FINAL

BASEWIDE RADIOLOGICAL REMOVAL ACTION ACTION MEMORANDUM – REVISION 2006 HUNTERS POINT SHIPYARD SAN FRANCISCO, CALIFORNIA

April 21, 2006

DEPARTMENT OF THE NAVY
Naval Facilities Engineering Command, Southwest
San Diego, California

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ACRONYMS AND ABBREVIATIONS

§	Section
AEC	Atomic Energy Commission
AM	Action Memorandum
ARAR	applicable or relevant and appropriate requirement
BRAC	Base Realignment and Closure
Ca-HSC	California Health and Safety Code
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cm^2	square centimeters
DHS	California Department of Health Services
dpm	disintegrations per minute
DTSC	California Environmental Protection Agency Department of Toxic Substances Control
EPA	U.S. Environmental Protection Agency
FUDS	Formerly Used Defense Sites
HPS	Hunters Point Shipyard
HRA	Historical Radiological Assessment
IC	institutional control
IR	Installation Restoration
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MDA	minimum detectable activity
mrem/yr	millirem per year
NaI	sodium iodide
Navy	U.S. Department of the Navy
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
NRC	U.S. Nuclear Regulatory Commission
NRDL	Naval Radiological Defense Laboratory
NWT	New World Technology
O&M	operation and maintenance
PCB	polychlorinated biphenyl
PCB Hot Spot	Polychlorinated Biphenyl Hot Spot Soil Excavation Site

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ACRONYMS AND ABBREVIATIONS
(Continued)

pCi/g	picocurie per gram
pCi/L	picocurie per liter
PRC	PRC Environmental Management, Inc.
PRG	preliminary remediation goal
PRP	potentially responsible party
RI/FS	remedial investigation and feasibility study
SARA	Superfund Amendments and Reauthorization Act of 1986
TCRA	time-critical removal action
TPH	total petroleum hydrocarbons
TMSRA	Technical Memorandum in Support of Record Of Decision Amendment
TtEC	Tetra Tech EC, Inc.
TtEMI	Tetra Tech EM, Inc.
USC	United States Code
Water Board	California Regional Water Quality Control Board, San Francisco Bay Region

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ACTION MEMORANDUM

Hunters Point Shipyard
San Francisco, California 94124

April 21, 2006

Subject: **Final Action Memorandum for Time-Critical Removal Action of Radiological Materials in Soils, Debris, or Structures at Hunters Point Shipyard, San Francisco, California**

Site Status: **National Priorities List: listed in November 1989; Parcel A was transferred in December 2004**

Removal Category: **Time-Critical Removal Action**
CERCLIS ID: **CA1170090087**
Site ID: **0902722**

I. PURPOSE

The purpose of this Action Memorandum (AM) is to document for the administrative record the U.S. Department of Navy's (Navy) decision to undertake time-critical removal actions (TCRAs), at areas throughout the base that may contain localized radioactive contamination in soils, debris/slag, and buildings at Hunters Point Shipyard (HPS), as identified in the *Historical Radiological Assessment, Volume II, Use of General Radioactive Materials, 1939-2003, Hunters Point Shipyard* (HRA). The Department of Defense has the authority to undertake Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) response actions, including removal actions, under Title 10 of the United States Code (USC) Section (§)§2701- 2705 and the federal Executive Order 12580. Further, this removal action is consistent, to the maximum extent possible, with Chapter 6.8 of California Health and Safety Code (Ca-HSC).

The proposed removal actions described in this AM will substantially eliminate identified pathways of exposure to radioactive contamination for surrounding populations and nearby ecosystems, such as nearby wetlands and the San Francisco Bay. Removal actions performed per this AM are anticipated to be complete cleanups to, or below, the cleanup goals specified in this document.

Removal actions performed per this AM are deemed consistent with (1) the factors set forth within the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) Title 40 of the Code of Federal Regulations (CFR) Part 300, and (2) Chapter 6.8, Ca-HSC, based on the findings below.

Threats to public health or welfare:

- Nearby human populations may be affected by exposure to low-level radioactive materials.
- Low-level radioactive materials may migrate or be released because of their presence near the surface.
- Low-level radioactive materials may migrate or be released because of weather conditions.

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Threats to the environment:

- Nearby animals, and food chains may be affected by exposure to low-level radioactive materials.
- Radioactive materials can have very long half-lives. Their release into the environment could be detrimental.

No nationally significant or precedent setting issues exist for this site.

II. SITE CONDITIONS AND BACKGROUND

This section describes the site history and background of HPS, summarizes each action conducted to date, and presents the findings of previous characterizations of radioactivity at HPS.

A. SITE DESCRIPTION

The following sections summarize characteristics of the site, any releases or threatened releases of contaminants, and the status of the site on the National Priorities List (NPL).

1. Removal Site Evaluation

To date, several radiological site investigations have been conducted at HPS to assess the presence of radioactive materials remaining from past operations associated with shipyard operations, the Naval Radiological Defense Laboratory (NRDL) and ship decontamination and maintenance procedures. Those investigations delineated certain areas at which low-level radioactive contaminants were found, and some of those areas have been addressed under a previous radiological removal action.

As investigations continue, additional areas throughout HPS are being considered for their potential to contain low-level radioactive contamination. This AM addresses those potential areas through proposed removal and off-site disposal actions.

Three general types of media exist in which radioactive contamination may be found:

1. Soils
2. Debris/Slag
3. Buildings: walls, foundations, slabs, and so on
4. Sanitary sewer and storm drain systems

Examples of previously identified low-level radioactive contamination include anomalies found in soils near buildings; debris/slag containing embedded radium dials; and surface contamination on concrete slabs, walls, and piping associated with buildings.

2. Physical Location

HPS is located in the City and County of San Francisco, California, shown on Figure 1. HPS is situated on a long promontory in southeast San Francisco, extending eastward into San Francisco Bay. The primary mission of HPS was naval shipyard activities. HPS consists of 848 acres, 416 acres of which are on land, and is divided into six parcels (B, C, D, E, E-2, and F) to facilitate environmental investigation and cleanup activities. A seventh parcel, Parcel A, was conveyed to the City of San Francisco in December 2004.

The climate is characterized as temperate, or Mediterranean, which typically has moist mild winters and dry summers. The average annual precipitation in the area is 21.79 inches. The precipitation occurs mostly during the months of December, January, and February. There are public residences within a mile radius of HPS and the nearest major thoroughfare is I-280, located roughly 5 miles west of the site.

3. Site Characteristics

HPS is a federally owned facility, which began using radioactive materials in the early 1940s. Radioactive materials were used in shipyard operations and NRDL research. In 1969, radiological studies by NRDL ended, and NRDL buildings were decontaminated and cleared for unrestricted reuse to the standards of the time. Shipyard operations ceased in 1974. The Navy also conducted ship decontamination, repair, and dismantling activities, which generated radium dial and sandblast grit waste streams. During NRDL operations, the Navy managed a radioactive waste disposal program, which included removal of high-level and low-level radioactive materials from HPS for transport and disposal of the materials to an off-site ocean-bottom disposal area.

As a result of past radiological operations, some buildings have been found to contain low-level radioactive contaminants and radium dials have been found embedded in both debris and slag, or buried in disposal areas. Hazardous materials have also been found at HPS. The site was placed on the NPL in 1989, pursuant to CERCLA, as amended by the Superfund Amendments and Reauthorization Act of 1986.

In 1991, HPS was slated for closure pursuant to the terms of the Defense Base Closure and Realignment Act of 1990 (Public Law 101-510). Closure of HPS includes conducting environmental remediation activities and transfer of the property to the City of San Francisco for future non-defense reuse.

4. Release or Threatened Release into the Environment of a Hazardous Substance or Pollutant or Contaminant

The radioisotopes encountered to date, and likely to be encountered during future investigations, include americium-241, cobalt-60, strontium-90, cesium-137 (and daughter products), europium-152, europium-154, plutonium-239, radium-226, tritium, thorium-232, and uranium-235 (and daughter products), which are hazardous substances, as defined by §101(14) of CERCLA, and pollutants or contaminants, as defined by §101(33) of CERCLA.

Because of the presence of low-level radioactive materials in areas exposed to erosion and weathering, a threat of migration and release to surrounding populations and the environment could exist.

To date, almost all radioactive materials encountered at HPS have been isolated from human contact and located in restricted-access areas. However, the threat of release does exist because of the persistence of radioactive materials in areas designated for future unrestricted use and areas that may be affected by weather and erosion.

Removal actions conducted in accordance with this AM are therefore designed to (1) substantially reduce ionizing radiation to cleanup goals and (2) eliminate identified pathways of exposure to ionizing radiation.

5. National Priorities List Status

HPS was placed on the NPL on November 21, 1989, with a Hazard Ranking Score of 48.77. Parcel A was delisted in February 1999 and transferred in December 2004. Each parcel has undergone, or is undergoing, a CERCLA remedial investigation and feasibility study (RI/FS). RI/FSs have been completed for Parcels A and B, and an Addendum to the Technical Memorandum in Support of Record of

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Decision Amendment (TMSRA) is being prepared for Parcel B. RI/FSs are currently being conducted for Parcels C, D, E and E-2. Radiological Addenda will be issued subsequent to the RI/FSs for the remaining parcels at HPS.

6. Maps, Pictures, and Other Geographical Representations

Figure 1 shows the location of HPS, and Figure 2 presents all currently known radiologically impacted areas at HPS. Many radiological areas have already been addressed by previous investigations and by previous radiological removal actions.

B. OTHER ACTIONS TO DATE

Several radiological investigations and radiological removal actions have been conducted at HPS. The following sections summarize those actions.

1. Previous Actions

Five phases of radiological investigations, as well as interim investigations, were performed at HPS, beginning in 1991. Phases I and II delineated the surface and subsurface distribution of radium-containing devices. Phases III and IV recommended and performed the removal of anomalies near Buildings 364, 509, 529, and 707 in Parcels D and E. Phase V conducted radiological surveys and remedial actions in Parcels B, C, D, and E. Each investigation is summarized below.

