CASE-BY-CASE MACT PERMIT APPLICATION

Texas Gulf Terminals Inc.
Texas Gulf Terminals Project

Appendix D

DRAFT Revised Intro

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July 2018

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1.1. EXECUTITIVE SUMMARY

Texas Gulf Terminals Inc. (TGTI) is proposing to construct, own, and operate a deepwater port (DWP) as part of the Texas Gulf Terminal Project, in Federal waters of the U.S. Gulf of Mexico located approximately 14 miles off the coast of North Padre Island in Kleberg County, Texas.

1.1.1. Project Background and Need

The purpose of the proposed project is to provide a safe, efficient and cost effective logistical solution for the export of crude oil from the United States of America (U.S.) to support the continued economic growth of the U.S. Currently the U.S. is exporting 2.4 MMbpd of crude oil. The U.S. crude oil production forecast indicates there will be a 3.8 million barrel per day (MMbpd) increase of U.S. crude oil production over the next 5 years. Forecasts from Turner Mason & Company predict that U.S. crude oil production could surpass 13.0 MMbpd by 2022.

The increase in U.S. crude oil production consists of grades of crude oil classified as light, low sulfur crude oil. Light, low sulfur crude oil can typically be defined as greater than 25 American Petroleum Institute (API) gravity and 0.5 wt% sulfur. Refineries are a complex series of processing units designed to convert a specific type of crude oil into refined products, such as gasoline and diesel. Existing U.S. refineries are either designed to process heavy, high sulfur crude oils or their ability to process light, low sulfur crude oil is currently at maximum capacity.

The additional production of light, low sulfur crude oil will ultimately be exported from the U.S. Forecasted production volumes of light, low sulfur crude oil within the U.S. equates to the export of 675 Very Large Crude Carriers (VLCCs) per year. Currently, no inland port can fully and directly load a VLCC due to the draft and dock limitations. As such, VLCCs are currently loaded via ship-to-ship (STS) transfer operations, also referred to as lightering and/or reverse lightering. STS operations involve the use of smaller vessel(s) requiring lesser draft depths to fully load a VLCC. During the STS operation, the VLCC stays positioned in water depths of greater than 71 feet, the minimum depth required to fully load a VLCC. The smaller vessels load at an inland port, transit to the VLCC, transfer their cargo to the VLCC via an STS operation, and transit back to the inland port. This process is repeated until the VLCC is fully loaded. As such, STS operations create several health, safety, security, and environment (HSSE) concerns including multiple discharge operations at the VLCC, multiple navigations in and out of the inland ports, multiple emission sources, and multiple exposures to workforce hazards.

The international market demand for crude oil will continue to grow. The development of a safe, efficient, and cost-effective logistical solution for the export of crude oil would result in significant benefits on a local, regional, national, and global sale and support the continued economic growth of the U.S. The oil and natural gas industry is a critical part of the U.S. economy. In 2015 these energy resources supported 10.3 million jobs and contributed more than $1.3 trillion to the U.S. economy. Without the proposed project, the export of crude oil from the U.S. would be limited due to existing logistical constraints, thereby likely limiting crude oil production, and exploration of new wells. Failure to develop a safe, efficient, and cost-effective logistical solution for the export of U.S. crude oil would result in the forfeiture of opportunities for the U.S. capitalization on international market demands and economic growth. The DWP terminal will include a Single Point Mooring (SPM) buoy system to moor a VLCC. The size of these VLCCs and inland port draft limitations prevent them from being fully loaded using the traditional docks at onshore terminals. Therefore, VLCCs have to be engaged offshore. The proposed SPM buoy system will be located in water with over 90 feet of depth, allowing a VLCC to be fully and directly loaded without the use of lightering (i.e., using smaller ships to transport crude oil from on-shore terminals out to VLCCs located in deeper waters).

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The project will serve as a crude oil export facility with a capacity of 60,000 barrels per hour (bph) and 192 million barrels per year. The project will be able to load approximately 96 VLCCs per year. The proposed project is comprised of two major offshore components: the SPM Buoy system and the offshore pipelines. A detailed description of the SPM Buoy system components and the offshore pipeline system is provided in Section 3.

1.1.2. Alternatives Summary

The proposed project represents the best available safe, efficient, and cost-effective logistical solution for the export of U.S. crude oil. TGTI analyzed several alternatives to the proposed project and concluded that each of the alternatives were inferior compared to the proposed SPM buoy system as they would lead to undesirable side effects compared to the proposed SPM buoy system (i.e., additional port congestion, increased safety and environmental hazards, lack of sufficient infrastructure, increased air emissions, etc). The alternatives analyses are provided under separate cover in the TGTI DWP License Application *Volume II – Environmental Evaluation, Section 2: Alternatives Analysis* and *Air Quality Information for Environmental Impact Statement – Appendix A.* As previously discussed, the alternative to the proposed SPM buoy system for the export of U.S. crude oil is through the use of STS lightering operations where a VLCC is fully loaded at a suitable location with adequate depth offshore by a series of smaller vessels capable of navigating the shallower inland waters.

