and PHMSA. However, federal budgetary rules count any funds withdrawn from the OSLTF for research purposes against an agency's overall budget, which means that oil pollution research initiatives still must compete against other agency missions to obtain funding. The National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling (2011) made the following comment on the funding levels for oil pollution research:

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> "Specifically, Congress should provide mandatory funding (i.e. funding not subject to the annual appropriations process) at a level equal to or greater than the amount authorized by the Oil Pollution Act of 1990 to increase federal funding for oil spill response research by agencies such as Interior, the Coast Guard, EPA, and NOAA—including NOAA's Office of Response and Restoration."

While mandatory funding, not subject to appropriations, may be impractical, Federal funding for coordinated Federal research, presumably through ICCOPR, is generally recognized as beneficial to the goal of improved prevention of and response to oil spills.

ICCOPR initially used Regional Research Grants authorized by Section 7001(c)(8) of OPA 90 to address regional oil spill issues. The objective of the Regional Research Program was to "coordinate a program of competitive grants to universities or other research institutions, or groups of universities or research institutions, for the purposes of conducting a coordinated research program related to the regional aspects of oil pollution, such as prevention, removal, mitigation, and the effects of discharged oil on regional environments." Congress authorized funding for the program for the fiscal years 1991 through 1995 but not for subsequent years. ICCOPR will consider additional Regional Research Grants if Congress authorizes funding in the future.

5.1.2 Continuity of Research

The ability of research programs or projects to continue to their logical conclusion is an important factor in successfully addressing oil pollution research needs. Changing agency missions, funding priorities, staffing, or site access may interrupt research programs. Breaks in research continuity, if long enough, can result in a "hiatus effect" where key knowledge or learning opportunities are lost. Particularly vulnerable are studies that measure trends over time (i.e., baseline and impact assessment biological studies, oil fate and effects studies, ocean current monitoring). The institutional knowledge resulting from research efforts can also be lost when program lapses or changes prompt employees to leave their federal positions.

5.1.3 Field Testing

ICCOPR recognizes that field testing is a valuable tool to validate laboratory results and to study techniques, treatments and equipment *in situ*. In 1993, the NAS Marine Board recommended that the federal R&T program include controlled field experiments that involve a deliberate, limited discharge of oil to advance research areas (i.e., oil dispersants, ISB, incineration, and bioremediation). The NAS Marine Board noted that laboratory experiments alone cannot replicate real-world process interactions and variables, and accidental spills provide limited learning opportunities because data on pre-spill conditions and/or spill volume usually are lacking. An independent report, "Responding to Oil Spill in the U.S. Arctic Marine Environment", also echoed the need for field testing (NRC, 2014). The report noted that

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countries such as Norway have consistently supported this type of research by permitting controlled spills when clear research needs, methods, and goals have been identified, and responsible cleanup and monitoring plans have been established.

Field tests may be justified when laboratory or other simulated settings (e.g., test tanks) cannot address specific Research Needs and no other open water research projects have addressed them. Experiments in large test tanks (i.e., Ohmsett) provide opportunities to simulate real environmental conditions and bridge the gap between laboratory and actual field experiments; however, they cannot completely replicate actual field conditions. ICCOPR will continue working with policy makers and permitting authorities to explore field testing opportunities. Field tests may be justified when laboratory or other simulated settings (e.g., test tanks) cannot address specific Research Needs and no other open water research projects have addressed them.

5.1.4 Building the Next Generation of Researchers

The federal oil pollution R&T program needs an adequate pool of researchers and policy makers interested in oil pollution research to replace those that are retiring or leaving for other opportunities. College students need to view the oil pollution management and research fields as a viable career path. Interest in pursuing these areas is strongest in the years following a major spill (i.e. *Exxon Valdez*, *Deepwater Horizon*) and decreases as events fade from national consciousness. Thus, generating and maintaining interest by college students about to enter the workforce in oil spill R&T careers is an important element of ICCOPR's efforts.

Several of the ICCOPR member agencies have programs to encourage students to become interested in oil pollution research or management. NOAA and the University of New Hampshire's Coastal Response Research Center (CRRC), educate students on issues related to oil spills and response and works with other university programs to encourage academic interest in the field. The U.S. Coast Guard Academy includes environmental protection and marine safety topics across its curriculum in many forms ranging from drilling technology and petroleum chemistry to the history of spills of national significance. In particular the Marine and Environmental Science major includes specific courses in geochemistry, analytical chemistry, and petroleum and oil spill science, and the Engineering Department offers marine engineering courses focused on the needs of the prevention community. Cadet research projects, which are part of their curriculum, from the Science and Engineering Departments often address oil spill issues.

NASA's DEVELOP National Program fosters an interdisciplinary research environment for students, where applied science research projects are conducted under the guidance of the agency and its partner science advisors. DEVELOP is unique in that young professionals lead projects that utilize NASA Earth observations to address community concerns and public policy issues, including oil pollution research.

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The International Oil Spill Conference (IOSC) Executive Committee, which includes several ICCOPR members, offers a scholarship program and student awards to promote interest in oil pollution research.

ICCOPR also provides annual advice to the NAS GRP on the direction of the GRP program, which includes education and training. A key program objective of the GRP is to support the development of future professionals and leaders in science, industry, health, policy, and education who can apply cross-boundary approaches to critical issues that span oil system safety, human health, and environmental resources.

The DOI's Youth Initiative includes outreach to students at the Ohmsett facility and at the annual Clean Gulf Conference. At the 2014 Clean Gulf Conference several ICCOPR members participated in a day-long outreach session with a local high school's Advanced Placement environmental science class.

5.1.5 Public Perceptions

The NAS Marine Board observed that public reactions and perceptions can play a significant part in making oil spill response decisions, regardless of their scientific validity. Adverse reactions to the use of a technology can lead to political pressures to limit its use. In 2010, public concerns about the use of dispersants during the *Deepwater Horizon* oil spill response prompted interest groups and state agencies to oppose the use of dispersants. Such opposition may increase the need for research to provide additional validation of dispersant safety and efficacy before approval as a response option. The ICCOPR agencies' research programs need to recognize public perceptions about different technologies and factor them into decisions about research initiatives.

5.2 Communicating Research and Technology Efforts

Researchers must effectively communicate their results to the broader oil spill research and response communities to provide the greatest benefit from their efforts. There are many avenues for transferring research knowledge (i.e., meetings, conferences, workshop, seminars, papers, presentations, journal publications, consensus-based best practice reports, and websites of organizations involved or interested in spill response). ICCOPR views communication as a two-way street and uses a variety of mechanisms, discussed below, to transfer research knowledge to stakeholders and to learn of advances by non-federal researchers.

5.2.1 ICCOPR OPRTP

OPA 90 established the ICCOPR OPRTP as the mechanism to inform Congress and the public on the status of oil pollution technologies, research needs and priorities, and agency roles and responsibilities. The 1992 and 1997 versions of the OPRTP provided ICCOPR's assessments of the state of knowledge at that time. This 2015 version updates the assessment of oil pollution

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R&T. ICCOPR intends for future versions of the OPRTP to serve as information sharing documents that provide the current federal perspective on oil pollution research. ICCOPR plans to update the OPRTP every six years to maintain timely information and may publish supplements if warranted.

5.2.2 ICCOPR Biennial Reports to Congress

Section 7001(e) of OPA 90 requires that ICCOPR submit a report biennially on its activities and those of its members during the previous two fiscal years and the anticipated activities for the next two fiscal years. The ICCOPR Biennial Reports to Congress serve as a reference document on ICCOPR activities, member initiatives, and planned activities. Appendices to the reports provide listings of publications by ICCOPR member agencies and descriptions of their research projects.

5.2.3 ICCOPR Meetings

ICCOPR conducts quarterly membership meetings and special meetings with interested stakeholders. The quarterly meetings include a session for agencies to present updates and share results of their research and development efforts. These sessions promotes coordination and collaboration among member agencies. The quarterly meetings also include time for presentations from invited speakers to discuss subjects of interest to the membership.

ICCOPR conducts public and other special meetings with outside organizations to discuss their issues and share oil pollution related information. ICCOPR conducted public meetings to gather input as part of efforts to revitalize ICCOPR and to identify areas of concern for future oil pollution research.

5.2.4 Meetings with Non-Federal Entities

ICCOPR participates in meetings with industry, state governments, NGOs, associations, academia, and other nations to exchange information and promote collaboration and cooperation. Stakeholders frequently ask ICCOPR to address these bodies to explain federal research priorities and initiatives. ICCOPR will continue participating in these meetings and encourage the entities to address the ICCOPR priority Research Needs.

5.2.5 Demonstration Projects

Section 7001(c)(6) of OPA 90 directed that ICCOPR conduct Port Oil Pollution Minimization Demonstration Projects in New York, New Orleans, and Los Angeles/Long Beach. The Great Lakes Oil Pollution Research and Development Act of 1990 amended OPA 90 to include a fourth demonstration in ports of the Great Lakes. ICCOPR conducted two demonstration projects in New Orleans (December 1994) and New York (October 1995). After these first two projects were completed, the USCG determined that they were cost prohibitive and ICCOPR

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agreed that the objectives for the demonstration projects requirement could be met through other means (ICCOPR, 2003). Since 1995, ICCOPR has addressed the objectives through interagency participation in, and support for, regularly scheduled domestic and international oil spill conferences (i.e., IOSC, Interspill, Spillcon).

In 2014, BSEE sponsored a demonstration of oil spill response processes at the 2014 IOSC in Savannah, Georgia. The theme of the On Water and Aerial Technical Demonstration was "A Complete Spill Response System." The objective is to demonstrate oil spill response resources involving new and existing technology configured to increase the response effectiveness through improved detection, tracking and increased encounter and recovery rates.

The 45-minute demonstration on the Savannah River followed a scripted, simulated spill scenario that included: a remote oil detection device that initiated an oil spill alert message with coordinates to the responsible party, spill management team, identified OSROs, and USCG Sector or Captain of the Port and interested parties. Surface oil spill response vessels, unmanned aerial vehicles and submersible response equipment all participated in the joint response effort. A mobile command center managed the demonstration and broadcast information via a live feed to conference participants.

ICCOPR and its member agencies will consider future demonstrations of response technologies within budgetary considerations.

5.2.6 Conferences

Participation in conferences is an important way to communicate research results, showcase technology, and provide opportunities for researchers and response professionals to interact. ICCOPR and its member agencies sponsor, support, and participate in several oil spill-related conferences domestically and internationally. Primary conferences promoted by ICCOPR include:

- International Oil Spill Conference (triennial in U.S.),
- Interspill (triennial in Europe),
- Spillcon (triennial in Australia),
- Clean Pacific (biennial) and Clean Gulf Conferences (annual),
- Offshore Technology Conference (annual),
- Gulf Oil Spill & Ecosystem Science Conference (annual), and
- Arctic Marine Oilspill Program Technical Seminars (annual).

These domestic and international conferences include both technical programs and equipment tradeshows that present the latest issues, products, and technologies available for oil spill and hazardous materials response, spill prevention, marine salvage, cleanup and remediation,

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professional services, and regulatory compliance.

The American Petroleum Institute (API) and the IOSC Executive Committee, which includes several of the ICCOPR agency representatives, worked to make all papers presented at the IOSC since its inception in 1969 available free of charge on the internet (http://ioscproceedings.org/loi/). This service provides a wealth of information specific to the oil spill research community.

5.2.7 Workshops and Seminars

Workshops and seminars are widely used in the oil pollution control community to bring together professionals to discuss specific topics and challenges. ICCOPR member agencies sponsor workshops on a wide variety of topics that address priority research issues.

5.2.8 Publications

The researchers funded by ICCOPR are encouraged to publish their research in peer reviewed journals, conference proceedings, books, special reports, and other publications. Literature generated from research could be from researchers within the traditional oil spill community or from academic scientists and engineers. Research published in peer-review journals, especially ones with high impact factors have value in oil spill litigation cases.

Examples of high impact factor peer-review journals and publications that address marine pollution topics include:

- *Applied and Environmental Microbiology,*
- *Environmental Science & Technology (SETAC),*
- *Environmental Toxicology and Chemistry,*
- *Human and Environmental Risk Assessment,*
- *Journal of the American Medical Association,*
- *Journal of Petroleum Technology*
- *Journal of Toxicology and Environmental Health,*
- *Marine Pollution Bulletin,*
- *Microbial Ecology Journal of Environmental Monitoring,*
- *Nature,*
- *Science, and*
- *Water Research.*

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5.2.9 Newsletters

ICCOPR monitors newsletters published by many organizations that announce news of their activities, highlight specific programs or initiatives, or summarize advancements in R&T. In addition, several of the ICCOPR member agencies also publish newsletters addressing elements of their oil pollution research missions.

5.2.10 Internet and Social Media

ICCOPR and the member agencies use the internet as a tool to provide oil spill research results and news to stakeholders and other users. ICCOPR maintains an internet site (www.uscg.mil/iccopr) to: share documents, provide links to other programs and resources, distribute research reports, announce conferences and other events, and provide news about research developments.

Some of the ICCOPR member agencies maintain websites and are using blogs and social media platforms (i.e., Facebook and Twitter) to share information with the public and researchers.

5.3 Monitoring the Status of Oil Pollution Technologies

The 2015-2021 version of the OPRTP marks a new baseline in ICCOPR's oil pollution research planning efforts, documenting the status of oil pollution Research Needs at the start of the planning process. Future OPRTP revisions, to be issued every six years, will include revised assessments of the status of oil pollution R&T.

Throughout each six-year planning cycle, ICCOPR will track newly identified Research Needs conducted by members, federal partners, NGOs, academia, and industry. ICCOPR will use the Oil Pollution Research Characterization Framework and research protocol described in Chapter 6 of this OPRTP, to compile information on studies that address future priority Research Needs.

ICCOPR will also assess the compiled information to determine the degree to which the priority Research Needs from the previous plan were addressed and then develop a new set of research priorities for the subsequent planning period. ICCOPR may also issue supplements to the OPRTP during a planning cycle to address emerging Research Needs that increase in priority. ICCOPR may periodically review after action reports, GAO reports, and other sources of identified gaps to inform the Oil Pollution Research Characterization Framework for future research needs

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PART TWO – ESTABLISHING RESEARCH PRIORITIES

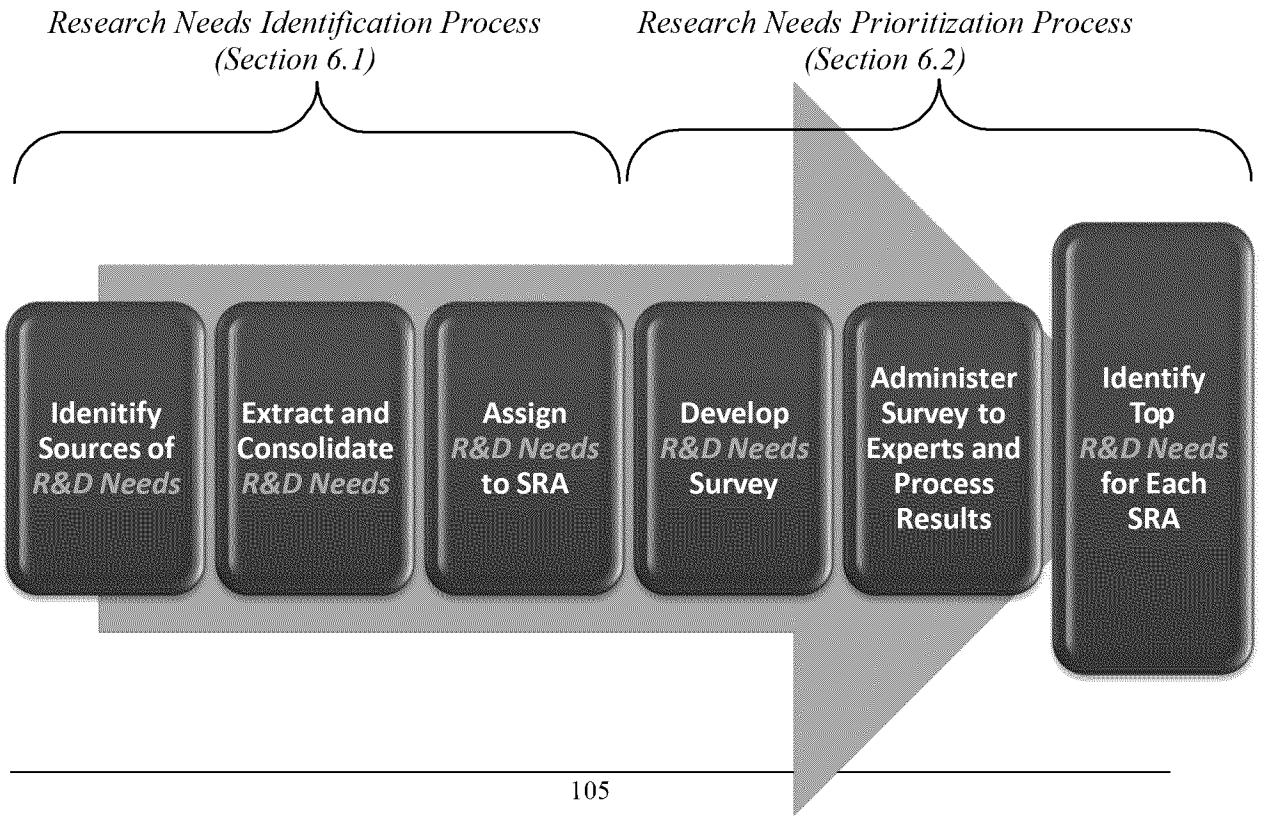
6. Oil Pollution Research Needs Identification and Prioritization Process

A significant number of oil pollution incidents have occurred and a substantial amount of research has been conducted since the completion of the 1997 version of the Oil Pollution Research and Technology Plan (OPRTP). In order to update the OPRTP, ICCOPR needed to develop a process for reviewing the lessons learned from these incidents and addressing any recommendations and gaps noted in the completed research.

ICCOPR established a Research and Technology (R&T) Workgroup with representatives from BSEE, DOE, EPA, NOAA, and USCG to lead development of the revised OPRTP and the Needs Identification and Prioritization Process. The R&T Workgroup was responsible for defining the SRAs, reviewing the Research Needs, and developing the proposed list of research priorities for overall ICCOPR approval.

This chapter describes the systematic process used by the R&T Workgroup to identify and prioritize the nation's future oil pollution Research Needs. Sections 6.1 and 6.2 describe in detail the elements of the process (Figure 6-1). Appendices B through E provide supporting information to the process.

Figure 6-1. Major steps in the Research Needs Identification and Prioritization Processes



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6.1 Research Needs Identification Process

The Research Needs identification process consisted of three steps: 1) identification of Research sources; 2) extracting Research Needs and consolidating them into a database; and, 3) assigning Research Needs to SRAs (Figure 6-1). Research Needs were identified through internet searches; discussions with experts; and detailed review of reports, meeting notes and workshop summaries. The R&T Workgroup considered sources that were published prior to initiation of the identification process in 2013. Needs identified in sources published after the process began will be evaluated and prioritized in the next planning cycle.

6.1.1 Identification of Sources of Research Needs

The first step was to identify all possible sources of new Research Needs published since the 1997 version of the OPRT Plan was released. For purposes of this plan, ICCOPR defined sources as: accident case studies; published papers; research reports; workshop or meeting proceedings; white papers; lessons learned; and agency or organizational opinions. More than 50 unique sources were identified as describing Research Needs that should be included in the database. Examples of sources reviewed include: oil spill incident after-action reports; the 1992 and 1997 versions of the OPRTP; Coastal Response Research Center (CRRC) workshop reports; ICCOPR Public Meeting transcripts; interagency reports; research solicitations and publications.

A complete list of the initial sources reviewed can be found in Table 6-1 and Appendix C. Although it was not possible to review every potential source of oil pollution Research Needs since 1997, the sources used in this plan addressed all of the initial set of 23 SRAs and were viewed as representing a comprehensive list.

Table 6-1. List of Sources Reviewed for Research Needs

Sources Reviewed for the ICCOPR Research Needs (by date)
Title 33 U.S. Code Chapter 40 Subchapter IV 2761 (Aug 1990)
Interagency Coordinating Committee on Oil Pollution Research and Technology Plan (April 1992)
Interagency Coordinating Committee on Oil Pollution Research and Technology Plan (1997)
Coastal Response Research Center - Research and Development Priorities: An Oil Spill Workshop (November 2003)

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Coastal Response Research Center – Workshop: Research & Development Needs For Making Decisions Regarding Dispersing Oil (September 2005)
National Research Council. Oil Spill Dispersants: Efficacy and Effects. Washington, DC: The National Academies Press (2005)
Potentially Polluting Wrecks in Marine Waters: An Issue Paper Prepared for the 2005 International Oil Spill Conference (2005)
EPA Act 2005 Section 999A(b)(4) DOE National Energy Technology Laboratory Complementary Research Program (2005)
Coastal Response Research Center – Workshop: R&D Needs for Addressing the Human Dimensions of Oil Spills (June 2006)
Coastal Response Research Center - Submerged Oil Workshop Report (December 2006)
DOE 2007 Annual Plan Ultra-Deepwater and Unconventional Natural Gas and Other Petroleum Resources Research and Development Program, Report (January 2008)
DOE 2009 Annual Plan Ultra-Deepwater and Unconventional Natural Gas and Other Petroleum Resources Research and Development Program, Report (December 2008)
Coastal Response Research Center - R&D Priorities: Oil Spill Workshop (March 2009)
House of Representatives, Committee on Science & Technology "A New Direction for Federal Oil Spill Research & Development" (June 2009)
DOE 2010 Annual Plan Ultra-Deepwater and Unconventional Natural Gas and Other Petroleum Resources Research and Development Program, Report (December 2009)
Wreck Oil Removal Program Overview (2009)
Prince William Sound Oil Spill Recovery Institute Research Plan 2011-2015 (February 2010)
Gulf of Mexico Research Initiative: Research Themes (May 2010)
Interagency Coordinating Committee on Oil Pollution Research Public Meetings - West (May 2010)
Pacific States/British Columbia Oil Spill Task Force Letter to Interagency Coordinating Committee on Oil Pollution Research (May 2010)

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House of Representatives, Committee on Science & Technology "Deluge of Oil Highlights Research & Technology Needs for Effective Cleanup of Oil Spills" (June 9, 2010)
U.S. Arctic Research Commission - White Paper (July 2010)
Interagency Coordinating Committee on Oil Pollution Research Public Meetings - East (September 2010)
Marine Mammal Commission Letter to Interagency Coordinating Committee on Oil Pollution Research (September 2010)
National Science and Technology Council Joint Subcommittee on Ocean Science and Technology - DWH Oil Spill Principal Investigator Conference Report (October 2010)
Interagency Coordinating Committee on Oil Pollution Research Public Meetings - Gulf (November 2010)
National Academy of Sciences Institutes of Medicine Research priorities for Assessing Health Effects from the Gulf of Mexico Oil Spill (2010)
Deepwater Horizon Incident Specific Preparedness Review (January 2011)
Environmental Protection Agency Draft Oil Spill Research Strategy (January 2011)
National Commission on BP Deepwater Horizon - Final Report (January 2011)
Ultra-Deepwater Advisory Committee 2011 Plan: Comments, Findings and Recommendations (April 2011)
Coastal Response Research Center - Coordinating R&D on Oil Spill Response In the Wake of Deepwater Horizon (July 2011)
Assessing the Long-term Effects of the BP Deepwater Horizon Oil Spill on Marine Mammals in the Gulf of Mexico: A Statement of Research Needs (August 2011)
DOE 2011 Annual Plan Ultra-Deepwater and Unconventional Natural Gas and Other Petroleum Resources Research and Development Program, Report To Congress (August 2011)
U.S. Department of Energy - 2011 Ultra-Deepwater and Unconventional Natural Gas and Other Petroleum Resources R&D Program (August 2011)
Science Advisory Board Review of Environmental Protection Agency's Draft Oil Spill Research Strategy (September 2011)

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National Science and Technology Council's Joint Subcommittee on Ocean Science and Technology - Deepwater Horizon Oil Spill Principal Investigator Conference Final Report (October 2011)
Oil Spill Preparedness and Response Joint Industry Task Force (November 2011)
U.S. Geological Survey. An Evaluation of the Science Needs to Inform Decisions on Outer Continental Shelf Energy Development in the Chukchi and Beaufort Seas (2011)
International Association of Oil and Gas Producers - Joint Industry Programme Solicitation for Expression of Interest (EOI) on Arctic Oil Spills (February 2012)
Coastal Response Research Center - The Future of Dispersant Use in Oil Spill Response Initiative (March 2012)
Ultra-Deepwater Advisory Committee 2012 Plan: Comments, Findings and Recommendations (March 2012)
OESC Letter Recommendations to BSEE Department of the Interior (April 2012)
U.S. Government Accountability Office Oil Dispersants Report (May 2012)
Government and Industry Pipeline Forum (July 2012)
DOE 2012 Annual Plan Ultra-Deepwater and Unconventional Natural Gas and Other Petroleum Resources Research and Development Program, Report To Congress (August 2012)
OESC Letter Recommendations to BSEE Department of the Interior (August 2012)
U.S. Department of Energy - Ultra-Deepwater and Unconventional Natural Gas and Other Petroleum Resources R&D Program (August 2012)
Ultra-Deepwater Advisory Committee 2013 Draft Plan: Findings and Recommendations (November 2012)
Center for Spills in the Environment Alberta Oil Sands Workshop for Maine DEP and U.S. EPA Region 1 (December 2012)
Bureau of Safety and Environmental Enforcement - BAA Proposed Research on Oil Spill Response Operations (2012)
OESC Letter Recommendations to BSEE Department of the Interior (January 2013)

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Center for Spills in the Environment Oil Spill Dispersant Research Workshop Report (March 2013)
Oil Spill Simulants Materials: Workshop Proceedings (March 2013)
University of Washington Transporting Alberta Oil Sands Products: Defining the Issues and Assessing the Risks (March 2013)
Center for Spills in the Environment Alberta Oil Sands Workshop for Washington State Department of Ecology, the Regional Response Team 10 and the Pacific States/British Columbia Oil Spill Task Force (April 2013)
DOE 2013 Annual Plan Ultra-Deepwater and Unconventional Natural Gas and Other Petroleum Resources Research and Development Program, Report To Congress (June 2013)
NRC An Ecosystem Approach to Assessing the Impact of the Deepwater Horizon Spill in the Gulf of Mexico (2013)
TRB Effect of Diluted Bitumen on Crude Oil Transmission Pipelines Special Report 311 (2013)

During the Prioritization Process, the R&T Workgroup increased the number of SRAs to 25 by adding a new "Rail and Truck Transport" SRA and redefining the Onshore and Offshore facilities SRAs to create a new "Pipeline" SRA. The R&T Workgroup reviewed the new and revised SRAs and determined that additional review of sources for the Rail and Truck Transport SRA and the Onshore Facilities SRA were needed. The R&T Workgroup used experts at PHMSA and the EPA to obtain information on potential missing needs for these two SRAs. Table 6-2 lists the supplemental sources reviewed to determine additional Research Needs.

Table 6-2. List of Supplemental Sources Reviewed for Research Needs

Supplemental Sources Reviewed for the ICCOPR Research Needs (by date)
FRA Research Review Conference (2012)
USDOT Emergency Order on Transport of Bakken Crude Oil (2014)
Federal Railroad Administrator Prepared Remarks - 50th Meeting of the Railroad Safety Advisory Committee (2014)
Discussions with U.S. EPA Office of Solid Waste (2014)

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Discussions with PHMSA Office of Pipeline Safety (2014)

6.1.2 Extraction and Consolidation of R&D Needs

A searchable Excel database was created to record information on the source, the applicable environment and the frequency the Research Need was mentioned in the sources reviewed. Initially, more than 900 Research Needs were identified from the source material. After elimination of duplicated Research Needs, the final list consisted of 570 separate Research Needs. This list of 570 Research Needs is located in Appendix B. The original list of more than 900 Research Needs was archived for future use.

6.1.3 Assignment of Research Needs to an SRA

The last step in the Needs Identification Process involved assigning each of the 570 Research Needs to one of the 25 SRAs described in Chapter 4 of this based on the definition of each SRA. Some SRAs had a much larger number of Research Needs than others. SRAs with a large number of needs were further divided into SRA subcategories. The rationale for using subcategories is described in Section 6.2. Figure 6-2 shows an example of the column headings for a typical entry in the Research Needs database.

Figure 6-2 Sample from the Research Needs Database

Standing Research Area (SRA)	SRA Subcategory	Research Need and Key Research Concept	Sources	Physical Location	Sources
Dispersants	Behavior	Constituents - Study chemistry data for individual dispersant components in the oil droplets during the DWH spill.	CRRC - The Future of Dispersant Use in Oil Spill Response Initiative (2012)	Marine and Estuarine	1

6.2 Research Need Prioritization Process

The ICCOPR R&T Workgroup determined that the most effective Needs prioritization process for this OPRTP was to develop a survey (Figure 6-1) that could be distributed to Subject Matter Experts (SMEs) (e.g., scientists, policy makers) familiar with current oil spill research needs. In some areas, there was a need to include state agency, academic, or industry experts in order to find the right expertise to address the R&D Needs

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questions. The Workgroup determined, however, that in no SRA category or subgroup should non-federal employees exceed the number of Federal SMEs. The survey results helped ICCOPR identify and prioritize the most important Research Needs within each SRA.

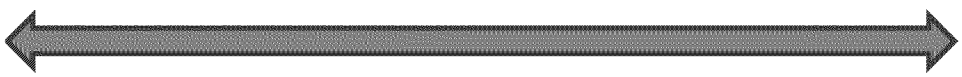
The R&T Workgroup created subcategories for 11 SRAs with a large number of Research Needs to reduce the number of Research Needs that each SME was required to evaluate. The decision to use this approach was based on the experience of UNH Survey Center experts (managers of the survey) who indicated that "survey fatigue" often occurs if a participant is asked to answer a large number of questions, thus affecting the validity of the results. Appendices D through F provide the survey technical report and examples of the survey instrument and results.

The Workgroup compiled a set of proposed priority research Needs for the SRAs and SRA subcategories and presented them to the whole ICCOPR for approval.

6.2.1 Development of Research Needs Survey

The R&T Workgroup developed and debated a series of key questions that reflected the various aspects of the research process and selected the following questions for the survey:

Question 1 - How important is this Research Need in improving any or all of the following: spill prevention, preparedness, response, and/or impact assessment/restoration? (Via sliding scale)



Low Medium High

Question 2 - Some research is designed to answer a small detail which refines our understanding of a research problem while other research answers key questions that become the building blocks for further advancements. Please estimate where this Research Need fits in this spectrum of oil pollution research (Via sliding scale)

Small Detail/Nuance Building Block/Key Question

Question 3 - What would be the estimated cost of the research to answer this Research Need? (Via text box)

Fill in blank text box

Example 50000000; no commas or dollar sign

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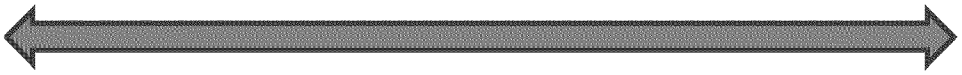
Question 4 - How soon would the results of this specific Research Need improve any or all of the following: spill prevention, preparedness, response, or impact assessment/restoration? (Via sliding scale)



Short (<2 year) 2-5 years Long (>5 years)

Question 5 - Solving research problems can require multiple steps. Some research projects take the initial steps while others will be the final step. Please estimate where this Research Need fits in the lifespan of solving a research problem. (Via sliding scale)

Initial Step Final Step

Questions 1-5 were designed to refer to a specific Research Need within the SRA or SRA subcategory that a SME was assigned. Questions 6 and 7 were designed to be asked at the end of the survey and refer to all of the Research Needs evaluated by an SME.