1.1 Phase I

In 1991, the Phase I radiological investigation to evaluate the extent of radium-containing devices identified in a surface radiation survey was conducted by Harding Lawson Associates (1990) in 1988. The Phase I investigation included Installation Restoration (IR) Sites 01/21, 02, 03 and portions of IR Sites 11/14/15.

Over 300 radium-containing point sources were detected in a centralized area in IR-02 Northwest during the Phase I investigation, and additional anomalies were observed in IR-01/21 and IR-02 Southeast. A dial with anomalously high gamma activity was also found on the door of a combination safe in IR-11/14/15.

Thirteen soil samples collected from the disposal area in IR-02 Northwest contained radium-226 at concentrations exceeding background levels. One soil sample collected from IR-01/21 and two soil samples collected from IR-02 Southeast contained radium-226 at concentrations exceeding background levels (PRC Environmental Management, Inc. [PRC], 1992).

The Phase I investigation concluded that elevated gamma activity was a result of the presence of radium-containing devices in surface soil at scattered locations at IR-01/21 and on the surface and in the subsurface of the centralized disposal area in IR-02 Northwest, which extends into IR-02 Central.

The Phase I radiation investigation recommended an investigation of the subsurface distribution of radium-containing devices in soil in IR-02 Northwest, removal of the combination safe from IR-11/14/15, and further investigation of radioactive analytes in groundwater. The first and second recommendations have been performed, and the third is ongoing.

1.2 Phase II

The Phase II radiological investigation was conducted in 1993 to delineate the subsurface distribution of radium-containing devices in the IR-01/21 landfill and in the disposal areas in IR-02 Northwest and IR-02

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Central. Field activities included excavation of trenches and test pits, collection of soil samples, and collection of air samples (PRC, 1996).

Excavation activities at the disposal area in IR-02 Northwest and in IR-02 Central revealed 111 discrete subsurface gamma-emitting point sources, all located within a well-defined disposal area. A large amount of industrial and construction debris was also found mixed with soils in the disposal area. Radium-containing devices and industrial debris were detected at the surface in IR-01/21, but not in the subsurface of IR-01/21 or at the beach and intertidal areas of IR-02 Northwest (PRC, 1996).

The Phase II radiological investigation concluded that the disposal area in IR-02 Northwest and IR-02 Central was the primary disposal area for all radium-containing devices generated at HPS as a result of ship repair and maintenance activities, and that radium-containing devices were only present on the surface of the landfill in IR-01/21.

1.3 Phase III

The Phase III radiological investigation was conducted in 1997 to address concerns about the use, storage, and disposal of radioactive materials during past NRDL operations at HPS. The goal of the Phase III investigation was the eventual release, for unrestricted use, of all remaining buildings and sites not previously released, including three formerly used defense sites. Radiological surveys were conducted within and around Buildings 506, 509, 517, and 529.

The Phase III radiological investigation recommended the following actions (Tetra Tech EM, Inc. [TtEMI], 1997):

- Excavation of a potential buried point source behind Building 529
- Excavation of an area with an anomalous count rate of 9,374 counts per minute near Building 509
- Further study of Buildings 364 and 707 (TtEMI, 1997)

All Phase III recommendations were implemented in the Phase IV investigation, or removal action.

1.4 Phase IV

The Phase IV radiological investigation was conducted in 1999 to quantify ambient concentrations of specific radionuclides and to further characterize two radiological sites located near Buildings 364 and 707. The goal of the Phase IV investigation was free release, for industrial use, of the areas located near Buildings 364 and 707.

The Phase IV investigation recommended the following actions:

- Removal of a cesium-137 spill site near Building 364
- Removal of anomalies near the former locations of Buildings 509, 529, and 707

Both Phase IV recommendations were implemented in the remedial action, which began in February 2001.

1.5 Interim Investigations Between Phase IV and Phase V

Three interim investigations were conducted after the Phase IV radiological investigation and before the Phase V radiological investigation. Available information for each investigation is summarized below:

1.5.1 1999 October IT Corporation Investigation

Sandblast waste was discovered and removed from an excavation site at IR-07. Five samples were collected and analyzed for radioactivity. Results were indicative of background concentrations. Several other areas containing sandblast waste have been investigated and sampled since this investigation. To date, none of the sandblast waste has been found to contain radionuclide concentrations above normal background levels.

1.5.2 2001 TtEMI Investigation

In June and July 2001, TtEMI contracted a survey of the Gun Mole Pier (Regunning Pier). Gamma and beta measurements were obtained on the surface of the pier to determine whether elevated radioactivity levels remained from previous operations. The measurement points were based on a newly found drawing, indicating the previous location of the concrete test pad and NRDL barge on the pier. Gamma levels were measured using a portable detection instrument equipped with a sodium iodide (NaI) scintillation probe. The measurements were made both in a systematic grid pattern and biased locations specifically over drains, surface cracks, and other unusual features.

Surface radioactivity at selected locations was also measured using a Geiger-Mueller detector sensitive to beta radiations.

Findings indicated that only background levels of radioactivity were present in the areas surveyed.

1.5.3 NWT Interim Investigation and Removal Action

During 2001, New World Technology (NWT) performed a removal action at the tank vault behind Building 364. The tanks, piping, and support equipment had been previously removed, and the remaining vault surfaces had been identified as exceeding site release criteria. After the concrete vault was removed, surveys and soil sampling indicated that no residual contamination remained that exceeded site release criteria.

Additionally, a Characterization Survey of the Parcel E shoreline was performed. The shoreline survey encompassed areas within approximately 50 feet on either side of the mean tide line. Several areas were noted during the survey that exceeded background gamma radiation levels, most significantly the areas known as the "Metal Debris Reef" and "Metal Slag Area." Samples obtained from those locations identified radium-226 as the contaminant. Although no removal actions were taken at the time of the survey, the Navy is still investigating and considering removal actions.

1.6 Phase V Investigations

Beginning in January 2002, NWT conducted Scoping and Characterization Surveys, soil and other media sampling programs, remediations, and Final Status Surveys at various open areas and in various buildings at HPS in accordance with *Multi-Agency Radiation Site Survey and Investigation Manual* (MARSSIM) guidelines. The investigations and surveys were in support of the release of buildings or areas that had been identified as areas where radioactive materials had been used or areas where remedial actions to remove known contamination had occurred.

Each site was assessed for potential radionuclides of concern with surveys designed according to the MARSSIM area classification (Class 1, 2, or 3). The extent of the surveys depended upon the classification of the area. Class 1 surveys covered 100 percent of the area, Class 2 surveys covered 50 percent of the area, and Class 3 surveys covered 20 percent of the area. If contamination was found in a Class 3 area, a 100 percent Characterization Survey was conducted followed by remediation as appropriate. A Class 1 Final Status Survey followed any remediation.

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1.7 Historical Radiological Assessment

The HRA was conducted to evaluate all previous uses of radioactive materials at HPS and to assess their potential to impact the site. The final version of the HRA was issued in August 2004. Based on the recommendations of the HRA, a total of 84 HPS sites have been designated as "impacted." This indicates that the site has a potential for radioactive contamination based on historic information or is known to contain radioactive contamination. These impacted sites, broken out by parcel, include:

- Parcel B – 14 sites
- Parcel C – 12 sites
- Parcel D – 19 sites
- Parcel E – 33 sites
- Parcel F – 2 sites
- Off-Base Facilities – 1 site
- Base-Wide Areas – 3 sites

2. Current Actions

Current radiological actions at HPS include TCRAs and surveys that were initiated under this AM and implementation of recommended actions identified in the HRA. These actions are described below.

2.1 TCRAs

Three TCRAs are currently being conducted on site in accordance with the requirements of the CERCLA and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

Metal Debris Reef / Metal Slag Area

The TCRA at the Metal Debris Reef in Parcel E and Metal Slag Area in Parcel E-2 involves the removal of radioactively contaminated metal debris and slag.

As described in *Final Removal Action Design and Implementation Work Plan, Metal Debris Reef and Metal Slag Areas* [Tetra Tech EC, Inc. (TtEC), 2005a], this TCRA includes radiological surveying and remediation, excavation of metal slag and debris, site restoration, and waste disposal.

PCB Hot Spot

The TCRA for the Polychlorinated Biphenyl Hot Spot Soil Excavation Site (PCB Hot Spot) in Parcel E-2 involves the removal of soils containing PCBs, total petroleum hydrocarbons (TPH), and any radioactive contaminants.

As described in *Final Removal Action Design and Implementation Work Plan, PCB Hot Spot Soil Excavation Site* (TtEC, 2005b), this TCRA includes radiological surveying and remediation, excavation of PCB- and TPH-contaminated soil, site restoration, and waste disposal.

IR-02 Northwest and Central

This TCRA is for the extraction of debris and soil containing radioactive contaminants present in the IR-02 Northwest and Central area of Parcel E.

As described in *Final Removal Action Design and Implementation Work Plan, TCRA for IR-02 Northwest and Central* (TtEC, 2005c), this TCRA includes radiological surveying and remediation, excavation of soil and debris, site restoration, and waste disposal.

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2.2 Radiologically Impacted Site Surveys

Building 322

This survey was performed to support release of the building for demolition and disposal. After the building was demolished, a Final Status Survey was performed that allowed release of the site for unrestricted reuse.

Building 819

This survey was performed to determine if residual radioactivity was present at the site. The survey was designed so that if no contamination was found above the release criteria, the data could be used to support release of the site for unrestricted reuse. The report is currently under review and a final determination will be made in 2006.

Building 114 Site

The Building 114 Site is the former location of the demolished Building 114. This survey was performed to determine if residual radioactivity is present at the site. The survey was designed using the *Base-wide Radiological Work Plan* (TtEC, 2005d) so that if no contamination is found above the release criteria, the data could be used to support unrestricted reuse. The report is currently being prepared for review by the regulatory agencies.

Building 146

This survey was performed to determine if residual radioactivity is present at Building 146. The survey was designed using the *Base-wide Radiological Work Plan* (TtEC, 2005d) to allow unrestricted reuse if no contamination was found above the release criteria. The report is currently being prepared for review by the regulatory agencies.