STS lightering is conducted to support the current level of U.S. crude oil export however scaling STS lightering to accommodate the predicted expansion of U.S. crude oil export is not a feasible option as it would place an unsustainable level of strain on the infrastructure of inland terminals, increase congestion in the port areas, and would result in significantly more emissions than the proposed SPM buoy system. While inland loading of service vessels can be controlled via vapor collection and control systems at a given onshore terminal, the STS transfer onto the VLCC is not controlled. The proposed SPM buoy system avoids the negative impacts generated from the service vessels lightering the cargo from the onshore terminal to an offshore lightering location with suitable depth for the VLCCs to be loaded through STS transfer. A comparison of the HAP emissions generated from the lightering alternative compared to the proposed SPM buoy system is provided in Section 4.2 of this application. A more detailed comparison of HAP and criteria pollutant emissions generated from the lightering alternative compared to the proposed SPM buoy system is provided in Table A-5 of the separate document, *Air Quality Information for Environmental Impact Statement – Appendix A.*

TGTI also evaluated modifying the existing channel dimensions to enable a fully loaded VLCC to navigate to onshore terminals to be loaded. To accomplish this, the channel would have to have a depth of at least 71 feet for a fully loaded VLCC to navigate it. Currently, the Corpus Christi Ship Channel has water depths of approximately 45 ft. As such, a minimum of 26 feet of material would be required to be dredged from the onshore terminal to the 71-foot water depth contour located approximately 10.5 miles offshore. Preliminary estimates approximate that over 10 million cubic yards of material would be required to be removed and relocated to establish 71 ft depths through dredging activities along a 10.5 mile corridor from the existing 71 ft depths to the nearest location within the Port of Corpus Christi. Additionally, the use of the onshore terminal alternatives for the direct and full loading of VLCC's at the necessary rates and frequencies to fulfill the proposed design throughput of 60,000 bbl/hr and approximately 8 VLCCs per month would require storage capacities of approximately 6,000,000 bbl, mooring structures, and terminal supporting infrastructures. The use of an onshore terminal would require the development of approximately 150 to 200 acres located adjacent to a navigable waterway, such as the Corpus Christi Ship Channel.

TGTI's has extensively researched and evaluated alternatives to the proposed SPM buoy system and through the analysis has shown that the proposed SPM buoy system is the best available safe, efficient, and cost-effective logistical solution for the increased export of U.S. crude oil.

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1.1.3. Evaluation of Control Options (MACT Limit) Summary

TGTI conducted this Case-by-Case maximum achievable control technology (MACT) determination in accordance with 40 CFR 63.40 through 63.44 and Section 112(g) of the Clean Air Act (CAA) because the proposed SPM buoy system will represent a major source of HAP emissions that is not specifically regulated or exempted from regulation under a standard issued pursuant to section 112(d), section 112(h), or section 112(j) and incorporated in another subpart of part 63.

1.1.3.1. MACT Floor

The first step in this process is the development of the "MACT floor" for similar sources to the proposed SPM buoy system. TGTI conducted an extensive review of SPM buoy technology through a literature review, consultation with industry experts such as SPM buoy manufacturers and VLCC Captains, and search of available databases. The results of this review indicated that the appropriate MACT floor for SPM buoy systems is submerged loading onto vessels which implement a VOC management plan that complies with the requirements of MEPC.185(59). Submerged loading provides a 60% reduction in emissions compared to splash loading.[1] The VOC management plan is a ship-specific plan that contains best management practices to reduce the VOC emissions during tanker vessel operations. The VOC management is developed and maintained by the vessel operators and thus, TGTI will not have control over the specifics of the plan. Details of the MACT floor determination are provided in Section 5.3 of this application.

1.1.3.2. Beyond-the-Floor

TGTI also evaluated potential "Beyond-the-Floor" MACT limits for the proposed SPM buoy system. Beyond the floor controls that were evaluated include a support vessel or support platform with control equipment located near the SPM buoy system and a subsea line to return vapors back to shore for control onshore.

1.1.3.2.1 Support Vessel with Emissions Control located inside the Safety Zone

TGTI considered a control scenario in which a dedicated vapor recovery support vessel would be moored to the VLCC during loading operations. The support vessel could theoretically establish a vapor collection connection to the VLCC to capture and control vapors generated from loading. There are several problems with this approach that prevent it from being a potentially applicable control technology for the proposed SPM buoy system. First, there are no vessels currently commercially available capable of this operation at the throughputs required. A novel, unique vessel would have to be designed for this specific purpose. Furthermore, there is no guarantee a vessel designed for this purpose would be sufficiently reliable to use in this application. While the basic control technology exists and is well established in onshore applications, the control technologies are not directly transferable to the proposed offshore SPM buoy system due to inherent challenges when applying the control technology to an offshore SPM application. TGTI is not required to undertake a research and development project for the proposed SPM buoy system to meet MACT requirements. If a research and development project were required to design a new type of control device, this would not meet the requirements of being "available."

In addition, the operational and safety concerns with this option also prohibit it from being an applicable control technology for the proposed SPM buoy system. An SPM is designed to allow for the moored VLCC to weathervane around the buoy depending on the prevailing weather conditions. This is designed to limit the strain on the mooring cables and improve overall safety of the loading process. Similarly, when two ships are moored together, there are operational and safety considerations given to the orientation of the ships with

[1] 75 FR 65115, Oct. 21, 2010.

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respect to the prevailing weather conditions. If a support vessel is moored to the VLCC while the VLCC is moored to the SPM buoy system, proper orientation of all of the vessels with respect to the prevailing weather conditions cannot be established. This presents significant safety challenges. Therefore, a feasible design has not been identified for mooring a support vessel with vapor control capabilities to the VLCC while it is being loaded at the SPM.