Question 6 - Of the research needs that you reviewed today, which rise to the top? For each, list (up to 3) impediments (other than cost or time to completion) for these top research Needs you identified. (Answers via text box)

Fill in blank text box

Question 7 - Are there any research needs related to this subject area that you feel need to be addressed, but were not on this list? (Answers via text box)

Fill in blank text box

In addition to the questions described above, the R&T Workgroup decided to ask each SME to provide a range of dollar values that they would expect for research projects associated with their assigned SRA or SRA subcategory. This information was intended to allow the R&T Workgroup to calibrate the difference in project costs between SMEs with different backgrounds and different types of research experience. Unfortunately, the number of responses to the inquiry on potential costs were limited and too variable to be

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of significant value to the decision making process.

The UNH Survey Center built and designed the survey instrument, in conjunction with the CRRC and the R&T Workgroup. A total of 46 separate surveys were developed, one for each SRA or SRA subcategory. Appendix E provides a sample of the survey for one of the Research Needs.

6.2.2 Administration of Survey to SMEs

The R&T Workgroup recruited 285 SMEs to provide at least five SMEs for each of the SRAs and SRA subcategories. These SMEs were selected for their knowledge and expertise in particular SRAs. Responses were received from 223 of these experts; 185 federal employees and 38 non-federal personnel. Survey groups were designed to include a majority of federal employees to avoid Federal Advisory Committee Act (FACA) issues. The UNH Survey Center administered the confidential survey and tabulated the scores.

6.2.3 Processing of Survey Results

In order to determine the highest priority Research Needs, the Survey Center calculated a mean and standard deviation for each of the questions using the answers provided by the SMEs. Questions #3 about costs could not be used in the final scoring because many SMEs did not answer it. The R&T Workgroup weighted the remaining questions based on its knowledge of their importance.

1. How important is this Research Need in improving any or all of the following: spill prevention, preparedness, response, and/or impact assessment/restoration? Weighting **55%**
2. Some research is designed to answer a small detail which refines our understanding of a research problem while other research answers key questions that become the building blocks for further advancements. Weighting **30%**
3. What would be the estimated cost of the research to answer this Research Need? Weighting **0%**
4. How soon would the results of this specific Research Need improve any or all of the following: spill prevention, preparedness, response, or impact assessment/restoration? Weighting **15%**

6.2.4 Identification of Top Priority Research Needs for Each SRA

The priority Research Needs were established based on a review and vote by ICCOPR on the recommended priorities selected by the R&T Workgroup during a series of working sessions during the summer of 2014. The R&T Workgroup's iterative process to select

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the recommended priorities consisted of the following steps:

- Evaluate statistical ranking and analysis of survey results. The UNH Survey Center provided a ranking of Research Needs by the raw and weighted scores and the standard deviations of both scores. The R&T Workgroup used these initial rankings as a starting point for discussions.

- Review missing Needs. Several SMEs identified potentially missing Research Needs in their responses to Question 7. The R&T Workgroup reviewed the suggestions to determine whether a different SRA or SRA subcategory included the Research Need. The R&T Workgroup added missing Research Needs to the appropriate SRA or SRA subcategory and assigned an appropriate rank based on the members' expert opinion.

- Consolidate research Needs. In many cases, an SRA or SRA subcategory listed similar Research Needs. The R&T Workgroup reviewed these similarities and consolidated them where appropriate. The draft ranking was adjusted to reflect the importance of the consolidated Research Need.

- Determine top three recommended priority Needs. The R&T Workgroup considered several factors in making its final recommendation on the three most important Research Needs for each SRA or SRA subcategory: 1) whether the impediments as listed by the SMEs in answer to Question 6 would prevent or severely limit the potential research to resolve the Need; 2) whether completed or ongoing research had already addressed the Research Need; and 3) did the results of Question 5 and 6 distinguish between similarly ranked Research Needs (however, this last factor was rarely necessary). The R&T Workgroup unanimously agreed upon the top three suggested priority Research Needs for each SRA or SRA subcategory before they were presented to the full ICCOPR.

- Develop the final description of each recommended priority Research Need. The R&T Workgroup reviewed the language of each SRA and the associated priority Research Needs to ensure each description was clearly articulated and consistent with the SRA definition.

- Obtain ICCOPR member feedback. The R&T Workgroup sent its draft list of priorities to the full ICCOPR membership for review and comment. The R&T Workgroup adjudicated the comments through discussions with commenting members and a meeting of the R&T Workgroup.

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- Finalize recommended priorities. The R&T Workgroup made its final edits to the recommendations based on the comment adjudication process and met on August 19, 2014 to formally vote on a final set of recommended priorities. The recommendations were sent to the full ICCOPR membership for consideration and adoption.

The full ICCOPR membership discussed the proposed SRA descriptions and the priority Research Needs at the Quarterly Meeting on September 17, 2014. Minor wording changes were made to two Research Needs based on the discussions, and by unanimous vote, ICCOPR adopted the top three priority Needs for each SRA and SRA subcategory as presented in Chapter 9.

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7. Noteworthy Oil Spill Incidents

This chapter provides a summary review of noteworthy oil spills since ICCOPR released the 1997 version of the OPRTP. The case studies describe the incidents, the significant causal factors, response issues, and the identified Research Needs. This section is organized chronologically by the type of incident as classified by the National Response Center:

- Vessel Spills (tank and non-tank),
- Offshore Drilling Operations,
- On-shore Pipeline Spills,
- Facility Spills, and
- Railroad Spills.

Information on the spill and response measures described in the case studies was acquired from various sources including: NOAA's Office of Response and Restoration's IncidentNews (www.incidentnews.noaa.gov) for open water spills; the EPA's OSC website (www.epaosc.gov) for inland spills; and State agency information and DOT reports. The Research Needs listed below the incident summaries were taken from Incident Specific Preparedness Reviews (ISPRs), NOAA OR&R reports; and contracted After Action Reviews (AARs) where available. In cases where specific no Research Needs were identified, the R&T Workgroup reviewed the case study information for applicable Research Needs.

7.1 Vessels Spills

Major spills from tankers have been declining globally for several decades according to ITOPF (2015). However, Spills from all vessels remain an on-going concern. The USCG (2012) reported that between 2001 and 2010 there were 20,710 spills from vessels responsible for more than 6.6 million gallons of oil. Tank barges accounted for more than 60 percent of the volume spilled.

TB Penn

In July 2000, the Tank Barge *Penn 460* ruptured and released ~12,600 gallons of No. 6 fuel oil into Narragansett Bay, Rhode Island, an active fishing and lobstering location. The spill oiled two miles of shoreline and numerous birds. Response measures included: the booming of heavily contaminated areas and surface skimming; low pressure flushing of shoreline and sediments; the use of sorbents and snares (passive collection) near the McAllister Hazardous Waste Landfill; a bird capture program for oiled birds;

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informational handouts on tar balls to the public; and fishery closures in the immediate area.

This incident is an example of a barge tank rupture that leaked heavy fuel oil into an estuary important for fishing and recreation. There were no specific research recommendations following the spill; however, the response action emphasized the need for further research in the following SRA areas:

- **In- and On-water Containment and Recovery (SRA 3400)** - improve boom and surface skimming equipment.
- **Shore Containment and Recovery (SRA 3500) -** develop improved methods for shoreline cleanup.
- **Environmental Impacts and Recovery (SRA 4100) -** develop improved methods of impact assessment and recovery (for fisheries and avian species).
- **Sociological and Human Impacts (SRA 4400) -** determine impacts to humans related to estuarine spills.

T/V Athos I

In November 2004, the single hull tanker *T/V Athos I* struck a submerged object and spilled approximately 264,000 gallons of heavy Venezuelan crude oil into the Delaware River creating a 20-mile slick that affected 214 miles of shoreline across four states (Pennsylvania, Delaware, New Jersey, and Maryland), with some of the oil submerged below the surface. The investigation by the USCG concluded that the vessel struck a submerged U-shaped pipeline while maneuvering en-route to its berth. The pipeline punctured the vessel's bottom plating in the ballast and cargo tanks.

Response included vessel stabilization and prevention of further discharge; facilitation of vessel traffic, as needed; deployment of protective booms and snares; skimming, collection and recovery of floating oil; enforcement of a safety zone; and collection and rehabilitation of injured wildlife. Economic losses were incurred due to delays in transportation on the Delaware River. The Salem Nuclear Power Plant shut down two reactors because submerged oil was identified in the sediment below some water intakes. The Plant shutdown affected regional electrical generation.

This incident was important for its identification of needed technology improvements including: subsurface object detection and the detection, tracking, mapping and recovery of subsurface and submerged oil. Although there were no specific recommendations for future research as a result of the spill and response actions, this spill highlighted the need for research in the following SRAs:

- **Vessel Design (SRA 1400)** - develop double hull designs.

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- **Structural Damage Assessment (SRA 3000) -** develop methods to determine vessel damage.
- **Environmental Impacts and Recovery (SRA 4100) -** develop better methods of wildlife rehabilitation.
- **Sociological and Economic Impacts (SRA 4400) -** study impacts related to primary and secondary economic impacts and costs.

M/V Selendang Ayu

During a large storm in December 2004, the *M/V Selendang Ayu*, carrying a cargo of soybeans, lost power and grounded on the west side of Unalaska Island, Alaska, where it broke into two and released 337,000 gallons of IFO-380 fuel oil, marine diesel, a small amount of lube oil as well as its soybean cargo. Most of the oil was carried onto the rocky shorelines of Makushin and Skan Bays. Half of the vessel sank, while the other half remained afloat, harboring fuel with the potential for additional releases.

Response measures included employing SCAT, an assessment process used for all spills where shorelines are impacted, and manual shoreline cleanup. The potential of an additional release from the floating half of the vessel triggered testing and approval for dispersants and *in situ* burning (ISB), which were not employed. After the initial response, cleanup was halted until April 2005 due to deteriorating winter weather conditions. In the spring, most shorelines were manually cleaned and dry mechanical tilling and berm relocation techniques were used where appropriate. Response actions continued during the weather-permitting seasons until June 2006.

This incident highlighted the difficulty of response operations in the Arctic environment and the availability of suitable response technologies in cold, icy conditions. The After Action Review for the *M/V Selendang Ayu* incident discussed the following specific R&D Needs (Wood & Associates, 2005):

- **Response Management Systems (SRA 2100) -** improve information sharing, including identification of response equipment and resource availability.
- **Chemical/Physical Modeling (SRA 3200) -** develop methods to determine the transportation and fate of oil in Arctic waters.
- **In and On-water Containment and Recovery (SRA 3400) -** develop measures of containment for application in Arctic conditions.
- **Shoreline Containment and Recovery (SRA 3500) -** develop technology improvements for Arctic shorelines and weather conditions.

T/V Bow Mariner

In February 2004, the *T/V Bow Mariner* crew was engaged in cleaning residual Methyl Tertiary Butyl Ether (MTBE) from a cargo tank while in transit. The MTBE caught fire

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and exploded and the ship sank about 45 nautical miles east of Virginia. Twenty-one men died in the incident and all the cargo was lost. The vessel was carrying 3,188,711 gallons of ethanol, 192,904 gallons of No. 6 fuel oil, and 48,266 gallons of diesel, which were all released during the incident. An ignition of a fuel/air mixture, either on deck or in the cargo tanks, caused this casualty; the precise source was not determined. The ethanol, which is miscible in water and diesel oil were dispersed rapidly. The fuel oil created an oil slick that required mechanical recovery. Response actions included fishery closures, and mechanical recovery using skimmers; the vessel was not salvaged. Corexit 9527 was tested for dispersants; however, it was not used due to the cold temperatures and the degree of oil weathering.

A significant contributing factor to this casualty was the failure of the operator, Ceres Hellenic Enterprises, Ltd., and the senior officers of the *Bow Mariner*, to properly implement the company and vessel Safety, Quality and Environmental Protection Management System (USCG, 2005). Although specific R&D Needs were not identified, this incident highlighted the need for research in key SRAs:

- **Human Error Factors (SRA 1000) -** study explosion hazards related to tank cleaning operations
- **Human Error Factors (SRA 1000) -** develop manuals for safe tank cleaning procedures.
- **Human Error Factors (SRA 1000) -** develop adequate training on tank cleaning procedures for crews of vessels carrying explosive materials.
- **Human Error Factors (SRA 1000) -** develop adequate training for multicultural crew cohesiveness.
- **In- and On-water Containment and Recovery (SRA 3400) -** study methods of containment and recovery of ethanol and alternative fuels.
- **Dispersants (SRA 3600) -** study the effectiveness of dispersants in cold water and with weathered oil.

M/V Cosco Busan

In November 2007, the container ship *M/V Cosco Busan* spilled 53,569 gallons of heavy fuel oil from its bunker tanks into San Francisco Bay after the vessel struck the San Francisco-Oakland Bay Bridge in thick fog. The source of the incident was not a tanker transporting crude oil as a component of the oil production and transportation system, but rather a non-tank vessel engaged in maritime commerce spilling oil used to fuel the ship. Investigators concluded that the vessel's pilot was impaired from his use of prescription pharmaceuticals, while piloting the container vessel, which rendered him unable to properly use the onboard radar and electronic navigation charts. The USCG Vessel Traffic Service (VTS) failed to warn the pilot that the vessel was headed for the bridge.

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The master of the *M/V Cosco Busan* did not implement several procedures found in the company safety management system related to safe vessel operations, which placed the vessel, crew and environment at risk.

The spill oiled about 200 miles of coastline. The near shore location, the type of oil, and proximity to sensitive and valuable coastal resources resulted in a substantial response. Response activities included: deployment of containment boom; mechanical collection and removal; natural attenuation; beach closures due to health and safety concerns with the fuel oil and; and oiled bird capture and cleaning programs.

This incident was an important driver for research needs involving human error, crew fitness, and waterways management because of the potential to prevent this incident and others like it had these needs been addressed. The ISPR for the *M/V Cosco Busan* (USCG, 2008a,b) noted these specific R&D Needs:

- **Human Error Factor (SRA 1000) -** develop protocols to report changes in crew fitness to the USCG, in a timely manner, including any substantive changes in their medical status or medications.
- **Waterways Management (SRA 1300) -** develop technology improvements to improve vessel traffic monitoring and communications.
- **Response Management Systems (SRA 2100) -** develop improvements to information management systems that provide timely and accurate information for the Federal On-scene Coordinator about the extent of the spill.
- **Environmental Impacts and Recovery (SRA 4100) -** develop improvements to aid in effective bird capture techniques and identify priorities and resources needed to provide the most effective wildlife rescue.
- **Environmental Impacts and Recovery (SRA 4100) -** develop a framework to make beach closure and reopening decisions and incorporate those into local government plans (coordinated through the Area Contingency Plan (ACP)).
- **Human Health and Safety (SRA 4300) -** develop protocols needed to close, open or restrict fisheries after a spill that are written into emergency plans and develop expedited tests to check whether impacted fish are a health risk.
- **Sociological and Economic Impacts (SRA 4400) -** evaluate proper use of and methods to monitor the use of social media during and after spills.

7.2 Offshore Drilling Operations

The explosion and collapse of the *Deepwater Horizon* drilling platform resulted in the largest marine oil spill in history and revealed several Research Needs associated with offshore drilling operations.

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***Deepwater Horizon (DWH)* Oil Spill**

In April 2010, an estimated 205.8 million gallons of oil began flowing from a subsea well blowout that followed an explosion and collapse of the *Deepwater Horizon* platform (also called the Macondo 252 well) during exploratory drilling. The platform was located approximately 50 miles south of the coast of Louisiana in waters about 5,000 ft. deep. The explosion on the drill rig killed 11 men and injured 17 others. For approximately three months, efforts to stop the flow at the source were unsuccessful until response operations temporarily capped the well on July 15, 2010. The complete well closure occurred on September 18, 2010. The resultant oil spill caused damage to deepwater and nearshore marine and wildlife habitats across the Gulf States and to the Gulf's fishing and tourism industries.

This spill was declared a Spill of National Significance (SONS). Response to the *Deepwater Horizon* spill was diverse and conducted on a larger scale than any previous efforts. Different response mechanisms were deployed depending on the day, the weather conditions, and the amount and location of oiled shoreline. This included: ISB, subsea and surface dispersant use, booming, and skimming. Application of 1.84 million gallons of dispersants, both aerially and sub-sea at the wellhead, was unprecedented, as was the use of controlled ISB (a global record of 411 individual burns were conducted). This spill was the first where dispersants were applied subsea at the wellhead. Existing options failed to satisfy the public expectations, which led to the testing and evaluation of more than 120,000 response technologies through the Alternative Response Technologies Evaluation System (ARTES) Program.

The magnitude and spatial extent of this spill resulted in the collection of a large amount of monitoring and experimental data. A substantial amount of research studying the effects of the spill and the response on the Gulf of Mexico are ongoing. The incident report (USCG, 2011) highlighted the following R&D Needs:

- **Pre-Baseline (SRA 2000)** - ensure minimum standards and consistency for Gulf of Mexico Area Contingency Plans (ACPs).
- **Pre-Baseline (SRA 2000) -** identify Environmentally Sensitive Areas (ESAs).
- **Source Control and Containment (SRA 3100) -** develop improved technology and response protocols for well blowouts.
- **Response Management Systems (SRA 2100) -** develop systems to better meet the needs of oil spill response organizations.
- **Response Management Systems (SRA 2100) -** establish standards and processes for rapid collection, processing, correlation, analysis and distribution of satellite imagery and oil thickness sensors to direct spill response operations with real-time data.

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- **Oil Spill Detection and Surveillance (SRA 3300) -** develop improvements for subsea oil detection.
- **Oil Spill Detection and Surveillance (SRA 3300) -** develop and use enhanced SMART monitoring technologies and protocols in offshore environments.
- **Oil Spill Detection and Surveillance (SRA 3300) -** develop technology to determine oil slick thickness.
- **In- and On-water Containment and Recovery (SRA 3400) -** develop improved and more efficient skimmers and mechanical recovery equipment.
- **In- and On-water Containment and Recovery (SRA 3400) -** use a fully operational Common Operating Picture (COP) available during drills, exercises, and actual events.
- **In- and On-water Containment and Recovery (SRA 3400) -** develop protocols for thorough, independent testing and evaluation of response technologies prior to being used on a spill.
- **Dispersants (SRA 3600) -** study the toxicity of dispersants as a function of oil and dispersant types, and different environments.
- **Dispersants (SRA 3600) -** study dispersant efficacy including volumetric limitations of applications.
- **Dispersants (SRA 3600) -** study dispersant efficacy in mitigation of environmental impacts.
- **Dispersants (SRA 3600) -** develop methods and programs to monitor and track large, dispersed oil plumes.
- **Dispersants (SRA 3600) -** conduct a case study analysis of all aspects of dispersant use including environmental effects of dispersants and dispersed oil.
- **Dispersants (SRA 3600) -** study the effectiveness of dispersants under different environmental conditions (e.g., subsea).
- **ISB (SRA 3700) -** study where ISB can be used as a response option and areas where it can be subject to expedited approval.
- **ISB (SRA 3700) -** study the performance of various fire boom designs and improve technologies for water-cooled and reusable booms.
- **Sociological and Economic Impacts (SRA 4400) -** develop outreach programs for, and incorporate state and local emergency managers into, spill preparedness and response.
- **Sociological and Economic Impacts (SRA 4400) -** Spill of National Significance (SONS) doctrine should be adapted to be more inclusive of state, local and tribal governments in a response.

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7.3 On-Shore Pipeline Spills

There are more than 300 oil and hazardous liquid spills annually along the more than 199,000 miles of hazardous liquid pipelines in the U.S. according to PHMSA statistics. Three such spills illustrate the types of Research Needs for pipeline spills.

Enbridge Pipeline

In July 2010, an Enbridge Energy Partners LLP pipeline (30-in. diameter) ruptured near Marshall, Michigan and spilled an estimated 843,000 gallons of crude oil produced from bitumen sands, also known as oil sands products (OSP). The rupture released the oil into Talmadge Creek and it then flowed into the Kalamazoo River, a Lake Michigan tributary. Heavy rains at the time of the incident affected spill behavior and transport causing the river to overtop existing dams and carry the OSP downstream contaminating 35 miles of the Kalamazoo River. The rains resulted during a 25-year flood event that also carried the OSP into the adjacent floodplain.

At the height of the response, more than 2,500 people were working along the impacted river and shoreline. Response measures for this spill included: fish advisories, river closure for dredging operations to remove sunken oil and oil in sediments, and deployment of sediment traps for oil that was not removed during dredging. A significant portion of the oil submerged in the river making detection and recovery difficult. Numerous methods were tried to recover the submerged oil because globules continued to rise from the bottom when bottom sediments were disturbed. Identification of submerged oil was determined by manually disturbing the sediments with a pole. Oil sheens would form where there was submerged oil. Vacuums or passive methods removed the oil. Passive methods of recovery in place continued for a long period after the spill.

Research Needs influenced by this spill included submerged oil detection and recovery for large areas, and cleanup methods for OSP in floodplains. Additional research needs identified by the NRDA team included:

- **Pipeline Systems (SRA 1700) -** develop new advanced technology for sensing pipeline leaks that will reduce leak detection false alarms for new construction and existing pipelines.
- **Pipeline Systems (SRA 1700) -** improve and develop in-line inspection (ILI) to locate and size defects in girth welds and for long seam defects including cracks in electric resistance welded pipe (ERW).
- **Chemical and Physical Modeling and Behavior (SRA 3200) -** study the behavior of OSP when spilled into rivers including weathering and interactions with sediments.

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- **Oil Spill Detection and Surveillance (SRA 3300) -** improve technology for detection of submerged oil in rivers.
- **Environmental Impacts and Recovery (SRA 4100) -** study the lethal and sublethal impacts of OSP on biota.
- **Environmental Impacts and Recovery (SRA 4100) -** study the impacts of cleanup activity on subtidal and floodplain habitats.
- **Human Health and Safety (SRA 4300) -** study the impacts of air quality on the community and responders from OSP spills.
- **Sociological and Economic Impacts (SRA 4400) -** study the impacts related to lost recreational opportunities from spills.

Yellowstone River Pipeline

On July 1, 2011, a break occurred in a 12 in. pipeline, owned by ExxonMobil Pipeline Company, under the Yellowstone River, 20 miles upstream from Billings, Montana. The ruptured pipeline leaked an estimated 63,000 gallons into the river before the pipeline was closed. USEPA led the response in close coordination with the State of Montana and other federal agencies. EPA's primary concern was protecting people's health and the environment. The river also is known for Yellowstone River cutthroat trout, a Montana fish of concern.

When the Yellowstone River dropped below pre-spill water levels, oil residue was visible in many areas, including some agricultural lands. Farmers were given instructions for crops and livestock. USEPA held ExxonMobil, the responsible party, accountable for assessment, cleanup and restoration. Cleanup crews recovered only about 420 gallons of crude.

As in the case of the Kalamazoo River, the amount of oil spilled was much higher than it might have been due to that lack of coordination and communication among the pipeline operators. In both cases, there was a substantial delay in closing the valves to shut off the flow. In the Yellowstone River incident, it was estimated two-thirds of the spill volume were attributable to the delay. Although there were no specific recommendations for R&D, this spill emphasized the need for:

- **Human Error Factor (SRA 1000) -** better training and coordination for operators.
- **Pipeline Systems (SRA 1700) -** research on methods of inspection of buried pipelines for erosion.
- **Pipeline Systems (SRA 1700) -** improve existing leak detection technology and health monitoring sensors that are miniaturized, automatic, and robust enough to withstand harsh environments.

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- **Environmental Impacts and Recovery (SRA 4100) -** research on the potential impacts of OSP on freshwater fisheries.
- **Environmental Impacts and Recovery (SRA 4100) -** research on the potential impacts and restoration of OSP on crops and livestock.

Pegasus Pipeline

ExxonMobil's Pegasus pipeline carries 3,990,000 gallons per day of crude oil a distance of 850 miles from Patoka, Illinois to Nederland, Texas. The spill occurred on March 29, 2013, when the pipeline carrying Canadian Wabasca heavy crude from the Athabasca oil sands ruptured in Mayflower, Arkansas, about 25 miles northwest of Little Rock. A reported 210,000 - 294,000 gallons of crude were spilled. Approximately 3,990,000 gallons of oil mixed with water were recovered by March 31. Twenty-two homes were evacuated. The EPA classified the leak as a major spill.

The crude oil entered a suburban neighborhood through a leak in the 20 in. pipeline, which was buried an average of two feet below ground. The oil flowed into storm drains leading to nearby Lake Conway, used for recreational fishing. First responders, including fire fighters, city employees, county road crews and police built dikes to block culverts and stop the crude from further fouling the lake. ExxonMobil deployed 3,600 feet of containment boom around the lake. By early morning on March 30, there was no more oil spilling from the pipeline.

The EPA and ExxonMobil conducted air quality monitoring. Overall, air emissions in the community were below levels likely to cause health effects to the public. The Arkansas Division of Environmental Quality (ADEQ) closely reviewed the cleanup, continued to monitor the surface water in the affected areas, and posted regular updates. Although reports identified no specific Research Needs, those that were evident from the Mayflower pipeline spill are similar to Research Needs from the Enbridge Kalamazoo OSP spill:

- **Pipeline Systems (SRA 1700) -** improve and develop in-line inspection (ILI) to locate and size defects in girth welds and long seam defects including cracks in electric resistance welded pipe (ERW).
- **Chemical and Physical Modeling and Behavior (SRA 3200) -** research on OSP weathering and interactions with sediments.
- **Environmental Impacts and Recovery (SRA 4100) -** more research on the impacts of cleanup on habitats.
- **Health and Safety (SRA 4300) -** research on air quality monitoring protocols for OSP spills.

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7.4 Facility Spills

Severe weather events, most notably hurricanes in the Gulf of Mexico and the East Coast, were responsible for several spills from facilities in the inland areas in recent years.

Hurricanes Katrina and Rita

Gulf of Mexico Hurricanes Katrina and Rita caused multi-state pollution events in 2005. In total, there were over 500 spills resulting from these storms. Storm damage caused above ground storage facilities to spill an estimated 8 million gallons of oil. The largest spill totaled 3.78 million gallons. It came from facilities operated by Bass Enterprises Production Company in Cox Bay, just east of Port Sulphur in Plaquemines Parish, LA. Another Bass Enterprises spill totaling 461,000 gallons occurred near Pointe a la Hache, LA. The second-largest spill, 1,050,000 gallons, was from a broken pipeline owned by Shell Pipeline Co. near Pilot Town, LA. Chevron Oil is believed to have spilled 991,000 gallons near Empire, LA and 53,000 gallons near Port Fourchon, LA, while Venice Energy Services Co. is believed responsible for the discharge of 840,000 gallons near Venice, LA. Shell also was responsible for 13,440 gallons discharged near Nairn, also in Plaquemines.

These incidents indicated a significant need to have more effective response plans for spills caused by natural disasters. In 2005, the National Response Plan (NRP) was revised into the National Response Framework (NRF), which established a single, comprehensive approach to domestic incident management to prevent, prepare for, respond to, and recover from all hazards including terrorist attacks, major natural disasters, and other emergencies.

The response actions during these storms although not specifically identified in reports, indicate the need for R&D in the following areas:

- **Pre-Spill Baseline (SRA 2000) -** research to identify ESA species and other sensitive or important resources near fixed petroleum facilities.
- **Response Management Systems (SRA 2100) -** develop systems that support response actions for multiple spills during natural disasters.
- **In- and On-water Containment and Recovery (SRA 3400) -** identify and pre-place equipment to support facility responses during natural disasters.

Super Storm Sandy

On October 29, 2012, Hurricane Sandy, also known as Super Storm Sandy, made landfall in New Jersey and caused severe damage in the New York and New Jersey metropolitan area. Official estimates indicate that 336,000 gallons of diesel fuel from the Motiva oil tank facility in Woodbridge, N.J spilled into the Arthur Kill, a tidal strait, after the Sandy

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storm surge lifted a storage tank and it ruptured. The USCG reported that a secondary containment tank caught most of the oil and that the liquid that escaped moved into the Arthur Kill where booms contained the oil. Two hundred responders were on scene to contain the spill. Initially, an acrid stench filled the air. Air samples collected by the USCG at Arthur Kill showed levels within acceptable thresholds within two days. On the adjacent land, a vacuum truck removed a diesel-and-water mixture next to a local park along the Arthur Kill. Although not specifically identified, the response to this type of storm reflected the research needs for:

- **Response Management Systems (SRA 2100) -** ability to rapidly respond to multiple spills during natural disasters.
- **In- and On-water Containment and Recovery (SRA 3400) -** establish pre-placed equipment to respond to onshore facility spills.

7.5 Railroad Spills

Increased oil production of Bakken crude and Canadian Tar Sands along with limitations on pipeline capacity has resulted in a four-fold increase in rail shipments of crude oil between 2010 and 2014. Two derailments illustrate the types of issues that arise with spills from railroad accidents.

Parkers Prairie Train Accident

On March 27, 2013, a mile-long train hauling oil from Canada derailed in western Minnesota and leaked its crude; the leak was the first major spill of the newly developed North American crude. Fourteen of the 94 cars of the Canadian Pacific mixed freight train left the tracks about 150 miles northwest of Minneapolis near the town of Parkers Prairie. The Minnesota Pollution Control Agency reported three tank cars ruptured and leaked an estimated 20,000 to 30,000 gallons. Cold weather made the crude thicker, hindering the ability to recover the oil.

This incident indicates the need for R&D in the following areas:

- **Rail and Truck Transportation (SRA 1600) -** evaluate accident and incident trends to identify ways to minimize the incident rate of leaks, spills, and damage to the environment due to oil spills.
- **Rail and Truck Transportation (SRA 1600) -** evaluate alternative tank car designs and modifications to minimize risk of oil spills during accidents.
- **In and On-water Containment and Recovery (SRA 3400)** - conduct field tests of cleanup techniques and create protocols for various habitats and conditions.

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Lac-Mégantic Train Accident

On July 5, 2013, a unit train with 72 cars of Bakken crude oil stopped at Nantes, Quebec. The engineer parked and left the train in accordance with an expected shift change. At approximately 00:56 hours on July 6, 2013, the train started to move down the track. It rolled down the approximately 1.2% grade into the center of the small tourist town of Lac-Mégantic, derailed and the locomotives detached from the rest of the train. Since there were no signals or track circuits, the rail traffic controller had no initial indication of the runaway train. Many of the derailed tank cars full of oil exploded and burned in the heart of the commercial district. The accident killed forty-seven people.

Canada's Transportation Safety Board investigated the incident and determined "the braking was insufficient to hold" the runaway train and that the crude was very volatile. The Board also found the tank cars were mislabeled and the crude was more flammable than originally thought. The deadly accident spurred USDOT's Federal Railroad Administration (FRA), to improve safety standards, specifically for the transport of hazardous materials. "No train or vehicles transporting specified hazardous materials can be left unattended on a mainline track or side track outside a yard or terminal, unless specifically authorized." New safety procedures are now in place in the U.S. to reduce the potential for any future incidents occurring. These procedures include requirements for notification prior to leaving an unattended train and mandatory safety inspections by first responders. FRA (2015) also proposed new regulations regarding rail cars carrying crude oil.