C. STATE AND LOCAL AUTHORITIES ROLE

The California Department of Health Services (DHS) and U.S. Environmental Protection Agency (EPA) have actively participated in the radiological investigations and the radiological removal actions at HPNS. In the past, EPA has provided site-specific input for the establishment of removal action cleanup goals and investigative strategies.

The California Environmental Protection Agency Department of Toxic Substances Control (DTSC) and California Regional Water Quality Control Board, San Francisco Bay Region (Water Board) are also regulatory agency stakeholders.

1. State and Local Actions to Date

As previously discussed, federal Executive Order 12580 delegates to the Department of Defense the President's authority to undertake CERCLA response actions. Congress further outlined this authority in its Defense Environmental Restoration Program Amendments, which can be found at 10 USC §2701-2705. Both CERCLA §120(f) and 10 USC §2705 require Navy facilities to ensure that state and local officials be given timely opportunity to review and comment on Navy response actions. CERCLA §120 further requires the Navy to apply state removal and remedial action law requirements at its facilities.

Accordingly, DHS, DTSC, and Water Board have provided technical advice and oversight during phases of the RI/FS process, during previous radiological investigations, and during current and future radiological removal actions.

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2. Potential for Continued State or Local Response

DHS, Water Board, and DTSC deferred to EPA for development of cleanup goals for the previous radiological removal action. Those cleanup goals were also chosen for this removal action. DHS, Water Board, and DTSC will continue to provide input through review of radiological documents and participation in the Base Realignment and Closure (BRAC) Cleanup Team.

III. THREATS TO PUBLIC HEALTH, WELFARE, OR THE ENVIRONMENT AND STATUTORY AND REGULATORY AUTHORITIES

In accordance with the NCP, the following threats must be considered in determining the appropriateness of a removal action (40 CFR §300.415[b][2]):

- Actual or potential exposure to hazardous substances, pollutants, or contaminants of nearby populations, animals, and food chains
- Actual or potential contamination of drinking water supplies and sensitive ecosystems
- Hazardous substances, pollutants, or contaminants in drums, barrels, tanks, and other bulk storage containers that may pose a threat of release
- High levels of hazardous substances or pollutants or contaminants in soils largely at, or near, the surface that may migrate
- Weather conditions that may cause hazardous substances, pollutants, or contaminants to migrate or to be released
- Threat of fire or explosion
- Other situations or factors that may pose threats to human health or the environment

A. THREATS TO PUBLIC HEALTH OR WELFARE

Three potential threats to public health or welfare exist:

- Nearby human populations may be affected by exposure to low-level radioactive materials.
- Low-level radioactive materials may migrate or be released because of their presence near the surface.
- Low-level radioactive materials may migrate or be released because of weather conditions.

Because of the possible adverse health effects from ionizing radiation (EPA, 1998) and the long decay periods (half-lives) for many radionuclides, removal and off-site disposal is considered the most effective option for most of the radioactive contaminants found at HPS. Physical removal of radioactive materials will ensure that the potential for diffuse radioactivity is reduced to levels that meet or are below cleanup goals.

B. THREATS TO THE ENVIRONMENT

Two potential threats to the environment exist:

- Nearby animals and food chains may be affected by exposure to low-level radioactive materials.
- Radioactive materials can have very long half-lives; therefore, their release into the environment could be detrimental.

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Physical removal of radioactive materials from HPS also provides the most effective option for mitigation of threats to the environment from ionizing radiation.

IV. DETERMINATION OF ENDANGERMENT

Results of radiological investigations conducted to date (TtEMI, 1997; 2000a) demonstrate that current conditions at HPS may present immediate and severe threats to the aquatic ecosystem, public health, welfare, or the environment.

Actual or threatened releases of radioactive materials from HPS, if not addressed by implementing the response action selected in this AM, may present an imminent and substantial endangerment to public health, welfare, or the environment. The primary endangerment mechanism is through migration: If radioactive contaminants migrate, they have the potential to contaminate water and soils. Water and soil contamination could be long lasting, since some radionuclides have half-lives in the tens of thousands of years.

The HRA provides a comprehensive review and assessment of the affect of past radiological operations at HPS.

V. PROPOSED ACTIONS AND ESTIMATED COSTS

The following sections summarize the actions proposed for any TCRA performed per this AM.

A. PROPOSED ACTION

The proposed action for localized radioactive material present at HPS is to physically remove it and dispose of the material at an off-site disposal facility. For purposes of this AM, localized is defined as any area less than approximately 3 acres in which radioactive material is the primary risk driver. The definition for "localized" is based on the results of past radiological investigations, the size of the radium dial disposal area in IR-02 Northwest and IR-02 Central, and the size of the intertidal debris area; these areas are assumed to be the largest probable areas this AM would address.

Estimates on the quantity of radioactive materials that will be removed per this AM remain pending, until more accurate information is gathered. Removal actions performed per this AM will comply with the off-site policy by using a fully licensed off-site disposal facility for low-level radioactive waste.

Removal actions performed per this AM are subject to the cleanup goals listed in Table 1, for soils/debris, surfaces, and water, respectively. Before initiating a removal action per this AM, the area being considered will be characterized using real-time radiation detection devices or soil sampling and analyses.

MARSSIM guidance is being used to apply the cleanup goals. Table 2 lists additional radionuclides that could be encountered at HPS, based on information from the HRA. If these additional radionuclides are encountered during surveys or removal actions, cleanup goals will be derived using regulatory involvement.

Areas where radioactive contamination may be too pervasive to conduct a localized removal action, where radioactive contamination is not the primary risk driver, or where excavation activities pose a high risk to workers, will be addressed as part of the ongoing CERCLA process. The IR-01/21 landfill is one example of an area that has multiple risk drivers, has a large affected area, and would pose excessive hazards to workers performing excavation activities.

Table 3 provides a listing of radiologically impacted sites at HPS that were identified in the HRA (NAVSEA, 2004). Table 3 does not include those sites in the former Parcel A that have received

regulatory release or the Formerly Used Defense Sites (FUDS). The remaining impacted sites (Buildings 813 and 819) in the former Parcel A have been reassigned to Parcel D after the Parcel A boundary was adjusted. Assessments of potentially contaminated media and migration pathways, as well as recommended actions are detailed in Table 3. The impacted sites listed in Table 3 will be addressed under this AM.

1. Proposed Action Description

Physical removal and off-site disposal of radioactive materials will follow the general steps listed below for three types of environmental media in which radioactive contamination is likely to be encountered at HPS. Removal actions will be preceded by preparation of site-specific work plans or task-specific plans in consonance with the *Base-Wide Radiological Work Plan* (TtEC, 2005d). To the extent practicable, radioactive materials will be segregated from other materials (such as construction debris or nonaffected soils) to minimize radioactive waste stream generation.

- **Soils**
  - Delineation of radioactive contamination using real-time radiation detection instruments or soil sampling and analyses
  - Excavation of radioactive materials and proper off-site disposal
  - Soil confirmation sampling and analyses; comparison of results against cleanup goals listed in Table 1 using MARSSIM methodology
  - Site backfilling and restoration
- **Debris/Slag**
  - Delineation of contamination, or general area of suspected contamination, using real-time radiation detection instruments or sampling and analyses
  - Collection and segregation of radioactive materials
  - Proper off-site disposal of materials
  - Comparison of remediated area against cleanup goals listed in Table 1, depending on the surrounding environmental media (soils or surfaces) using MARSSIM methodology
  - Site backfilling or restoration
- **Concrete Surfaces (walls, slabs, and foundations)**
  - Delineation of radioactive contamination using real-time radiation detection instruments or wipe samples and analyses
  - Decontamination of surfaces by acid or solvent washing or mechanical removal such as scabbling (scabbling will be preferred in order to reduce mixed-waste stream generation)
  - Proper off-site disposal
  - Comparison of residual radioactivity to the cleanup goals listed in Table 1, using MARSSIM methodology

  Note: if surface decontamination is not technically feasible, the entire structure may be removed and disposed of appropriately.

If radiological areas are found in or near wetlands or intertidal areas, removal actions will be modified to minimize the affect to those areas.

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The following laboratory analyses are associated with characterization of the radioactive materials that may be addressed by this AM:

- Isotopic americium, plutonium (238 and 239), thorium (228 and 232) and uranium (234, 235, 238) analyses
- Gamma spectroscopy analyses
- Strontium analyses
- Gross alpha/beta analysis
- Swipes for removable contamination (including tritium)

Removal actions performed under this AM will not include institutional controls (ICs); therefore, any ICs which may be required will be discussed in the CERCLA Record of Decision. Radiological sites not addressed under this AM will continue to have restricted access, until a final remedy is selected.

Post-removal site controls will not be required following removal actions performed per this AM, since the intent of each removal action is to reduce radioactive contaminants to or below the cleanup goals.

2. Contribution to Remedial Performance

Removal of radioactive contamination per this AM will allow for the ongoing CERCLA process to address any remaining contamination and will avoid future "mixed waste" (waste with both chemical and radioactive contamination). Each removal action taken per this AM is an interim action, and that the final action for radiological site cleanup will be selected in the Record of Decision. Removal actions taken per this AM will also take into account the City of San Francisco's reuse plan for the site.

3. Description of Removal Alternative

Several removal action alternatives were considered for use in this AM; however, physical removal and proper off-site disposal was the only viable alternative retained for evaluation.

Other actions such as in-place stabilization, and removal and consolidation in the closed HPS industrial landfill, were considered; however, those alternatives would not physically remove the contamination (requiring long operation and maintenance [O&M] periods), would involve large costs, or would require restricted reuse of certain areas of HPS for long periods of time.

The steps required to remove and properly dispose of low-level radioactive materials at an approved off-site facility were detailed in Section V.A.1.

Removal and proper disposal of radioactive materials will provide a timely response and the best option for protection of human health and the environment. Previous radiological soil removals have been completed within several months, and achievement of cleanup goals ensures that human health risks related to radioactive materials are eliminated from the site in question.

Sections 3.1 and 3.2 summarize the criteria used to evaluate the proposed alternative and results of the evaluation.