1.1.3.2.2 Platform or Support Vessel with Emissions Control located outside the Safety Zone

In order to safely operate the SPM buoy system, any additional support vessel or platform would have to be located outside of the swing circle that is established around the SPM buoy system to allow the VLCC to weathervane. As such the vapor recovery line would have to be fed back to the SPM then down through subsea lines that connect to the service vessel or platform. An extended distance of vapor lines under water presents safety concerns because of the opportunity for vapor to condense in the line, potentially leading to increased line pressures due to flow blockage and electrostatic charge accumulation risks on the surface of the liquid.[2] Section 11.1.13.6 of the International Safety Guide for Oil Tankers and Terminals, 5th Edition (ISGOTT) states that a detonation arrestor should be fitted "in close proximity to the terminal vapor connection at the jetty head in order to provide primary protection against the transfer or propagation of a flame from ship to shore or shore to ship." Per 33 CFR 154.2105, the Coast Guard requires a detonation arrester to be located as close as practicable to the facility vapor connection but not more than 18 meters. The hypothetical setup for either a support vessel or a support platform near the SPM buoy system to control loading emissions would necessarily prevent compliance with this requirement as the first potential location for a detonation arrester would be significantly further than 18 meters away.

1.1.3.2.3 Land-based Emissions Control

The same safety concerns that apply to transporting vapors for control outside the safety zone would apply to a subsea line attempting to route vapors back to a land-based control device.

Therefore each of the beyond the floor control technologies were determined to not be an applicable control technology to the proposed SPM buoy system as they cannot reasonably be designed, installed, and operated on the source type under consideration. Additional details for the beyond the floor evaluation are provided in Section 5.3 of this application.

The results of the Case-by-Case MACT determination indicate submerged loading onto vessels which implement a VOC management plan which results in an emissions reduction of 60% is MACT for the proposed TGTI project.

1.2. PURPOSE OF APPLICATION

As noted previously, the proposed SPM buoy system will represent a major source of HAP emissions that is not specifically regulated or exempted from regulation under a standard issued pursuant to section 112(d), section 112(h) or section 112(j) and incorporated in another subpart of part 63. Accordingly, the requirements of 40 CFR 63.40 through 63.44 apply. The regulations contained in 40 CFR 63.40 through 63.44 carry out section 112(g)(2)(B) of the CAA as it relates to a Case-by-Case MACT determination. As such, TGTI has prepared a Case-by-Case MACT determination application in accordance with 40 CFR 63.40 through 63.44 and Section 112(g) of the CAA.

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[2] International Safety Guide for Oil Tankers and Terminals, 5th Edition, 2016.

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To reach this conclusion, TGTI conducted an extensive review of each of the National Emissions Standards for Hazardous Air Pollutants (NESHAP) regulation to identify any potentially applicable NESHAP regulations that might apply to the proposed SPM buoy system. Only one type of NESHAP regulations was identified that could be potentially applicable to the proposed SPM buoy system: NESHAP Subpart Y – National Emissions Standards for Marine Tank Vessel Loading Operations. The following section details why TGTI concluded NESHAP Subpart Y does not apply to the proposed SPM buoy system.

1.2.1. NESHAP Subpart Y - Marine Tank Vessel Loading Operations Inapplicability

NESHAP Subpart Y applies to affected sources of Marine Tank Vessel Loading Operations. The following definitions from NESHAP Subpart Y (40 CFR 63.561) are important provisions used to determine what qualifies as an affected source regulated under NESHAP Subpart Y.

> ***Affected source*** *means a source with emissions of 10 or 25 tons, a new major source with emissions less than 10 and 25 tons, a new major source offshore loading terminal, a source with throughput of 10 M barrels or 200 M barrels, or the VMT source, that is subject to the emission standards in §63.562.*
>
> ***Source(s)*** *means any location where at least* ***one dock or loading berth*** *is bulk loading onto marine tank vessels, except offshore drilling platforms and lightering operations.*
>
> ***Offshore Loading Terminal*** *means a location that has at least* ***one loading berth*** *that is 0.81 km (0.5 miles) or more from the shore that is used for mooring a marine tank vessel and loading liquids from shore."*
>
> ***Loading berth*** *means the loading arms, pumps, meters, shutoff valves, relief valves, and other piping and valves necessary to fill marine tank vessels. The loading berth includes those items necessary for an offshore loading terminal.*

The proposed SPM buoy system does not fit the definition of a "loading berth" per the definition set forth in 40 CFR 63.561 since the proposed SPM buoy system will not have loading arms, pumps, meters, shutoff valves, nor relief valves. Additionally, the proposed SPM buoy system does not have a "dock" or any fixed structure resembling a dock structure. Per the Cambridge Dictionary, a dock is defined as "a structure built out over the water in a port along which ships can land to load and unload, or the enclosed area of water between two such structures."

Therefore the proposed SPM buoy system does not fit the definition of an "affected source" because it does not meet the definition of a "source" as stated in 40 CFR 63.561.

The definitions of "offshore loading terminal" and "loading berth" are essentially circular. Therefore, TGTI also reviewed the NESHAP Subpart Y preamble and technological support documents to determine if there were any sources similar to the proposed SPM buoy system that were considered in the rulemaking. Based on this review, TGTI concluded that there were no similar sources to the proposed SPM buoy system (i.e., SPM buoy systems for directly and completely loading a VLCC for crude oil export) considered in the development of the NESHAP Subpart Y regulations. The proposed SPM buoy system will be a first of its kind for the United States. Export of crude oil was banned in the United States from 1975, following the 1973 OPEC oil embargo, until 2015 to all countries except Canada. Therefore, because of this legal restriction, there could not have been similar sources in operation when NESHAP Subpart Y was developed in 1995 nor when it was reconsidered in 2011.