This incident indicates additional Research Needs for trains carrying oil in these SRAs:

- **Human Error Factor (SRA 1000) -** increase training in the areas of communication and safety for trainman and dispatchers.
- **Human Error Factors (SRA 1000) -** develop programs for vessel crews to improve their understanding of automated vessel functions.
- **Railway and Truck Transport (SRA 1600) -** analyze hazards and develop corresponding mitigation methods and technologies for headspace gases in tank cars.
- **Railway and Truck Transport (SRA 1600) -** evaluate and determine minimum crew size requirements for safe operations of unit trains.
- **Human Safety and Health (SRA 4300) -** develop protocols for first responders and railroad workers to improve safety and communications in locations where railroads are carrying hazardous cargos.
- **Human Safety and Health (SRA 4300) -** study the impacts of burning crude oil on first responders and residents.
- **Sociological and Economic Impacts (SRA 4400) -** study the economic impacts of a major train disaster on a small community.

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8. Current State of Oil Pollution Knowledge

The ICCOPR research and technology planning process involves continually assessing the current state of oil pollution knowledge. ICCOPR and its members continue to monitor and participate in a wide range of studies, workshops, and other events to gain insight into the state of knowledge regarding oil spill prevention, preparedness, response, and impact assessment and restoration. This chapter highlights some of the major sources of information since the 1997 version of the OPRTP was issued.

8.1 National Research Council - Oil Spill Dispersants: Efficacy and Effects

In 2005, the MMS, NOAA, USCG, and API funded the National Research Council (NRC) to convene a committee of experts to review the state of knowledge on the use of dispersants as a response technology for oil spills. They asked NRC to identify the adequacy of existing information and ongoing research regarding the efficacy and effects of dispersants. The study focused on: understanding the limitations imposed by the various methods used in previous studies; recommending steps to better understand the efficacy of dispersant use; and the effect of dispersed oil on freshwater, estuarine, and marine environments. The NRC completed the report well before the *Deepwater Horizon* oil spill and therefore did not envision the extensive use of dispersants during that response.

The NRC Committee emphasized the need to conduct bench-scale and meso-scale testing in order to be able to better control the environmental factors that are present in large-scale field experiments. They specifically recommended:

- Studies to better predict the effectiveness of dispersants for different oil types and environmental conditions;
- Bench-scale experiments to test effectiveness over a wide range of operating conditions;
- Investigations of the kinetics and transformation products of dispersed oil biodegradation at conditions that represent those that follow significant dilution of the dispersed oil plume;
- Toxicity studies to determine the mechanisms of acute and sublethal toxicity to key organisms from exposure to dispersed oil;
- Wave-tank studies that specifically address the chemical treatment of weathered oil emulsions; and
- Studies to quantify the weathering rates and final fate of chemically dispersed oil droplets compared with undispersed oil.

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8.2 The Coastal Response Research Center Workshops

The Coastal Response Research Center (CRRC) was established as a partnership between the NOAA OR&R, and the University of New Hampshire (UNH) in 2003. The CRRC's complementary organization is the Center for Spills in the Environment (CSE). CSE receives funding from sources other than NOAA.

The primary purpose of the CRRC and CSE is to bring together the resources of a research-oriented university and the expertise of governmental agencies, NGOs, academia and industry to conduct and oversee basic and applied research, conduct outreach, and encourage strategic partnerships in spill response, assessment and restoration. The CRRC and CSE hosted numerous workshops that brought together national and international oil spill experts to discuss future R&D Needs. The following workshops identified Research Needs that are important to the improvement of oil spill response and the understanding of potential effects:

- Research & Development Priorities: An Oil Spill Workshop (November 2003)
- Research & Development Needs For Making Decisions Regarding Dispersing Oil (September 2005)
- R&D Needs for Addressing the Human Dimensions of Oil Spills (June 2006)
- Submerged Oil Workshop Report (December 2006)
- R&D Priorities: Oil Spill Workshop (March 2009)
- Coordinating R&D on Oil Spill Response In the Wake of *Deepwater Horizon* (July 2011)
- A Forum – Oil Spill Research (January 2012)
- The Future of Dispersant Use in Oil Spill Response Initiative (March 2012)
- Oil Spill Dispersant Research Forum (March 2013)
- Alberta Oil Sands Workshop (April 2013) Washington State Department of Ecology, the Regional Response Team 10 and Pacific States/British Columbia Oil Spill Task Force (April 2013)
- Environmental Disaster Data Management Workshop (September 2014)

Research and Development Priorities: An Oil Spill Workshop (November 2003)

This CRRC workshop provided a foundation for a NOAA R&D strategic plan and a road map for funding decisions for five years. The participants considered Research Needs and then prioritized them in terms of short- and long-term research objectives, cost effectiveness, and applicability to response and restoration actions.

The topics were grouped into themes because many overlapped or were similar:

- Physical Transport Forecasting;
- Oil Weathering: Data Development and Modeling;

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- Ecosystem Services: Identification and Valuation;
- Communication: Public and Stakeholder Participation in Response and Restoration;
- Restoration Review;
- Chronic Effects of Oil at Individual and Habitat Levels;
- Methods and Techniques; and
- New Tools for Restoration and Recovery.

Research & Development Needs For Making Decisions Regarding Dispersing Oil (September 2005)

This CRRC workshop used the major topic recommendations from the 2005 NRC study on dispersant efficacy and effects to serve as the basis for the workshop discussion. The NRC report provided recommendations for major research topic areas within six R&D categories:

- chemical effectiveness of dispersant formulations;
- operational effectiveness parameters;
- hydrodynamics and integration of data needed to develop modeling capabilities to predict and evaluate dispersant effectiveness;
- short- and long-term toxicity of dispersants and dispersed oil;
- long-term fate of dispersants and dispersed oil, including biodegradation; and
- development of relevant exposure regimes.

R&D Needs for Addressing the Human Dimensions of Oil Spills (June 2006)

The goal of the CRRC Human Dimensions of Oil Spills Workshop was to bring together a broad spectrum of human dimensions researchers and oil spill practitioners, including industry representatives and regulators, to develop a list of research needs on human dimensions that the Center could use in Request for Proposals (RFPs) and announcements from other funding entities. CRRC specifically designed the workshop to gather holistic perspectives and feedback from all stakeholder groups involved in oil spill response and restoration.

Six research topics were noted as critical components to incorporate into NRDA and other spill response processes. They were:

- Human Use Dimensions;
- Risk Communication;
- Valuing Natural Resources;
- Social Impacts;
- Subsistence;

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- Coordination in Response and Restoration; and
- Environmental Ethics.

Submerged Oil Workshop (December 2006)

The overall goal of this CRRC workshop was to identify Research Needs information on submerged oil pertaining to the following response and restoration topics:

- Detection and Monitoring;
- Fate and Transport;
- Containment and Recovery (including Protection of Water Intakes); and
- Effects and Restoration.

R&D Priorities: Oil Spill Workshop (March 2009)

This CRRC workshop focused on areas where significant Research Needs still existed. This was a follow-up to the 2003 CRRC five-year R&D Needs Workshop. Participants were asked to discuss the needs in the areas of:

- **Spill Response During Disasters** - This area addressed issues that are encountered during natural (e.g., earthquakes, hurricanes, floods) or anthropogenic (e.g., accidents) disasters resulting in nearshore and offshore oil spills. Planning and implementation gaps and health and safety issues were the primary focus.

- **Response Technologies** - This research area addressed planning, implementation, technology and effectiveness issues for response (i.e., bioremediation, surface washing agents, solidifiers, sorbents, dispersants, and ISB).

- **Acquisition, Synthesis and Management of Information** - This research topic focused on practices and methodologies for accessing and using remote-sensing data, real-time observational data systems, electronic data collection via field surveys, and geographic information systems (GIS).

- **Human Dimensions** - This research topic addressed the human dimension as part of a response, including: 1) minimizing social impacts and subsequent response activities; 2) developing strategies to address the long-term socioeconomic effects oil spills have on a region's culture and vitality; 3) translating and incorporating social science research, methodologies, and initiatives into individual and collective response plans; and 4) assessing where social science research "fits" into the spill management structure.

- **Ecological Monitoring and Recovery Following Spills** – This research area focused on: 1) understanding long-term ecological recovery to make informed

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decisions from response to restoration; 2) understanding the ecological factors affecting recovery rates; 3) developing ecological 'metrics' that can be applied by resource managers to develop restoration projects that best compensate for lost resources.

- **Biofuels** – This topic addressed research on first generation biofuel blends in terms of spill response technologies and determination of fate and effects after a spill.
- **Ecological Effects of Oil Spills** – This topic addressed issues around the long-term effects of residual oil in the environment, including the levels and types of adverse effects resulting when oil remains, and the effects of an oil spill that may be magnified by the clean-up technologies.
- **Environmental Forensics** - This topic focused on chemical fingerprinting methods to determine the source and extent of oil resulting from an incident. This information can be important for clean-up, assessment, recovery, monitoring, and associated liability issues.

Coordinating R&D on Oil Spill Response in the Wake of Deepwater Horizon (April 2011)

The CSE organized this workshop to bring together experts from across a broad spectrum of organizations to address the state of future oil spill response research and practices. The overarching goals were to: (1) develop an updated list of Research Needs for response related to dispersant efficacy and effects, spill trajectory modeling, detection of surface and subsurface oil, human dimensions in spill response, seafood safety monitoring and information management; and (2) create a dialogue between researchers and responders in order to ensure translation of research results into practice.

A Forum –Oil Spill Research (January 2012)

The goal of this forum is to encourage dialogue among Principal investigators (PI's) of current research related to oil spill response (e.g., GoMRI, NSF) and industry and government representatives in order to coordinate R&D activities regarding future oil spill response in the wake of the *Deepwater Horizon*.

The objectives of this forum were to review previous and on-going R&D conducted by academic, governmental agencies and industry; present newly funded projects so that everyone is aware of what types of research are being conducted; and evaluate mechanisms for scientific exchange and coordination of oil spill response R&D efforts going forward.

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As defined for this forum, oil spill response R&D encompassed any of the following topics:

- Physical, Chemical and Biological Fate and Transport;
- Biological Effects - Resources at Risk;
- Response Technologies;
- Oil Spill Modeling;
- Monitoring and Detection of Surface, Subsurface and Dispersed Oil;
- Human Dimensions and Risk Communication.

The Future of Dispersant Use in Oil Spill Response Initiative (March 2012)

CRRC convened this workshop with the goal of bringing together federal and state representatives, academic scientists, responders, and other stakeholders to discuss the future of dispersant use in spill response in the United States. The overall goals for the workshop were to:

- Build a fact-based consensus on the trade-offs associated with dispersant use;
- Evaluate the current state-of-knowledge on the monitoring, behavior, effects, and fate of dispersants;
- Identify information gaps; and
- Recommend R&D topics to help inform dispersant use in future spill response.

Oil Spill Dispersant Research Forum (March 2013)

Coordination with research, technology, application, and response is needed to optimize dispersant efficacy and effectiveness. After the *Deepwater Horizon* oil spill, there was an increase of research on dispersants and dispersed oil, with a large amount of research coming from the Gulf of Mexico Research Initiative (GoMRI), BSEE, and industry.

This workshop focuses on enhancing communication about dispersant related research and its application, use, and transition to spill response efforts. It was convened with the goal of encouraging, opening, and continuing dialogue among principal investigators (PIs) of research related to dispersant use and response practitioners. The overall objective was to review prior and current research and development (R&D) conducted by academia, government agencies and industry and evaluate mechanisms for scientific exchange and coordination of these efforts. Specific objectives were to:

- Learn about on-going and newly funded R&D on dispersants and dispersed oil (DDO);
- Determine how on-going and new R&D on DDO can improve dispersant use (assuming that dispersants will continue to be a tool in some spill responses);

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- Develop mechanisms for information exchange/interaction among researchers, practitioners and public/nongovernmental organizations regarding DDO;
- Explore data needs, tradeoffs, and decisions of practitioners regarding DDO before, during and after spills; and
- Identify potential R&D efforts on DDO that could improve dispersant use during future spills offshore. Other goals were to (1) encourage and continue dialogue on DDO among researchers, spill practitioners and NGO's; and 2) foster mechanisms to enhance public understanding;
- Common themes across breakout groups at the meeting included: enhancing and continuing communication between researchers and responders regarding DDO; increasing public outreach and education; and improving comprehensive and transparent transition of research from laboratory to field application. Modeling is a tool that could act as a potential bridge between laboratory research and field application.

Alberta Oil Sands Workshop (April 2013)

The Washington Department of Ecology contacted the University of New Hampshire's CSE to conduct a workshop for relevant state and Federal agencies on the important issues related to OSP characteristics, transportation and response planning. A similar training was conducted for the State of Maine related to transport of OSP and Bakken crude through that State.

The first day of the workshop was an open forum, which provided information to a broad group of stakeholders from the region. The second day was a working session for response practitioners to focus on issues related to potential OSP spill scenarios. Task groups were given four potential scenarios to test the current understanding of OSP and identify future information and other needs. The breakout groups identified actions that could be taken to improve both near- and longer-term OSP spill response.

Environmental Disaster Data Management Workshop (September 2014)

In the wake of the *Deepwater Horizon* oil spill, the significant body of information, including new research, has highlighted the need for improved coordination of data management. It is common for multiple organizations to collect data that vary significantly in quality, collection methods, access, and other factors that affect use by others. These differences result in limitations for use of the data including comparing results or making inferences.

The Environmental Disasters Data Management (EDDM) Workshop, organized by NOAA's OR&R with assistance from CRRC, was the beginning of a project to foster communication between collectors, managers, and users of with a goal to identify and

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establish best practices for orderly collection, storage, and retrieval of data. The objectives of the EDDM project are to:

- Engage the community of data users, data managers, and data collectors to foster a culture of applying consistent terms and concepts, data flow, and quality assurance and control;
- Provide oversight in the establishment and integration of foundational, baseline data collected prior to an environmental event;
- Provide best-practice guidance for data and metadata management
- Suggest infrastructure design elements to facilitate quick and efficient search, discovery, and retrieval of data; and
- Define the characteristics of a "gold standard" data management plan for appropriate data sampling, formatting, reliability, and retrievability.

8.3 Department of Energy (DOE) Programs

DOE's ongoing research within the Office of Fossil Energy is focused on the prudent development of domestic oil and gas resources. Onshore research is coordinated with the USEPA and the Department of the Interior (DOI)/US Geological Survey (USGS). The three agencies jointly developed a framework for Federal research that addresses how to safely and prudently develop the Nation's unconventional oil and gas resources. The unique and specific core research competencies of each agency underpin the synergy of this research effort. This multiagency research strategy includes key research questions the agencies will address in a coordinated fashion. These research questions focus on protecting groundwater and air quality, reducing, reusing, and recycling water used in upstream exploration and production operations, reducing the surface and subsurface impacts of oil and gas exploration and production activities, and improve the understanding for the purpose of mitigating induced seismicity.

Offshore research is coordinated with the DOI/Bureau of Safety and Environmental Enforcement (BSEE). Prior to the BP Deepwater Horizon oil spill, DOE's offshore research had been directed at maximizing the value of the Nation's offshore oil and gas resources while protecting the environment. A recommendation of the President's National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling was that DOE should refocus its offshore research activities. In working with the DOI/BSEE Ocean Energy Safety Advisory Committee, DOE refocused its offshore research program on oil spill prevention. DOE's focus has since been on assessment and mitigation of the risk of loss of well control so as to prevent oil spills. Research pathways include: identification of geologic hazards, well control during the drilling and completion process, integrity of the surface facilities and umbilicals, and subsea reliability and automation.

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8.4 Ultra-Deepwater Advisory Committee Annual Plan Reviews

The Ultra-Deepwater Advisory Committee (UDAC) was formed in 2007 to advise the Secretary of Energy on the development and implementation of programs related to ultra-deepwater (UDW). The Committee, sunset in 2013, provided recommendations for incorporation into DOE's annual plan of research.

In 2011, the UDAC suggested that, because of the *Deepwater Horizon* accident, there should be projects aimed at placing additional measuring instruments in the well and/or at the wellhead to determine the nature of the well fluids, pressures, and their flow status in real time. They recommended that this work be combined with development of secure methods for transmitting the data to the surface and providing timely interpretation. Analysis of the *Deepwater Horizon* incident indicated that a lack of reliable information hampered control efforts from the initial blowout to the final capping of the well. The UDAC also recommended conducting studies of current subsea containment and capture technologies (hardware), including gap analyses and needs for future technologies with emphasis on subsea capture systems that are independent of surface facilities. Because a number of behavioral factors associated with operations, maintenance, and training contributed to the *Deepwater Horizon* incident, the UDAC recommended research aimed at discovering the fundamental attitudes of rig personnel and associated groups to health and safety issues.

In the 2012 review of the DOE offshore research plan, the UDAC indicated that there was a strong emphasis on the engineering aspects of increasing safety, but little attention was given to the aspects of human behavior regarding safety. However, given the causal factors in the *Deepwater Horizon* incident, research into how to conduct the human aspect of operations safety and how to use advanced decision support and backup systems is not only prudent, but also mandatory.

The UDAC indicated that information is limited regarding methods to prevent and respond to catastrophic events, and mitigate the negative impacts of spills in remote, harsh and sensitive environments. Environmental protection and personnel health and safety working in harsh, unique and sensitive marine habitats, such as Arctic waters and tropical coral reef areas, requires additional focus. To accomplish this, the UDAC recommended that a gap analysis be conducted to catalog and characterize the salient differences between operations in the Gulf of Mexico and those environments encountered in drilling and completion in unique and sensitive marine habitats, such as Arctic waters and tropical coral reef environments, to assess the risks that demand more research.

Finally to further improve safety, the UDAC recommended the present scope of expert (case-based) systems be determined, and then benefits and limitations be identified, as

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well as other applications (e.g., cementing, completions, wellbore design), that would reduce the risk when operating in deepwater.

8.5 Deepwater Horizon Oil Spill Principal Investigator Conferences

The *Deepwater Horizon* oil spill focused unprecedented attention on the Gulf of Mexico ecosystem. During the response to the *Deepwater Horizon* event, resource managers and researchers from across the country collaborated to conduct science, monitoring, and response activities to understand impacts from the spill. The data and information collected from those efforts have since been used to make progress towards the long-term goal of protecting and restoring public health and natural resources in the Gulf of Mexico.

In 2010 and 2011, the National Science and Technology Council's Joint Subcommittee on Ocean Science and Technology (NSTC JSOST) convened two major workshops in St. Petersburg, Florida of Principal Investigators (PIs) actively involved in research, sampling, and monitoring activities in response to the *Deepwater Horizon* incident. Each of the workshops was an opportunity for PIs to foster new collaborations, compare initial results, interact with federal agencies, and discuss recommendations for longer-term research activities.

> The October 2010 Conference had six breakout groups. Five groups addressed oil/dispersant: fate and extent; impacts and mitigation in the offshore; impacts and mitigation in coastal areas; impacts and mitigation on living marine resources; and impacts and mitigation on human health and socio-economic systems. The sixth group addressed the use of *in situ* and remote sensors, sampling, and systems for assessing the extent, fate, impacts, and mitigation of oil/dispersant.

The follow-on workshop in October 2011 was an opportunity for researchers to present results of studies that were in progress during the first conference in October 2010. The second conference provided a significant amount of information regarding the spill impacts, early recovery, and the scientific efforts to capture that information. Researchers presented numerous potential research needs going forward. As in the initial 2010 conference, the participants identified a series of overall recommendations and observations about gaps and needs for continued research and ways to improve scientific understanding of Gulf of Mexico science issues.

8.6 Deepwater Horizon Incident Specific Preparedness Review

In January 2011, the USCG Commandant chartered the Incident Specific Preparedness Review (ISPR) for the response to the *Deepwater Horizon* oil spill in 2010 to examine the implementation and effectiveness of the preparedness and response to the incident as

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it related to the National Contingency Plan, Area Contingency Plans, and other oil spill response plans. The report was divided into three main chapters: Planning and Plan Execution, Organization, and Resources and Readiness. The ISRP also provided a list of lessons learned and recommendations.

- **Planning and Preparedness** - There was a general weakness in the USCG's ability to respond to this type of large spill. The problems were the result of budget reductions organizational structure. The agency needs to reassess its readiness programmatically and reinvest to the extent that Marine Environmental Response (MER) is, once again, firmly established as one of the USCG's core competencies.
- **Area Contingency Plans** - The ISPR found these plans to be inadequate for this size of incident. The USCG needs to provide service-wide direction to all Area Committees, develop minimum standards for contingency plans, and establish an oversight, review, and compliance program.
- **Environmentally Sensitive Areas** - In some planning areas, the ESAs were not identified. In some plans where the areas were listed, they were not prioritized. In a few instances, ESAs did have protection strategies for the heavily affected areas. There must be a national planning process that identifies ESAs and ensures that there are trained personnel, equipment, and strategies adequate to protect these resources.
- **Alternative Response Technologies** - The use of two alternative response technologies, dispersants and ISB, proved critical to preventing wholesale impacts to ESAs. This was possible because the spill characteristics, location, and distribution of ESAs were favorable to the use of these technologies. However, important concerns and questions remain about their impacts on the environment, and more research is necessary before bringing them into the mainstream of spill response options. The use of dispersants during the *Deepwater Horizon* incident identified a need for a thorough review of this response option, its efficacy in minimizing environmental impacts, its overall effect on the environment, and conditions under which they are most effective. Dispersant protocols and authorization procedures should be established and articulated in ACPs. The National Response Team should require that all RRTs establish ISB guidelines as a viable response option in their area of responsibility, consistent with public health and safety issues.
- **Effective Daily Recovery Capacity (EDRC)** - EDRC is the planning standard used to estimate the rate at which mechanical means (e.g., skimmers) can recover an amount of oil and rate capabilities of oil spill removal organizations (OSROs). Revised EDRC requirements could stimulate OSROs to invest in response research and development, with the goal of developing skimmers and other recovery equipment that are more efficient.

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- **Funding** - Many of the recommendations provided in the report require additional or new funding. The *Deepwater Horizon* incident showed the response community and the public that a "business as usual" approach to funding would not work.
- **National Response Framework (NRF)** - The USCG should fully implement its policy on connectivity with the NRF, including an expanded outreach program to state and local emergency managers through sector participation with Local Emergency Planning Committees, and District participation with Regional Interagency Steering Committees.
- **Crisis Leadership** - The *Deepwater Horizon* incident placed individuals into crisis management roles, and not all were able to demonstrate the required leadership. The National Incident Command concept worked very well during this incident, and it provides a model for selecting individuals with the necessary crisis management skills to lead response efforts and to manage effectively future national incidents.
- **Lessons Learned** - The USCG needs to formally address lessons learned, institutionalize them through programmatic changes, and in some cases, through cultural changes.

8.7 National Commission on BP Deepwater Horizon - Final Report

In January 2011, the National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling (Commission) issued their Report to the President – Deepwater: The Gulf Oil Disaster and the Future of Offshore Drilling. The Commission's complete recommendations in the report reflect the government's sweeping sovereign authority as owner of the seabed and water column and, as the regulator of activities there, with the overriding responsibility to manage and protect the valuable resources of the outer continental shelf (OCS) on behalf of current and future generations. The Commission's report grouped recommendations in nine distinct areas:

- Improving the safety of offshore operations through greater government oversight and control including a new regulatory organizational structure;
- Improving the safety of offshore operations by industry through greater emphasis on a more risk based approach to operations and safety;
- Safeguarding the environment;
- Strengthening oil spill response, planning, and capacity;
- Advancing well-containment capabilities;
- Overcoming the impacts of the *Deepwater Horizon* spill and restoring the Gulf;
- Ensuring financial responsibility;
- Promoting Congressional engagement to ensure responsible offshore drilling; and

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- Developing approaches for frontier regions to incorporate lessons learned during the *Deepwater Horizon* oil spill.

Within each of the major categories, the Commission had additional specific actions and recommendations to improve offshore drilling prevention, preparedness, response and environmental protection and restoration.

The Commission Staff Working Paper No. 7, "Response/Clean-up Technology Research & Development and the BP Deepwater Horizon Oil Spill," documented the state of research and development by the private sector and federal government specific to containment and well-control technology. The paper was provided to the full Commission for consideration as it deliberated it report to the President. The paper discussed three basic questions:

- Does the private sector invest less than the socially optimal amount in response/cleanup technology?
- Do federal agencies lack adequate long-term funding to maintain response/cleanup preparedness?
- Can the federal government and industry create a set of incentive for private companies and government agencies that would optimize levels of investment in response/cleanup technology?

The paper concluded that there was a response R&D gap. The paper suggested that the National Commission consider:

- Recommending language in OPA 90 to guarantee the full oil spill research authorization provided in the Act as originally intended.
- Recommending OPA 90 be amended to guarantee sustained and additional funding for Ohmsett.
- Recommending ways to stimulate the cleanup technology market and incentivize related R&D,
- Recommending that the EDRC regulations be revised to give an incentive for response companies to employ the most efficient recovery equipment.
- Recommending that EPA streamline the permitting process for open-water testing and that EPA loosen its oiled-water discharge requirements for technology testing purposes.

8.8 Public Meetings, Letters, and Reports Submitted to ICCOPR

As part of the R&T planning process, ICCOPR held three public meetings in 2010 to solicit input on future oil pollution research needs. ICOCPR advertised the public meetings in the Federal Register and conducted them on the West, East, and Gulf Coasts to obtain different regional interests and perspectives.

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In addition to the public meetings, ICCOPR also received letters from the Pacific States/British Columbia Oil Spill Task Force, the U.S. Arctic Research Commission, and the Marine Mammal Commission and a report entitled "Assessing the Long-term Effects of the BP Deepwater Horizon Oil Spill on Marine Mammals in the Gulf of Mexico: A Statement of Research Needs."

8.9 National Research Council: Responding to Oil Spills in the U.S. Arctic Marine Environment

A group of organizations requested that the National Research Council of the National Academy of Sciences conduct a study of the current capabilities to respond to oil spills in the Arctic. ICCOPR sponsors included the USCG, BSEE, BOEM, NOAA, and USARC. Other sponsors included API, Marine Mammal Commission, and OSRI. The report had four main sections: 1) Environmental Conditions and Natural Resources in the U.S. Arctic; 2) Arctic Oil Spill Response Research; 3) Operations, Logistics, and Coordination in an Arctic Oil Spill; and, 4) Strategies for Response and Mitigation. Each section described the current state of knowledge or capabilities of the U.S. response organizations and made recommendations for an effective prevention, preparedness, and response system.

NRC released the report after ICCOPR had completed the Research Needs Identification Process (see section 6.1) and was in the Needs Prioritization Process (see section 6.2). The R&T Plan Workgroup reviewed the NRC report and determined that the recommendations were consistent with the Research Needs already under consideration. The Workgroup used the NRC recommendations as a factor in selecting priority Research Needs.

8.10 National Petroleum Council: Arctic Potential – Realizing the Promise of U.S. Arctic Oil and Gas Resources

In 2013, the Secretary of Energy commissioned the National Petroleum Council (NPC) to conduct a comprehensive study considering the research and technology opportunities to enable prudent development of U.S. Arctic oil and gas resources. The study included an in-depth assessment of available offshore oil and gas technology, ongoing research, and research opportunities, in six areas:

- Ice characterization
- Oil and gas exploration and development
- Logistics and infrastructure
- Oil spill prevention and response
- Ecology, and
- Human environment.

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The report includes extensive information on the state of knowledge on Arctic technologies and operations, spill prevention and response capabilities, and the ecological and human environment. The NPC issued the Executive Summary of the report in March 2015 after ICCOPR had completed the prioritization process and was in the final stages of developing the text of this OPRTP. As such, the NPC report was issued too late for ICCOPR to consider it in developing this version of the Plan. However, ICCOPR will continue to review the NPC report and use it as a source of information.

8.11 Industry Reports

The oil and gas industry convened the Joint Industry Oil Spill Preparedness and Response (OSPR) Task Force (JITF) in June 2010 to evaluate procedures and lessons learned during the *Deepwater Horizon* oil spill response. The initial focus of the JITF was to identify potential opportunities for improvement to oil spill response systems in the areas of planning and coordination, optimization of each response tool, R&D, technology advancement, and training/education of all parties preparing for or responding to an oil spill. The JITF spent several months developing and prioritizing project plans to address each preliminary recommendation, and subsequently received approval and Industry funding for a multi-year work program. The JITF divided its recommendations into seven categories, or work streams:

- Planning;
- Dispersants;
- Shoreline protection and cleanup;
- Oil sensing and tracking;
- *In-situ* burning;
- Mechanical recovery; and
- Alternative technologies.

Nine oil and gas companies established the Arctic Oil Spill Response Technology Oil Joint Industry Programme (JIP) to further build on existing research and improve the technologies and methodologies for Arctic oil spill response. The goal of the JIP was to advance Arctic oil spill response strategies, improve equipment and increase understanding of potential impacts of oil on the Arctic marine environment. There were seven key areas of research addressed by the JIP specifically for the Arctic:

- Dispersants;
- Environmental effects;
- Trajectory modeling;
- Remote sensing;

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- Mechanical recovery;
- *In-situ burning*; and
- Field research.

8.12 Prince William Sound Oil Spill Recovery Institute (OSRI) Research Plan 2011-2015 (February 2010)

The Prince William Sound (PWS) Oil Spill Recovery Institute (OSRI) was authorized in 1990 by the United States Congress to "identify and develop the best available techniques, equipment, and materials for dealing with oil spills in the Arctic and sub-Arctic marine environments" (Title V, Section 5001, Oil Pollution Act of 1990). OPA 90 amendments in 1996 and 2005expanded the area of emphasis and extended the life of OSRI programs until one year after the completion of oil exploration and development efforts in Alaska.

OSRI sponsors research programs on physical oceanography and meteorology designed to improve the ability to forecast weather and ocean conditions. OSRI works with a wide array of industry and agency organizations to sponsor technological improvements for oil spill response. This includes contributing to the testing of new skimmer technologies, sensitivity index maps, and sponsoring workshops to identify best practices and research needs. It supports K-12 classroom programs and recently worked to include more technology in the education programs. With the increased desire by industry to develop offshore regions of the Arctic, there is greater emphasis on improving technologies for oil spill response in ice-laden waters.

OSRI's 2011-2015 Research Plan outlines the priority research areas that it will be funding:

- Interdisciplinary approaches to understanding the fate and effects of an oil spill in the Arctic and the recovery of that oil;
- Development of response tools to assist responders to mitigate the impact of spills in the Arctic; and
- Communication and education of the public on the issues related to oil spills in the Arctic.

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9. Oil Spill Research and Technology Priorities

ICCOPR selected 150 priority oil pollution Research Needs to address the 25 SRAs and SRA subcategories using the deliberative process described in Chapter 6. These priorities represent the federal opinion on where federal research programs should focus in order to make the most progress to addressing the overall Research Needs. Each federal agency should consider these priorities as they make their research investments. ICCOPR encourages non-federal research programs to use these priorities as well. ICCOPR will track progress toward addressing these priorities during the next planning cycle and establish a new set of priorities at that time.

ICCOPR organized the priority Research Needs by the four major Classes of research: Prevention, Preparedness, Response, and Injury Assessment and Restoration (Figure 9-1)

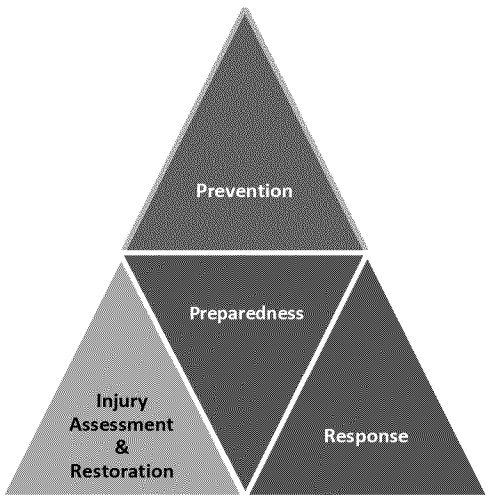

Figure 9-1 - The Oil Spill Research Categorization Framework

As discussed in Section 4.1, this framework embodies the concept that the research in each Class can inform and support the research from other classes; and that the Preparedness class plays a central role in supporting them all. Member organizations may conduct or support research in a single Class or multiple Classes depending on their specific mission, regulatory responsibilities, and/or expertise.