3.1 Evaluation Criteria

Three criteria were used to evaluate the removal and disposal alternative proposed in this AM: effectiveness, implementability, and cost.

Effectiveness

Three general factors were considered in evaluating effectiveness: (1) overall protection of human health and the environment, (2) short-term effectiveness, and (3) long-term effectiveness and permanence.

Implementability

This criterion addresses the technical and administrative feasibility of implementing the removal action. Items evaluated include (1) the availability of services and materials required during implementation of the action, (2) the institutional or social concerns that could preclude the action, and (3) state and community concerns that could affect implementation. The following factors were considered:

- Technical feasibility: the ease or difficulty of implementing the alternative and the reliability of the technology
- Administrative feasibility: activities, such as obtaining waivers or permits, requiring coordination with other offices and agencies

Cost

This criterion is concerned with the estimated costs of the alternatives, and is based on previous radiological removal actions for soils and building surfaces. O&M costs were not considered in the cost evaluation since removal actions will be performed in less than a year, and no follow-on costs are associated once this removal action has been completed.

3.2 Evaluation of Proposed Removal and Off-site Disposal Action

The removal and off-site disposal alternative provides the highest degree of effectiveness, is feasible to implement, and is also economically feasible.

Effectiveness

Removal and off-site disposal provides the highest degree of protection for human health and the environment by physically removing the materials from HPS. Removal and off-site disposal will also comply with chemical-, action-, and location-specific ARARs.

Implementability

This alternative does not have administrative constraints and has few technical constraints. Most of the radioactive contamination identified at HPS to date has been in localized areas. Surface scans performed in the past have found point-source anomalies and specific disposal areas containing radioactive contamination. Subsurface investigations have found concentrated areas where disposal of dials or other radioactive materials occurred. Physical removal is very feasible for these types of situations. If large quantities of radioactive materials are found, physical removal and off-site disposal may have significant technical constraints. Any areas found to contain large quantities of low-level radioactive waste will not be addressed by this AM, but will be evaluated further in the ongoing CERCLA process.

Cost

Unit costs for labor, mobilization, and site remediation are comparable with a standard soil removal and disposal project involving chemical contamination. The unit cost for disposal of radioactive materials is on average greater than the unit cost of chemical contamination in soils; however, the cost does not become prohibitive unless very large volumes of radioactive materials are removed and disposed. Further details regarding the unit costs for this alternative are provided in Section V.B.

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4. Engineering Evaluation and Cost Analysis

Since this is a TCRA, an engineering evaluation and cost analysis is not applicable.

5. Applicable or Relevant and Appropriate Requirements

Section 300.415(j) of the NCP provides that removal actions must attain applicable or relevant and appropriate requirements (ARARs) to the extent practicable, considering the exigencies of the situation.

Section 300.5 of the NCP defines applicable requirements as cleanup standards, standards of control, and other substantive environmental protection requirements, criteria or limitations promulgated under federal or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location or other circumstances at a CERCLA site.

Section 300.5 of the NCP defines relevant and appropriate requirements as cleanup standards, standards of control and other substantive requirements, criteria, or limitations promulgated under federal or state environmental or facility siting laws that, while not "applicable" to a hazardous substance, pollutant, or contaminant, remedial action, location, or other circumstances at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site and are well-suited to the particular site.

Because CERCLA on-site response actions do not require permitting, only substantive requirements are considered as possible ARARs. Administrative requirements such as approval of, or consultation with administrative bodies, issuance of permits, documentation, reporting, record keeping, and enforcement are not ARARs for CERCLA actions confined to the site.

Only those state standards that are identified by a state in a timely manner and are more stringent than federal requirements may be applicable or relevant and appropriate.

There are three types of ARARs: contaminant-specific, location-specific, and action-specific. The first type includes contaminant-specific requirements. These ARARs set limits on concentrations of specific hazardous substances, contaminants, and pollutants in the environment. Examples of this type of ARAR are ambient water quality criteria and drinking water standards. The second type of ARAR includes location-specific requirements that set restrictions on certain types of activities based on site characteristics. These include restrictions on activities in wetlands, floodplains, and historic sites. The third type of ARAR includes action-specific requirements. These are technology-based restrictions that are triggered by the type of action under consideration. Examples of action-specific ARARs are Resource Conservation and Recovery Act regulations for waste treatment, storage, and disposal.

ARARs must be identified on a site-specific basis from information about specific chemicals at the site, specific features of the site location, and actions that are being considered as removal actions.

The ARARs used to prepare this AM are presented in Appendix A.

The cleanup goals presented in this AM were derived by considering the following:

- Soil cleanup goals: EPA decay-corrected PRGs (EPA, 1991)
- Radium-226 contamination in soils: per agreement with EPA
- Radioactive contamination on structures: These limits are based on 25 millirem per year (mrem/y), using RESRAD or Atomic Energy Commission's (AEC's) *Regulatory Guide 1.86* (1974), whichever is lower.

- Radioactive contamination on surfaces designated as equipment or waste: These limits are based on AEC's *Regulatory Guide 1.86*. Limits for removable surface activity are 20 percent of these values.
- Application of soils, debris, and surface cleanup goals to sites: MARSSIM guidance (EPA et al., 2001)
- Radioactive contamination in wastewater: A release criterion for water has been derived from *Radionuclides Notice of Data Availability Technical Document* (EPA, 2000) by comparing the limits from two criteria and using the most conservative limit.

The cleanup goals derived for the project are considered to be the most conservative available. For example, use of EPA decay-corrected preliminary remediation goals (PRGs) for soil removal actions is more conservative than use of other federal ARARs listed in Appendix A.

6. Project Schedule

Individual removal action project schedules will be generated as each site is identified for survey or removal of radioactive materials. Based on previous removal actions for radioactive materials, field events are expected to last from 1 to 4 months. Prior to commencing fieldwork, detailed work plans/task-specific plans and health and safety plans will be generated. Following field events, analytical reports, data validation reports, or summary reports will also be generated to summarize actions taken.

B. ESTIMATED COSTS

The Navy has made a present worth estimate of the removal action costs. The Navy has estimated the cost to complete the required radiological removal actions at $60 million. The estimated costs include the direct and indirect capital costs. The items listed below are considered capital costs. They are based on a previous removal action, which removed and disposed of 13 cubic yards of contaminated soils. Costs for removal actions involving debris or surfaces will be comparable, if the quantity of radioactive materials disposed of is similar.

Estimated Costs – Typical 13-cubic-yards Soil Removal Action

Direct Capital Costs	
Construction/Equipment/Materials:	$17,000
Soil excavation ($75.00/cubic yard):	$ 1,275
Transport and disposal:	$21,250
Analytical (12 confirmation samples)	$ 5,400
Indirect Capital Costs	
Work plans, engineering, etc.	$ 2,000
Soils Removal Action Total:	$46,925

VI. EXPECTED CHANGE IN THE SITUATION SHOULD ACTION BE DELAYED OR NOT TAKEN

If action should be delayed or not taken, exposure of human populations to low-level radioactive materials may occur. Contamination may spread from HPS to nearby areas from wind erosion, surface water runoff, or other erosion mechanisms. Migration of radioactive contamination could result in an

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increased health risk to local populations because of prolonged exposure to low-level radioactive materials.

Since the half-lives of radioactive contaminants can range up to tens of thousands of years, the associated risk could be very long term, and migration over this time period may result in a greater volume of material to be remediated. This would also result in an increase in treatment or disposal costs.

VII. PUBLIC INVOLVEMENT

This document will be added to the Administrative Record (Appendix B) and will be made available for public review at the following locations:

San Francisco Public Library
Government Documents
100 Larkin Street
San Francisco, California 94102

Anna E. Waden Library
5075 Third Street
San Francisco, California 94124

VIII. OUTSTANDING POLICY ISSUES

No outstanding policy issues exist for this removal action.

IX. RECOMMENDATION

To date, the Navy has not acquired evidence identifying other potentially responsible parties (PRP) at this site. However, information acquired in the future, including but not limited to, information acquired during the implementation of this removal action or future response actions at the site, could result in the identification of other PRPs.

This AM was prepared in accordance with current EPA and Navy guidance documents for TCRAs under CERCLA. The purpose of this AM is to identify and analyze removal actions to address localized radioactive contamination in soils, debris/slag and buildings base-wide.

Based on the analysis of the removal action alternatives completed in Section V.A.3, the recommended removal action is removal of radioactive contamination from localized areas in soils, debris/slag, and buildings, followed by appropriate off-site disposal at a fully licensed low-level radioactive waste disposal facility. This alternative will apply to localized areas throughout HPS, provide a high degree of protection for human health and the environment, does not have significant administrative or technical constraints, and is not cost prohibitive.

This decision document represents the selected removal action for HPS located in San Francisco, California, developed in accordance with CERCLA, as amended, and is consistent with the NCP. This decision is based on the Administrative Record for the site (included in Appendix B).

Base Realignment and Closure Environmental Coordinator:

Keith S. Forman

4/21/06
Date

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TABLES

TABLE 1

RELEASE CRITERIA

Radionuclide	Surfaces			Soil[d] (pCi/g)				Water[h] (pCi/L)
	Equipment, Waste (dpm/100 cm^2)[a]	Structures (dpm/100 cm^2)[b]	Residual Dose (mrem/yr)[c]	Outdoor Worker (pCi/g)[e]	Residual Dose (mrem/yr)[c]	Residential (pCi/g)[e]	Residual Dose (mrem/yr)[c]	
Americium-241	100	100	18.7	5.67	0.8661	1.36	24.84	15
Cesium-137	5,000	5,000	1.72	0.113	0.2142	0.113	0.2561	119
Cobalt-60	5,000	5,000	6.01	0.0602	0.5164	0.0361	0.3918	100
Europium-152	5,000	5,000	3.21	0.13[f]	0.5018	0.13[f]	0.502	60
Europium-154	5,000	5,000	3.49	0.23[f]	0.9593	0.23[f]	0.9599	200
Plutonium-239	100	100	18.1	14.0	1.743	2.59	1.138	15
Radium-226	100	100	0.612	1.0[g]	6.342	1.0[g]	14.59	5[i]
Strontium-90	1,000	1,000	0.685	10.8	0.1931	0.331	1.648	8
Thorium-232	1,000	36.5	24.9	2.7	24.91	1.07 1.69	25	15
Tritium	5,000	5,000	0.00053	4.23	0.00179	2.28	0.05263	20,000
Uranium-235+D	5,000	488	25	0.398	0.178	0.195	0.8453	30

Notes:

Risk 10^{-4} @ 25 mrems

[a] These limits are based on AEC *Regulatory Guide 1.86* (1974). Limits for removable surface activity are 20 percent of these values. Risk [illegible]

[b] These limits are based on 25 mrem/yr, using RESRAD-Build Version 3.3 or *Regulatory Guide 1.86*, whichever is lower.