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The proposed SPM buoy system also presents unique technical, environmental, and operational concerns compared to the sources that were considered in the establishment of MACT Subpart Y standards. EPA acknowledged in responses to comments on the 1995 NESHAP Subpart Y rule that the subcategory established for "offshore terminals" could be expanded to include additional subcategories based on throughputs, products handled, etc. It did not, however, consider doing so in 1995 because the public comments did not justify additional subcategories. This reinforces TGTI's conclusion that the proposed SPM buoy system is not an affected source under NESHAP Subpart Y.

1.2.2. Case-by-Case MACT Submittal

Since there are no applicable standards in either 40 CFR Part 61 or Part 63 that apply to the proposed SPM buoy system, this Case-by-Case MACT application has been prepared to present a Case-by-Case MACT determination for the proposed SPM buoy system in accordance with Section 112(g) of the Clean Air Act (CAA) and the implementing regulations in 40 CFR Part 63, Subpart B (40 CFR 63.40 – 63.56). Since Texas is the most adjacent seaward state, TCEQ regulations are also potentially applicable. Therefore, this application is also being submitted in accordance with 30 TAC Chapter 116, Subchapter E which implements Section 112(g) and 40 CFR Part 63, Subchapter B.

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The following section provides information required for a case-by-case MACT determination as detailed in 40 CFR Part 63. In each case, the requirement is quoted from 40 CFR Part 63 and followed by the relevant information.

3.1.1. Section 63.43(e)(2)(i)

In each instance where a constructed or reconstructed major source would require additional control technology or a change in control technology, the application for a MACT determination shall contain the following information:

The name and address (physical location) of the major source to be constructed or reconstructed;

The unit to be constructed is an SPM buoy system for export of crude oil loaded onto VLCCs. The proposed SPM buoy system will be located within territorial seas of the OCS Mustang Island Area TX3 (Gulf of Mexico), within the Bureau of Ocean Energy Management (BOEM) block number 823. The proposed SPM buoy system is positioned at Latitude N27° 28' 42.60" and Longitude W97° 00' 48.43", approximately 12.7 nautical miles (14.62 statute miles) off the coast of North Padre Island in Kleberg County, Texas. An aerial shot of the location of the proposed SPM buoy system is provided at the end of this section.

3.1.2. Section 63.43(e)(2)(ii)

A brief description of the major source to be constructed or reconstructed and identification of any listed source category or categories in which it is included;

The proposed SPM buoy system will load crude oil/condensate onto VLCCs connected to the SPM buoy system's loading hose. The crude oil/condensate will be supplied from the Onshore Storage Terminal Facility (OSTF) through subsea pipelines to the SPM buoy and onto the vessel being loaded. The overall handling capacity of the proposed SPM buoy system will be 60,000 barrels per hour (bph) and up to 192 million barrels per year (bpy). A process flow diagram is provided at the end of this section.

3.1.3. Section 63.43(e)(2)(iii)

The expected commencement date for the construction or reconstruction of the major source;

Construction of the proposed SPM buoy system is expected to begin in the 1st quarter of 2020, pending the issuance of all necessary permits and licenses.

3.1.4. Section 63.43(e)(2)(iv)

The expected completion date for construction or reconstruction of the major source;

Construction of the SPM buoy system is expected to take approximately 22 weeks. Construction is expected to be completed on the proposed SPM buoy system in the 3rd quarter of 2020.

3.1.5. Section 63.43(e)(2)(v)

The anticipated date of start-up for the constructed or reconstructed major source;

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The initial startup of the proposed SPM buoy system is expected to occur shortly after construction is complete in the 3rd quarter of 2020.

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4.1. CRITERIA POLLUTANTS EMISSIONS SUMMARY

4.1.1. Section 63.43(e)(2)(vi)

The HAP emitted by the constructed or reconstructed major source, and the estimated emission rate for each such HAP, to the extent this information is needed by the permitting authority to determine MACT;

HAPs emitted from the proposed SPM buoy system will be those that volatilize from crude oil/condensate as it is loaded onto the VLCC. Detailed emission calculations are provided in Attachment 3.

4.1.2. Section 63.43(e)(2)(vii)

Any federally enforceable emission limitations applicable to the constructed or reconstructed major source;

The PSD/Title V permits issued based on the PSD and Title V permit applications will establish federally enforceable limitations for the proposed SPM system.

4.1.3. Section 63.43(e)(2)(viii)

The maximum and expected utilization of capacity of the constructed or reconstructed major source, and the associated uncontrolled emission rate for that source, to the extent this information is needed by the permitting authority to determine MACT;

As discussed in Section 5 of the NSR application for the proposed SPM buoy system, criteria pollutant emissions from the proposed SPM buoy system will result from loading losses associated with the displacement of air inside the vessel as the vessel is loaded. TGTI estimated the emissions of VOC associated with loading losses of the vessels using TCEQ's Air Permit Technical Guidance for Chemical Sources: Loading Operations (October 2000) and the following equation from US EPA's AP-42, Section 5.2:

$$L = 12.46 \times S \times P \times M/T$$

Where:

L = Loading Loss (lb/10^3 gal of liquid loaded)

S = Saturation factor

P = True vapor pressure of liquid loaded (psia)

M = Molecular weight of vapors (lb/lbmole)

T = Temperature of bulk liquid loaded (R)

A saturation factor of 0.2 is used for submerged loading of ships. A maximum true vapor pressure of 11 psia is used for crude oil/condensate loading.

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The maximum loading capacity of the SPM buoy system is 60,000 bph and 192 million bpy. The proposed SPM buoy system is expected to have an expected utilization near 100%. HAP emissions from the proposed SPM buoy system will consist of those HAPs which make up crude oil/condensate. HAP emissions are calculated by assuming the speciation in the vapors lost are the same makeup as the speciation of the crude oil/condensate in the liquid.