Table 9-1 lists the Classes and the SRAs they encompass. The following sections present the top priority Research Needs by Class and SRA or SRA subcategory. The order of the three priorities listed within an SRA or SRA subcategory is not indicative of their relative importance. All three are of equal importance. The Classes are:

Prevention Class - Research that supports the development of practices and technologies designed to reduce the likelihood of releases or minimize the volume of oil released into the environment.

Preparedness Class - Research that determines baseline conditions or supports the activities, programs, and systems typically developed prior to an oil spill to improve the

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planning, decision-making, and management processes needed for responding to and recovering from oil spills.

Response Class - Research that supports techniques and technologies that address the immediate and short-term effects of an oil spill and encompasses all activities involved in containing, cleaning up and treating oil in order to: 1) maintain safety of human life; 2) stabilize a situation to preclude it from worsening, and 3) minimize adverse environmental and socioeconomic effects.

Injury Assessment and Restoration Class - Research that involves the collection and analysis of information to evaluate the nature and extent of environmental, human health, and socioeconomic injuries resulting from an incident, and determine and refine the restoration actions needed to bring injured natural resources and services back to pre-spill conditions and make the environment and public whole after interim losses.

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Table 9-1 Standing Research Areas (SRAs) by Research Class

Prevention	Preparedness	Response	Injury Assessment & Restoration
• Human Error Factors • Offshore Facility and Systems • Onshore Facilities and Systems • Waterways Management • Vessel Design • Drilling • Rail & Truck Transportation • Pipeline Systems	• Pre-spill Baseline Studies • Response Management Systems	• Structural Damage Assessment and Salvage • At Source Control and Containment • Chemical and Physical Behavior Modeling • Oil Spill Detection and Surveillance • In- and On-water Containment and Recovery • Shore Containment and Recovery • Dispersants • In-situ Burning • Alternative Countermeasures • Oily and Oil Waste Disposal • Bioremediation	• Environmental Impacts and Ecosystem Recovery • Environmental Restoration Methods and Technologies • Human Safety and Health • Sociological and Economic Impacts

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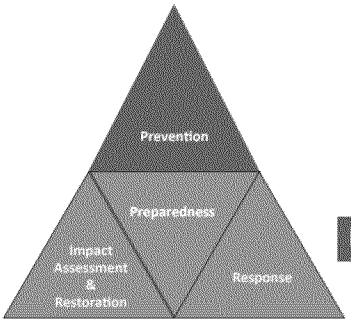
9.1 Prevention Priority Research Needs



PREVENTION

9.1.1 Human Error Factors Priorities (Section 4.3.1.1)

This SRA focuses on how human performance and factors contribute to accidents in the oil production/transportation system. It includes the development of advanced methods and systems for training operational personnel, basic research on operating personnel performance in preventing oil spills (safe navigation on vessels, proper oil transfer practices, analysis/evaluation of equipment monitoring systems, decision-making processes), and the development of methods and technologies to evaluate the ability and knowledge of operating personnel in performing their duties. This may extend to evaluation of the overall management culture and its ability to foster the appropriate organizational safety, preparedness and response operating environment.

The priorities selected focus on improving the performance of individuals to reduce potential spills through better technology and improved training methods. ICCOPR selected Research Needs that emphasized development of innovative training methods by using simulations and gaming. At the operational level, improvements in instrumentation and data interpretation technology are essential to allow better decisions to be made on vessels, in ports, and on railway and pipeline transportation systems.

☐ Improve performance and decision-making by developing innovative training methods including readiness evaluations, gaming and simulators.
☐ Conduct research to determine current level of expertise for operators within modern transportation systems including marine, rail, truck, and pipeline.
☐ Improve and develop sensors; instrumentation; command electronics; and advanced data interpretation technologies and alert systems, including data analysis and expert systems to enhance decision-making capabilities.

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9.1.2 Offshore Facilities and Systems Priorities (Section 4.3.1.2)

This SRA includes: offshore exploration and development wells, platforms, and well control systems; the methods, techniques, and equipment for system reliability inspections; systems to detect, prevent, and mitigate oil and gas discharges; and equipment to regain control of a well blowout or any other accidental discharge. It also includes transfer equipment, storage units, and piping used to transfer oil within the offshore system and connect the system to transfer pipelines. This technology is relevant for the multiple operating environments of exploration and production activities (e.g., Arctic, shallow, deep and ultra-deep waters).

One of the selected priorities acknowledges the special conditions that occur in the Arctic. Another priority recognizes the need to address material integrity in deepwater, the Arctic and other frontier drilling locations.

☐ Evaluate corrosion and corrosion mitigation processes at the splash zone for offshore platforms.
☐ Study effects of ice forces, scour and gouging with respect to prevention of oil spills from offshore facilities.
☐ Conduct studies related to the longevity and integrity of metallic materials used under extreme conditions in relation to new surface treatments and alloys.

9.1.3 Onshore Facilities and Systems Priorities (Section 4.3.1.3)

This SRA includes designs, techniques, operational procedures and equipment for fixed onshore facilities including wells. It covers inspections and systems to detect, prevent, and mitigate oil and gas discharges from the facilities and their systems, including transfer equipment, storage, and piping.

The priorities for this SRA emphasize the need to improve the integrity and operations of onshore facilities. As in other SRAs, the priorities for Onshore Facilities recognize the need to address the effects of emerging crude and Arctic environments on facility infrastructure. There are two subcategories under this SRA: 1) Tank and Piping Inspection, Operations, Design, and Data; and, 2) Emerging Issues.

TANK AND PIPING INSPECTION, OPERATIONS, DESIGN, AND DATA
☐ Analyze upstream and/or downstream causes and magnitude of discharges from tanks, appurtenances, and associated piping.
☐ Develop improved methods and protocols used to determine the imperviousness of secondary containment structures.
☐ Evaluate the efficacy of sorbent and similar technologies used as oil spill control measures for storm water filtration and secondary containment shut-off drains.

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EMERGING ISSUES
Identify the effects of an aging oil storage infrastructure (tanks, appurtenances, and piping systems) and develop methodologies/protocols to predict/minimize failures.
Assess the effects of emerging crude oils and alternative fuels on tanks, appurtenances and piping.
Assess the effects of Arctic and cold weather environments on the operation and maintenance of tanks, appurtenances, and associated piping.

9.1.4 Waterways Management Priorities (Section 4.3.1.4)

This SRA includes methods, equipment, and integrated systems designed to improve navigation at sea and in ports, rivers, and inland waterways. It includes on-board navigation systems, such as integrated navigation and bridge systems and collision avoidance systems. It also includes systems external to the vessel, such as vessel traffic and tracking systems, navigational aids and piloting systems, as well as includes general research into navigation risks, the effects of navigational safety programs, and the development of decision support tools for waterways management efforts. This SRA includes development of navigational channel maintenance programs and analysis of voyage pre-planning processes.

The priorities selected recognize the special nature of operations and navigation in ice-infested waters of the Arctic. They also focus on the need to improve technology on ships and in ports for traffic control.

Improve navigation through enhanced piloting systems, electronic charts and information systems.
Improve systems and protocols needed for traffic control in ports.
Improve Arctic waterways management/vessel accident prevention, including improvements in (a) Arctic communications, (b) emergency response paradigms for vessel accidents (e.g., vessel foundering), (c) ice piloting requirements/qualifications, (d) Arctic weather, and (e) ice forecasting.

9.1.5 Vessel Design Priorities (Section 4.3.1.5)

This SRA includes the development, physical and numerical modeling, and testing of advanced tanker and barge designs to make these vessels less susceptible to damage and less likely to spill their cargoes into the waterways if an accidental grounding, collision or structural failure occurs. This SRA also includes research on non-tank vessel designs

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(e.g., double-hulled fuel and lube oil tanks) to minimize the possibility of spillage from collisions, allisions, and groundings.

The selection of priorities recognizes the significant progress made because of the double hull tanker design mandated by OPA '90. The priorities in this SRA emphasize the design of vessels for survivability during accidents and the tools and models necessary to assess the effectiveness of ship structures to estimate spill potential. ICCOPR recognizes the need for design improvements for operating in the extreme environments of the Arctic.

- Develop designs and methods to improve survivability of ships and structures in damaged condition.
- Develop improved analytical tools (procedures, computer models, and software) to evaluate performance of structures in collisions, allisions, and groundings, so that estimates of damage extent and loss of oil-tight boundaries are available.
- Develop improved designs and analytical tools (procedures, computer models, and software) for design and operation of ships and marine structures in extreme environments.

9.1.6 Drilling Priorities (Section 4.3.1.6)

This SRA focuses on: the design, construction, and placement of wells (deepwater and ultra-deepwater, and onshore); materials, sensors, and systems needed for offshore drilling and production platforms, and well heads/risers; and techniques and equipment for well and facility monitoring and inspection under extreme pressure and temperature environments. Also included are efforts aimed at understanding the chemical and physical characteristics for the full range of petroleum oils under varying conditions of pressure and temperature; predicting their phase/state, behavior and their physical interaction with other materials in the environment (e.g., rock and sediments); and their impact on engineered systems. Example issues include: early kick detection; systems for communicating and responding to changes in downhole parameters; strategies and methods for training operational personnel on the use of advanced technology; systems to detect and prevent oil and gas discharges; and well-head systems and equipment to control wild wells and cap well blowouts.

ICCOPR again recognizes the need to prioritize research that focuses on operational differences in the Arctic. Other research priorities focus on improving drilling systems and the knowledge of complex reservoir conditions to better assess potential incidents related to stratigraphy and hydrocarbon pathways. There are two subcategories to this SRA: Deepwater Drilling and Technology and Reservoir Characterization.

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DEEPWATER DRILLING AND TECHNOLOGY
☐ Evaluate subsea blowout preventer control pod batteries including assessments of battery design, life expectancy, performance, and reliability with respect to different manufacturers.
☐ Conduct a gap analysis on current managed pressure drilling (MPD) techniques to identify future critical needs.
☐ Study the interaction and potential for failure at the interface of each system (formation - cement - instrumentation) and develop advanced downhole tools to assess the integrity of the system *in situ*.
RESERVOIR CHARACTERIZATION
☐ Conduct research, including improved modeling, on the conditions (e.g., *in-situ* stress, sediment rheology, fluid pressure, flow rate, and blowout duration) where hydrocarbon pathways to the sea floor are established through hydraulic fractures and reactivated natural faults.
☐ Characterize reservoirs to identify geologic conditions, such as bounding strata weaknesses that need special engineering considerations to ensure hydrocarbon containment.
☐ Characterize reservoir conditions associated with offshore Arctic oil and gas provinces to identify potential issues in areas of offshore clathrates, sea ice, and other effects.

9.1.7 Rail and Truck Transportation Priorities (Section 4.3.1.7)

This SRA includes the development and testing of rail and truck transport system designs, operations, and infrastructure to make oil tanks less susceptible to damage and loss of cargo during normal operations, train accidents and derailments, or truck accidents. This SRA includes evaluation of vehicle designs, construction materials, spill prevention devices, and loading/unloading systems and equipment. It also includes evaluations of: the physical and chemical characteristics and behavior of the crude oils being shipped, the effects of those characteristics on the tanks during operations and under accident conditions, and systems to control these characteristics. This SRA also includes evaluations of safety systems and processes to: manage the movement and composition of trains and trucks carrying crude oil, prevent accidents and derailments, select preferred shipping routes, and respond safely to an oil spill emergency.

The selection of priorities under this SRA recognizes the increased volume of crude oil transported by rail and truck in response to the energy renaissance in the U.S. and

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Canada. ICCOPR also recognizes the unique characteristics of the crude oils transported by rail and trucks and the hazards they pose under accident conditions.

☐ Analyze hazards and develop corresponding mitigation methods/technologies for head space gases in tank cars.
☐ Evaluate accident and incident trends to identify ways to minimize the incident rate of leaks, spills, and damage to the environment due to oil spills.
☐ Evaluate alternative designs and modifications to minimize risk of oil spills during accidents.

9.1.8 Pipeline Systems Priorities (4.3.1.8)

This SRA includes the development, operation, monitoring, and inspection of offshore and onshore pipeline systems used to transport oil between facilities. It covers the pipeline system design, procedures, and equipment for pipeline operations and inspection protocols to prevent, detect, and mitigate oil discharges. Pipeline research under this SRA also includes technologies to prevent (detection/characterization and repair of anomalies before failure) and detect failures, as well as monitor/control systems that can rapidly isolate and shut down operations in order to minimize spillage when failures occur.

ICCOPR in the selection of priorities recognized the need for better detection technology to prevent incidents and protect human health. In the area of ensuring pipeline integrity, ICCOPR recognized the need to develop technology that will detect potential anomalies and failures in pipeline materials. There are two subcategories for this SRA: Materials and Integrity.

MATERIALS
☐ Develop new advanced technology for sensing pipeline leaks that will reduce leak detection false alarms for new construction and existing pipelines.
☐ Improve existing leak detection technology and health monitoring sensors so that they are miniaturized, automatic, robust and withstand harsh environments.
☐ Evaluate the performance, reliability and failure mechanisms of the use of composites technology for pipelines.
INTEGRITY
☐ Develop technology that detects the presence, location and separation between multiple utilities (underground, through various soil conditions) in a common corridor.

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- Improve and develop in-line inspection (ILI) to locate and size defects in girth welds and long seam defects including cracks in electric resistance welded (ERW) pipe.
- Assess the remaining integrity of pipelines that have multiple different anomalies in proximity.

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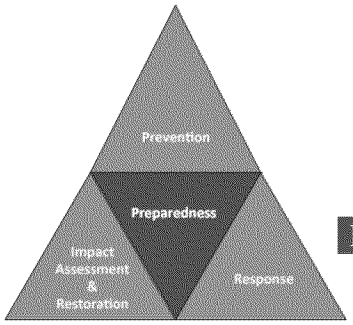
9.2 Preparedness Priority Research Needs



PREPAREDNESS

9.2.1 Pre-spill Baseline Studies Priorities (4.3.2.1)

This SRA includes research to characterize and analyze baseline data on the natural environment, human health, and socio-economic characteristics in areas at risk for oil spills. Research includes risk assessments conducted in areas involved in the oil production and transportation systems to identify locations most at risk from pollution events and therefore priority candidates for baseline studies. Baseline information and studies may include: location and population data on species and their habitats, especially ecologically sensitive species; the epidemiology/human health characteristics of people in potential impact areas; and potential community and economic impacts in these areas (e.g., tourism, commercial/recreational fishing, and seafood industry).

ICCOPR divided this SRA into three subcategories: Habitat and Species Baselines; Oceanographic and Geological Baselines; and Environmental Baseline Planning. In the area of habitat and species planning, there is an emphasis on the need to understand more about important Arctic species, intertidal habitats and species that are often impacted by oil spills, and the deepwater and ultra-deepwater habitats and microbiological assemblages (about which little is known). Some of these environments are or soon will be subject to drilling operations (e.g., Arctic, ultra-deepwater). ICCOPR also identified research needs related to understanding currents and coastal processes in areas where oil and gas extraction occurs to aid in future oil spill response or coastal protection should an incident occur. Research on the amount of variability that exists in baseline data is extremely important in order to document change, identify potential Natural Resource Damages, and establish restoration goals.

HABITATS AND SPECIES BASELINES
☐ Study ecological structure and population of key Arctic indicator species and protected species (including those with subsistence and ecosystem importance) particularly in areas that are likely to be explored/developed for oil and gas extraction in the near to mid- term.

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☐ Study and synthesize existing information for intertidal habitats (i.e., sand beaches, rocky and cobble habitats) regarding productivity, species diversity, community structure, and the effects of oil on these parameters, including recovery time, with consideration for regional variation.
☐ Study ecological structure and population of key indicator and protected species in deepwater and ultra-deepwater (including those with subsistence and ecosystem importance), particularly in areas that are likely to be explored/developed for oil and gas extraction in the near to mid-term.
OCEANOGRAPHIC AND GEOLOGICAL BASELINES
☐ Conduct a series of large-scale Arctic studies of oceanographic exchanges, shelf-basin exchanges via wind and eddies, coastal boundaries, under-ice river plumes, and sea-ice boundaries to better inform pre- and post-spill modeling and response.
☐ Develop a better understanding of coastal processes unique to the Gulf of Mexico (i.e., changing shorelines due to erosion, deposition from the Mississippi River) to help inform protection and recovery strategies for oil spills.
☐ Develop methodologies for using baseline flow characteristic data (such as tidal energy mapping and other energy sources) to support shallow water inlet protection strategies during oil spills.
ENVIRONMENTAL BASELINE PLANNING
☐ Develop models of background variability relative to habitat and species data in various environments where oil is transported or extracted so that the impacts from oil or other stressor(s) can be delineated from those of natural variation.
☐ Evaluate the adequacy of existing ecosystem-based scientific studies for legal defense of Natural Resource Damage Assessment (NRDA) injury assessments for Outer Continental Shelf areas that are currently in production or likely to be explored/developed.
☐ Conduct baseline studies of microbial communities in a variety of areas where oil is transported or extracted (e.g., Great Lakes, rivers, ports, offshore) and their potential for hydrocarbon degradation in the event of a spill.

9.2.2 Response Management Systems Priorities (Section 4.3.2.2)

This SRA includes analysis and development of systems to manage how data and information are collected, analyzed, documented, and shared between and among, the planning/preparedness and response communities, the Incident Command System (ICS), and the public. These systems are used to integrate diverse sets of narrative, graphic, and

video information and many sets and types of raw and analyzed data. Examples of oil spill information systems include: ICS forms; computer systems; data management software and databases; Geographic Information Systems (GIS); routing, spill and incident management tracking systems; electronic mail and web content; documents, photographs, and video management and archiving systems; communication systems; public information messages and protocols; and graphical displays.

ICCOPR priorities under this SRA recognize the need to upgrade information management systems, develop more rapid methods of incorporating data prior to and during a spill, and improve spill response planning tools. Improved pre-spill planning, development of information management tools, and incorporation of baseline data from current oil and gas extraction areas and potential frontier areas will greatly enhance response should an incident occur.

☐ Develop techniques and/or software for automatically translating data collected from different sources into common, usable formats.
☐ Develop spill planning and response tools based on gap analysis of the availability of countermeasures in different Arctic locations and seasons.
☐ Develop improved information systems for decision-making, including the use of data from coastal mapping, baseline data, and other data related to the environmental effects of oil discharges and cleanup technologies.

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9.3 Response Priority Research Needs

9.3.1 Structural Damage Assessment and Salvage Priorities (Section 4.3.3.1)

This SRA includes the development of methodologies and equipment to assess the extent of damage to a stricken vessel caused by collision, allision, grounding, or improper hull stresses during cargo transfers or explosion. This area also includes development of methods and technology to graphically present the implications of various measures that can be implemented to stabilize the vessel's condition, reduce the potential for further pollution, and allow it to be moved safely for repairs or disposal.

The priorities in this SRA include the need to improve technology to determine the oil and water interface in tanks and develop remote vehicles capable of assessing external integrity of vessel hulls. Another important priority is to evaluate existing wrecks that have the potential to leak petroleum products into marine water.

- Study methods for remotely and rapidly determining whether a cargo tank contains sea water and the extent of the water bottom (height of the oil/water interface from the bottom of the tank).
- Develop technologies and techniques to better determine the presence of oil and the probability of its release from specific sunken vessels.
- Develop improved use of remotely operated vehicles (ROVs) and emerging technologies for underwater assessment of vessel and marine structure integrity.

9.3.2 At-Source Control and Containment Priorities (Section 4.3.3.2)

This SRA includes the development of methods, systems, and equipment for containing and recovering the oil at or from the source and for mitigating oil flow from a damaged vessel, onshore/offshore pipeline, and an exploration or production platform, temporarily abandoned (plugged) well, or well head once the spill has begun. Such technologies include well-head capping systems, remotely operated vehicles (ROVs) for subsea

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containment activities, and patching, plugging and sealing systems. This technology is applicable to all geographic/environmental areas (Arctic, terrestrial, water surface, subsurface shallow, and deep and ultra-deep water).

ICCOPR selected priorities that reflect the difficulties in containing the well during the *Deepwater Horizon* oil spill. The priorities also reflect an anticipated need to provide at source containment in more extreme environments.

- ☐ Study the range of failure states and flow rates for which subsea containment may be required.
- ☐ Develop subsea containment equipment for integration into spill response operations, including relevant procedures and standards for training personnel.
- ☐ Determine how extreme environmental conditions affect at-source containment and control (including Arctic, ultra-deep and other extreme conditions).

9.3.3 Chemical and Physical Modeling and Behavior Priorities (4.3.3.3)

This SRA includes laboratory and theoretical research and field studies aimed at understanding the behavior and characteristics of the full range of petroleum oils including: behavior and transport in the environment, partitioning of hydrocarbon constituents, and physical interaction with other materials in the environment (rock, sediments, and ice). It includes studies of oil behavior and changes throughout the water column from deepwater blowouts. There is particular interest in non-conventional oils such as those produced in the Bakken and Canadian Tars sands (diluted bitumen (dilbit) and synthetic bitumen (synbit)). It also includes the development and verification of numerical models to predict the surface and subsurface movement and weathering (i.e., spreading, evaporation, dispersion, and dissolution) of oil spills. This SRA also includes methodologies to provide accurate model input data to verify model outputs. This SRA includes development of user-friendly programs to enhance contingency planning and to serve as training aides for spill response teams. Models should be available for various spill scenarios at specific locations for different tidal, current, and weather conditions to pre-plan potential boom deployment strategies and estimate response resource needs.

ICCOPR recognized the importance of addressing research needs related to understanding how oil behaves under differing conditions in both fresh and saltwater, and developing models to use during oil spills. ICCOPR specifically identified priority Research Needs to improve the understanding of how oil behaves in the Arctic and how new emerging oils such as oil sands products and Bakken crude oils behave in the environment. There are five subcategories for this SRA: 1) Arctic Behavior and

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Modeling; 2) Oil Behavior Models; 3) Transport Models; 4) Oceanographic Models; and, 5) Emerging Crudes.

ARCTIC BEHAVIOR AND MODELING
☐ Develop improved modeling tools and trajectory models in order to predict spreading of oil in different weather and ice conditions in the Arctic.
☐ Study the fate of oil in Arctic conditions; including open water, ice infested water and oil trapped in ice, particularly as it relates to the effectiveness of spill response countermeasures and the potential for ecosystem exposure.
☐ Study Arctic-based indigenous microbial populations in the water column and benthic sediment, and define rates of microbial processes to determine the role such communities have in the oil weathering process.
OIL BEHAVIOR MODELS
☐ Study the oil droplet size from deepwater blowouts, the thickness of surfacing oil and the behavior of dissolvable components.
☐ Study bottom substrate dynamics that might affect submerged oil fate and behavior.
☐ Study how oil degrades in intertidal and shallow subtidal habitats (e.g., cobble, pebble, sand, mud, mussel beds, mangrove, and marsh).
TRANSPORT MODELS
☐ Use best available scientific data on oil weathering and fate to develop and improve transport model parameters (e.g., volatilization, solubilization, emulsification, biodegradation).
☐ Develop/improve oil trajectory and fate models that can be used during spill response to predict the behavior and transport of dispersed oil and verify/validate them in an appropriately designed experimental setting or during actual spills.
☐ Develop a decision template or conceptual model of the conditions under which oil might become submerged that considers oil properties and environmental characteristics.
OCEANOGRAPHIC MODELS
☐ Link ocean circulation models to observations (e.g., ocean observing systems) to better incorporate real-time data.
☐ Increase development and availability of high resolution nearshore models.

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☐ Integrate upper sea-surface turbulence, with particular emphasis on quantifying horizontal and vertical diffusivities and the rate of energy dissipation, to improve 3D and 4D spill transport models.
EMERGING CRUDE (including oil sands products (OSP) and Bakken, etc.)
☐ Conduct research on the fate and transport of oil sands products in freshwater and marine environments.
☐ Study the persistence of oil sands products in marine and freshwater environments.
☐ Conduct research on the chemical and physical characteristics of various crudes (including blends of dilbit, synbit and Bakken crude) to better understand how to address spills.

9.3.4 Oil Spill Detection and Surveillance Priorities (Section 4.3.3.4)

This SRA principally refers to methods and equipment for characterizing and monitoring oil pre- and post-implementation of response options, and the detection of unknown discharges. This SRA includes surface and subsurface oil spill surveillance including devices, sensors, and systems for detecting and tracking oil spills, determining the area and thickness of the oil slick, and measuring the physical properties of the oil. Examples of equipment considered in this area are: surface oil spill tracking buoys; airborne remote sensors and data analysis systems; fluorometers and light-scattering sensors; and satellite remote sensing data and on/in-water oil detection devices with the ability to conduct nighttime and low light recovery operations. It includes research that provides information to support development of monitoring protocols for subsea and surface responses or improvements to existing ones such as the NRT Atypical guidance or the SMART guidance, as applicable. This SRA also includes evaluation of techniques for autonomous sensing operations and reporting from remote locations where logistical challenges limit human accessibility.

The priorities for this SRA focus on the development of improved technologies that can more rapidly and effectively identify the presence and the characteristics of oil in the water column and on the seafloor. These priorities would address some of the issues that arose from the *Deepwater Horizon* spill and may assist responders to react more effectively to future incidents. There are three subcategories for this SRA: Remote Detection, Monitoring, and Submerged Oil Detection.

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REMOTE DETECTION
☐ Develop technologies that enable remote oil spill detection and mapping in low visibility conditions (e.g., night, fog).
☐ Develop enhanced technology for detecting oil under ice, encapsulated in ice, and floating within broken ice fields.
☐ Identify specific characteristics of crude oil exposed to the full microwave radiation spectrum (at hyperspectral intervals) and develop high resolution sensors for oil spill visualization, detection and quantification.
MONITORING
☐ Develop a refined SMART or equivalent protocol and operational procedures for use during subsea and surface responses based on recent experiences.
☐ Develop technology to rapidly analyze physio-chemical properties of spilled oil to improve decision-making regarding dispersant use and *in situ* burning (ISB).
☐ Develop new technologies to improve oil, dispersant, and oil/dispersant detection in the water column and on the seafloor, and for monitoring dispersant effectiveness in the field.
SUBMERGED OIL DETECTION
☐ Study the potential of acoustic systems and Light Detection and Ranging (LiDAR), both individually and as packaged suites, to detect submerged oil on the seafloor and in the water column.
☐ Develop new or improve existing chemical sensors for detecting submerged oil.
☐ Develop methods to calibrate the degree of oiling on snare sampling systems with the amount of oil on the seafloor or in the water column.

9.3.5 In- and On-water Containment and Recovery Priorities (Section 4.3.3.5)

This SRA includes the development of methods, equipment, and materials for physically containing and removing oil from the surface of the water, the water column, or on the bottom of the sea/river bed. This SRA focuses on improving traditional equipment such as booms, skimmers, and sorbent materials, as well as developing new approaches to surface containment, and equipment and systems specific to containment and recovery of subsurface oils.

The priority Research Needs in this SRA focus on the Arctic and other northern areas where cold water and ice will require innovative methods and technologies. There was

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also recognition of the need for better technologies to control and recover submerged oil given the greater emphasis on deep and ultra-deep water drilling. ICCOPR acknowledged the need for better testing protocols for new technologies and methods and identified research priorities that could improve laboratory and field testing. ICCOPR identified priorities in two subcategories: Control and Recovery Technology, and Recovery Operations and Testing.

CONTROL AND RECOVERY TECHNOLOGY
☐ Develop new mechanical recovery methods/technologies for logistically challenging (e.g., cold water, ice, broken ice) Arctic conditions.
☐ Develop new tools to control and recover oil that is submerged, suspended in the water column, or on the seafloor.
☐ Develop control and recovery capabilities for oil in river conditions with pack ice and ice flows.
RECOVERY OPERATIONS AND TESTING
☐ Develop/improve standardized testing protocols (especially for wave tanks) that yield cross-comparability of results and establish practical oil recovery limits that are achievable during response operations.
☐ Conduct field tests of cleanup techniques and create protocols for various habitats and conditions, including Arctic conditions.
☐ Develop surrogates for different types of oil to be used for training and for research and development testing.

9.3.6 Shore Containment and Recovery Priorities (Section 4.3.3.6)

This SRA covers new methods, treating agents, and equipment for removing oil from shorelines, as well as mitigating the environmental impact of oil that cannot be removed. Specifically, this SRA includes water washing and flooding techniques, the use of chemical treating agents, and novel applications of mechanical removal techniques and equipment. It also includes analysis, evaluation and decision-making (risk and benefits) for the use of active shoreline oil removal techniques versus passive naturally-occurring processes.

ICCOPR recognizes the difficulty of relying solely on physical recovery on shorelines. Therefore, priorities in this SRA focus on developing chemicals that prevent shoreline contact.

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- Study the effectiveness of a range of technologies for shoreline or nearshore cleanup; including dispersants, bioremediation agents, shoreline cleaners, and mechanical methods.
- Study the effectiveness of surface washing for shoreline cleanup and develop standards for surface washing.
- Conduct research to assess the ability of chemicals to prevent oil from reaching or sticking to shorelines.

9.3.7 Dispersants Priorities (Section 4.3.3.7)

This SRA addresses the use of chemical products designed to interact with marine oil slicks by reducing the oil/water interfacial tension and breaking up the slick into tiny droplets with the aid of wave or other energy sources. Research areas for dispersants include: developing appropriate dispersant applications for cold weather and deep sea environments; increasing dispersant effectiveness for water surface and subsurface applications (e.g., effective on a wider viscosity and emulsification range, and calm sea conditions); reducing ecological effects of individual dispersant components and combined components in the water column; refining vessel, aircraft, and subsurface application methodologies and equipment; developing enhanced monitoring methods and systems for determining the effectiveness of surface and subsurface application of dispersants; determining how to distinguish physically versus chemically dispersed oil; studying the distribution and impact of the chemicals and dispersed oil in the environment; and understanding regional variations in dispersant performance and environmental effects. This SRA may include characterization to enhance the ability to predict dispersant effectiveness on various oil types and at varying application rates, including the effectiveness of dispersants on weathered/emulsified oils and in a range of water salinities. This SRA also encompasses studies to determine the suitability of subsea application of dispersants in the Arctic region where the unique conditions (e.g., shallow depths, water salinity, ice-infested water, under-ice discharges) could influence their fate and effects. An important supporting activity is the development of an information database on dispersant product effectiveness, application procedures, and effects. Since dispersants shift the risk from the surface to the water column, additional research is needed to address questions about the potential acute and chronic effects of dispersants on water column organisms and populations at various depths.

The *Deepwater Horizon* spill resulted in a very widespread use of dispersants and the first application of subsurface dispersants near the well head. This use of dispersants resulted in a significant interest in the effectiveness of dispersant use and its potential impacts. The importance of this SRA to future oil response is demonstrated by the large

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number of research needs identified. It is important to understand how dispersants behave in the environment and what their potential impacts are when applied. Specifically, ICCOPR identified Research Needs such as: dispersant use in Arctic conditions; the behavior of dispersants and dispersed oil in the environment; the toxicity of dispersants and dispersed oil; efficacy and effectiveness of dispersants; fate of dispersants and dispersed oil; and the application of subsurface dispersants.