[c] The resulting dose is based on modeling using RESRAD-Build Version 3.3 or RESRAD Version 6.3, with radon pathways turned off.

[d] EPA PRGs for two future-use scenarios.

[e] The on-site and off-site laboratory will ensure that the MDA meets the listed release criteria by increasing sample size or counting time as necessary. The MDA is defined as the lowest net response level, in counts, that can be seen with a fixed level of certainty, customarily 95 percent. The MDA is calculated per sample by considering background counts, amount of sample used, and counting time.

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TABLE 1

RELEASE CRITERIA

[f] Based on EPA-decay corrected PRGs for commercial reuse and a previous action memorandum (TtEMI, 2000a, 2001).

[g] Limit is 1 pCi/g above background, per agreement with EPA.

[h] Release criteria for water have been derived from *Radionuclides Notice of Data Availability Technical Document*, (EPA, 2000) by comparing the limits from two criteria and using the most conservative limit.

[i] Limit is for total radium concentration.

AEC – Atomic Energy Commission
cm^2 – square centimeters
dpm – disintegrations per minute
EPA – U.S. Environmental Protection Agency
MDA – minimum detectable activity
mrem/yr – millirem per year
pCi/g – picocurie per gram
pCi/L – picocurie per liter
PRG – preliminary remediation goal
TtEMI – Tetra Tech EM, Inc.

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TABLE 2

ADDITIONAL POTENTIAL RADIONUCLIDES OF CONCERN

Radionuclide	Half-Life	Radiations
Actinium-227	21.8 years	Alpha, beta, gamma
Amercium-243	7,370 years	Alpha, gamma
Barium-133	10.5 years	Beta, gamma
Bismuth-207	32 years	Beta, gamma
Carbon-214	5,715 years	Beta
Chlorine-36	3.01×10^5 years	Beta
Curium-244	18.1 years	Alpha, gamma
Europium-152	13.5 years	Beta, gamma
Europium-154	8.6 years	Beta, gamma
Gadolinium-152	1.1×10^{14} years	Alpha
Indium-115	4.4×10^{14} years	Beta
Potassium-40	1.27×10^9 years	Beta, gamma
Niobium-94	2×10^4 years	Beta, gamma
Nickel-63	100 years	Beta
Neptunium-237	2.14×10^6 years	Alpha, gamma
Lead-210	22.6 years	Beta, gamma
Plutonium-238	87.7 years	Alpha, gamma
Technetium-97	2.6×10^6 years	Beta, gamma
Technetium-99	2.1×10^5 years	Beta, gamma
Titanium-44	67 years	Gamma
Thallium-204	3.78 years	Beta
Uranium-233	1.59×10^5 years	Alpha, gamma
Uranium-236	2.34×10^7 years	Alpha, gamma
Uranium-238	4.478×10^9 years	Alpha, gamma

TABLE 3

BUILDING/AREA ASSESSMENT AND CLASSIFICATION

Building No. or Area	Contamination Potential					Contaminated Media							Potential Migration Pathways							Recommended Actions
	Known-restricted Access	Known-continued Access	Likely	Unlikely	Unknown	Surface Soil	Subsurface Soils	Surface Water	Groundwater	Air	Structures	Drainage System	Surface Soil	Subsurface Soil	Surface Water	Groundwater	Air	Structures	Drainage System	
Parcel B																				
103				✓		N	N	N	N	N	L	L	N	N	N	N	N	L	N	Review Final Status Survey Report
113				✓		N	N	N	N	N	L	N	N	N	N	N	N	L	N	Review Final Status Survey Report
113A				✓		N	N	N	N	N	L	N	N	N	N	N	N	L	N	Review Final Status Survey Report
114				✓		L	N	N	N	N	N	N	L	N	N	N	N	N	N	Scoping Survey
130				✓		N	N	N	N	N	L	N	N	N	N	N	N	L	N	Review Final Status Survey Report
140 and Discharge Channel				✓		N	N	N	N	N	L	L	N	N	N	N	N	L	L	Scoping Survey
142				✓		L	N	N	N	N	L	N	L	N	N	N	N	L	N	Scoping Survey
146			✓			N	N	N	N	N	L	N	N	N	N	N	N	L	N	Characterization Survey
157				✓		N	N	N	N	N	L	N	N	N	N	N	N	L	N	Scoping Survey

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TABLE 3

BUILDING/AREA ASSESSMENT AND CLASSIFICATION

Building No. or Area	Contamination Potential					Contaminated Media							Potential Migration Pathways							Recommended Actions
	Known-restricted Access	Known-continued Access	Likely	Unlikely	Unknown	Surface Soil	Subsurface Soils	Surface Water	Groundwater	Air	Structures	Drainage System	Surface Soil	Subsurface Soil	Surface Water	Groundwater	Air	Structures	Drainage System	
IR-07				✓		L	L	N	N	N	N	N	L	L	N	N	N	N	N	Scoping Survey
IR-18				✓		L	L	N	N	N	N	N	L	L	N	N	N	N	N	Scoping Survey
Drydock 5				✓		N	N	N	N	N	L	L	N	N	N	N	N	L	L	Scoping Survey
Drydock 6				✓		N	N	N	N	N	L	L	N	N	N	N	N	L	L	Review Final Status Survey Report
Drydock 7				✓		N	N	N	N	N	L	L	N	N	N	N	N	L	L	Scoping Survey
Parcel C																				
203				✓		L	N	N	N	N	L	N	L	N	N	N	N	L	N	Scoping Survey
205 and Discharge Channel				✓		N	N	N	N	N	L	L	N	N	N	N	N	L	L	Scoping Survey
211		✓				N	N	N	N	N	M	L	N	N	N	N	N	L	L	Remediation and Final Status Survey
214				✓		N	N	N	N	N	L	N	N	N	N	N	N	L	N	Review Final Status Survey Report

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TABLE 3

BUILDING/AREA ASSESSMENT AND CLASSIFICATION

Building No. or Area	Contamination Potential					Contaminated Media							Potential Migration Pathways							Recommended Actions
	Known-restricted Access	Known-continued Access	Likely	Unlikely	Unknown	Surface Soil	Subsurface Soils	Surface Water	Groundwater	Air	Structures	Drainage System	Surface Soil	Subsurface Soil	Surface Water	Groundwater	Air	Structures	Drainage System	
224			✓			N	N	N	N	N	L	N	N	N	N	N	N	L	N	Review Final Status Survey Report
241				✓		N	N	N	N	N	L	N	N	N	N	N	N	L	N	Review Final Status Survey Report
253		✓				N	N	N	N	N	H	H	N	N	N	N	N	M	M	Remediation and Final Status Survey
271				✓		N	N	N	N	N	L	N	N	N	N	N	N	L	N	Review Final Status Survey Report
272				✓		N	N	N	N	N	L	N	N	N	N	N	N	L	N	Review Final Status Survey Report
Drydock 2			✓			N	N	N	N	N	M	L	N	N	N	N	N	L	L	Review Final Status Survey Report
Drydock 3			✓			N	N	N	N	N	M	L	N	N	N	N	N	L	L	Review Final Status Survey Report
Drydock 4			✓			N	N	N	N	N	M	L	N	N	N	N	N	L	L	Review Final Status Survey Report

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TABLE 3

BUILDING/AREA ASSESSMENT AND CLASSIFICATION

Building No. or Area	Contamination Potential					Contaminated Media							Potential Migration Pathways							Recommended Actions
	Known-restricted Access	Known-continued Access	Likely	Unlikely	Unknown	Surface Soil	Subsurface Soils	Surface Water	Groundwater	Air	Structures	Drainage System	Surface Soil	Subsurface Soil	Surface Water	Groundwater	Air	Structures	Drainage System	
Parcel D																				
274				✓		N	N	N	N	N	L	N	N	N	N	N	N	L	N	Review Final Status Survey Report
313 Site			✓			L	L	N	N	N	N	N	L	L	N	N	N	N	N	Review Final Status Survey Report
313A Site			✓			M	L	N	N	N	N	M	L	L	N	N	N	N	L	Review Final Status Survey Report
317 Site			✓			L	L	N	N	N	N	N	L	L	N	N	N	N	N	Review Final Status Survey Report
322 Site			✓			L	N	N	N	N	N	N	L	N	N	N	N	N	N	Review Final Status Survey Report
351			✓			N	N	N	N	N	M	L	N	N	N	N	N	L	L	Review Final Status Survey Report
351A		✓				M	N	N	N	N	M	M	M	N	N	N	N	L	L	Characterization Survey
364		✓				H	M	N	N	N	H	H	M	L	N	N	N	M	M	Remediation and Final Status Survey
365				✓		N	N	N	N	N	L	L	N	N	N	N	N	L	L	Review Final Status Survey Report