4.1.4. Section 63.43(e)(2)(ix)

The controlled emissions for the constructed or reconstructed major source in tons/yr at expected and maximum utilization of capacity, to the extent this information is needed by the permitting authority to determine MACT;

Maximum controlled potential emissions for the proposed SPM system are provided in the table below.

Table 4-1 - Potential HAP Emissions from Proposed SPM Buoy System

Source	HAPs (tpy)
Vessel Loading	200
Fugitives	0.004
Total	**200**

4.2. ALTERNATIVES ANALYSIS

As mentioned in the project background, the purpose of the proposed SPM buoy system will be to fully and directly load VLCCs with crude oil/condensate for export. The proposed SPM buoy system is unique and different from current crude oil/condensate export operations that are currently conducted in the United States. Because of their size (2 MMbbls fully loaded), VLCCs are used for long haul trips to transport cargos long distances across the globe economically. However, their immense size and draft limitations prevents VLCCs from navigating to onshore terminals to be loaded fully. Therefore, VLCCs are currently loaded by lightering, which is the process of using smaller ships to shuttle crude oil/condensate from onshore terminals out to the VLCC. As part of the lightering, crude oil/condensate is loaded onto the VLCC via ship-to-ship (STS) transfer in off-shore waters with a depth that VLCCs can navigate while fully loaded. Emissions from STS transfer during lightering operations are not regulated by CAA regulations and therefore result in uncontrolled emissions of VOC.

Lightering is the current practice for loading VLCCs with crude oil/condensate for export. The STS transfers that occur during the lightering operations generate similar emissions as will occur during when the proposed SPM buoy system conducts its marine tank vessel loading transfer process. However, lightering generates many other emissions during ship movements that do not occur with the SPM buoy system. When comparing wholistic emissions from the entire lightering process to the entire process associated with use of the proposed SPM buoy system, the benefit of the proposed SPM buoy system is clear. Not only does the proposed SPM buoy system reduce the total amount of air emissions, but the proposed SPM buoy system also reduces ship channel traffic and results in a safer and more efficient process to fully load a VLCC with crude oil/condensate for export.

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The additional air emissions impacts of lightering compared to the proposed SPM buoy system are generated from the additional combustion emissions required to shuttle the crude oil/condensate on smaller oil tankers from onshore terminals out to the VLCC. With the proposed SPM buoy system, the only tanker involved is the VLCC and it does not have to come any closer to shore than the location of the proposed SPM buoy system, saving on propulsion fuel use. Furthermore, any emissions from the VLCC will be produced further away from the public than those generated by lightering vessels. The table below shows a comparison of the wholistic potential emissions from lightering and the proposed SPM buoy system.

Table 4-2 – Lightering HAP Emissions Comparison

Method	HAPs (tpy)
Lightering[1]	248
SPM Buoy System[2]	201
Savings from Proposed SPM Design	**47**

1. Accounts for full and partial lightering of VLCC based on a representation of historical lightering operations. HAP emissions represent the emissions from STS loading and any *additional* emissions generated in the lightering process (i.e., Loading of the lightering vessel onshore, propulsion of the lightering vessel, etc.).
2. Represents HAP emissions from SPM buoy system operations only (including product loading, propulsion, and various support vessel emissions).
3. Detailed emission calculations are provided under separate cover in the *Air Quality Information for Environmental Impact Statement, Appendix A*.

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This section discusses the case-by-case MACT determination for the proposed SPM system. TGTI developed a case-by-case MACT under section 112(g) of the CAA and 40 CFR 63, as referenced in 30 TAC Chapter 116, Subchapter E. This case-by-case application was developed because the SPM buoy system will be a major source of HAP emissions that is not regulated by an existing MACT standard. The rationale for and support of the case-by-case MACT are presented in the following section.

5.1. DEFINITION OF MACT

MACT for new sources is defined in 40 CFR §63.41 follows:

> *"Maximum achievable control technology (MACT) emission limitation for new sources" means the emission limitation which is not less stringent than the emission limitation achieved in practice by the best controlled similar source, and which reflects the maximum degree of reduction in emissions that the permitting authority, taking into consideration the cost of achieving such emission reduction, and any non-air quality health and environmental impacts and energy requirements, determines is achievable by the constructed or reconstructed major source.*

This MACT definition applies in two related, but distinct, regulatory contexts for controlling HAP emissions. The first context in which the MACT definition applies is in the development of MACT standards by EPA for specific source categories pursuant to section 112(d) of the CAA. EPA is required to adopt such MACT standards for every listed major source category of HAP emissions through notice and comment rulemaking. The second context in which the MACT definition applies is in regard to the establishment of case-by-case MACT standards for a proposed new (or reconstructed) major source of HAP emissions pursuant to section 112(g) of the CAA. Permitting authorities are required to adopt such case-by-case standards in those instances when EPA has not established a MACT standard under Section 112(d) that applies to the proposed new (or reconstructed) source. This latter case-by-case permitting review is the regulatory context that potentially applies to the proposed SPM system.

5.2. CASE-BY-CASE MACT IMPLEMENTION REGULATIONS

40 CFR §63.43(d) provides the regulatory basis for preparing a Case-by-Case MACT Assessment.

> *(d) Principles of MACT determinations. The following general principles shall be used to make a case-by-case MACT determination concerning construction or reconstruction of a major source under this Rule:*
>
> *(1) The MACT emission limitation or MACT requirements recommended by the applicant and approved by the Division shall not be less stringent than the emission control that is achieved in practice by the best controlled similar source, as determined by the Division.*
>
> *(2) Based upon available information, the MACT emission limitation and control technology (including any requirements under Subparagraph (3) of this Paragraph) recommended by the applicant and approved by the Division shall achieve the maximum degree of reduction in emissions of HAP that can be achieved by utilizing those control technologies that can be identified from the available information, taking into consideration the costs of achieving such emission reduction and any non-air quality health and environmental impacts and energy requirements associated with the emission reduction.*

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(3) The owner or operator may recommend a specific design, equipment, work practice, or operational standard, or a combination thereof, and the Director may approve such a standard if the Division specifically determines that it is not feasible to prescribe or enforce an emission limitation under the criteria set forth in Section 112(h)(2) of the federal Clean Air Act.