This SRA includes six subcategories: Cold Weather and Ice Conditions, Behavior, Impacts, Efficacy and Effectiveness, Fate, and Subsurface. The Research Needs for this SRA include formulations appropriate for dispersant applications in cold weather and deep sea environments, and increasing dispersion effectiveness for water surface and subsurface applications.

COLD WEATHER AND ICE CONDITIONS
☐ Understand the "window of opportunity" for potential deployment of all dispersants in the Arctic and sub-Arctic.
☐ Study the best dispersants for different types of crude oil over a range of environmental conditions, including ice infested waters.
☐ Study the fate and effects of subsea application of dispersants in Arctic waters, including in ice infested water and under ice.
BEHAVIOR
☐ Study the transport and detection of oil, dispersants, and oil/dispersants in surface and subsurface environments, including deepwater.
☐ Study the impact of natural processes such as flocculation and hydrate encapsulation on oil and dispersed oil.
☐ Quantify degradation rates of chemically dispersed, physically dispersed, and undispersed oil, including biodegradation kinetics.
IMPACTS
☐ Improve protocols for testing toxicity of dispersants and other chemical agents to better represent real world exposure scenarios.
☐ Study and evaluate dispersant and dispersed oil chronic and sub-lethal effects on key species, and subsequent long-term ecological effects for varying real world exposure scenarios and durations.
☐ Collect existing dispersed oil toxicity data and studies to aid in risk-based decision-making regarding use of dispersants at spills.

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EFFICACY AND EFFECTIVENESS
☐ Study the relative effectiveness of various surface dispersant delivery techniques/systems.
☐ Study the effects of subsea dispersant application on subsequent mechanical recovery of oil.
☐ Develop methods and quantify the factors needed to scale results of laboratory and wave tank experiments so that they become more accurate indicators of real world effectiveness.
FATE
☐ Develop studies to quantify the weathering rates and final fate of chemically dispersed vs. physically-dispersed oil droplets under different scenarios.
☐ Study the differences in the effects of photolysis on undispersed, chemically dispersed, and physically dispersed oil droplets.
☐ Study the adhesiveness of physically and chemically dispersed oil on organisms and habitats, including how adhesion changes over time and with oil type.
SUBSURFACE
☐ Study the relationship between subsurface application of dispersants, the characteristics of oil at the surface, and the fate of oil constituents, including Volatile Organic Compounds (VOCs), in the water column and at the surface.
☐ Develop conditions of operability for dispersant use in the subsea, including the characteristics of the most effective dispersant, application methods, and dispersant to oil ratios.
☐ Conduct research involving the application of dispersants at high pressure and low temperatures including quantifying the mixing energy at the wellhead.

9.3.8 *In Situ* Burning (ISB) Priorities (Section 4.3.3.8)

This SRA includes equipment and techniques required to ignite and sustain combustion of oil spills on the water, along shorelines, and on land. A source of ignition must be present for the mix of fuel (e.g., oil) and oxidant (e.g. oxygen) in a slick to burn. Because slick thickness is a key variable in determining whether the oil will burn, this research area includes development of equipment such as fire-resistant booms and herders to concentrate the slick thickness, and improved ignition devices. This SRA also includes developing knowledge of the conditions under which this equipment and technique can

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be applied effectively, including evaluation of use in frigid (i.e., Arctic) environments, where cold conditions and ice limit operational effectiveness of mechanical containment and recovery of spilled oil. This SRA also includes research to develop new methods to enhance burn efficiency and burn weathered, emulsified, and more viscous oils. Research into the production of residuals including soot and other ISB residues, and the techniques and equipment to recover these residues is also included in this SRA.

The priorities for this SRA address issues related to potential public health and environmental health from the burning of oil. The ICCOPR priorities also emphasize the need for improved technology to address containment, sustain burning and understand the potential for application of ISB in Arctic and other special environments. There are two subcategories: 1) Effectiveness and 2) Impacts and Planning and Technology.

EFFECTIVENESS AND IMPACTS
☐ Develop improved pre- and post-spill plume modeling to determine whether an *in situ* burn should be conducted and facilitate decisions on measures to protect local populations, including the potential effect of "fall-out" from a smoke plume that goes over land-based subsistence resources.
☐ Study *in situ* burning residues, especially toxicity, physical properties, and bioavailability of contaminants contained within the residue matrix, especially regarding potential benthic community effects.
☐ Conduct additional research to improve *in situ* burning effectiveness in the Arctic and better define its applicability under various conditions.
PLANNING AND TECHNOLOGY
☐ Conduct a comparative study of *in situ* burning vs. mechanical, chemical and natural attenuation methods in cleanup of wetlands or marshy areas.
☐ Develop enhanced designs for containment of burning oil, such as reusable and high seas capable booms.
☐ Develop methods to improve and sustain combustion of emulsions.

9.3.9 Alternative Chemical Countermeasures Priorities (Section 4.3.3.9)

This SRA includes the development and use of various spill response chemicals to treat oil slicks on the surface of the water making the oil more amenable to other recovery techniques, such as mechanical recovery and ISB. These chemicals include solidifiers, herding agents, elasticity modifiers, shoreline pre-treatment agents, and emulsion treating agents (demulsifiers). Development activities include improving chemical formulations,

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refining application techniques, and conducting studies of effectiveness and environmental effects.

ICCOPR priorities in this SRA recognize the potential of alternate chemical treatments to break emulsions and herd oil slicks to enhance other response techniques.

☐ Study the potential use of chemical herders to enhance response capabilities of *in situ* burning, recovery of oil-in-ice, or recovery of oil in confined/covered spaces.
☐ Study the value and impact of chemical herders with respect to the timing for deployment of various countermeasures, particularly with respect to a second-stage recovery effort during ice melt to target oil that had previously been entrained in sea ice.
☐ Conduct laboratory and field tests of chemical agents for breaking or inhibiting emulsions.

9.3.10 Oily and Oil Waste Disposal Priorities (Section 4.3.3.10)

This SRA includes study and development of analytical methods, procedures, equipment and techniques to manage and dispose of oil, oily water, oiled soils, and oiled debris recovered during both on-water and on land oil pollution incidents. Specific technologies include, but are not limited to, waste segregation, temporary storage, solidification and stabilization prior to landfill disposal or recycling, oil reclamation, incineration, and biological treatment (i.e., land farming and composting). It also includes techniques and equipment for onsite oil-water separation, filtration, and decanting operations that would reduce the volumes of oil/water material that would need to be handled, transported, and disposed.

ICCOPR priorities for this SRA focus on storage, waste issues and recycling.

☐ Develop innovative techniques for oil/water separation decanting systems for various oil types.
☐ Develop methods to recycle sorbents and reduce the waste created by using sorbents as a recovery option.
☐ Develop methods to temporarily store or dispose of recovered oil/pollutants in remote or harsh environments.

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9.3.11 Bioremediation and Biodegradation Priorities (Section 4.3.3.11)

This SRA includes research and technology to exploit the capabilities of microorganisms and plants to accelerate the rate of degradation of oil typically through aerobic degradation, but also through anaerobic degradation processes. Bioremediation is largely an *in-situ* technology as *ex-situ* use requires excavation and further manipulations that may have a greater potential for environmental harm. Research and development opportunities include the development of methodologies for the use of nutrient enrichment and possibly microbes to accelerate the biodegradation process on land, a process called bio-augmentation. This topic area also covers research to understand the conditions needed for effective bioremediation in the presence or absence of dispersants, herders, and other chemical agents. In areas such as coastal wetlands, where stranded oil may have penetrated into the anaerobic subsurface, this research area would include studies to wick the oil up to the surface where aerobic conditions and nutrient enrichment may result in enhanced biodegradation. This SRA also includes development of methodologies to apply bioremediation for more effective response and restoration efforts. For purposes of this OPRTP, bioremediation includes phytoremediation (remediation using plants), a longer-term restoration technique.

ICOCPR priorities under this SRA focus on gaining a better understanding of the bioremediation process and the factors associated with its use in oil spill remediation.

☐ Study the relative effectiveness and environmental impacts of bioremediation technologies.
☐ Develop an improved understanding of bioremediation processes with a wider range of conditions/environments (e.g., cold water), multiple types of oil, nutrient enrichment, toxicity and eutrophication.
☐ Study the factors controlling bioavailability of petroleum hydrocarbons in estuarine and freshwater sediments.

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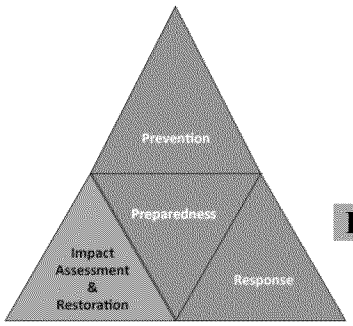
9.4 Injury Assessment and Restoration Priority Research Needs



INJURY ASSESSMENT AND RESTORATION

9.4.1 Environmental Impacts and Ecosystem Recovery Priorities (Section 4.3.4.1)

This SRA includes laboratory research, field studies, and modeling efforts to better understand and predict the short- and long-term effects of oil spills at the ecosystem level. It includes research into the short- and long-term recovery of various types of environments and the chronic effects of oil spills on habitat, species, recovery and rehabilitation of wildlife, and community structures. This SRA includes the effects of the oil and the countermeasures and cleanup techniques used to remove the oil. It also includes research to determine the rate of ecosystem recovery both with and without countermeasures and cleanup.

The priorities selected by ICCOPR reflect the continued need to assess the short- and long-term effects of the *Deepwater Horizon* oil spill through the NRDA process. ICCOIPR identified priorities within six subcategories for this SRA due to the large number of identified Research Needs: 1) Species Impacts; 2) Toxicological and Sub-lethal Impacts; 3) Submerged and Submerged Oil Impacts; 4) Ecosystem and Habitat Impacts; 5) Recovery; and 6) Risk Assessment and Impact Metrics.

SPECIES IMPACTS
☐ Study the effect of exposure to oil on: physiological functions of organisms (immune, reproductive, and other vital systems); potential impacts on individual fitness; and population vitality rates, abundance and trends.
☐ Develop an increased understanding of the environmental effects of *in situ* burning, chemical dispersants and herding agents on Arctic ecology.
☐ Conduct research that examines the state of knowledge of specific NRDA metrics that would help identify specific population, physiological, habitat, and exposure data to support future NRDA activities in Arctic areas that are likely to be explored/developed for oil and gas extraction in the near to mid-term.

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TOXICOLOGICAL AND SUB-LETHAL IMPACTS
☐ Develop relevant biological markers of exposure and guidelines for their use.
☐ Conduct research on key species to determine the long-term, sub-lethal effects of short-term exposure to oil.
☐ Study the bioavailability and toxicity of oil sands products in freshwater and marine environments.
SUNKEN AND SUBMERGED OIL IMPACTS
☐ Develop an understanding of the pathways of exposure and mechanisms of chronic toxicity of submerged oil to benthic communities.
☐ Develop approaches for long-term monitoring of the impacts of submerged oil spills after termination of cleanup efforts.
☐ Develop an understanding of the potential threats of chronic releases from sediments containing oil and oily residues.
ECOSYSTEM AND HABITAT IMPACTS
☐ Develop relevant exposure conditions (spatially and temporally) and examine connections between exposure and ecological effects.
☐ Develop an understanding of trophic and habitat linkages among organisms to incorporate into models predicting cascading effects.
☐ Develop an understanding of the difference between oil effects and natural stressors by assessing community structure and function for different habitats.
RECOVERY
☐ Study recovery rates of injured habitats using different types of oils and methods (e.g., previous spills, mesocosm, field studies).
☐ Develop conceptual models of service loss and recovery from key habitats, and gather the information necessary to parameterize recovery models.
☐ Conduct a study comparing environmental injury footprints and ecosystem recovery times after implementation of various response technologies and techniques.

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RISK ASSESSMENT AND IMPACT METRICS
☐ Develop models to estimate injury to natural resources encompassing a range of exposure scenarios to biota at different life stages.
☐ Conduct research to determine the best metrics for assessing injury and damages to natural resources.
☐ Conduct single species toxicity research to assess population effects and help risk-based decision-making during an event.

9.4.2 Environmental Restoration Methods and Technologies Priorities (Section 4.3.4.2)

This SRA includes development of methods and technologies to facilitate and accelerate the recovery of resources following an oil spill. It includes research into the effectiveness of approaches for environmental restoration. It also includes evaluations and comparisons of the factors affecting success of the restoration methods and technologies. It also involves studying previous restoration efforts, as well as natural recovery, to better understand ways to improve or enhance future recovery from oil spills.

ICCOPR recognized that the *Deepwater Horizon* oil spill, as well as other marine and onshore spills, offer opportunities to assess restoration techniques and improve the state of the art.

☐ Develop methods for restoration assessment (including establishing indicators and applying performance metrics) and estimation of restoration cost.
☐ Conduct comparative analysis of restoration vs. natural attenuation.
☐ Study the factors associated with long-term restoration success.

9.4.3 Human Safety and Health Priorities (Section 4.3.4.3)

This SRA includes studies on the effects of spilled oil and oil spill response activities on human health and safety for both workers and the public. It includes the study of oil weathering throughout the water column and the potential concerns relative to worker health and safety. It focuses on the development of monitoring instruments, procedures, and processes to inform personnel engaged in oil spill response activities, as well as the general public, who could be affected by the oil spill and response options. It also includes studies of the safety of fish and shellfish in a spill area to determine if they are safe to market and consume. Research on seafood safety may include petrochemical

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toxicology and profiling, risk analysis, sampling and testing methodology development, and risk communications.

The research priorities focus on worker safety and human exposure, as well as on seafood safety. The *Deepwater Horizon* spill has provided opportunities for short- and long-term monitoring of workers and the public related to these topics. There are two subcategories to this SRA: Safety and Human Exposure.

SAFETY
☐ Develop technologies, methods, and standards for protecting on-scene personnel, including the incorporation of training, adequate supervision, information databases, protective equipment, maximum exposure limits, and decontamination procedures.
☐ Study the levels of oil constituents, including Volatile Organic Compounds (VOCs), throughout the water column under different dispersant application scenarios (e.g., subsea, surface) and establish their contribution to potential worker health and safety issues.
☐ Conduct research on the short- and long-term safety of seafood following a spill or fisheries closure and develop methods to communicate these to the public.
HUMAN EXPOSURE
☐ Develop the framework needed to conduct rapid research response on human exposure during oil spills.
☐ Study the short- and long-term impacts to humans from exposure to contaminants from oil spills (e.g., dermal, oral (through seafood), and respiratory).
☐ Study the toxicological effects and the causal or correlative relationships between chemical (i.e., oil and dispersants) exposure and human health.

9.4.4 Sociological and Economic Impacts Priorities (Section 4.3.4.4)

This SRA includes studies on how oil spills and the response to oil spills affect the sociological fabric of communities and their economies. Disciplines encompassed in this research area include sociology, economics, behavioral sciences, political science, and law. It also involves studies on risk communication and community resilience.

The priorities in this SRA identify the need for improving communication methods and understanding the human and community impacts of a spill, particularly by improving

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research frameworks and studying previous spills. There are two subcategories in this SRA: Community and Economic Impacts, and Human Impacts.

COMMUNITY AND ECONOMIC IMPACTS
☐ Develop more effective models/frameworks for community/stakeholder involvement in oil spill planning, response and restoration.
☐ Develop improved methods for communicating risks and tradeoffs to various audiences, including tradeoffs of mechanical recovery, dispersant use, and other technologies.
☐ Study cumulative community vulnerability and resilience to past spills, including social impacts.
HUMAN IMPACTS
☐ Study the resilience of social-ecological systems to environmental disasters, including the degree of impact on human well-being from ecosystem services losses.
☐ Determine human/community impacts associated with a spill, including subsistence losses and culturally-significant natural resource injuries.
☐ Study the effects of media and community groups in shaping individual and public perceptions of a spill's impact.

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APPENDICES

A. Numbered List of Standing Research Areas (SRAs)

B. ICCOPR Standing Research Areas – 2014 Database

C. ICCOPR Standing Research Areas – 2014 Sources

D. Survey Technical Report

E. Sample of Research Priority Survey

F. Sample of Survey Data

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From: Vocke, William CIV
Sent: Thur 9/24/2015 6:10:51 PM
Subject: ICCOPR Biennial Report - Input needed
Draft FY14-15 Report to Congress - 2015-09-24.docx

All,

As I've indicated during our previous meetings, ICCOPR is required to provide a biennial report to Congress for the past two fiscal years (FY14/15). I prepared a rough draft based on the FY12/13 Biennial Report and updated it with as much information that I could. It is now time for the members to provide the following input:
1. Provide a paragraph (or 2) on any agency initiatives that you would like highlighted in the main body of the report. If it is already described in the rough draft please edit/correct to rough draft.
2. Update any oil pollution related conferences and workshops that you or the agency participated in during the period.
3. Provide project descriptions for your agency (Appendix B). I have included those listed in the FY12/13 report as still active at the end of FY13 and added some that I was aware of.
4. Provide a list of publications by people in your agency. Again, I have included some that I am aware of and will continue to add to the list as I get them.

Thank you to those members that already provided input. I look forward to completing this report, which will showcase all our great work.

I would like your input by the end of next week (That is, if we don't have a shutdown.).

Bill

To: Principe, Vanessa[Principe.Vanessa@epa.gov]
From: Wilson, Gregory
Sent: Tue 5/26/2015 8:38:51 PM
Subject: RE: ICCOPR R&T Plan Chapters 7 , 8, and 9 for review
Ch 9 - Member Early review 2015MAY13_VP_GW.docx
Ch 78 Member Draft 2015-05-13_VP_GW.docx

-----Original Message-----
From: Principe, Vanessa
Sent: Wednesday, May 20, 2015 3:27 PM
To: Wilson, Gregory
Subject: RE: ICCOPR R&T Plan Chapters 7 , 8, and 9 for review

G:

Took a quick look at these Chapters. I have some comments and some questions/concerns, that given the timing might be too late to address (I figure these research needs/priorities are already set in stone). I may be misunderstanding some, and perhaps in the full write up in previous chapters the concerns have been addressed.

Not sure if you already started looking at these, we can add the ones you agree with to your comments and disregard the others.

Was curious about this reference in Chapter 8: Deepwater Horizon (DWH) Incident Specific Preparedness Review (January 2011) http://www.uscg.mil/foia/docs/DWH/BPDWH.pdf. Perhaps you were already aware of it. The cover memo from the USCG Commandant is very interesting, in directing reviews of ACPs to include worst case scenarios, which I understood to already be required. Might be good to take a look prior to any public interaction where EPA and USCG are participating, and where we could potentially take some public hits from them (Clean Gulf).

V

-----Original Message-----
From: Vocke, William CIV [mailto:William.T.Vocke@uscg.mil]
Sent: Wednesday, May 13, 2015 1:16 PM
To: Loring, Joseph B CAPT; david.moore@bsee.gov; kurt.a.hansen@uscg.mil; Jenkins, Shannon R CIV; Lundgren, Scott; Vocke, William CIV; Platt, Jeffrey R LT; Conmy, Robyn; Wilson, Gregory; Principe, Vanessa; wayne.yoder@dhs.gov; christina_kravitz@fws.gov; daniel.yuska@dot.gov; michael.carter@dot.gov; michael.j.green-1@nasa.gov; Kemp.skudin@navy.mil; Stephanie A. Brown; steve.lehmann@noaa.gov; robert.w.smith@dot.gov; Steven.V.Cary@usace.army.mil; jfarrell@arctic.gov; Andrew.J.Bruzewicz@usace.army.mil; Elena.Melchert@hq.doe.gov; Lori.Medley@bsee.gov; kevin.easley@hq.doe.gov; debbie.payton@noaa.gov; Jeff.Ji@boem.gov; Walter.Johnson@boem.gov; jason.boehm@nist.gov; john.kucklick@nist.gov; john.kucklick@noaa.gov; robb.hyde@navy.mil; steven.pearson@bsee.gov; Abe.nachabe@navy.mil; dave.westerholm@noaa.gov; Weaver, James (USCG); Erica.Folio@Hq.Doe.Gov; barry_Forsythe@fws.gov; David.Lehman@dot.gov; frank.stone@navy.mil; rachel.hardey.ctr@navy.mil; Crecy, Stacey L LCDR; Carnegie, Tammie R LT; Turner, Arden C CIV; mark.g.vanhaverbeke@uscg.mil; Balsley, Alexander CIV; Fletcher, James E CIV; mfocazio@usgs.gov; DiRenzo, Joseph CIV; Hall, Gregory CDR (EDU)
Subject: ICCOPR R&T Plan Chapters 7 , 8, and 9 for review

All,

Thank you for comments on chapters 2 through 6. Attached for your early review are chapters 7 (Noteworthy Oil Spills), 8 (Current State of Oil Pollution Knowledge), and 9 (Priorities). Please review

these chapters and provide me with comments or edits by COB May 27, 2015.

I expect to send out the remaining chapter (1-Need for Oil Pollution Research) sometime next week. At that point, all chapters of the R&T Plan will be drafted and under review. I appreciate any input you have so I can address issues before we undergo formal review.

Bill Vocke
ICCOPR Executive Director
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To: Wilson, Gregory[Wilson.Gregory@epa.gov]; Principe, Vanessa[Principe.Vanessa@epa.gov]; Barron, Mace[Barron.Mace@epa.gov]
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Sent: Mon 5/18/2015 6:53:03 PM
Subject: a little light reading if you haven't already seen it....
2015Prince_EST.PDF

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Oil Spill Dispersants: Boon or Bane?

Roger C. Prince*

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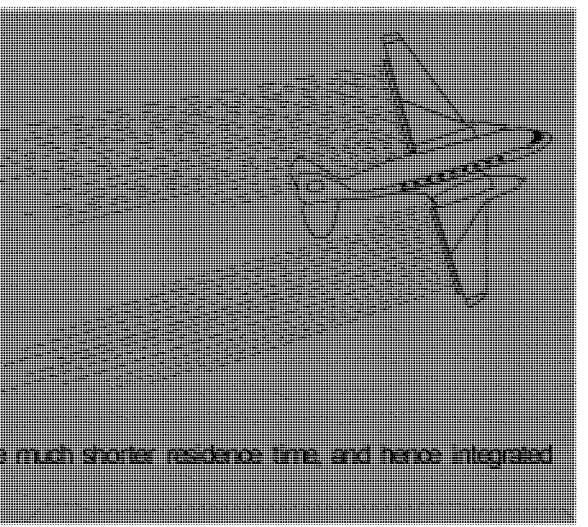
Dispersants provide a reliable large-scale response to catastrophic oil spills that can be used when the preferable option of recapturing the oil cannot be achieved. By allowing even mild wave action to disperse floating oil into tiny droplets (<70 μm) in the water column, seabirds, reptiles, and mammals are protected from lethal oiling at the surface, and microbial biodegradation is dramatically increased. Recent work has clarified how dramatic this increase is likely to be: beached oil has an environmental residence of years, whereas dispersed oil has a half-life of weeks. Oil spill response operations endorse the concept of net environmental benefit, that any environmental costs imposed by a response technique must be outweighed by the likely benefits. This critical review discusses the potential environmental debits and credits from dispersant use and concludes that, in most cases, the potential environmental costs of adding these chemicals to a polluted area are likely outweighed by the much shorter residence time, and hence integrated environmental impact, of the spilled oil in the environment.



INTRODUCTION

Oil fuels our modern world, accounting for some 33% of energy consumption in 2013; daily consumption was 87 million barrels per day.[1] Some of this crude oil is produced from wells drilled under the sea, and a large percentage travels by sea between production and consumption. Despite the best efforts of the oil and shipping industries, some gets spilled. Catastrophic spills appropriately garner the public's attention, although, in fact, most spills are rather small. Natural seeps are likely the largest contributor of oil to the world's oceans, followed by nonpoint sources on land.[2] Tanker accidents are becoming less common,[3] but it is still true that a few large spills contribute the most oil released to the sea by ships, and where such spills occur, they release far more oil in a few days than even the most active seeps. The tragic 2010 blowout from the Deepwater Horizon well[4] is a reminder that large releases can also occur from drilling operations.

Crude oil has been part of the biosphere for millions of years,[5] and a large number of microbes, both prokaryotic[6] and eukaryotic,[7] have evolved to consume it. Biodegradation is the eventual fate for all spilled oil that is not collected or burned, and both collection and combustion require that spilled oil be corralled with booms.[8] While skimming can be an effective process if equipment is close to hand and the weather is reasonably calm, and is frequently part of oil spill response plans (e.g., refs 9−12), large spills in remote areas can spread so quickly that skimming becomes extremely difficult. For example, the Deepwater Horizon response, despite enormous efforts, collected only some 3% of the oil released and burned another 5%.[4] Considerable research has been expended, therefore, on trying to enhance the rate of oil biodegradation.

Oil is an unusual substrate for microbial growth for two distinct reasons. On the one hand, most oil molecules have low density and are very sparingly soluble, so oil tends to stay as surface slicks or droplets dispersed by wave action. Biodegradation is then limited by the surface area of the oil−water interface. On the other, whereas hydrocarbons are rich sources of carbon and energy, oil contains no other useful elements for microbial growth. Nitrogen and phosphorus are the most usual limiting nutrients in the sea,[13] followed by iron and other trace requirements.[14] While seawater contains trace levels of these nutrients,[15] the biodegradation of significant concentrations of oil, such as on a shoreline, is likely to exhaust the local supply. Bioremediation, the stimulation of biodegradation, thus aims to overcome these two limitations.

In the case of oil stranded on shorelines in Prince William Sound AK following the spill from the Exxon Valdez, the first response was to remove oil from beaches by washing it back to the sea and collecting it with skimmers.[16] This had the effect of leaving a relatively thin film of oil on the gravel and rocks of the intertidal (and sometimes supra-tidal) zone, and this was bioremediated by the careful addition of oleophilic and slow-release fertilizers to increase the supply of bioavailable nitrogen and phosphorus. This worked quite well, stimulating oil biodegradation between 2- and 5-fold without causing any additional adverse effects,[17−20] but it should be born in mind that the oil had already been on the shoreline for a year before the quantitative experiments reported therein were begun.

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Floating oil presents different challenges. Floating oil is a very real hazard to diving birds and mammals (e.g., refs 21 and 22), and oil that beaches is a hazard to shorebirds,[23] invertebrates,[24,25] and mangroves.[26] Ameliorating these hazards was a primary impetus for the initial development of oil spill dispersants in the 1970s.[27] Modern dispersants are complex mixtures of anionic and neutral surfactants in a hydrocarbon solvent (e.g., ref 28) that lower the interfacial tension between oil and water so that minimal wave action and turbulence can disperse the oil into tiny droplets (<70 μm) in the water column. Such droplets are essentially neutrally buoyant, so with minimal turbulence they stay in the water column and diffuse apart. Concentrations of dispersed oil may be ≈1000 ppm in the first minutes after dispersion, but they fall to a few ppm, in a correspondingly larger volume, within hours, and to sub parts per million levels within a day.[29−34] Furthermore, even these concentrations are found only in the top few meters of the sea. Similarly, dispersants can harness the ejection turbulence of oil emanating from an uncontrolled subsea release and allow the formation of tiny oil droplets in the deep sea;[4,34−37] again, the droplets diffuse apart until they are in the sub parts per million concentration range. This diffusive dilution means that, although the levels of nutrients in the sea are relatively low,[13] it does not take long for oil concentrations to fall so that even those low levels are adequate for significant and rapid biodegradation. Hazen et al.[14,35] measured half-lives of n-alkanes of a few days in the dilute (2−442 ppb[34]) dispersed submarine plume from the Deepwater Horizon at 1100−1220 m (and 5 °C), and very similar results were reported for a broad array of individual hydrocarbons at low concentrations in New Jersey seawater at 8 °C,[36,37] in a flume in Trondheim, Norway,[38] at 30−32 °C and in water off the Penang, Malaysia, shore[39] at 27.5 °C. The approximate biodegradation half-life of the total measurable hydrocarbons was 11−14 days, both at low oil concentrations with indigenous nutrients[36,38] (2.5 and 43 ppm oil, respectively) and at slightly higher concentrations (100 ppm oil) with added nutrients.[39] Even the four ring aromatic chrysene and its methyl-, dimethyl-, and ethyl-alkylated forms had half-lives on the order of a month.[36]

DISPERSANTS

Dispersants have been used on a large scale in many responses, notably, the 1993 Braer wreck in the Shetland Islands,[40] the 1996 Sea Empress spill in South Wales,[41] and the 2010 Deepwater Horizon blowout in the Gulf of Mexico.[33] Seven spills in the US portion of the Gulf of Mexico were treated with dispersants between 1995 and 2004.[42] Dispersants are stockpiled, with equipment for their use, in large quantities around the world,[43] and substantial illustrated guidelines for their use are freely available.[44] Nevertheless, their deployment is still controversial, for clearly dispersants are not without potential drawbacks. Most dispersants are not themselves significantly toxic; they have toxicities indistinguishable from common household dish liquids and shampoos,[45] including those used for cleaning oiled seabirds,[46,47] and the majority, including those used in the Deepwater Horizon response, show neither androgen- nor estrogen-receptor activity.[48] Nevertheless, the use of dispersants involves adding more chemicals to an already impacted area, and the water under a recently dispersed oil slick is significantly transiently more toxic to organisms than under the undispersed slick, albeit because of the greater concentrations of oil in the water, not because of any increase in toxicity on an oil weight basis.[47,48,50]

So, how should spill response coordinators decide when and where to use dispersants? Most responders rely on a net environmental benefit analysis, often abbreviated NEBA.[51−55] At first glance, the concept seems oxymoronic: how can anything related to an oil spill have an environmental benefit? However, in actuality, the concept is very useful: everyone involved in a cleanup recognizes that an oil spill is a dreadful environmental insult and is working diligently to minimize adverse impacts and to remove the oil as quickly as possible. The question is whether a response tool will end up doing more harm than good, of whether there will be net environmental improvement despite potential collateral harm done in the short term by the response. Table 1 offers a comparison of the potential hazards and environmental fate of floating slicks and dispersed oils that need to be considered in such analyses.