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TABLE 3

BUILDING/AREA ASSESSMENT AND CLASSIFICATION

Building No. or Area	Contamination Potential					Contaminated Media							Potential Migration Pathways							Recommended Actions
	Known-restricted Access	Known-continued Access	Likely	Unlikely	Unknown	Surface Soil	Subsurface Soils	Surface Water	Groundwater	Air	Structures	Drainage System	Surface Soil	Subsurface Soil	Surface Water	Groundwater	Air	Structures	Drainage System	
366/351B		✓				N	N	N	N	N	M	M	N	N	N	N	N	L	L	Remediation and Final Status Survey
383				✓		N	N	N	N	N	L	N	N	N	N	N	N	L	N	Review Final Status Survey Report
408			✓			N	N	N	N	N	M	N	N	N	N	N	N	L	N	Scoping Survey
411				✓		N	N	N	N	N	L	N	N	N	N	N	N	L	N	Review Final Status Survey Report
Gun Mole(Regunning)Pier			✓			L	L	N	N	N	L	N	L	L	N	N	N	L	N	Review Characterization Report
500				✓		N	N	N	N	N	L	N	N	N	N	N	N	L	N	Scoping Survey
503 Site			✓			N	L	N	N	N	N	L	N	L	N	N	N	N	L	Scoping Survey
Mahan Street-NRDL			✓			M	M	N	N	N	N	N	L	L	N	N	N	N	N	Review Final Status Survey Report
813				✓		N	N	N	N	N	L	N	N	N	N	N	N	L	N	Scoping Survey
819			✓			N	N	N	N	N	L	M	N	N	N	N	N	L	M	Scoping Survey

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TABLE 3

BUILDING/AREA ASSESSMENT AND CLASSIFICATION

Building No. or Area	Contamination Potential					Contaminated Media							Potential Migration Pathways							Recommended Actions
	Known-restricted Access	Known-continued Access	Likely	Unlikely	Unknown	Surface Soil	Subsurface Soils	Surface Water	Groundwater	Air	Structures	Drainage System	Surface Soil	Subsurface Soil	Surface Water	Groundwater	Air	Structures	Drainage System	
Parcel E																				
406			✓			N	N	N	N	N	M	N	N	N	N	N	N	L	N	Review Final Status Survey Report
414				✓		N	N	N	N	N	L	N	N	N	N	N	N	L	N	Review Final Status Survey Report
500 Building Series			✓			M	H	N	N	N	N	H	L	M	N	N	N	N	H	Scoping Survey
506 Site			✓			M	M	N	N	N	N	M	L	L	N	N	N	N	M	Scoping Survey
507 Site			✓			L	L	N	N	N	N	M	L	L	N	N	N	N	L	Characterization Survey
508 Site			✓			L	L	N	N	N	N	M	L	L	N	N	N	N	L	Characterization Survey
509 Site			✓			L	L	N	N	N	N	M	L	L	N	N	N	N	L	Characterization Survey
510 Site			✓			L	L	N	N	N	N	M	L	L	N	N	N	N	L	Characterization Survey
510A Site			✓			L	L	N	N	N	N	M	L	L	N	N	N	N	L	Scoping Survey

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TABLE 3

BUILDING/AREA ASSESSMENT AND CLASSIFICATION

Building No. or Area	Contamination Potential					Contaminated Media							Potential Migration Pathways							Recommended Actions
	Known-restricted Access	Known-continued Access	Likely	Unlikely	Unknown	Surface Soil	Subsurface Soils	Surface Water	Groundwater	Air	Structures	Drainage System	Surface Soil	Subsurface Soil	Surface Water	Groundwater	Air	Structures	Drainage System	
517 Site			✓			L	L	N	N	N	N	M	L	L	N	N	N	N	L	Characterization Survey
520 Site		✓				M	M	N	N	N	N	M	M	M	N	N	N	N	L	Characterization Survey
521				✓		L	N	N	N	N	L	N	N	N	N	N	N	N	N	Scoping Survey
529 Site		✓				M	M	N	N	N	M	H	L	L	N	N	N	L	M	Scoping Survey
701 Site				✓		L	N	N	N	N	N	N	L	N	N	N	N	N	N	Review Final Status Survey Report
704 Area			✓			L	L	N	N	N	N	N	L	L	N	N	N	N	N	Scoping Survey
704/Pens				✓		L	L	N	N	N	N	N	L	L	N	N	N	N	N	Scoping Survey
707/Kennels		✓				L	L	N	N	N	L	M	L	L	N	N	N	L	M	Characterization Survey
707 B Site				✓		L	L	N	N	N	N	N	N	L	N	N	N	N	L	Characterization Survey (as part of 707 Triangle Area Survey)

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TABLE 3

BUILDING/AREA ASSESSMENT AND CLASSIFICATION

Building No. or Area	Contamination Potential					Contaminated Media							Potential Migration Pathways							Recommended Actions
	Known-restricted Access	Known-continued Access	Likely	Unlikely	Unknown	Surface Soil	Subsurface Soils	Surface Water	Groundwater	Air	Structures	Drainage System	Surface Soil	Subsurface Soil	Surface Water	Groundwater	Air	Structures	Drainage System	
707 C Site				✓		L	L	N	N	N	N	N	L	L	N	N	N	N	N	Characterization Survey as (part of 707 Triangle Area Survey)
707 Triangle Area		✓				L	H	N	N	N	N	H	L	M	N	N	N	N	M	Characterization Survey
708				✓		L	N	N	N	N	L	N	L	N	N	N	N	N	N	Review Final Status Survey Report
719 Site				✓		L	L	N	N	N	N	N	L	N	N	N	N	N	N	Scoping Survey
807 Site				✓		L	L	N	N	N	N	N	L	L	N	N	N	L	N	Scoping Survey
810		✓				M	N	N	N	N	M	N	L	N	N	N	N	L	N	Remediation and Scoping Survey
Shack 79 Site			✓			M	L	N	N	N	N	N	L	L	N	N	N	N	N	Final Status Survey
Shack 80 Site		✓				H	M	N	N	N	N	N	M	L	N	N	N	N	N	Remediation and Final Status Survey
Experimental Shielding Range			✓			M	L	N	N	N	N	N	L	L	N	N	N	N	N	Review Final Status Survey Report

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TABLE 3

BUILDING/AREA ASSESSMENT AND CLASSIFICATION

Building No. or Area	Contamination Potential					Contaminated Media							Potential Migration Pathways							Recommended Actions
	Known-restricted Access	Known-continued Access	Likely	Unlikely	Unknown	Surface Soil	Subsurface Soils	Surface Water	Groundwater	Air	Structures	Drainage System	Surface Soil	Subsurface Soil	Surface Water	Groundwater	Air	Structures	Drainage System	
IR-01/21, Industrial Landfill		✓				H	H	N	N	N	N	N	M	M	N	N	N	N	N	Review Characterization Survey Report, Remediation, and Final Status Survey
IR-02, Bay Fill		✓				H	H	N	L	N	N	N	M	M	N	L	N	N	N	Characterization Survey
IR-03			✓			M	M	N	N	N	N	N	L	L	N	N	N	N	N	Scoping Survey
IR-04		✓				H	M	N	N	N	N	N	M	L	N	N	N	N	N	Characterization Survey
Former Salvage Yard			✓			M	M	N	N	N	N	N	L	L	N	N	N	N	N	Scoping Survey
Shoreline		✓				H	M	L	N	N	N	N	M	M	L	N	N	N	N	Characterization Survey

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TABLE 3

BUILDING/AREA ASSESSMENT AND CLASSIFICATION

Building No. or Area	Contamination Potential					Contaminated Media							Potential Migration Pathways							Recommended Actions
	Known-restricted Access	Known-continued Access	Likely	Unlikely	Unknown	Surface Soil	Subsurface Soils	Surface Water	Groundwater	Air	Structures	Drainage System	Surface Soil	Subsurface Soil	Surface Water	Groundwater	Air	Structures	Drainage System	
Base-wide																				
Storm Drain lines		✓				N	L	N	N	N	L	H	N	L	N	N	N	L	M	Scoping/Characterization Surveys of systems associated with NRDL sites or sites associated with radium use
Sanitary Sewers		✓				N	L	N	N	N	L	H	N	L	N	N	N	L	M	Scoping/Characterization Survey of systems associated with NRDL sites or sites associated with radium use
Septic Systems			✓			N	M	N	N	N	N	H	N	L	N	N	N	N	M	Scoping/Characterization Surveys of systems associated with NRDL buildings
Parcel H																				
Underwater Areas			✓			N	L	N	N	N	N	N	L	N	N	N	N	N	N	Scoping Surveys in areas of Operation CROSSROADS decontamination activities and site outfall discharge

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TABLE 3

BUILDING/AREA ASSESSMENT AND CLASSIFICATION

Building No. or Area	Contamination Potential					Contaminated Media						Potential Migration Pathways								Recommended Actions
	Known-restricted Access	Known-continued Access	Likely	Unlikely	Unknown	Surface Soil	Subsurface Soils	Surface Water	Groundwater	Air	Structures	Drainage System	Surface Soil	Subsurface Soil	Surface Water	Groundwater	Air	Structures	Drainage System	
All Ships' Berths				✓		L	L	N	N	N	L	N	N	L	N	N	N	L	N	Review Final Status Survey Report for completed berths; Scoping Survey on remainder
Off-site Facility																				
ICW 418				✓		N	N	N	N	N	L	N	N	N	N	N	N	L	N	Scoping Survey

Notes:

H High = Evidence of contamination in the media or migration pathway has been identified.

L Low = The potential for contamination in the type of media or migration pathway is remote.

M Moderate = The potential for contamination in the media or migration pathway exists, although the extent has not been fully assessed.

N None = Evidence of contamination in the specific media or migration pathway has not been found, or known contamination has been removed, and surveys indicate that the media or migration pathway meets today's release criteria.