(4) If the EPA has either proposed a relevant emission standard pursuant to Section 112(d) or 112(h) of the federal Clean Air Act or adopted a presumptive MACT determination for the source category that includes the constructed or reconstructed major source, then the MACT requirements applied to the constructed or reconstructed major source shall have considered those MACT emission limitations and requirements of the proposed standard or presumptive MACT determination.

5.3. SETTING THE MACT LIMIT

40 CFR 63.55 states the requirement for MACT determinations for affected sources subject to case-by-case determination of equivalent emission limitations. 40 CFR 63.55(a)(3) applies to the proposed SPM buoy system and reads as follows:

Each emission limitation for a new affected source must reflect the maximum degree of reduction in emissions of hazardous air pollutants (including a prohibition on such emissions, where achievable) that the permitting authority, taking into consideration the cost of achieving such emission reduction and any non-air quality health and environmental impacts and energy requirements, determines is achievable. This limitation must not be less stringent than the emission limitation achieved in practice by the best controlled similar source which must be established by the permitting authority according to the requirements of section 112(d)(3). This limitation must be based upon available information.

Therefore, setting the MACT limit for the proposed SPM buoy system is a two-part exercise. First, the MACT floor for a new source, which is "the emission control achieved in practice by the best controlled similar source" must be established to determine the minimum acceptable level of emissions control. After conducting an exhaustive search of available information, TGTI has determined the applicable MACT floor for the proposed SPM buoy is submerged fill into a ship. Additionally, TGTI identified ship that are loaded should have developed and implemented a VOC Management Plan using submerged fill in accordance with the requirements of Marine Environment Protection Committee Resolution 185(59) (MEPC.185(59)) as the applicable MACT floor for the proposed SPM buoy system. Details of this search are provided in Section 5.3.1. below.

The second step of setting the Case-by-Case MACT standard is referred to as the "beyond-the-floor" (BTF) analysis. The BTF analysis entails an evaluation of whether it is appropriate to set a MACT standard that is more stringent than the applicable floor level of control determined under the first step. A MACT standard stricter than the applicable MACT floor can be appropriate if justified by an evaluation of available methods and technologies for further limiting emissions. TGTI has evaluated beyond-the-floor emissions control technologies and has determined that a BTF MACT limit is not appropriate for the proposed SPM buoy system and that submerged fill represents the maximum degree of reduction in emissions of HAPs that is achievable.

Each of these requirements is briefly discussed below and, where appropriate, the discussion also explains how these requirements apply to the Case-by-Case MACT determination for the proposed SPM buoy system.

5.3.1. Identifying the Best Controlled Similar Source

The first step in determining the MACT floor is to identify the best controlled similar source, as compared to the design, operational, and performance characteristics of the proposed SPM buoy system. TGTI conducted

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exhaustive research to identify all potentially similar sources to the proposed SPM buoy. The results of this search are identified in the following sections.

5.3.1.1. MACT Subpart Y Sources

EPA established NESHAP Subpart Y for Marine Vessel Loading Operations in 1995. While NESHAP Subpart Y does not apply to the proposed SPM buoy system, it is the most similar MACT subpart and can offer some insights into the MACT applicability threshold determination for the proposed SPM buoy system.

There is broad authority to "distinguish among classes, types, and sizes of sources" in identifying and evaluating the performance of similar sources for the MACT floor analysis.[3] This step of the analysis – referred to as subcategorization – is an important step in determining the MACT floor, as is discussed in further detail below. Second, Section 112(d)(3) of CAA requires that the MACT floor levels be based on HAP control levels that are "achieved in practice" by the selected best controlled similar source. Courts repeatedly have interpreted this statutory language to require that MACT floors be set at a level that reflects what the best performing source can "achieve under the worst foreseeable conditions."[4]

EPA has subcategorized sources within a general source category in many past MACT rulemakings. In particular, EPA subcategorized sources in their NESHAP Subpart Y rulemakings in 1995 and 2011. In this rulemaking, EPA established the following subcategories for marine vessel loading operations:

- New and existing terminals having throughput of ≥ 1.6 billion liters per year (10 million barrels per year) of gasoline of ≥ 32 billion liters per year (200 million barrels per year) of crude oil;
- Existing major source terminals having emissions of hazardous air pollutants (HAP) of 10/25 tons per year or more from loading of marine tank vessels;
- Existing major source terminals collocated at petroleum refineries having HAP emissions of 10/25 tons per year or more from loading of marine tank vessels; new major source terminals regardless of HAP emissions from marine tank vessel loading (both existing and new sources are regulated under the Gasoline Refineries NESHAP);
- Existing major source terminals regardless of HAP emissions from marine tank vessel loading,
- Existing major source terminals located more than 0.8 kilometers (0.5 miles) offshore;
- New major source terminals located more than 0.8 kilometers (0.5 miles) offshore; and
- Alyeska Pipeline Services Company's Valdez Marine Terminal.