The first hurdle for dispersants is to demonstrate their fundamental efficacy. In the United States, the U.S. Environmental Protection Agency (USEPA) maintains the National Oil and Hazardous Substances Pollution Contingency Plan Product Schedule[56] as part of the National Contingency Plan and lists chemical dispersants that may be authorized for use. Dispersants on the Product Schedule have demonstrated effectiveness; they can disperse at least 45% of Prudhoe Bay or South Louisiana crude oil in a standard swirling flask test.[57] The swirling flask test is one of several tests designed to discriminate between dispersants with different efficacies on a simple laboratory scale. It does this reasonably well (although the USEPA is considering revising it with a baffled flask test[58]), but unfortunately the passing grade of 45% has often been assumed to indicate expected field performance. In fact, the test dramatically underestimates efficacy in the field, primarily due to the amount of energy it imparts to the floating oil and the volume available for diffusion. Tests in the OHMSETT facility,[59] a wave tank in New Jersey that is 200 m long, 20 m wide, and 2.5 m deep, routinely measure dispersant efficiencies >95%, even at low temperatures with ice in the water.[60]

A second requirement for listing on the USEPA product schedule is that the acute toxicity of the dispersant to two reference species (silverside fish, Menidia beryllina (96 h), and mysid shrimp, Americamysis bahia (48 h)[49,59]) be reported. During the Deepwater Horizon response, the USEPA required that dispersants "have a toxicity value less than or equal to (sic) 23.00 (sic) ppm LC_{50} toxicity value for Menidia or 18.00 ppm LC_{50} for Mysidopsis (Americamysis)";[62] the dispersants being used passed this hurdle.[49]

As mentioned above, the toxicity of modern dispersants is usually so low as to likely have only minimal adverse effects at levels used in response operations (nominal aerial dispersant application rates are 5 gallons of dispersant per acre, 47 L/hectare;[63] diffusion into the top 20 cm of seawater would give concentrations around 23 ppm, and of course further diffusion will continually lower the concentration). However, dispersed oil is significantly more toxic, with acute LC_{50} values more than an order of magnitude lower.[49] There has been some confusion around quantifying the toxicity of dispersed oil;[64,65] acute toxicity arises from a general narcosis caused by dissolved hydrocarbons moving to the lipids of the test organism,[66−68] so if estimates of oil concentrations include small droplets, the toxicity expressed on a per milligram hydrocarbon basis are lower (higher LC_{50}) than that for dissolved components. In any case, dispersants encourage solubility by increasing the surface-

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Table 1

potential hazards and environmental fate of floating slick	potential hazards and environmental fate of dispersants and dispersed oil
	Dispersant application has the potential to create aerosols with potentially adverse effects on humans and wildlife. Such effects are seen only in the laboratory at quite high concentrations and with prolonged exposures.[99-102] They are minimized by protective equipment for applicators and exclusion zones around application. Aerial application is very unlikely to be approved within several miles of a coast.
	The addition of dispersants puts additional chemicals into a polluted area. Nominal application rates of dispersants are 5 gallons per acre (47 L ha^{-1}) for surface spills,[63] equivalent to a dispersant/oil ratio of about 1:20. Subsea injection seems to be effective at much lower doses, perhaps 1:100 or less. Dispersants are composed of chemicals that are generally acceptable for food contact and are biodegradable,[28,93,94] but when they are used at suboptimal doses, they may become incorporated into persistent tarballs.[95]
	Dispersants may persist in the environment. Dispersants are complex mixtures of surfactants and solvents, and very few techniques can measure them all.[104] Much published work has focused on individual chemicals, but since all of the components are widely used in consumer products on a far greater scale than in dispersants, care must be taken in attributing detection to dispersant use.[97]
	Dispersants may not penetrate heavy oils and may "roll-off" before they can be effective.[103,105] Nevertheless, dispersants have been shown to be effective with many heavy oils,[117] and new formulations are being developed to further this use.[106]
	Suboptimal dispersant application may not disperse the oil but may hinder subsequent skimming operations.
	Several studies appear to show that dispersants do not stimulate biodegradation very much.[139-141,36,78] Those experiments were based on a misunderstanding of the role of dispersants,[37] which is simply to disperse oil into tiny droplets that can diffuse apart. Such dilute small droplets, whether generated by dispersants or by low concentrations of oil, are degraded rapidly,[36-38,78] and dispersants show no significant stimulatory effect. Dispersed oils that can recoalesce into larger droplets, as occurs in laboratory experiments with more than a few parts per million oil,[139-141] again show only a small stimulation of biodegradation by dispersants. A clear stimulation of biodegradation by dispersants (many fold) is seen only when dispersed oil at environmentally realistic concentrations[29-36] is compared to an undispersed slick.[37] It is the latter that is the target of dispersants.
	Dispersants have been reported to be toxic to some bacteria.[142] These experiments looked at a few isolated cultivars from beach sand rather than pelagic organisms likely to be exposed to dispersants. Dispersants had no inhibitory effects in experiments with pelagic microbes[36-38,78] and were significantly less toxic than oil alone to Vibrio fischeri (now Aliivibrio fischeri[143]) in the Microtox test.[144]
Floating oil can be lethal to birds or mammals that penetrate it. The oil reduces the insulating properties of feathers and fur and may be toxic if ingested during preening or grooming.[21,22] Mild oiling may be transferred to eggs, chicks, and young.[107] Floating oil also likely kills small invertebrates, algae, fish eggs, and young that are at the sea surface under the slick.[108]	Dispersed oil is potentially toxic to organisms close to the surface when the oil is initially dispersed. This is particularly true for small invertebrates, algae, fish eggs, and young that cannot swim away.[109] Nevertheless, measured dilution suggests that they will not be exposed for very long.[29-36] The remarkably heterogeneous distribution of planktonic organisms, on all scales, probably has more influence on local populations than relatively small-scale mortality due to concentrated dispersions of oil.[145,146] Planktonic microbial species respond remarkably rapidly, even to diel cycles.[147] Fish kills are rarely noted after dispersant use, presumably because fish and other nekton swim away from the dispersed oil.
Floating oil is subject to photooxidation, which polymerizes polycyclic aromatic compounds to polar materials.[110,111] This eventually leads to very persistent tarballs.[112] Beached oil undergoes a similar process, leading to very persistent "pavements".[126,127]	
Transparent planktonic organisms may accumulate polycyclic aromatic compounds leached from slicks and beached oil and may be subject to phototoxicity in the surface layer of the sea.[113]	Dispersed polycyclic aromatic compounds may be accumulated by transparent planktonic organisms, which may then be subject to phototoxicity in the surface layer of the sea.[113]
Floating oil absorbs water; it is not unusual for floating slicks to increase their volume by >50% in 24 h.[114-116] This phenomenon makes dispersion more difficult but not impossible.[117] Over several days, many floating oils emulsify, forming water-in-oil emulsions known as mousse.[118-120] The encapsulated water no longer exchanges with bulk seawater, and biodegradation is likely even more nutrient- and oxygen-limited than in the floating slick. Mousse may be consumed by fish, turtles, etc. and also lead to tarballs.[111,112]	
Small molecules in floating oil evaporate rapidly, becoming volatile organic compounds (VOCs)[119,120] that can reach levels of concern for spill responders.[121] Evaporated molecules may be destroyed by photochemistry[122] or biodegradation.[123]	Dispersion slows evaporation, especially if the oil is dispersed subsea, as some was in the Deepwater Horizon response. The potentially toxic small molecules are retained in the water column until they are biodegraded or escape to the atmosphere over a much greater area due to diffusion at depth.
If it is not physically dispersed by storms or recovered mechanically, then an oil slick will likely beach on a shoreline. If it stays on the shoreline surface, then it may be possible to remove it by physical means, but storms will likely incorporate oil deep into sandy beaches,[124,125] where, if left alone, it will likely remain for decades.[126,127] Beached oil can be a major threat to turtle and shorebird nesting[128] and to mangroves[129] and marshes,[130] and recovery may take years.[131,132]	Dispersants are typically used far from shore in deep water (e.g., >3 miles[148]). Dispersed oil diffuses to sub parts per million levels and is very unlikely to reach a shoreline in noticeable quantities.
If the slick arrives at a shoreline, then biodegradation will be slow because of the high concentration of oil in comparison to the low concentrations of bioavailable nutrients in tidal flows. Biodegradation was too slow to measure directly in the absence of bioremediation in Prince William Sound following the Exxon Valdez spill,[18,19] but even with effective bioremediation, the half-life of total detectable hydrocarbons was of the order of 10 weeks.[18,19] The	Dispersed oil dilutes to such low concentrations that biodegradation is rapid. Measured half-lives are in the days to few weeks time frame.[14,33-37] Even the four ring aromatic chrysene and its methyl-, dimethyl-, and ethyl- forms have half-lives on the order of a month.[36] Nearshore waters from the Chukchi Sea,[78] the North West Atlantic,[36] and deepwater from Trondheim Fjord[38] all contained enough nutrients for substantial biodegradation of a few parts per million oil in 60 days, and it is reasonable to extrapolate that further dilution in more oligotrophic waters would allow similar degradation on similar time scales.

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Table 1. continued

potential hazards and environmental fate of floating slick	potential hazards and environmental fate of dispersants and dispersed oil
biodegradation of bulk oil in the Gulf of Mexico was very slow[74,75] compared to that of dispersed oil.[35,14]	
While oil hydrocarbons are essentially completely biodegradable (eg., ref 36), many of the deeply colored molecules (resins, asphaltenes, polars, etc) are more resistant to biodegradation, although at least some are consumed.[133,134] While these have minimal biological effects, the lifetime of these molecules in a sandy beach may be prolonged, especially if they have been entrained deep in a beach by storm action.[124,132]	While oil hydrocarbons are essentially completely biodegradable (eg., ref 36), many of the deeply colored molecules (resins, asphaltenes, polars, etc) are more resistant to biodegradation, although at least some are consumed.[133,134] Once the hydrocarbons have been degraded, these fractions lack oily characteristics and become essentially indistinguishable from other inert organic matter in the environment, such as humins.[135]
Physical deanup of beached oil can take weeks to years and requires hundreds to thousands of workers with their ancillary vehicles and support services.[16,128,136]	Optimal dispersant application for surface slicks uses planes that can carry 5000 gallons (19000 L) of dispersant, appropriate to treat 1000 acres (405 ha) of slick.[63] Depending on distances from airfields, several sorties can be flown per day, and spills from a tanker can be treated in a few days. Aerial spraying requires daylight (Figure 1). Subsea injection has the advantage of continuing 24 h a day, and the lower application rates mean that dispersant stocks will potentially last longer. If fully successful, oil from a subsea release may never reach the surface before it is biodegraded.[103]

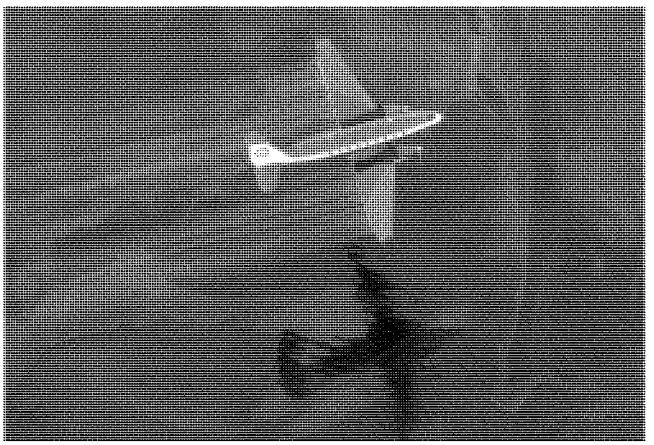

Figure 1. An updated DC3C spraying dispersants on oil from the Deepwater Horizon blowout. The wingspan is 29 m. Reproduced with permission from Airborne Support.

to-volume ratio of the oil, and there is a potential for short-term toxic effects in a dispersed plume. The question is how significant these effects might be in the field. Canonical acute toxicity tests involve constant exposures for 48 or 96 h,[61] but in a response at sea, the concentrations of oil will be dropping rapidly due to dilution by mixing and diffusion. As noted above, concentrations of dispersed oil drop to below 1 ppm within a few hours.[29−33]

Only acute toxicity tests are required for listing under the National Contingency Plan, but of course chronic effects are also a real concern. As expected, the longer exposure required to see chronic effects allows lower concentrations of hydrocarbons to exert an effect, and typical acute-to-chronic ratios are 1:10, that is, it may only take 10% of the acute LC_{50} to have a chronic EC_{50}.[69−72] Again, these concentrations are for prolonged exposures, and it is not clear how these relate to the very low concentrations[29−34] of dispersed oil that are found several days after dispersion.[73]

As noted at the outset, dispersants were initially conceived as a tool for minimizing seabird mortality, and early use weighed that benefit against potential toxicity to planktonic species.[27] However, an additional substantial benefit has now been clearly documented: the biodegradation of dispersed oil is dramatically faster than that of oil in a slick or on a shoreline. Oil on shorelines of Prince William Sound, Alaska, had a half-life of a year or more,[18−20] even with the substantial washing and bioremediation program.[16] Tarballs and mousse associated with the Deepwater Horizon blowout had similar persistence in the environment.[74,75] However, the biodegradation of dispersed oil is rapid and extensive.[14,35−37]

The oil spill response community agrees that the best response to an oil spill would be to collect it from the environment before it reached a shoreline, and many response plans focus on this requirement by staging large amounts of equipment aimed at achieving this goal even in the face of a very large spill (e.g., refs 9−12). However, if oil cannot be collected, particularly if it is unsafe for responders to perform mechanical recovery or because of remote location or hours of daylight, then responders must look to other methods. It is important to recognize that time is of the essence: deciding not to use a response option today may preclude its use tomorrow. This phenomenon, the window-of-opportunity,[76] is particularly relevant to the use of dispersants because as oil weathers by

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evaporation and absorption of underlying water, it becomes progressively more and more difficult to disperse with dispersants. (As an aside, dispersants incorporated into relatively fresh oil will help the dispersion of that oil even after some time if conditions are initially too calm for immediate dispersion,[77] a potential problem for requirements that dispersants be seen to be effective on a trial basis before large-scale application can begin.) Responders must weigh the potential additional short-term toxicity likely incurred immediately under a dispersed surface slick against the benefit of protecting diving birds and animals and having the oil removed from the environment by biodegradation on a time scale of a few weeks rather than years with a vastly smaller human footprint of spill response. The speed of biodegradation is particularly important if the over-riding concern about dispersant use is the potential local increase in toxicity; beached oil and undispersed mousse leach hydrocarbons and have their own potential environmental impacts for a prolonged period. It would also be prudent to bear in mind the environmental impact of large shoreline cleanup operations, which often involve hundreds of workers and the ancillary impacts of their support services. There is also the potential legacy of the final disposal of the oil, which may well involve burial at a secure landfill rather than combustion or biodegradation. Finally, while not an environmental impact, the economic impacts of an oiled marina or shoreline also need to be weighed as responders decide the most appropriate spill-response.

CONCLUDING REMARKS

In the final analysis, some accidents occur so close to shore that oil will undoubtedly reach the shoreline and most likely require some physical cleanup, perhaps followed by bioremediation. However, if the release is in deep water, then it ought to be possible to mobilize dispersants to keep bulk oil from ever reaching a shoreline. If oil is successfully dispersed into the water column, then it is likely that biodegradation will remove the vast majority of it in weeks to months, even in the Arctic and Antarctic.[78] What remains will likely be finely dispersed fragments of nonoily (to the touch) material depleted of hydrocarbons and rich in asphaltic materials and saturated biomarkers such as the hopanes.[36,79,80]

Many questions remain to be answered:

- How does the density of dispersed oil change as biodegradation proceeds? Alkanes are much lighter than water,[81] even at high pressure,[82] as are cyclic alkanes and monoaromatics. However, larger aromatic hydrocarbons, such as chrysene, have densities greater than 1,[83] as do the resins and asphaltenes.[84,85] Since biodegradation preferentially removes alkanes, initially buoyant droplets will become neutral and eventually sink. Is this partially degraded oil further metabolized once deposited on the surface sediment at depth? Reports of substantial amounts of fossil (radiocarbon silent) carbon on the surface sediment at depth[86] could be either unmetabolized oil molecules or the biomass of organisms degrading the oil or, more likely, both. As noted above, some molecules, such as the hopanes, seem very resistant to biodegradation and likely remain with very biodegraded oil (and degrading biomass) as a fingerprint of the initial source.[36,75,79,80]
- What fraction of the oil carbon is mineralized to CO_2 in the initial biodegradation, and what fraction is incorporated into biomass? Classical experiments with aerobes growing on glucose suggest a biomass yield of about 50%,[87] but what is the fate of that biomass? Levy and Lee[88] propose that it is the base for substantial fisheries offshore Atlantic Canada. Chemical analysis of the radiocarbon silent material reported by Chanton et al.[86] will shed light on this question.
- What role does microbial succession play in the biodegradation of oil? Such succession was clearly seen in the Gulf of Mexico following the Deepwater Horizon release,[87−92] but how did it relate to the chemical composition of the residual oil or to the nutrient levels in the water? Do dispersants affect this succession?
- How rapidly are dispersant components degraded in the sea? Early work established the biodegradation of nonionic surfactants in seawater,[93] and dioctylsulfosuccinate is known to be biodegradable[94] and clearly was being degraded close to the Deepwater Horizon spill site where it was being applied in the Corexit dispersant.[95] Nevertheless, traces of dioctylsulfosuccinate have been found far from the Deepwater Horizon accident;[96] was that associated with dispersant application? Traces found close to shore are more likely related to stormwater discharges.[95] Small quantities associated with tarballs[98] are likely the result of suboptimal dispersant application and highlight the need to apply an effective amount of dispersant if its benefits are to be achieved.
- Is biodegradation at depth (>1500 m) fundamentally distinct from biodegradation at the surface? Early work suggested that it is not,[137] but that work was clearly limited in its experimental tools, and there is much to learn. There is no doubt that active hydrocarbon-degrading microbial communities, both aerobic and anaerobic, are present in deep sea sediments.[138]

Already, however, we know enough from laboratory, mesocosm, and field experience to say that dispersed oil is degraded much more rapidly than undispersed oil, likely orders of magnitude more rapidly. This is the key piece of information that seems to be overlooked in most discussions of the potential adverse impacts of using dispersants. Even if there is an adverse local impact of dispersed oil, it will not last long. On the other hand, oil that reaches a shoreline may be there for years.

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Notes

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Oil Spill Dispersants: Boon or Bane?

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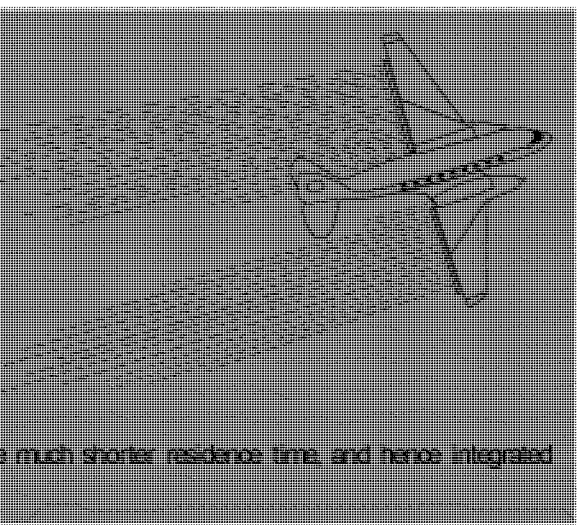
Dispersants provide a reliable large-scale response to catastrophic oil spills that can be used when the preferable option of recapturing the oil cannot be achieved. By allowing even mild wave action to disperse floating oil into tiny droplets (<70 μm) in the water column, seabirds, reptiles, and mammals are protected from lethal oiling at the surface, and microbial biodegradation is dramatically increased. Recent work has clarified how dramatic this increase is likely to be: beached oil has an environmental residence of years, whereas dispersed oil has a half-life of weeks. Oil spill response operations endorse the concept of net environmental benefit, that any environmental costs imposed by a response technique must be outweighed by the likely benefits. This critical review discusses the potential environmental debits and credits from dispersant use and concludes that, in most cases, the potential environmental costs of adding these chemicals to a polluted area are likely outweighed by the much shorter residence time, and hence integrated environmental impact, of the spilled oil in the environment.



INTRODUCTION

Oil fuels our modern world, accounting for some 33% of energy consumption in 2013; daily consumption was 87 million barrels per day.[1] Some of this crude oil is produced from wells drilled under the sea, and a large percentage travels by sea between production and consumption. Despite the best efforts of the oil and shipping industries, some gets spilled. Catastrophic spills appropriately garner the public's attention, although, in fact, most spills are rather small. Natural seeps are likely the largest contributor of oil to the world's oceans, followed by nonpoint sources on land.[2] Tanker accidents are becoming less common,[3] but it is still true that a few large spills contribute the most oil released to the sea by ships, and where such spills occur, they release far more oil in a few days than even the most active seeps. The tragic 2010 blowout from the Deepwater Horizon well[4] is a reminder that large releases can also occur from drilling operations.

Crude oil has been part of the biosphere for millions of years,[5] and a large number of microbes, both prokaryotic[6] and eukaryotic,[7] have evolved to consume it. Biodegradation is the eventual fate for all spilled oil that is not collected or burned, and both collection and combustion require that spilled oil be corralled with booms.[8] While skimming can be an effective process if equipment is close to hand and the weather is reasonably calm, and is frequently part of oil spill response plans (e.g., refs 9−12), large spills in remote areas can spread so quickly that skimming becomes extremely difficult. For example, the Deepwater Horizon response, despite enormous efforts, collected only some 3% of the oil released and burned another 5%.[4] Considerable research has been expended, therefore, on trying to enhance the rate of oil biodegradation.

Oil is an unusual substrate for microbial growth for two distinct reasons. On the one hand, most oil molecules have low density and are very sparingly soluble, so oil tends to stay as surface slicks or droplets dispersed by wave action. Biodegradation is then limited by the surface area of the oil−water interface. On the other, whereas hydrocarbons are rich sources of carbon and energy, oil contains no other useful elements for microbial growth. Nitrogen and phosphorus are the most usual limiting nutrients in the sea,[13] followed by iron and other trace requirements.[14] While seawater contains trace levels of these nutrients,[15] the biodegradation of significant concentrations of oil, such as on a shoreline, is likely to exhaust the local supply. Bioremediation, the stimulation of biodegradation, thus aims to overcome these two limitations.

In the case of oil stranded on shorelines in Prince William Sound AK following the spill from the Exxon Valdez, the first response was to remove oil from beaches by washing it back to the sea and collecting it with skimmers.[16] This had the effect of leaving a relatively thin film of oil on the gravel and rocks of the intertidal (and sometimes supra-tidal) zone, and this was bioremediated by the careful addition of oleophilic and slow-release fertilizers to increase the supply of bioavailable nitrogen and phosphorus. This worked quite well, stimulating oil biodegradation between 2- and 5-fold without causing any additional adverse effects,[17−20] but it should be born in mind that the oil had already been on the shoreline for a year before the quantitative experiments reported therein were begun.

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Floating oil presents different challenges. Floating oil is a very real hazard to diving birds and mammals (e.g., refs 21 and 22), and oil that beaches is a hazard to shorebirds,[23] invertebrates,[24,25] and mangroves.[26] Ameliorating these hazards was a primary impetus for the initial development of oil spill dispersants in the 1970s.[27] Modern dispersants are complex mixtures of anionic and neutral surfactants in a hydrocarbon solvent (e.g., ref 28) that lower the interfacial tension between oil and water so that minimal wave action and turbulence can disperse the oil into tiny droplets (<70 μm) in the water column. Such droplets are essentially neutrally buoyant, so with minimal turbulence they stay in the water column and diffuse apart. Concentrations of dispersed oil may be ≈1000 ppm in the first minutes after dispersion, but they fall to a few ppm, in a correspondingly larger volume, within hours, and to sub parts per million levels within a day.[29−34] Furthermore, even these concentrations are found only in the top few meters of the sea. Similarly, dispersants can harness the ejection turbulence of oil emanating from an uncontrolled subsea release and allow the formation of tiny oil droplets in the deep sea;[4,34−37] again, the droplets diffuse apart until they are in the sub parts per million concentration range. This diffusive dilution means that, although the levels of nutrients in the sea are relatively low,[13] it does not take long for oil concentrations to fall so that even those low levels are adequate for significant and rapid biodegradation. Hazen et al.[14,35] measured half-lives of n-alkanes of a few days in the dilute (2−442 ppb[34]) dispersed submarine plume from the Deepwater Horizon at 1100−1220 m (and 5 °C), and very similar results were reported for a broad array of individual hydrocarbons at low concentrations in New Jersey seawater at 8 °C,[36,37] in a flume in Trondheim, Norway,[38] at 30−32 °C and in water off the Penang, Malaysia, shore[39] at 27.5 °C. The approximate biodegradation half-life of the total measurable hydrocarbons was 11−14 days, both at low oil concentrations with indigenous nutrients[36,38] (2.5 and 43 ppm oil, respectively) and at slightly higher concentrations (100 ppm oil) with added nutrients.[39] Even the four ring aromatic chrysene and its methyl-, dimethyl-, and ethyl-alkylated forms had half-lives on the order of a month.[36]

DISPERSANTS

Dispersants have been used on a large scale in many responses, notably, the 1993 Braer wreck in the Shetland Islands,[40] the 1996 Sea Empress spill in South Wales,[41] and the 2010 Deepwater Horizon blowout in the Gulf of Mexico.[33] Seven spills in the US portion of the Gulf of Mexico were treated with dispersants between 1995 and 2004.[42] Dispersants are stockpiled, with equipment for their use, in large quantities around the world,[43] and substantial illustrated guidelines for their use are freely available.[44] Nevertheless, their deployment is still controversial, for clearly dispersants are not without potential drawbacks. Most dispersants are not themselves significantly toxic; they have toxicities indistinguishable from common household dish liquids and shampoos,[45] including those used for cleaning oiled seabirds,[46,47] and the majority, including those used in the Deepwater Horizon response, show neither androgen- nor estrogen-receptor activity.[48] Nevertheless, the use of dispersants involves adding more chemicals to an already impacted area, and the water under a recently dispersed oil slick is significantly transiently more toxic to organisms than under the undispersed slick, albeit because of the greater concentrations of oil in the water, not because of any increase in toxicity on an oil weight basis.[47,48,50]

So, how should spill response coordinators decide when and where to use dispersants? Most responders rely on a net environmental benefit analysis, often abbreviated NEBA.[51−55] At first glance, the concept seems oxymoronic: how can anything related to an oil spill have an environmental benefit? However, in actuality, the concept is very useful: everyone involved in a cleanup recognizes that an oil spill is a dreadful environmental insult and is working diligently to minimize adverse impacts and to remove the oil as quickly as possible. The question is whether a response tool will end up doing more harm than good, of whether there will be net environmental improvement despite potential collateral harm done in the short term by the response. Table 1 offers a comparison of the potential hazards and environmental fate of floating slicks and dispersed oils that need to be considered in such analyses.

The first hurdle for dispersants is to demonstrate their fundamental efficacy. In the United States, the U.S. Environmental Protection Agency (USEPA) maintains the National Oil and Hazardous Substances Pollution Contingency Plan Product Schedule[56] as part of the National Contingency Plan and lists chemical dispersants that may be authorized for use. Dispersants on the Product Schedule have demonstrated effectiveness; they can disperse at least 45% of Prudhoe Bay or South Louisiana crude oil in a standard swirling flask test.[57] The swirling flask test is one of several tests designed to discriminate between dispersants with different efficacies on a simple laboratory scale. It does this reasonably well (although the USEPA is considering revising it with a baffled flask test[58]), but unfortunately the passing grade of 45% has often been assumed to indicate expected field performance. In fact, the test dramatically underestimates efficacy in the field, primarily due to the amount of energy it imparts to the floating oil and the volume available for diffusion. Tests in the OHMSETT facility,[59] a wave tank in New Jersey that is 200 m long, 20 m wide, and 2.5 m deep, routinely measure dispersant efficiencies >95%, even at low temperatures with ice in the water.[60]

A second requirement for listing on the USEPA product schedule is that the acute toxicity of the dispersant to two reference species (silverside fish, Menidia beryllina (96 h), and mysid shrimp, Americamysis bahia (48 h)[49,59]) be reported. During the Deepwater Horizon response, the USEPA required that dispersants "have a toxicity value less than or equal to (sic) 23.00 (sic) ppm LC_{50} toxicity value for Menidia or 18.00 ppm LC_{50} for Mysidopsis (Americamysis)";[62] the dispersants being used passed this hurdle.[49]

As mentioned above, the toxicity of modern dispersants is usually so low as to likely have only minimal adverse effects at levels used in response operations (nominal aerial dispersant application rates are 5 gallons of dispersant per acre, 47 L/hectare;[63] diffusion into the top 20 cm of seawater would give concentrations around 23 ppm, and of course further diffusion will continually lower the concentration). However, dispersed oil is significantly more toxic, with acute LC_{50} values more than an order of magnitude lower.[49] There has been some confusion around quantifying the toxicity of dispersed oil;[64,65] acute toxicity arises from a general narcosis caused by dissolved hydrocarbons moving to the lipids of the test organism,[66−68] so if estimates of oil concentrations include small droplets, the toxicity expressed on a per milligram hydrocarbon basis are lower (higher LC_{50}) than that for dissolved components. In any case, dispersants encourage solubility by increasing the surface-

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Table 1

potential hazards and environmental fate of floating slick	potential hazards and environmental fate of dispersants and dispersed oil
	Dispersant application has the potential to create aerosols with potentially adverse effects on humans and wildlife. Such effects are seen only in the laboratory at quite high concentrations and with prolonged exposures.[99-102] They are minimized by protective equipment for applicators and exclusion zones around application. Aerial application is very unlikely to be approved within several miles of a coast.
	The addition of dispersants puts additional chemicals into a polluted area. Nominal application rates of dispersants are 5 gallons per acre (47 L ha^{-1}) for surface spills,[63] equivalent to a dispersant/oil ratio of about 1:20. Subsea injection seems to be effective at much lower doses, perhaps 1:100 or less. Dispersants are composed of chemicals that are generally acceptable for food contact and are biodegradable,[28,93,94] but when they are used at suboptimal doses, they may become incorporated into persistent tarballs.[95]
	Dispersants may persist in the environment. Dispersants are complex mixtures of surfactants and solvents, and very few techniques can measure them all.[104] Much published work has focused on individual chemicals, but since all of the components are widely used in consumer products on a far greater scale than in dispersants, care must be taken in attributing detection to dispersant use.[97]
	Dispersants may not penetrate heavy oils and may "roll-off" before they can be effective.[103,105] Nevertheless, dispersants have been shown to be effective with many heavy oils,[117] and new formulations are being developed to further this use.[106]
	Suboptimal dispersant application may not disperse the oil but may hinder subsequent skimming operations.
	Several studies appear to show that dispersants do not stimulate biodegradation very much.[139-141,36,78] Those experiments were based on a misunderstanding of the role of dispersants,[37] which is simply to disperse oil into tiny droplets that can diffuse apart. Such dilute small droplets, whether generated by dispersants or by low concentrations of oil, are degraded rapidly,[36-38,78] and dispersants show no significant stimulatory effect. Dispersed oils that can recoalesce into larger droplets, as occurs in laboratory experiments with more than a few parts per million oil,[139-141] again show only a small stimulation of biodegradation by dispersants. A clear stimulation of biodegradation by dispersants (many fold) is seen only when dispersed oil at environmentally realistic concentrations[29-36] is compared to an undispersed slick.[37] It is the latter that is the target of dispersants.
	Dispersants have been reported to be toxic to some bacteria.[142] These experiments looked at a few isolated cultivars from beach sand rather than pelagic organisms likely to be exposed to dispersants. Dispersants had no inhibitory effects in experiments with pelagic microbes[36-38,78] and were significantly less toxic than oil alone to Vibrio fischeri (now Aliivibrio fischeri[143]) in the Microtox test.[144]
Floating oil can be lethal to birds or mammals that penetrate it. The oil reduces the insulating properties of feathers and fur and may be toxic if ingested during preening or grooming.[21,22] Mild oiling may be transferred to eggs, chicks, and young.[107] Floating oil also likely kills small invertebrates, algae, fish eggs, and young that are at the sea surface under the slick.[108]	Dispersed oil is potentially toxic to organisms close to the surface when the oil is initially dispersed. This is particularly true for small invertebrates, algae, fish eggs, and young that cannot swim away.[109] Nevertheless, measured dilution suggests that they will not be exposed for very long.[29-36] The remarkably heterogeneous distribution of planktonic organisms, on all scales, probably has more influence on local populations than relatively small-scale mortality due to concentrated dispersions of oil.[145,146] Planktonic microbial species respond remarkably rapidly, even to diel cycles.[147] Fish kills are rarely noted after dispersant use, presumably because fish and other nekton swim away from the dispersed oil.
Floating oil is subject to photooxidation, which polymerizes polycyclic aromatic compounds to polar materials.[110,111] This eventually leads to very persistent tarballs.[112] Beached oil undergoes a similar process, leading to very persistent "pavements".[126,127]	
Transparent planktonic organisms may accumulate polycyclic aromatic compounds leached from slicks and beached oil and may be subject to phototoxicity in the surface layer of the sea.[113]	Dispersed polycyclic aromatic compounds may be accumulated by transparent planktonic organisms, which may then be subject to phototoxicity in the surface layer of the sea.[113]
Floating oil absorbs water; it is not unusual for floating slicks to increase their volume by >50% in 24 h.[114-116] This phenomenon makes dispersion more difficult but not impossible.[117] Over several days, many floating oils emulsify, forming water-in-oil emulsions known as mousse.[118-120] The encapsulated water no longer exchanges with bulk seawater, and biodegradation is likely even more nutrient- and oxygen-limited than in the floating slick. Mousse may be consumed by fish, turtles, etc. and also lead to tarballs.[111,112]	
Small molecules in floating oil evaporate rapidly, becoming volatile organic compounds (VOCs)[119,120] that can reach levels of concern for spill responders.[121] Evaporated molecules may be destroyed by photochemistry[122] or biodegradation.[123]	Dispersion slows evaporation, especially if the oil is dispersed subsea, as some was in the Deepwater Horizon response. The potentially toxic small molecules are retained in the water column until they are biodegraded or escape to the atmosphere over a much greater area due to diffusion at depth.
If it is not physically dispersed by storms or recovered mechanically, then an oil slick will likely beach on a shoreline. If it stays on the shoreline surface, then it may be possible to remove it by physical means, but storms will likely incorporate oil deep into sandy beaches,[124,125] where, if left alone, it will likely remain for decades.[126,127] Beached oil can be a major threat to turtle and shorebird nesting[128] and to mangroves[129] and marshes,[130] and recovery may take years.[131,132]	Dispersants are typically used far from shore in deep water (e.g., >3 miles[148]). Dispersed oil diffuses to sub parts per million levels and is very unlikely to reach a shoreline in noticeable quantities.
If the slick arrives at a shoreline, then biodegradation will be slow because of the high concentration of oil in comparison to the low concentrations of bioavailable nutrients in tidal flows. Biodegradation was too slow to measure directly in the absence of bioremediation in Prince William Sound following the Exxon Valdez spill,[18,19] but even with effective bioremediation, the half-life of total detectable hydrocarbons was of the order of 10 weeks.[18,19] The	Dispersed oil dilutes to such low concentrations that biodegradation is rapid. Measured half-lives are in the days to few weeks time frame.[14,33-37] Even the four ring aromatic chrysene and its methyl-, dimethyl-, and ethyl- forms have half-lives on the order of a month.[36] Nearshore waters from the Chukchi Sea,[78] the North West Atlantic,[36] and deepwater from Trondheim Fjord[38] all contained enough nutrients for substantial biodegradation of a few parts per million oil in 60 days, and it is reasonable to extrapolate that further dilution in more oligotrophic waters would allow similar degradation on similar time scales.