NRDL – Navy Radiological Defense Laboratory

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FIGURES

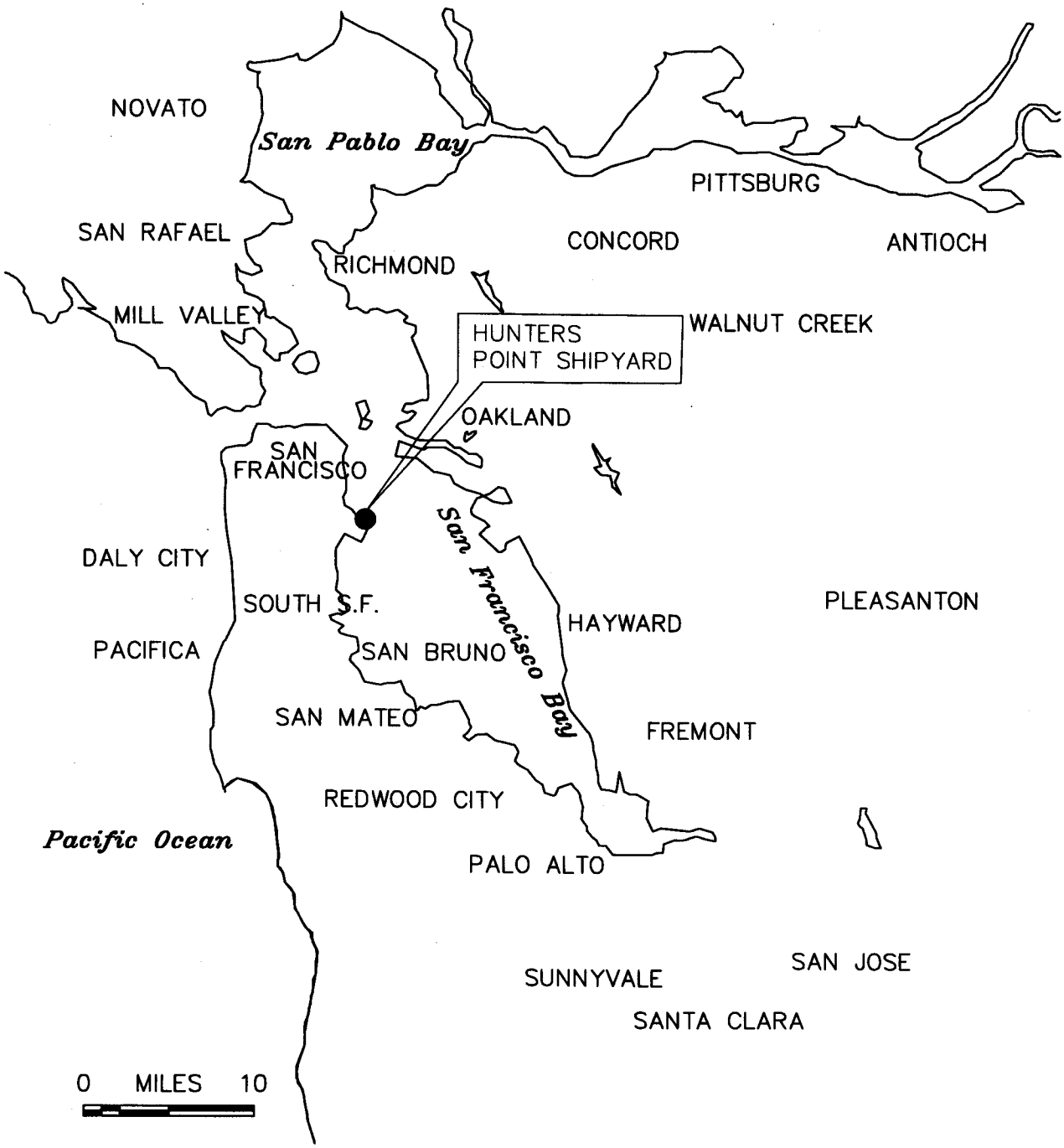


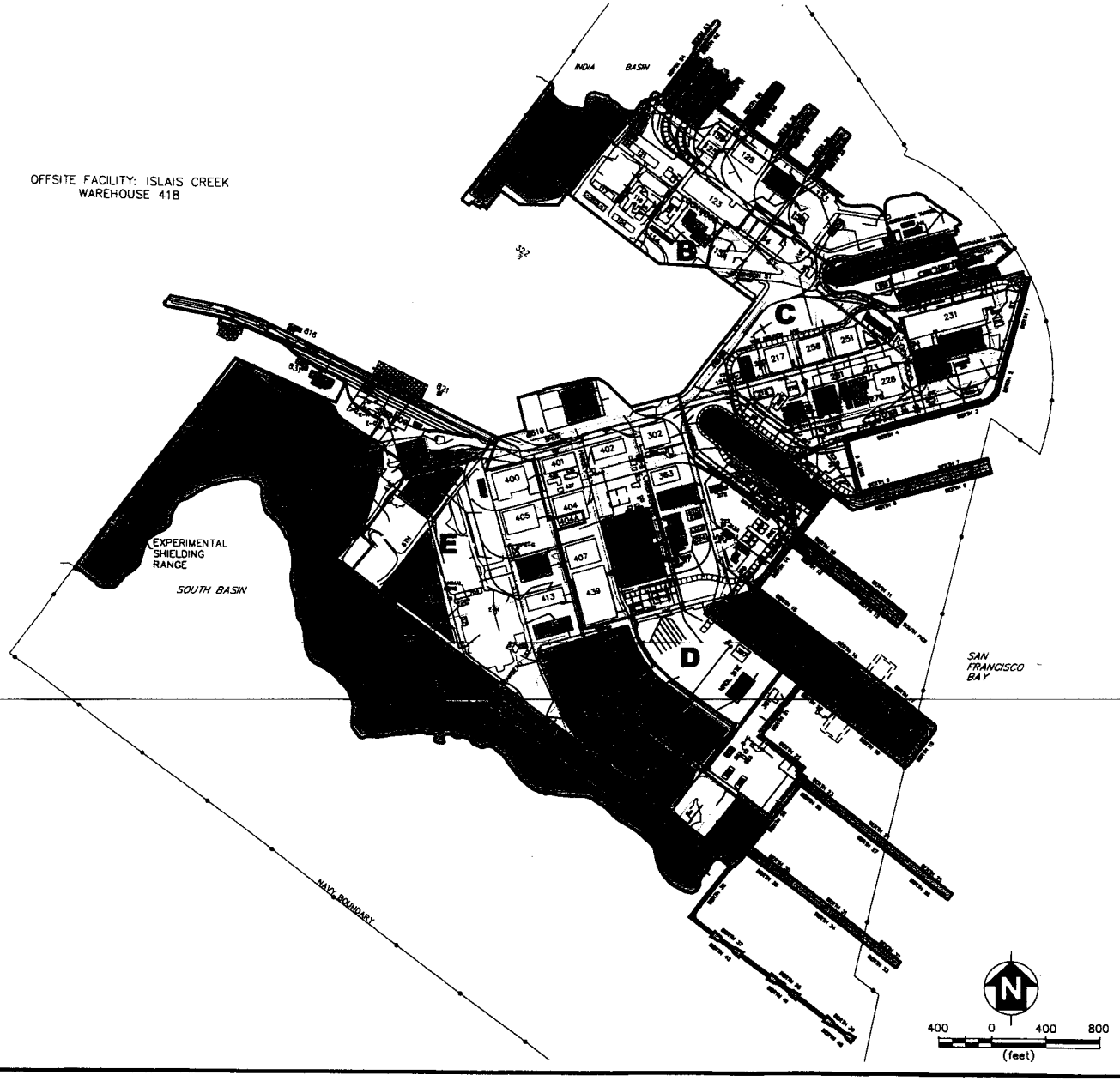
FIGURE 1
HUNTERS POINT SHIPYARD LOCATION

HUNTERS POINT SHIPYARD–SAN FRANCISCO, CA

TETRA TECH EC, INC.

DRAWING NO: 0606761.DWG
DCN: FWSD-RAC-06-0676
CTO: 0072
APPROVED BY: JS
CHECKED BY: JS
REV:
DRAWN BY: MD
DATE: 04/07/06

P:\1990-RAC\CTO-0072\DWG\060676\0606761.DWG
PLOT/UPDATE: APR 06 2006 15:57:57



LEGEND

- NAVY PROPERTY BOUNDARY (OFFSHORE)
- PARCEL BOUNDARY
- IMPACTED SANITARY SEWER SYSTEM
- IMPACTED STORM DRAIN SYSTEM
- IMPACTED BUILDINGS OR SITES
- DEMOLISHED IMPACTED BUILDINGS/STRUCTURES
- DEMOLISHED BUILDINGS/STRUCTURES
- IMPACTED SITES THAT HAVE OBTAINED REGULATORY RELEASE
- IMPACTED FUDS SITES
- NON-IMPACTED BUILDINGS WITHIN AN IMPACTED SITE, RADIOLOGICAL PRECAUTIONS MAY BE REQUIRED

NOTE
IMPACTED SITES ARE SITES THAT HAVE KNOWN RADIOLOGICAL CONTAMINATION OR WHERE SITE HISTORY INDICATES THAT RADIOLOGICAL CONTAMINATION MAY BE PRESENT.

FIGURE 2
RADIOLOGICALLY IMPACTED SITES MAP

HUNTERS POINT SHIPYARD–SAN FRANCISCO, CA

TETRA TECH EC, INC.