In the case of the proposed SPM buoy system, the subcategories of most interest are those regulating the offshore terminals. In the 1995 development of NESHAP Subpart Y, EPA established no control as the MACT floor for existing offshore terminals and 95% control of HAP emissions for new offshore terminals. These subcategories were again confirmed in 2011 when EPA updated NESHAP Subpart Y regulations adding submerged fill as the new MACT floor for existing offshore terminals and keeping the 95% control requirement for new offshore terminals.

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[3] Section 112(d)(1) of the CAA. This statutory basis for subcategorization was clearly articulated in the Judge Williams' concurring opinion in *Sierra Club v. EPA*, 479 F.3d 875, 884-85 (D.C. Cir. 2007) (hereafter referred to as *"Sierra Club III"*).

[4] *Sierra Club v. EPA*, 167 F.3d 658 (D.C. Cir. 1999) (herein after referred to as "*Sierra Club I*").

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In the 1995 rulemaking, EPA estimated that less than 20 offshore terminals with subsea lines were in operation and that none of these facilities controlled emissions from marine tank vessel loading. The EPA received comments that two offshore terminals [just beyond the half mile mark] that do not have subsea lines did control emissions of marine tank vessel loading operations but received no additional information on how or to what degree the emissions were controlled. EPA established a subcategory for offshore terminals based on this very limited information but neglected to consider further additional subcategories for these offshore terminals based on other inherent properties such as types of commodities loaded, the size of the terminal, or the type of operation with which the terminal is associated. As such, the EPA established a MACT floor of 95% control of HAP emissions for new offshore terminals without taking into consideration the additional subcategories of offshore terminals that could be justified. EPA itself admitted that offshore terminals should be broken down into additional subcategories in their summary of public comments and responses on the 1995 NESHAP Subpart Y development.[5]

The proposed SPM system will be unlike any of the sources that were in existence when NESHAP Subpart Y was developed in 1995 and reconsidered in 2011. It will engage in activities that could not be performed during those periods because export of crude oil was banned from 1975 until 2015 as part of the 1975 Energy Policy and Conservation Act. The sole purpose of the proposed SPM buoy system is to fully and completely load VLCC vessels for the export of crude oil/condensate to countries other than the U.S. Therefore, the proposed SPM system will be the only system of its kind in the United States and therefore could not have been considered when the subcategory determinations were conducted in the 1995 and 2011 rulemakings. As explained above, NESHAP Subpart Y is not applicable to the proposed SPM buoy system, and its nature and operational processes make it inherently different than all of the sources that were considered and subcategorized as part of the NESHAP Subpart Y rulemaking. The uniqueness of this source as the only stand-alone SPM DWP capable of directly and fully loading a VLCC for crude oil/condensate export from the United States, demands it be evaluated on a case-by-case basis to determine the level of emission controls that are appropriate for MACT.

5.3.1.2. Santa Barbra Ellwood Marine Terminal

TGTI is aware that the Ellwood Marine Terminal (EMT) in Santa Barbara, California used to operate an SPM buoy system ~0.49 miles off the coast of California for the loading of crude oil and condensate that was produced from the Platform Holly. The EMT was permitted to load barge vessels for the transportation of crude oil from the EMT to refineries throughout California. The EMT has since constructed the infrastructure necessary to transport the crude oil produced by Platform Holly via pipeline and no longer utilizes that SPM buoy system.

When the EMT was in operation, emissions from the loading of the marine barges were controlled by only utilizing two limited-capacity barges Jovalan and Olympic Spirit, which were both equipped with VOC capture and refrigeration control systems. Barge Jovalan (a single hulled barge) was put out of service and replaced by the barge Olympic Spirit (a double hulled barge) in 2010. Neither barge has self-propulsion capabilities and are therefore transported by tug boat to and from each destination. Barge Jovalan had a capacity of 56,000 bbl and Barge Olympic Spirit had a capacity of 80,360. Both barges were loaded at a maximum loading rate of 4,200 bbl/hr from the EMT.

The EMT is not a similar source to the proposed SPM buoy system. The most obvious difference is the major difference in size of the two systems. From 1998 through 2009 the maximum annual throughput of the EMT was

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[5] *Federal Standards for Marine Tank Vessel Loading Operations and National Emission Standards for Hazardous Air Pollutants for Marine Tank Vessel Loading Operations. Technical Support Document for Final Standards: Summary of Public Comments and Responses.* EPA-453/R-95-014. July 1995. Pg. 2-69.

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just under 1.4 MMbbl of crude oil loaded onto barges (with a maximum hourly loading rate of 4,200 bbl/hr). The proposed SPM buoy system will have a capacity that is orders of magnitude larger than this with a potential annual throughput of 192 MMbbl/yr and a maximum hourly loading rate of 60,000 bbl/hr. The proposed SPM buoy system will also be located much further off the coast than the EMT, around 14 miles offshore versus 0.49 miles, and will load VLCCs which have a 2 MMbbl capacity.

Additionally, there are no VLCCs in operation that have onboard VOC capture and control technology like the Barges Jovalan and Olympic Spirit used. Even if there were a single VLCC that had onboard VOC capture and control technology, like the two barges used at the EMT for transporting crude, that could be exclusively loaded at the proposed SPM buoy system, the logistics of exporting crude throughout the world would make this an infeasible option. The EMT's two different barges were only used to transport relatively small amounts of crude short distances to refineries in northern or southern California. That practice was totally different from the world-wide deliveries of millions of barrels the VLCC vessels will make after being loaded for those proposes at the SPM buoy system. For these reasons, the EMT is not a similar source to the proposed SPM buoy system, and the EMT's use of small, dedicated barges to control emissions is not considered in the development of the MACT floor for the proposed SPM buoy system.