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Table 1. continued

potential hazards and environmental fate of floating slick	potential hazards and environmental fate of dispersants and dispersed oil
biodegradation of bulk oil in the Gulf of Mexico was very slow[74,75] compared to that of dispersed oil.[35,14]	
While oil hydrocarbons are essentially completely biodegradable (eg., ref 36), many of the deeply colored molecules (resins, asphaltenes, polars, etc) are more resistant to biodegradation, although at least some are consumed.[133,134] While these have minimal biological effects, the lifetime of these molecules in a sandy beach may be prolonged, especially if they have been entrained deep in a beach by storm action.[124,132]	While oil hydrocarbons are essentially completely biodegradable (eg., ref 36), many of the deeply colored molecules (resins, asphaltenes, polars, etc) are more resistant to biodegradation, although at least some are consumed.[133,134] Once the hydrocarbons have been degraded, these fractions lack oily characteristics and become essentially indistinguishable from other inert organic matter in the environment, such as humins.[135]
Physical deanup of beached oil can take weeks to years and requires hundreds to thousands of workers with their ancillary vehicles and support services.[16,128,136]	Optimal dispersant application for surface slicks uses planes that can carry 5000 gallons (19000 L) of dispersant, appropriate to treat 1000 acres (405 ha) of slick.[63] Depending on distances from airfields, several sorties can be flown per day, and spills from a tanker can be treated in a few days. Aerial spraying requires daylight (Figure 1). Subsea injection has the advantage of continuing 24 h a day, and the lower application rates mean that dispersant stocks will potentially last longer. If fully successful, oil from a subsea release may never reach the surface before it is biodegraded.[103]

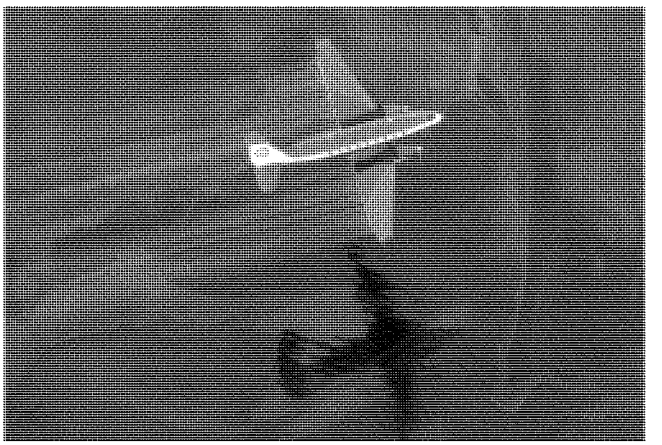

Figure 1. An updated DC3C spraying dispersants on oil from the Deepwater Horizon blowout. The wingspan is 29 m. Reproduced with permission from Airborne Support.

to-volume ratio of the oil, and there is a potential for short-term toxic effects in a dispersed plume. The question is how significant these effects might be in the field. Canonical acute toxicity tests involve constant exposures for 48 or 96 h,[61] but in a response at sea, the concentrations of oil will be dropping rapidly due to dilution by mixing and diffusion. As noted above, concentrations of dispersed oil drop to below 1 ppm within a few hours.[29−33]

Only acute toxicity tests are required for listing under the National Contingency Plan, but of course chronic effects are also a real concern. As expected, the longer exposure required to see chronic effects allows lower concentrations of hydrocarbons to exert an effect, and typical acute-to-chronic ratios are 1:10, that is, it may only take 10% of the acute LC_{50} to have a chronic EC_{50}.[69−72] Again, these concentrations are for prolonged exposures, and it is not clear how these relate to the very low concentrations[29−34] of dispersed oil that are found several days after dispersion.[73]

As noted at the outset, dispersants were initially conceived as a tool for minimizing seabird mortality, and early use weighed that benefit against potential toxicity to planktonic species.[27] However, an additional substantial benefit has now been clearly documented: the biodegradation of dispersed oil is dramatically faster than that of oil in a slick or on a shoreline. Oil on shorelines of Prince William Sound, Alaska, had a half-life of a year or more,[18−20] even with the substantial washing and bioremediation program.[16] Tarballs and mousse associated with the Deepwater Horizon blowout had similar persistence in the environment.[74,75] However, the biodegradation of dispersed oil is rapid and extensive.[14,35−37]

The oil spill response community agrees that the best response to an oil spill would be to collect it from the environment before it reached a shoreline, and many response plans focus on this requirement by staging large amounts of equipment aimed at achieving this goal even in the face of a very large spill (e.g., refs 9−12). However, if oil cannot be collected, particularly if it is unsafe for responders to perform mechanical recovery or because of remote location or hours of daylight, then responders must look to other methods. It is important to recognize that time is of the essence: deciding not to use a response option today may preclude its use tomorrow. This phenomenon, the window-of-opportunity,[76] is particularly relevant to the use of dispersants because as oil weathers by

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evaporation and absorption of underlying water, it becomes progressively more and more difficult to disperse with dispersants. (As an aside, dispersants incorporated into relatively fresh oil will help the dispersion of that oil even after some time if conditions are initially too calm for immediate dispersion,[77] a potential problem for requirements that dispersants be seen to be effective on a trial basis before large-scale application can begin.) Responders must weigh the potential additional short-term toxicity likely incurred immediately under a dispersed surface slick against the benefit of protecting diving birds and animals and having the oil removed from the environment by biodegradation on a time scale of a few weeks rather than years with a vastly smaller human footprint of spill response. The speed of biodegradation is particularly important if the over-riding concern about dispersant use is the potential local increase in toxicity; beached oil and undispersed mousse leach hydrocarbons and have their own potential environmental impacts for a prolonged period. It would also be prudent to bear in mind the environmental impact of large shoreline cleanup operations, which often involve hundreds of workers and the ancillary impacts of their support services. There is also the potential legacy of the final disposal of the oil, which may well involve burial at a secure landfill rather than combustion or biodegradation. Finally, while not an environmental impact, the economic impacts of an oiled marina or shoreline also need to be weighed as responders decide the most appropriate spill-response.

CONCLUDING REMARKS

In the final analysis, some accidents occur so close to shore that oil will undoubtedly reach the shoreline and most likely require some physical cleanup, perhaps followed by bioremediation. However, if the release is in deep water, then it ought to be possible to mobilize dispersants to keep bulk oil from ever reaching a shoreline. If oil is successfully dispersed into the water column, then it is likely that biodegradation will remove the vast majority of it in weeks to months, even in the Arctic and Antarctic.[78] What remains will likely be finely dispersed fragments of nonoily (to the touch) material depleted of hydrocarbons and rich in asphaltic materials and saturated biomarkers such as the hopanes.[36,79,80]

Many questions remain to be answered:

- How does the density of dispersed oil change as biodegradation proceeds? Alkanes are much lighter than water,[81] even at high pressure,[82] as are cyclic alkanes and monoaromatics. However, larger aromatic hydrocarbons, such as chrysene, have densities greater than 1,[83] as do the resins and asphaltenes.[84,85] Since biodegradation preferentially removes alkanes, initially buoyant droplets will become neutral and eventually sink. Is this partially degraded oil further metabolized once deposited on the surface sediment at depth? Reports of substantial amounts of fossil (radiocarbon silent) carbon on the surface sediment at depth[86] could be either unmetabolized oil molecules or the biomass of organisms degrading the oil or, more likely, both. As noted above, some molecules, such as the hopanes, seem very resistant to biodegradation and likely remain with very biodegraded oil (and degrading biomass) as a fingerprint of the initial source.[36,75,79,80]
- What fraction of the oil carbon is mineralized to CO_2 in the initial biodegradation, and what fraction is incorporated into biomass? Classical experiments with aerobes growing on glucose suggest a biomass yield of about 50%,[87] but what is the fate of that biomass? Levy and Lee[88] propose that it is the base for substantial fisheries offshore Atlantic Canada. Chemical analysis of the radiocarbon silent material reported by Chanton et al.[86] will shed light on this question.
- What role does microbial succession play in the biodegradation of oil? Such succession was clearly seen in the Gulf of Mexico following the Deepwater Horizon release,[87−92] but how did it relate to the chemical composition of the residual oil or to the nutrient levels in the water? Do dispersants affect this succession?
- How rapidly are dispersant components degraded in the sea? Early work established the biodegradation of nonionic surfactants in seawater,[93] and dioctylsulfosuccinate is known to be biodegradable[94] and clearly was being degraded close to the Deepwater Horizon spill site where it was being applied in the Corexit dispersant.[95] Nevertheless, traces of dioctylsulfosuccinate have been found far from the Deepwater Horizon accident;[96] was that associated with dispersant application? Traces found close to shore are more likely related to stormwater discharges.[95] Small quantities associated with tarballs[98] are likely the result of suboptimal dispersant application and highlight the need to apply an effective amount of dispersant if its benefits are to be achieved.
- Is biodegradation at depth (>1500 m) fundamentally distinct from biodegradation at the surface? Early work suggested that it is not,[137] but that work was clearly limited in its experimental tools, and there is much to learn. There is no doubt that active hydrocarbon-degrading microbial communities, both aerobic and anaerobic, are present in deep sea sediments.[138]

Already, however, we know enough from laboratory, mesocosm, and field experience to say that dispersed oil is degraded much more rapidly than undispersed oil, likely orders of magnitude more rapidly. This is the key piece of information that seems to be overlooked in most discussions of the potential adverse impacts of using dispersants. Even if there is an adverse local impact of dispersed oil, it will not last long. On the other hand, oil that reaches a shoreline may be there for years.

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Notes

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To: Conmy, Robyn[Conmy.Robyn@epa.gov]; Principe, Vanessa[Principe.Vanessa@epa.gov]
From: Wilson, Gregory
Sent: Tue 4/14/2015 1:48:01 PM
Subject: RE: dispersants

http://www.bsee.gov/Technology-and-Research/Oil-Spill-Response-Research/Projects/Project1016/

From: Conmy, Robyn
Sent: Tuesday, April 14, 2015 9:14 AM
To: Wilson, Gregory; Principe, Vanessa
Subject: dispersants

Wondering if either of you have any experience or knowledge of Accell® Clean DWD and ZI 400 dispersants? We do not have them in the lab, so no working knowledge here. BSEE has requested that I include Accell® Clean DWD as a product in the brine pool DE experiments. Also, I am about to review a report for them from some Ohmsett work and these two products were used.

Just curious if these products are a high priority for some reason?

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To: Conmy, Robyn[Conmy.Robyn@epa.gov]; Principe, Vanessa[Principe.Vanessa@epa.gov]
From: Wilson, Gregory
Sent: Tue 4/14/2015 1:31:30 PM
Subject: RE: dispersants

According to the Product Schedule, Accell® Clean DWD was added to the Schedule in 2011 and ZI-400 in 2005.

http://www2.epa.gov/emergency-response/national-contingency-plan-subpart-j#schedule

Also, it looks like ZI-400 was one of the dispersants Mace used in his study:
http://onlinelibrary.wiley.com/doi/10.1002/etc.619/pdf

From: Conmy, Robyn
Sent: Tuesday, April 14, 2015 9:14 AM
To: Wilson, Gregory; Principe, Vanessa
Subject: dispersants

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To: Wilson, Gregory[Wilson.Gregory@epa.gov]; Principe, Vanessa[Principe.Vanessa@epa.gov]
From: Conmy, Robyn
Sent: Tue 4/14/2015 1:13:36 PM
Subject: dispersants

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Just curious if these products are a high priority for some reason?

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Cc: Conmy, Robyn[Conmy.Robyn@epa.gov]
From: Barron, Mace
Sent: Thur 8/13/2015 6:31:19 PM
Subject: fyi on interesting paper on modeled dispersed oil tox
Vikebø et al. 2015.pdf

Environmental Science & Technology

Article

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Dispersants Have Limited Effects on Exposure Rates of Oil Spills on Fish Eggs and Larvae in Shelf Seas

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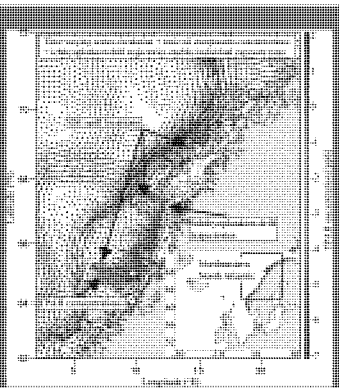
* Supporting Information

Early life stages of fish are particularly vulnerable to oil spills. Simulations of overlap of fish eggs and larvae with oil from different oil-spill scenarios, both without and with the dispersant Corexit 9500, enable quantitative comparisons of dispersants as a mitigation alternative. We have used model simulations of a blow out of 4500 m^3 of crude oil per day (Statfjord light crude) for 30 days at three locations along the Norwegian coast. Eggs were released from nine different known spawning grounds, in the period from March 1st until the end of April, and all spawning products were followed for 90 days from the spill start at April first independent of time for spawning. We have modeled overlap between spawning products and oil concentrations giving a total polycyclic hydrocarbon (TPAH) concentration of more than 10 or 0.1 ppb (µg/l). At these orders of magnitude, we expect acute mortality or sublethal effects, respectively. In general, adding dispersants results in higher concentrations of TPAHs in a reduced volume of water compared to not adding dispersants. Also, the TPAHs are displaced deeper in the water column. Model simulations of the spill scenarios showed that addition of chemical dispersant in general moderately decreased the fraction of eggs and larvae that were exposed above the selected threshold values.



INTRODUCTION

The development of petroleum resources in the marine environment comes with the risk of introducing substances toxic to the inhabitants of the near-field waters. This may be part of normal production[1] or accidental spills.[2,3] National authorities therefore impose requirements on the oil industry of assessing risks before allowing search, development, and production of petroleum resources in their respective economic zones. Whether the risks are acceptable is a political question that is debated on by considering both the risk assessment and corresponding recommendations by the responsible governmental agencies along with the potential profit. A risk assessment typically involves mapping marine resources and physical oceanic features to enable numerical estimates of exposure to oil by key marine species in various oil-spill scenarios (OSSs). Field observations enable biophysical models to be adapted to the area of interest and to marine resources that have been prescreened to be most vulnerable. For the Lofoten-Barents Sea, this has been identified to be early life stages (ELS) of fish and seabirds.[4,5]

If the authorities allow for petroleum extraction, accidental spill of oil may occur. This will result in oil being introduced to the sea at a certain rate, depth, and duration. The oil characteristics, the dynamics of the ocean and atmosphere immediately above, and the presence and composition of oil degrading bacteria determine spatiotemporal oil dispersal, degradation, emulsification, and evaporation. At this point, the responsible oil companies and governmental agencies need to address plans for combating the oil. Several options are at hand. The options for controlling the dispersal of oil are to burn or collect it (surface spill only), or to add chemical dispersants, with the aim of causing the least possible harm to the marine environment and its inhabitants. In this study, we will focus on the use of chemical dispersants.

Research and public debate on the use of dispersants have recently been fueled by the massive use after the Macondo blow-out in 2010. In total, 780 000 m^3 of oil was spilled during 86 days, and a total of 7000 m^3 of dispersants was used at the surface and at the oil release site at approximately 1500 m in depth.[6] Until now, history has shown that use of dispersants may cut both ways. It is suggested that the use of 10 000 tonnes of dispersants in connection with the Torrey Canyon shipwreck had larger environmental impacts than the 119 000 tonnes of oil itself[7] due to the toxicity of the dispersants used at that time. Contrary, it was estimated that the 446 tonnes of dispersants used during the 72 000 tonnes release of oil after the Sea Empress shipwreck in 1996 prohibited between 57 000 - 110 000 tonnes of oil emulsion to reach shore and thereby reduced the environmental impacts.[8] It is believed that the use of dispersants during the Macondo blow-out reduced the amount of oil reaching the shore by trapping it at great depths and increasing the biological degradation of the oil. However, the fate and the impacts of the oil spill still remain uncertain.[9,10]

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In short, the introduction of dispersants shifts the oil droplet spectra toward smaller droplet sizes. Oil droplet sizes and densities, together with the ambient density of the seawater and the level of vertical mixing, determine the vertical displacement of the individual droplets. Smaller droplet sizes due to the introduction of dispersants result in less buoyancy and parts of the spilled oil descending. At the same time, the reduction in droplet sizes enhances the solvability of the oil and, hence, speeds up the transition from oil droplets to the water accommodated fraction (WAF). In turn, this will increase the availability of oil to microbial biodegradation favored by smaller droplets with a higher surface to volume ratio and dissolved oil.[11-13] There are studies that have shown that dispersants may inhibit bacterial degradation of oil,[14] but this has been questioned and attributed to the unrealistic high doses used in the experiments.[15] It has been shown that bacteria can degrade oil at high rates even at low temperatures, although the population growth of the bacteria at these temperatures is low.[12,16-18]

Prior studies have shown that fish ELS are particularly sensitive to total polycyclic aromatic hydrocarbon (TPAH) concentrations, and exposure to low concentrations of TPAHs (1-20 µg/l) is associated with irreversible heart failure, which leads to a number of secondary effects from loss of circulation, like spinal and jaw deformities, that again results in reduced swimming and feeding, and ultimately death during larvae stages (e.g., see refs 19-24). Hence, adding dispersants speeds up the transition from large droplets to smaller droplets, and TPAHs in the WAF before the concentration of toxic components are reduced to below threshold levels for effects due to dilution. While many studies indicate elevated toxicity as a result of introducing dispersants,[25-29] they all attributed this to enhanced concentrations of TPAHs due to the promotion of smaller droplets and hence increasing fraction of oil in WAF. At open sea, biodegradation and dilution rapidly decrease concentrations of toxic components, and the overall effect of introducing dispersants is therefore not obvious. However, there are also studies indicating that chemically dispersed oil appears to be less toxic than mechanically dispersed oil as shown by gene transcription.[30] While dispersants are toxic themselves, their effective doze are higher than what can be expected in the water column during realistic operations.[15] It is therefore not to be expected that oil and dispersants have synergistic effects besides the enhanced amount of small droplets and WAF.[29]

Less attention has been paid at the potential benefits of actively using dispersants to guide oil plumes away from particularly vulnerable species. The use of dispersants, as opposed to not using them, implies oil distributed deeper in the water column. This may in turn affect the dispersal of oil if horizontal currents vary with depth,[31] equivalent to the dispersal of plankton.[32] Numerical predictions supported by measurements of oil dispersal and fate and distribution of relevant marine resources enable such considerations.[31]

We hypothesize that the introduction of dispersants increases the near-field concentrations of toxic components of the oil (here represented by the TPAHs) due to generation of lesser oil droplets and consequently more oil in WAF, but at the same time decreases the volume of water contaminated with toxic levels above effect concentrations reported for fish ELS due to biodegradation and dilution. As a consequence, we expect that introducing dispersants does not increase the amount of fish ELS experiencing levels of oil above effect concentrations. To study this, we simulate the dispersal and fate of oil from three sites at the continental shelf along the Norwegian coast and the corresponding exposure of Northeast Arctic (NEA) cod ELS with and without applying dispersants (Figure 1). We quantify

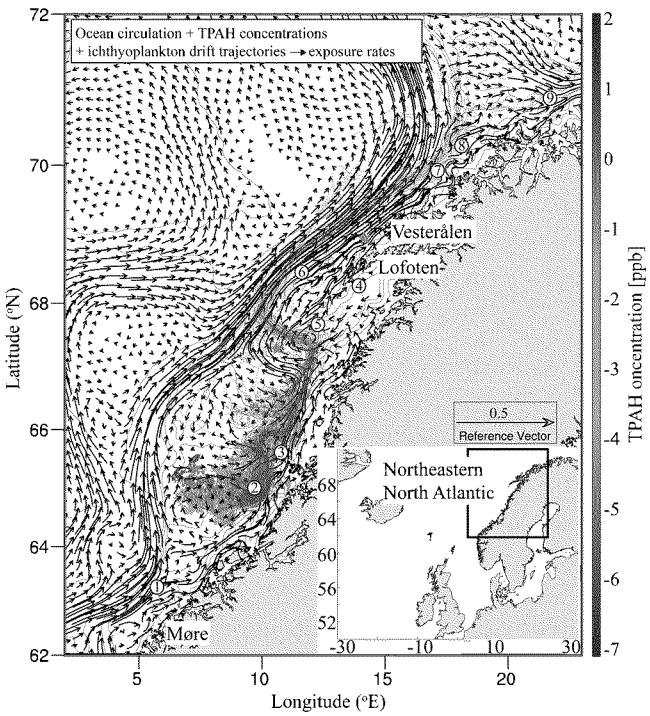

Figure 1. Monthly mean circulation at 20 m depth for April 1997. Blue stars indicate the three oil spill locations investigated here. Oil spilled from the southernmost location results in concentrations (maximum concentration in the water column) of TPAHs according to the colorbar (log 10 ppb). The nine different known SGs considered here are indicated with numbers enclosed by circles. Red lines indicate random examples of egg/larvae drift trajectories originating from SG 2.

the fraction of individuals that are exposed to concentrations of TPAHs of more than 1.0 or 0.1 ppb (µg/l). At these orders of magnitude, we expect acute mortality or sublethal effects, respectively, as described in ref 3. By doing so, we may quantify the (1) effects of using dispersants on the fraction of spawning products exposed to above-threshold levels of TPAHs and (2) how this varies with spill site and distance to the spawning ground (SG). In turn, this allows us to discuss the potential for (3) utilizing dispersants for guiding an oil plume spatially to minimize environmental impact here exemplified by the overlap of fish ELS and toxic components of the oil.

MATERIALS AND METHODS

To quantify the effect of adding dispersants to potential oil slicks on spatiotemporal oil distribution and overlap with fish ELS, we build on the study by Vikebø et al.[31] by adding dispersants sufficient to fully treat all oil released in spill scenarios 1-3. By comparing with scenarios where no dispersants are added, we may contrast the effects on NEA cod ELS. In short, we released 4500 m^3 d^{-1} of oil (Statfjord light crude) at three locations along the coast (65.00° N N7.00° E; 67.00° N N10.33° E; 68.67° N N13.92° E) at the surface April 1, 1997 with duration of 30 days. The overlap (%) of TPAHs with NEA cod ELS from nine spatially separated SGs, distributed from Møre to the Finmark coast (Figure 1), were

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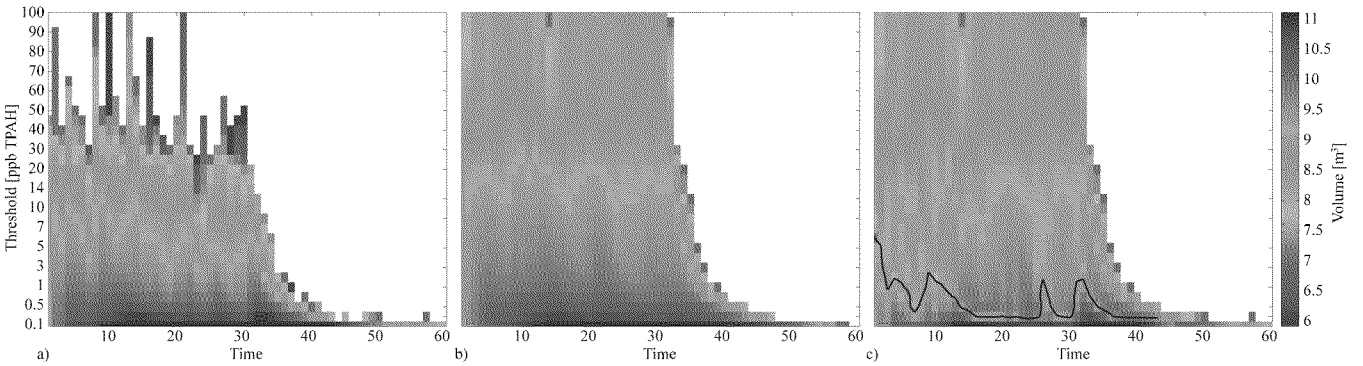

Figure 2. Volume (log 10, m^3) of water with concentrations of TPAHs above threshold values ranging from 0.1 - 100 ppb as a function of time without (a) and with (b) dispersants. The absolute difference between the two is shown in panel c. The solid thick line indicates where they are equal. Below this line, concentrations without dispersants are highest and opposite above this line. The colorbar range 6 - 11 is equivalent to volumes of 1 km^3 of 1 m depth to 100 km^3 of 10 m depth.

quantified for TPAH concentrations at two different vertical levels, either the maximum TPAHs in the water column or the TPAH concentrations at the depth of the diurnally migrating larvae. This is because empiri tells us that NEA cod ELS do migrate vertically according to day or night but that this behavior is uncertain due to scarse data and varying ambient environmental conditions. Hence, it is therefore also relevant to consider the maximum TPAH concentration in the water column at the same lon, lat position and compare this to the concentration if also considering the actual depth of the individual.

Ocean Model ROMS. The ocean model used is the Regional Ocean Model System (ROMS; http://www.myroms.org/). It provides daily mean three-dimensional physics to the oil drift and fate model OSCAR and the individual-based NEA cod egg and larval model. The simulation period (1989 - 2008), area (Nordic Seas and the Barents Sea), spatial resolution (4 × 4 km^2 and 30 vertical sigma layers), boundary forcing, and model performance are described in refs 33 and 34 indicating that coastal shelf and shelf slope dynamics are well reproduced.

Oil Drift and Fate Model OSCAR. The oil drift and fate model OSCAR[35 - 37] is a pseudolagrangian three-dimensional model where particles resemble oil components and predicts spatiotemporal dispersal along with buoyancy effects on vertical displacements, hydrocarbon dissolution, and hydrate formation.[31] The OSCAR model represents oil by 25 pseudocomponents and is here set up to only report on the TPAH concentrations. The pseudocomponents included in the OSCAR model are given in ref 38. Of these, the TPAHs comprise two different pseudocomponents for Naphtalenes and two different pseudocomponents for TPAHs.

OSCAR features the possibility of modeling response actions by introducing dispersants at various rates and locations. This includes surface application of dispersants from either seaborne or airborne vessels. These response vessels account for storage capacity of dispersants, efficiency of application methods, equipment, and weather conditions.[39] A primary function of dispersant agents is to reduce the oil - water interfacial tension and thereby promote breakup of oil into smaller droplets due to turbulence and breaking waves in the surface layer of the sea.[40]

To compare results with and without the use of dispersants, we choose to avoid the complexity of modeling response vessels. Instead, the oil spill model assumes that application methods, efficiency, weather conditions, and amount of dispersant available is sufficient to fully treat the entire release of oil. This treatment is performed immediately after release to the sea, causing the oil to be fully mixed into the water column as droplets and dissolved constituents. Weathering effects on surface slicks, such as emulsification and evaporation, therefore no longer occur. Furthermore, it is assumed that the reduction in oil - water interfacial tension and the turbulence in the surface layer are sufficient to break the oil into droplets with a diameter of order 10 μm. These assumptions result in an oil-in-water dispersion of near-neutrally buoyant droplets and neutrally buoyant dissolved constituents. The oil remains submerged in the upper water column, where the primary contributors to transport are advection by ocean currents and turbulent diffusion.