DRAWN BY: MD	CHECKED BY: JS	APPROVED BY: JS	DCN: FWSD-RAC-06-0676	DRAWING NO: 0606762.DWG
DATE: 04/07/06	REV: 0		CTO: 0072	

P:\1990-RAC\CTO-0072\DWG\060676\0606762.DWG
PLOT/UPDATE: APR 06 2006 16:02:49

APPENDIX A

POTENTIAL FEDERAL AND STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS AND TO-BE-CONSIDERED CRITERIA FOR POTENTIALLY CONTAMINATED SITES AT HUNTERS POINT SHIPYARD

APPENDIX A

POTENTIAL FEDERAL AND STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS AND TO-BE-CONSIDERED CRITERIA FOR POTENTIALLY CONTAMINATED SITES AT HUNTERS POINT SHIPYARD

Regulation	Requirement	Citation[b]	ARAR Determination	Comments
Chemical-specific[a] ARAR				
Health and Environmental Standards for Drinking Water	MCLs for radionuclides • Combined radium-226 and radium-228 – 5 pCi/L • Gross alpha (including radium-226 but excluding radon and uranium) – 15 pCi/L • Tritium – 20,000 pCi/L • Strontium-90 – 8 p/Ci/L • Beta and photon – 4 mrem/yr • Uranium – 30 µg/L	40 CFR §141.66	Applicable	This requirement is applicable to the wastewater limits established for the site.
Radiological Criteria for Unrestricted Use at Closing NRC Licensed Facilities	A site will be considered acceptable for unrestricted use if the residual radioactivity that is distinguishable from background radiation results in TEDE to an average member of the critical group that does not exceed 25 mrem/yr, including that from groundwater sources of drinking water, and that the residual radioactivity has been reduced to ALARA.	10 CFR § 20.1402	Relevant and Appropriate	The Navy would apply this requirement, with the exception that 15 mrem/yr TEDE is substituted for 25 mrem, as ALARA.
Radiological Criteria for License Termination Under Restricted Conditions	As a condition for license termination with restricted site use, the licensee must demonstrate that further reductions in residual radioactivity necessary to comply with the provisions of 10 USC § 20.1402 would result in net public or environmental harm or were not being made because the residual levels associated with restricted conditions are ALARA.	10 CFR § 20.1403(a)	Relevant and Appropriate	Potentially relevant and appropriate for a restricted land use scenario since radioactive materials may be left on site at fill areas.
Radiological Criteria for License Termination Under Restricted Conditions	As a condition for license termination with restricted site use, the licensee must make provisions for legally enforceable institutional controls that provide reasonable assurance that the TEDE from residual radioactivity distinguishable from background to the average member of the critical group will not exceed 25 mrem/yr.	10 CFR § 20.1403(b)	Applicable	Restricted land use scenarios may be used in areas that are associated with fill and surveys will not be performed at depths greater than 1 foot below ground surface. The 25 mrem/yr will still apply to the surface dose.

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APPENDIX A

POTENTIAL FEDERAL AND STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS AND TO-BE-CONSIDERED CRITERIA FOR POTENTIALLY CONTAMINATED SITES AT HUNTERS POINT SHIPYARD

Regulation	Requirement	Citation[b]	ARAR Determination	Comments
Chemical-specific[a] ARAR (Continued)				
Alternate Radiological Criteria for License Termination	Alternate criteria are allowed for license termination as long as assurance is provided that public health and safety would continue to be protected and that it is unlikely that the dose from all man-made sources combined, other than medical, would be more than the 100 mrem/yr limit of subpt. D, by submitting an analysis of possible sources of exposure; to the extent practical restrictions on site use are employed according to the provisions of § 20.1403 in minimizing exposures at the site; and doses are reduced to ALARA levels, taking into consideration any detriments such as traffic accidents expected to potentially result from decontamination and waste disposal.	10 CFR §20.1404(a)(1) - (a)(3)	Applicable	Sites will be dose modeled to show that residual radioactivity present does not exceed 25 mrem/yr. Therefore, members of the public are not expected to receive more than 100 mrem/yr.
Dose Limits for Individual Members of the Public	Requires that the TEDE to individual members of public not exceed 0.1 rem from licensed operation: construction, operation, and decommissioning of commercial reactors and fuel cycle facilities; possession, use, processing, exporting, and certain aspects of transporting nuclear materials and waste; and siting, design, construction, operations, and closure of waste disposal sites.	10 CFR §20.1301(a)(1)	Applicable	This requirement is a health-based standard that is applicable for exposure to members of the public during removal actions.
ALIs and DACs of Radionuclides for Occupational Exposure	Establishes limits for effluent releases to unrestricted area particularly in the implementation of the provisions of §20.1302, which implement the radiation dose limits for the public as listed in 10 CFR §20.1301	10 CFR pt. 20, Appendix B, Table 2	Applicable	This requirement is applicable to all removal actions performed as gaseous emissions of radionuclides may occur and is addressed by 10 CFR §20.1301.
Location-specific ARAR				
Federal Coastal Zone Management Act	This act specifies that federal actions that affect the coastal zone must be consistent with the policies of the San Francisco Bay Conservation and Development Commission's federally approved coastal management program.	16 USC 1456(c)(1)(A)	Applicable	This requirement is applicable to all removal actions performed in proximity to San Francisco Bay.

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APPENDIX A

POTENTIAL FEDERAL AND STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS AND TO-BE-CONSIDERED CRITERIA FOR POTENTIALLY CONTAMINATED SITES AT HUNTERS POINT SHIPYARD

Regulation	Requirement	Citation[b]	ARAR Determination	Comments
Action-specific ARAR				
Storage and Control of Licensed Material	The licensee shall secure from unauthorized removal or access licensed materials that are stored in controlled or unrestricted areas.	10 CFR §20.1801	Relevant and Appropriate	Potentially relevant and appropriate for a restricted land use scenario since waste will be left on site.
	The licensee shall control and maintain constant surveillance of licensed material that is in a controlled or unrestricted area and that is not in storage.	10 CFR §20.1802	Relevant and Appropriate	Potentially relevant and appropriate for sites where radioactive material may remain on site if the site can meet the criteria.
Protection of the General Population from Releases of Radioactivity	Performance objectives for the land disposal of LLRW. Concentrations of radioactive material that may be released to the general environment must not result in an annual dose exceeding 25 mrem to the body or any organ of a member of the general public.	10 CFR §61.41	Applicable	Applicable for sites where radioactive materials may remain on site if the site can meet the criteria.
Protection of the Individuals from Inadvertent Intrusion	Design, operation, and closure of the land disposal facility must ensure protection of any individual inadvertently intruding into the disposal site and occupying the site or contacting the waste at any time after active institutional controls over the disposal site are removed.	10 CFR §61.42	Relevant and Appropriate	Potentially relevant and appropriate for sites where radioactive waste may remain on site if the site can meet the criteria.
Protection of Individuals During Operation	Every reasonable effort shall be made to maintain radiation exposures ALARA.	10 CFR §61.43	Applicable	Potentially relevant and appropriate for sites where radioactive waste will remain on site.
Stability of the Disposal Site After Closure	The disposal facility must be sited, designed, used, operated, and closed to achieve long-term stability of the disposal site and to eliminate to the extent practicable the need for ongoing active maintenance of the disposal site following closure so that only surveillance, monitoring, or minor custodial care are required.	10 CFR§61.44	Relevant and Appropriate	Potentially relevant and appropriate for a site with radionuclides.

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POTENTIAL FEDERAL AND STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS AND TO-BE-CONSIDERED CRITERIA FOR POTENTIALLY CONTAMINATED SITES AT HUNTERS POINT SHIPYARD

Regulation	Requirement	Citation[b]	ARAR Determination	Comments
Action-specific ARAR (Continued)				
Waste Disposal by Release into Sanitary Sewage	A licensee may discharge licensed material into sanitary sewerage if each of the following conditions is satisfied: the material is readily soluble in water; and the quantity that the licensee releases into the sewer in 1 month divided by the average monthly volume of water released does not exceed the concentration listed in Table 3 of appendix B to pt. 20; and if more than one radionuclide is released, the licensee shall determine the fraction of the limit in Table 3 of appendix B to pt. 20 represented by discharges into sanitary sewerage by dividing the actual monthly average concentration of each radionuclide released by the licensee into the sewer by the concentration of that radionuclide listed in Table 3 of appendix B to pt. 20; and the sum of the fractions for each radionuclide required by paragraph (a)(3)(i) of this section does not exceed unity; and the total quantity of licensed and other radioactive material that the licensee releases into the sanitary sewerage system in a year does not exceed 5 Ci (185 GBq) of hydrogen-3, 1 Ci (37 GBq) of carbon-14, and 1 Ci (37 GBq) of all other radioactive materials combined.	10 CFR §20.2003	Relevant and Appropriate	The Navy would apply this requirement, with the exception that waste water discharged to the sanitary sewer system will meet the release criteria established in Table 1, which is more conservative than the values listed in this ARAR.

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APPENDIX A

POTENTIAL FEDERAL AND STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS AND TO-BE-CONSIDERED CRITERIA FOR POTENTIALLY CONTAMINATED SITES AT HUNTERS POINT SHIPYARD

Notes:

[a] Many potential action-specific ARARs contain chemical-specific limitations and are addressed in the action-specific ARAR tables.
[b] Only the substantive provisions of the requirements cited in this table are potential ARARs.

Abbreviations and Acronyms:

µg/L – microgram per liter
ALARA – as low as reasonably achievable
ALI – Annual Limit of Intake
ARAR – applicable or relevant and appropriate requirement
CFR – Code of Federal Regulations
Ci – curie
DAC – derived airborne concentration
GBq – gigabecquerel
LLRW – low-level radioactive waste
MCL – Maximum Contaminant Level
mrem – millirem
mrem/yr – millirem per year
Navy – U.S. Department of the Navy
NRC – Nuclear Regulatory Commission
pCi/L – picocurie per Liter
pt. – part
subpt. – subpart
TEDE – total effective dose equivalent
USC – United States Code

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APPENDIX B

ADMINISTRATIVE RECORD INDEX

APPENDIX B

ADMINISTRATIVE RECORD INDEX

Document Date	Document Type	Classification	Author Affiliation	Title or Subject
11/03/92	Report	AR	PRC	Surface Confirmation Radiation Survey (Phase I Investigation)
05/08/96	Report	AR	PRC	Results of Subsurface Radiation Investigation in Parcels B and E, HPS, San Francisco, California (Phase II Investigation)
10/27/97	Report	AR	TtEMI	Draft Final Parcel E RI Report, HPS, San Francisco, California (Phase I-III Investigation Summary)
05/15/00	Report	AR	TtEMI	Draft Phase IV Radiation Investigation Report, HPS, San Francisco, California
08/17/00	Report	AR	TtEMI	Radiological Removal Action, Action Memorandum, HPS, San Francisco, California
11/19/01	Report	AR	DON	Basewide Radiological Removal Action, Action Memorandum, HPS, San Francisco, California
8/31/04	Report	AR	DON	Final Historical Radiological Assessment Volume II, History of the Use of General Radioactive Materials, 1939-2003, HPS, San Francisco, California

Notes:

AR – Administrative Record
HPS – Hunters Point Shipyard
Navy – U.S. Department of the Navy
PRC – PRC Environmental Management, Inc.
RI – remedial investigation
TtEMI – Tetra Tech EM, Inc.