ELS Individual-Based Model for NEA Cod. The ELS biophysical model is a particle-tracking model, with build-in modules for individual physiological and behavioral responses in eggs and larvae to ambient forcing. Particles, representing either eggs or larvae, move according to a daily mean modeled circulation archive established with the ROMS model application as described above. Each particle keeps track of the daily temperature exposure allowing for temperature-dependent growth according to ref 41. The egg stage duration is set to 21 days. During this period, the particles are displaced vertically with a binned random walk[42] according to their buoyancy[43] and mixing as reported by the turbulence scheme in the ocean model. After hatching of the eggs, the larvae start migrating vertically depending on the light availability and their individual size. Clearly, there are many factors that might affect larvae behavior,[32,44,45] but our knowledge of this, and field samples of the individual larval state and environmental conditions, is limited. Hence, we have incorporated a diurnal migration dependent on the individual larval swimming capability (here a function of larval length) and the light availability. The larvae are set to ascend during night toward an upper limit of 5 m and descend during day toward a lower limit of 40 m.[46,47,44]

At each of the nine different SGs,[48,49] we introduce 10 500 particles released every third day across 60 days from early March until late April. Each particle is transported according to the currents at the time and location of the respective spatiotemporal varying positions. By coupling the model output of the ELS individual-based model and the oil drift and fate model OSCAR, we keep track of the time-varying TPAH concentrations along the individual egg and larval drift trajectories. To assess overall effect of the various OSSs, we

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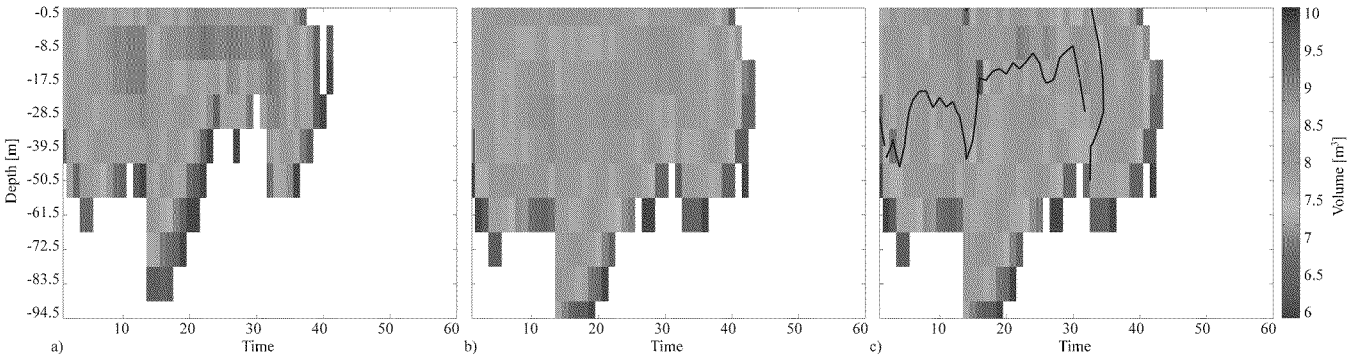

Figure 3. Volume (log 10, m^3) of water per vertical meter with concentrations of TPAHs above 1 ppb in the cases without (a) and with (b) dispersants. The absolute difference between the two is shown in panel c. The solid thick line indicates where they are equal. Above this line, concentrations without dispersants are highest and opposite below this line.

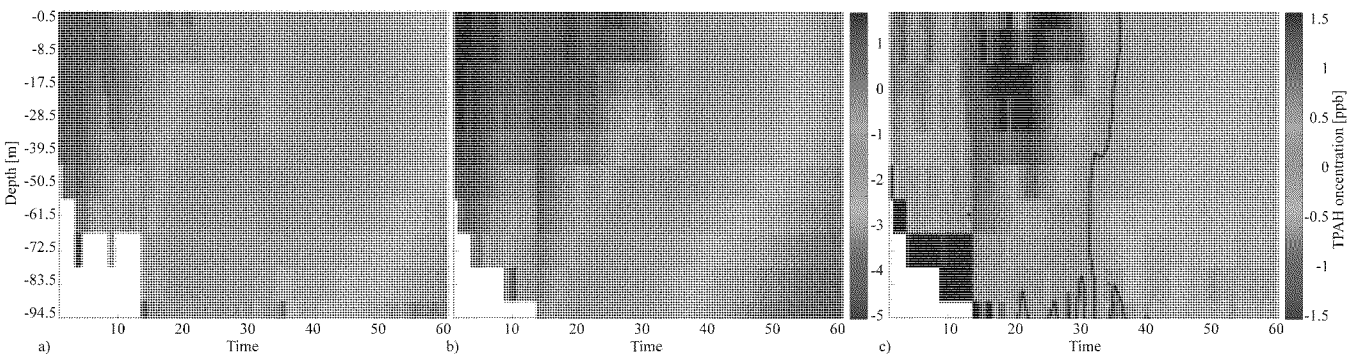

Figure 4. Mean horizontal concentrations of water masses with TPAH concentrations above 1 ppb per depth interval without (a) and with (b) dispersants. The absolute difference between the two is shown in panel c. The solid thick line indicates where they are equal. To the right of this line, concentrations without dispersants are highest and opposite to the left of this line.

scale the different SGs according to recent years of temporal and spatial spawning intensities.[49] The SGs 1-9 contribute with approximately 5, 5, 5, 20, 10, 20, 15, 10, and 10% of the eggs, respectively. Considering each particle as a super-individual representing multiple eggs and larvae enables us to scale the particle release according to our empirical knowledge of spatial and temporal spawning intensities.

RESULTS

General Features of TPAH Dispersal. The OSCAR model simulates the concentrations of dissolved TPAHs in the water column as a function of time after the oil spill starts, without and with dispersants (Corexit 9500). Figure 2 shows the total volume of water (log 10, m^3) with concentrations above various threshold levels of TPAHs from 0.1, 0.5, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 14, 16, 18, and 20 to 100 ppb with increment 5 ppb, as a function of time after the oil spill starts, without (a) and with (b) dispersants (Corexit 9500) as a result of OSS 1. As expected, the water volume with minimum values of TPAHs above the lowest threshold level (0.1 ppb, on the order of 3×10^{11} m^3) is several hundred thousand times greater than for the high threshold levels (100 ppb, on the order of 3×10^6 m^3). The corresponding difference in volume estimates (c) is also shown (b minus a), along with a solid black line showing where they are equal. Clearly, for low threshold levels, below about 8 ppb TPAHs and less depending on time, the total volume of water above the respective threshold levels of TPAHs is higher in the case without the use of dispersants (Figure 2c). If the considered threshold level is above the black line, it is consistently oppositely higher with use of dispersants. It is similar for the OSS 2 (Figure S1a-c, Supporting Information), while scenario 3 results in a volume estimate being the highest when adding dispersants for most thresholds and times (Figure S4a-c). It is evident that introducing dispersants results in concentrations above thresholds also for elevated threshold levels (Figure 2b), while this is not the case when dispersants are not used (Figure 2a). This is similar for all OSSs.

Figure 3 shows the total volume (log 10, m^3) of water with concentrations above 1 ppb TPAHs as a function of depth, without (a) and with (b) dispersants. Again, the corresponding difference is shown in the right panel (c). From above, we have learned that at 1 ppb TPAHs, the total volume of water is higher in the case without dispersants. Here, we can see that this is true in the upper part of the water column, down to about 10-40 m depending on the number of days after the spill starts (Figure 3c). Below this depth, the volume of water is higher in the case with dispersants. This is also a dominating feature for OSS2 (Figure S2a-c) but opposite for OSS3 (Figure S5a-c).

Figure 4 shows the mean horizontal concentration for each depth level including only grid cells above 1 ppb TPAH without (a) and with (b) dispersants. The right-hand panel (c) shows the difference in mean concentration estimates. Here, we can see that though the total volume of water masses with concentrations of TPAHs above 1 ppb is higher in the upper water column without dispersants (Figure 3), the mean concentrations are always higher when dispersants are added as long as the spill endures (Figure 4c; day 1-30). However, after the spill has ended, the mean concentrations throughout

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the water column are higher in the case without dispersants. This is similar for OSS2, but not entirely so for OSS3 (Figures S3a - c and S6a - c).

Hence, in general, the introduction of dispersants results in less water being contaminated with TPAHs, but the contaminated water has higher concentrations of TPAHs. Also, the TPAHs are displaced deeper in the water column.

Eggs and Larvae Exposed to TPAHs. Given the fact that processes controlling vertical distribution of NEA cod larvae are only partly known, and here represented numerically according to our current level of knowledge, we summarize the overlap estimates of TPAHs and ichthyoplankton with and without the use of dispersants for two different values of TPAH concentrations in the water column: the maximum and the depth specific values at the time-varying geographical position of each individual. The exposure values then represent the maximum and the best approximation given our current knowledge of larval behavior. In the following, we present the fraction of individuals from the different SGs exposed to above 1.0 or 0.1 ppb PAH at least once during the 60 day drift period. Also, we have indicated which combinations of OSSs and SGs result in exposures more than 1 standard deviation (s.d.) above the mean of all combinations. Furthermore, we add information on recent years observed spawning distribution and spawning intensity and report on the overall effect of the various OSSs on the eggs and larvae, and quantify how the use of dispersants modifies the results. Finally, we quantify the size of the fractions being exposed to various durations above the threshold levels.

Fraction Exposed to >1.0 ppb TPAHs. Figure 5, panel a shows the fraction exposed to >1.0 ppb TPAHs when accounting for maximum concentrations of oil in the water column. If not introducing dispersants, the results show that a southern oil spill (OSS1) mostly affects eggs and larvae from the southern SGs,[1-3] while northern oil spills (OSS3 and partly OSS2) affect eggs and larvae from almost all SGs. The combinations of oil spills and SGs that result in >1 s.d. (corresponds to about 7% of the individuals) are SG1 - 3 for OSS2 and SG5 for OSS3. When introducing dispersants, the fractions of exposed individuals in the case of OSS1 and OSS2 are reduced, while they are either elevated or reduced depending on SGs in the north (OSS3). The same combinations of OSSs and SGs surpass 1 s.d. above the mean when introducing dispersants (except SG2 during OSS2).

Figure 5, panel b shows the fraction exposed to >1.0 ppb TPAHs when accounting for the egg and larval depth-specific concentrations of oil in the water column along the individual trajectories. The general features of the results, both with and without the use of dispersants, are similar to the case when accounting for maximum concentrationTs of PAHs in the water column, but the overall level of exposure is reduced. The level of 1 s.d. above mean is reduced from about 7% to about 5%.

Fraction Exposed to >0.1 ppb TPAHs. Figure 6, panel a shows the fraction exposed to >0.1 ppb PAH when accounting for maximum concentrations of oil in the water column, with and without the use of dispersants. In the case without dispersants, the results reveal that the combination of OSS1 and SG2 results in the highest fraction of exposure amounting to about 58%. Apart from that, the results are similar to the features of the two previous figures, but with much higher exposure levels. Here, 1 s.d. above the mean is about 21%. Introducing dispersants decreases the exposure levels in the south (OSS1 - 2), while it kept them almost fixed in the north. When accounting for the exposure levels at the depth of the individual egg or larvae (Figure 6b), the features of the results are similar, but the exposure levels generally decrease as indicated by the value of 1 s.d. above mean now reduced from about 21 to 17%.

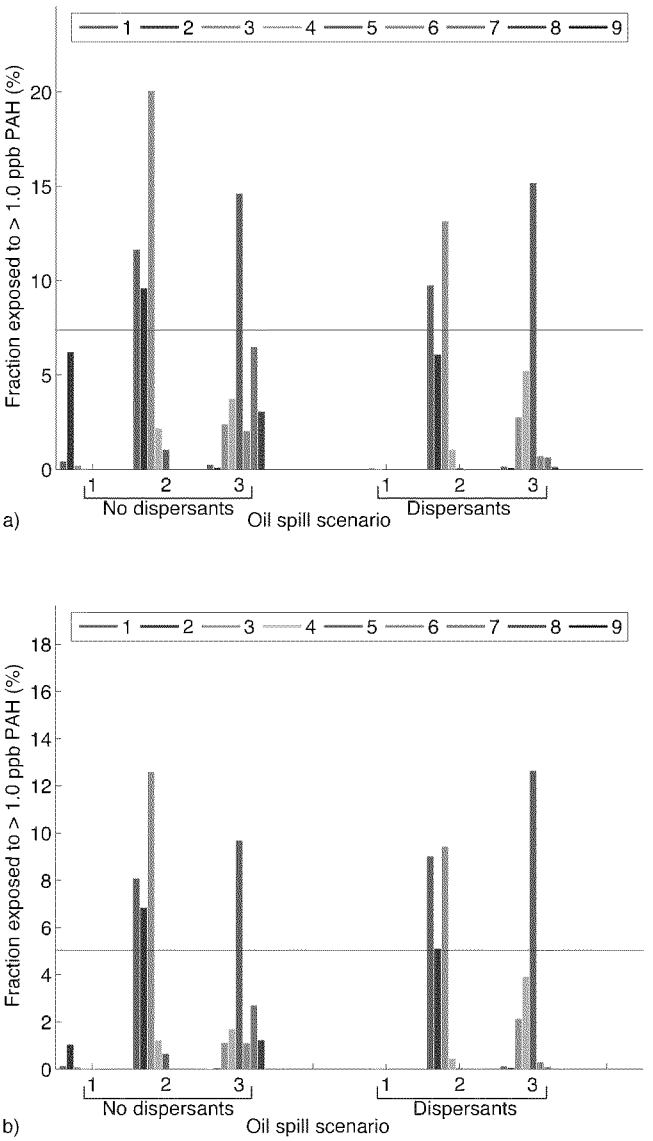

Figure 5. Percentage overlap of the spawning products with TPAH concentrations above 1.0 ppb at least once during the first 60 days after the beginning of the oil spill in OSSs 1 - 3, with and without the use of dispersant, based on the maximum TPAH concentrations in the water column (a) or the individual depth of the offspring (b). The horizontal line denotes one standard deviation above the mean.

Overall Results When Accounting for Realistic Spawning Distribution and Intensity. Figure 7 shows the fraction of eggs and larvae that are exposed to concentrations above the threshold levels (1.0 or 0.1 ppb) of TPAHs for the different OSSs, with and without the use of dispersants, when accounting for the seasonal and spatial spawning intensity. In general, there is a reduction in the fraction of exposed individuals for OSSs, mostly in the south and moderate farther north, when introducing dispersants. This is the case independent of threshold level 1.0 or 0.1 ppb TPAHs or whether the concentration represents the maximum concentration in the water column or the concentration at the depth of the individuals. Note that sublethal effects affect several times

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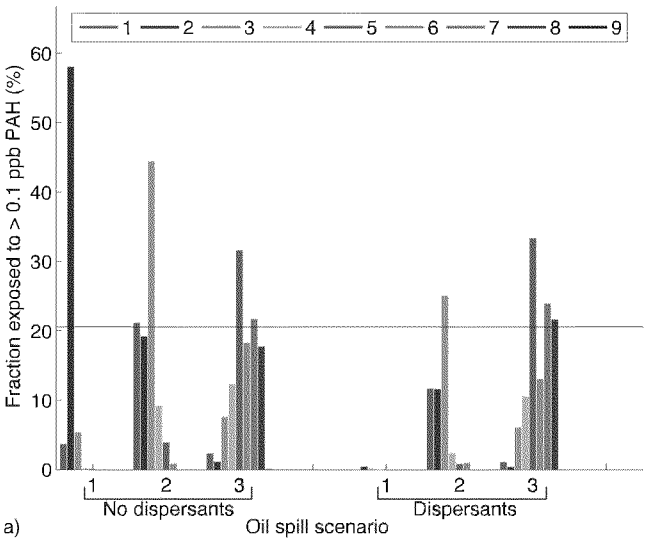

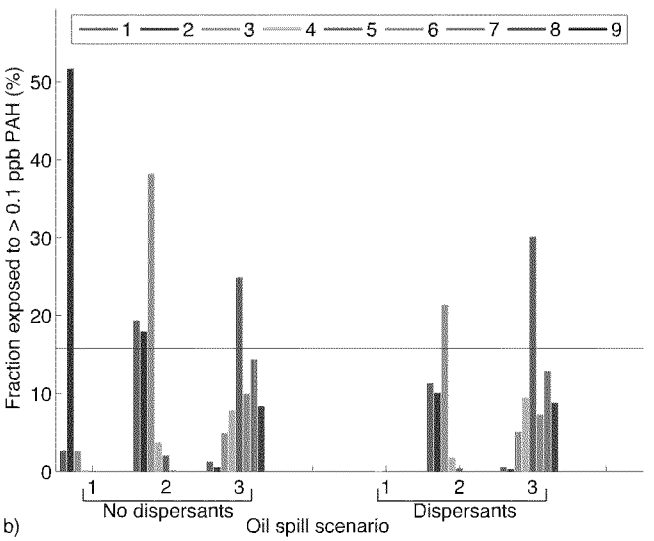

Figure 6. Percentage overlap of the spawning products with TPAH concentrations above 0.1 ppb at least once during the first 60 days after the beginning of the oil spill in OSSs 1-3, with and without the use of dispersant, based on the maximum TPAH concentrations in the water column (a) or the individual depth of the offspring (b). The horizontal line denotes one standard deviation above the mean.

more individuals than those experiencing acute effects, independent of whether one consider TPAH concentrations at the individual depths of eggs or larvae or the maximum in the water column.

Durations of Exposure above Thresholds. Figure 8 shows the fraction of individuals that are exposed to above 1.0 or 0.1 ppb TPAHs for the three different OSSs independent of SGs, without (Figure 8a) and with (Figure 8b) the use of dispersants for different durations. In the case of 1.0 pbb TPAHs, few individuals are exposed to above threshold levels of TPAHs for more than 5 days. At the same time, dependent on the OSS, up to about 50% of the individuals are exposed more than 1 day. In the case of sublethal effects, accounting for the fraction exposed to >0.1 ppb TPAHs, the ratio of individuals exposed to above threshold levels more than a day compared to only a single day increases substantially. In fact, this is now more frequent than only being exposed a single

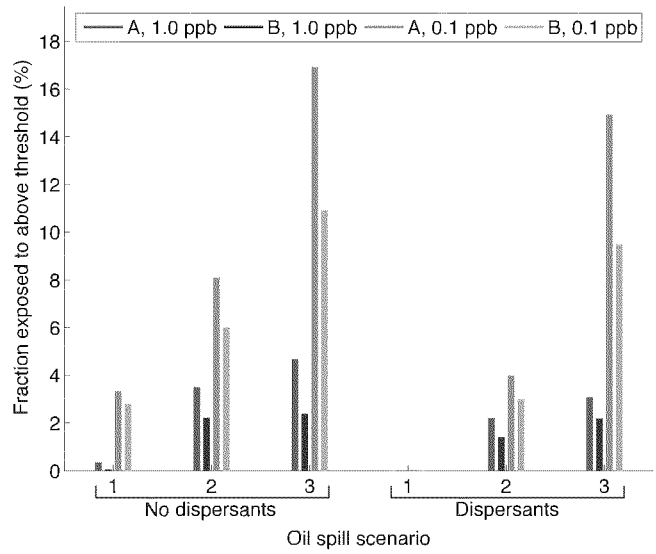

Figure 7. Percentage overlap of offspring with TPAH concentrations above 1.0 or 0.1 ppb at least once during the first 60 days after the beginning of the oil spill in OSSs 1-3, with and without the use of dispersant, based on either the maximum TPAH concentrations in the water column (A) or the TPAH concentrations at the individual depths of the offspring (B) when the seasonal and spatial spawning intensity are incorporated in the analysis.

day. Fewer individuals are affected by above threshold levels of ppb TPAHs when introducing dispersants. However, there is a tendency toward longer durations of exposure.

DISCUSSION

Adding dispersant (Corexit 9500) in case of an oil spill reduces the surface tension of the oil droplets and results in a shift of the oil droplet size spectra toward smaller droplets sizes. In turn, this facilitates both a shift toward more dissolved oil and a displacement away from the surface and into the water column. This also occurs naturally by turbulent mixing caused by, for example, wave breaking and vertical current shear due to wind stress, but adding dispersant chemicals further fuels the process. There are several laboratory studies addressing potential toxic effects of adding dispersant (e.g., 50) and tank studies to quantify changes in the droplet size spectra and concentrations of different oil components in the droplet or WAF. However, to integrate large-scale effects of major oil spills and address how the use of dispersants may contribute to minimize ecosystem effects, one must combine observations and models. Here, we utilize the oil spill and fate model OSCAR, which is parametrized based on observations from both laboratory and field measurements, in combination with an individual-based model for early life stages of NEA cod eggs and larvae to reveal the effects of adding dispersants to a major oil spill.

Adding unlimited dispersant to the oil immediately following the release so that all the oil is fully treated, disregarding the limitations of ship or aeroplane capacities to provide sufficient supplies, results in higher concentrations of TPAHs but in a reduced volume of water compared to a situation where no dispersants are added. Also, adding dispersants causes the TPAHs to be displaced farther down in the water column, and the duration of elevated concentrations of TPAHs after the spill has ended is shortened. However, this is valid for threshold levels of effects around 1.0 ppb TPAHs. If considering threshold levels of toxicity on the order of 10 ppb TPAHs or

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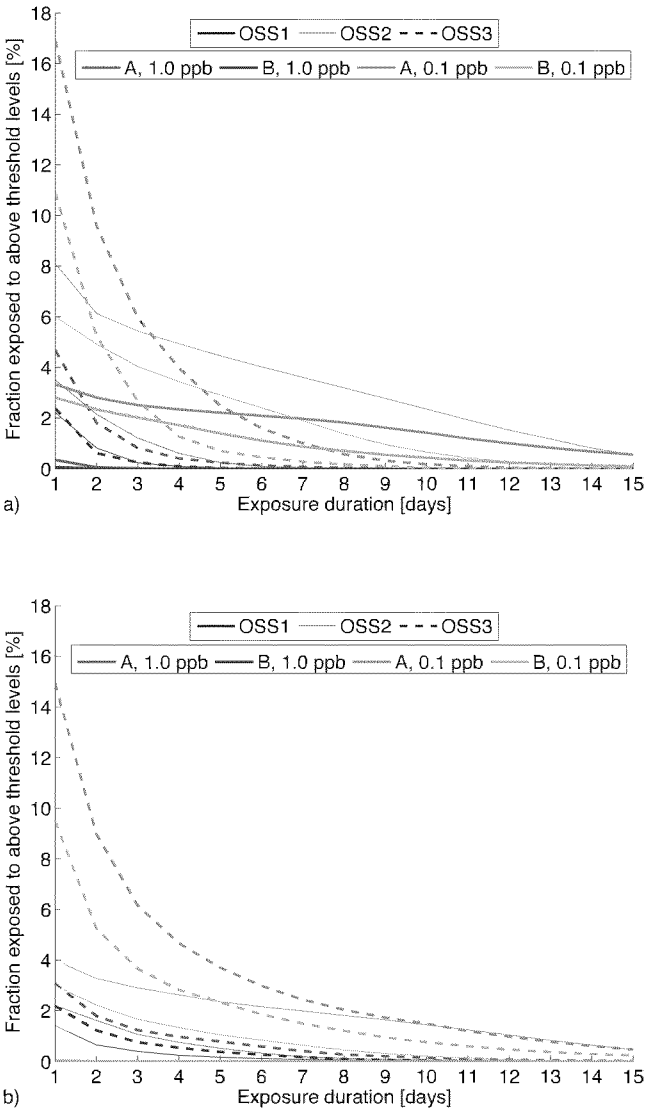

Figure 8. Fraction of individuals exposed to above 1.0 or 0.1 ppb TPAHs for an increasing numbers of days, without (a) or with (b) the use of dispersant, based on either the maximum TPAH concentrations in the water column (A) or the TPAH concentrations at the individual depths of the offspring (B) when the seasonal and spatial spawning intensity are incorporated in the analysis.

higher, the results indicate that the volume of water with above threshold levels of TPAHs is higher when adding dispersants. Hence, establishing accurate no effect concentrations for the marine organism considered is critical to enable assessment of the effects of adding dispersants.

Furthermore, the results show that the location of the oil spill significantly affects the fraction of eggs and larvae that experience above threshold levels of TPAHs. A southern oil spill affects eggs and larvae from nearby SGs, while the northern spills tend to affect offspring from the entire coast, though to a varying degree. This is mainly because the shelf becomes narrower farther north thus limiting the dispersal distance from the coast. At the same time, all individuals that drift toward the nursery grounds of the Barents Sea have to pass close to the spill site. Introducing dispersants to decrease droplet sizes and submerging the oil moderately reduces the fraction of eggs and larvae that are affected by above threshold values of TPAHs. Accounting for maximum concentrations in the water column results in moderately elevated fractions of individuals experiencing above threshold levels of toxins as compared to the modeled depth of the eggs and larvae. However, addressing overlap with concentrations here defined to represent acute or sublethal effects (1.0 or 0.1 ppb TPAHs) makes a significant difference, as sublethal effects affect several times more individuals than those experiencing acute effects. In sum, this emphasizes the importance of continued research on larval behavior and sublethal effects for evaluating the fraction of individuals affected by an oil spill and whether it is recommendable to add dispersant. Also, it is evident from the results presented here that the design of OSSs for oil spill impact assessment is critical.

The duration of exposure heavily depends on the location of the spill. The OSS farthest north results in the shortest exposure, while opposite for the OSS in the south. This is true independent of whether or not dispersants are added. The duration of the exposure may significantly affect the degree of response in the marine organism dependent on the species and stage-dependent net uptake rates.

Toxicity testing in laboratories has focused on acute effects and partly neglected sublethal effects. The reason is obvious. Sublethal effects require long-term monitoring, ideally across generations, while detecting acute effects can be carried out in experiments of much shorter duration and less complexity. This has led to a bias in our knowledge of long-term effects of oil spills. The results here show that a much higher fraction of eggs and larvae experience above threshold levels of TPAHs corresponding to sublethal effects than acute effects. Also, the durations of exposure to such levels of TPAHs are generally longer. While moving toward a consensus in literature on levels and durations resulting in acute effects, the case of sublethal effects is more open. Sublethal effects in many individuals may over time have stronger impact on a population level than acute lethal effects in fewer individuals. This can be the case especially if the sublethal effects lead to developmental disorders in the fish larvae.[20-23] Anyhow, the results presented here indicate that the use of dispersants does not significantly change the fractions of eggs or larvae exposed to either of the two threshold levels.

The situation is more obvious for other marine species. Seabirds breed in colonies along the coast and migrate to feed in an area surrounding the colony.[51] While some seabird species only explore the surface waters, others dive to great depths. Despite their preference for feeding depth, they have to penetrate the surface slick either to feed pelagically or swim down through the water column to reach the preferred prey. If dispersants are added, fewer toxic components of oil will stay at the surface, and more will be submerged as smaller droplets and dissolved. Hence, the use of dispersants may favor seabird survival in case of an accident. On the other hand, the benthic environment may experience more toxic components of oil if dispersants are used. The massive use of dispersants following the Macondo blow-out resulted in deep-ocean intrusion layers of oil that is shown to be the source of elevated levels of hydrocarbons at the seabed.[10] This could be particularly harmful to stationary sponges and corals that filter large amounts of seawater for nutritional uptake while not being able to move out of contaminated areas.[52,53]

Clearly, considering the use of dispersants to minimize ecosystem impacts depends on our understanding of the ecosystem functioning of the area in question. In addition to direct effects, there are secondary effects that complicate such

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considerations, for example, the importance of sponges and corals as spawning locations for fish or the contamination of zooplankton that is fed upon by larval fish. Also, while dispersants may guide part of the oil away from the upper parts of the water column occupied by ELS of fish, it may still affect fish through impacts on SGs in the case when they are located at the seabed (e.g., Norwegian Spring Spawning herring, ref 33).

ASSOCIATED CONTENT

* Supporting Information

For oil spill scenarios 2 and 3: volume (log 10, m^3) of water with concentrations of TPAHs above threshold values ranging from 0.1 - 100 ppb as a function of time without and with dispersants; volume (log 10, m^3) of water per vertical meter with concentrations of TPAHs above 1 ppb in the cases without and with dispersants; and mean horizontal concentrations of water masses with TPAH concentrations above 1 ppb per depth interval without and with dispersants. This material is available free of charge via the Internet at http://pubs.acs.org.

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Notes

The authors declare no competing financial interest.

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From: Vocke, William CIV
Sent: Wed 9/16/2015 7:35:02 PM
Subject: Voting to approve the ICCOPR R&T Plan
ICCOPR R&T Plan Voting Memo - signed.pdf

All,

Attached is a memo announcing the opportunity to vote for approval of the ICCOPR Oil Pollution Research and Technology Plan (OPRTP), FY2-15-2021. The draft OPRTP is the product of considerable work by the membership and supporting organizations. The version attached to the memo incorporates changes based on multiple rounds of review of individual chapters and most recently two rounds of review by the members on the full document.

The formal vote will take place during the FY2015 Fourth Quarterly meeting on September 29, 2015. The ICCOPR charter allows voting by electronic mail. If your agency will not have a representative at the meeting, I encourage you to cast your agency vote by proxy in an email to the Executive Director at William.t.vocke@uscg.mil. The email should indicate that you wish to cast your agency's vote by proxy either for, or against, approval of the OPRTP.

Please call me if you have any questions or concerns.

v/r
William T. Vocke
Executive Director

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To: Matthiessen, Craig[Matthiessen.Craig@epa.gov]
Cc: Principe, Vanessa[Principe.Vanessa@epa.gov]
From: Wilson, Gregory
Sent: Wed 7/8/2015 2:14:27 PM
Subject: FW: Milestone Update - Alternative Methods/SMART - 2015 OSC Academy
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SMART_Protocol_OSC_2011.ppt

See below

From: Eskelsen, Joann
Sent: Tuesday, July 07, 2015 12:54 PM
To: Gawarzewski, Joseph; DeHaven, Leigh; Wilson, Gregory; Sprenger, Mark; Humphrey, Alan
Subject: RE: Milestone Update - Alternative Methods/SMART - 2015 OSC Academy

Hi all, I will serve as your point of contact with the track development team, and will help in whatever way I can. I have attached presentations on SMART and countermeasures from the 2011 OSC readiness conference. Feel free to use these as a starting point.

At the moment the plans are for all of you to work on developing the module and for Mark Sprenger to present the module at the Academy, since he will be presenting a few other modules also.

I would suggest having a conference call in the next week or so to develop the agenda and outline, either Joe or myself can set up a call if you like.

Based on notes I took, the track development team would like you to address the following topics:

Bioremediation/landfarming

Burning (SMART)

Surface Washing Agents

Herders

Solidifiers

Coastal zone use of dispersants (SMART)

Selection guide/legal considerations/Subpart

Any other issues you think are appropriate.

We have a template for slides, which Joe attached to his e-mail. You don't need to worry about that right now, you can work on a blank template and Joe can format it later; but please take a look at it and follow the tips on pages 2 and 3 of the template.

Thanks

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From: Gawarzewski, Joseph [mailto:Joseph.Gawwarzewski@tetratech.com]
Sent: Tuesday, July 07, 2015 9:11 AM
To: Eskelsen, Joann; DeHaven, Leigh; Wilson, Gregory; Sprenger, Mark; Humphrey, Alan
Subject: Milestone Update - Alternative Methods/SMART - 2015 OSC Academy

Hi Everyone,

Thank you again for your involvement in the ***Alternative Methods/SMART*** course to be held as part of the Advanced Oil Response - Emergency Response track of the September 2015 OSC Academy.

I am the contractor support assigned to this course and I wanted to touch base with all initial members of

the development team. I realize I may not have the emails of all proposed team members; please feel free to forward to those that are not on this email.

•□□□□□□□□ The OSC Academy is planned for September 21 – 25, 2015.

•□□□□□□□□ The *Alternative Methods/SMART* module is scheduled to be 1.75 hours in duration.

Below are some milestones that are quickly approaching.

Milestones for *Alternative Methods/SMART* Presentation:

July 9, 2015 – Objectives and Outline due - *Please send to me any draft objectives and a rough outline for the course. We understand that it may change as the delivery approaches. This can be in paragraph or bulleted form. Also, if you have any additions or revisions to the proposed instructors, please let me know.*

July 31, 2015 – Draft Course Materials due – *These can be emailed directly to me or if they are large, we can go through an ftp site. It is key that we at least get powerpoints or videos that are planned to be used by this date. A powerpoint template for the course materials is attached to this email. Please see some helpful hints on Slide 3 of the template. You do not have to use this template, but it is there if you would like to use as you develop material.*

August 30, 2015 - Final electronic presentations due – *We are asking for the presentations to be submitted by this date so that we can test all presentations and ensure consistency in slides.*

If you have any questions or require further assistance, please contact Joe Gawarzewski at (302) 283-2290 or by e-mail at joseph.gawarzewski@tetratech.com

Thank you in advance for your help and time. I know the Objectives and Outline milestone is right around the corner. We ask that you do your best to submit by the end of this week or early next week.

If the development team determines that a series of conference calls are necessary leading up to the delivery, I can help coordinate.

Thanks,

Joe

Joseph Gawarzewski

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