5.3.1.3. North Sea Shuttle Vessels

TGTI is also aware of plans to construct tanker shuttles in the North Sea that incorporate onboard VOC capture and control. Wartsila and Teekay Offshore Partners have developed and started construction of 4 Suezmax-sized (850,000 bbl capacity) shuttle vessels based on the Shuttle Spirit design.[6] The Shuttle Spirit design is a new shuttle tanker design that allows the tanker to operate using both liquefied natural gas (LNG) as the primary fuel along with VOC that is captured from the oil cargo tanks.[7] The VOC recovery plant uses compression and cooling phases to liquefy the heavier hydrocarbon to be stored in a tank on the deck of the ship.

These sources are not similar to or applicable to the proposed SPM buoy system because of their size differences. The proposed SPM buoy system will only be able to load VLCC vessels with a capacity of 2 MMbbl. The Suezmax-sized vessels being built will only have a capacity of 850,000 bbl and could not load at the proposed SPM buoy system because the cranes aboard Suezmax-sized vessels are not large enough to connect to the proposed SPM buoy system properly. The purpose of the proposed SPM buoy system is to enable full and complete loading of a VLCC vessel for crude oil/condensate export from the United States. Full and complete loading of a VLCC is not possible at onshore terminals since VLCCs exceed the size restrictions on vessels that can navigate to onshore terminals. Therefore, because the proposed SPM buoy system is not designed to load Suezmax-sized vessels, a future-built Suezmax-sized vessel with a VOC recovery plant is not a similar source to the proposed SPM buoy system.

5.3.2. Achieved in Practice

Once the best controlled technology in use by a similar source is identified, the next step is to establish what emissions limitation can be achieved in practice with that control technology. Since submerged loading is not a control technology but rather a standard operating practice, there are no accompanying emissions limitations associated with the use of submerged loading. As provided for in 40 CFR § 63.43(d)(3), a specific design, equipment, work practice, or operational standard, or combination thereof, can be approved in lieu of an

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[6] https://www.teekay.com/blog/2017/11/28/teekay-offshore-partners-places-order-for-two-additional-shuttle-tankers/

[7] https://www.wartsila.com/twentyfour7/in-detail/the-new-shuttle-tanker

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emission limitation if it is not feasible to prescribe or enforce an emission limitation under the criteria set forth in Section 112(h)(2) of the Clean Air Act.

Submerged loading in the case of the proposed SPM buoy system is a loading procedure by which the discharge of crude oil/condensate into the VLCC tanks is located at or below the surface of the crude oil/condensate in the vessel. By discharging the crude oil/condensate into the hold at a point below the surface of the liquid, VOC emissions are mitigated compared to splash loading because the surface of the cargo is not disturbed in submerged loading. Compared to splash loading, this minimizes the generation of VOC emissions because it reduces the surface area liquid/vapor interface and thus minimizes the volatilization of hydrocarbons from the liquid. As mentioned previously, submerged loading provides a 60% reduction in VOC emissions generated when compared to splash loading.

In addition to submerged loading as a method of VOC control, Regulation 15.6 of the International Convention for the Prevention of Pollution from Ships (MARPOL) Annex VI requires that all tankers carrying crude oil have an approved and effectively implemented ship specific VOC Management Plan covering at least the points given in the regulation. Guidelines for the development of VOC Management Plans is given in MEPC.185(59) and additional information on systems and operations of VOC Management Plans is given in MEPC.1/Circ.680. For reference, MEPC.185(59) and MEPC.1/Circ.680 have been provided as Attachments 1 and 2, respectively.

The VOC Management Plan is a ship-specific management plan designed to ensure that the operation of a tanker, to which Regulation 15 of MARPOL Annex VI applies, prevents or minimizes VOC emissions to the extent possible. To comply with the plan, the loading and carriage of cargoes which generate VOC emissions should be evaluated and procedures written to ensure that the operations of a ship follow best management practices for preventing and minimizing VOC emissions to the extent possible. With respect to the loading operations at the proposed SPM buoy system, Rule 1.4. of the VOC Management Plan Guideline (MEPC.185(59)) states that while maintaining the safety of the ship, the VOC Management Plan should encourage and set forth the following best management practices as appropriate:

1. The loading procedures should take into account potential gas releases due to low pressure and, where possible, the routing of oil from crude oil manifolds into the tanks should be done so as to avoid or minimize excessive throttling and high flow velocity in pipes;
2. The ship should define a target operating pressure for the cargo tanks. This pressure should be as high as safely possible and the ship should aim to maintain tanks at this level during the loading and carriage of relevant cargo;
3. When venting to reduce tank pressure is required, the decrease in the pressure in the tanks should be as small as possible to maintain the tank pressure as high as possible;
4. The amount of inert gas added should be minimized. Increasing tank pressure by adding inert gas does not prevent VOC release but it may increase venting and therefore increase VOC emissions.

Technical information for the development of VOC Management Plans for tankers carrying crude oil are provided in MEPC.1/Circ.680 (Attachment 2).

Since VOC Management Plans are ship-specific plans, the emission rate of HAPs will vary depending on the specific ship being loaded. Therefore it is not practical to set an emissions limitation for the proposed SPM buoy system. Instead, the following conditions are appropriate as the MACT floor limitation for the proposed SPM buoy system:

Submerged loading onto vessels which have onboard and implement a VOC management plan that complies with the requirements of MEPC.185(59).

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5.3.3. Beyond the MACT Floor

Having identified the MACT floor, the next step is to determine if BTF control measures are justified. To date, no SPM buoy systems similar to the proposed SPM buoy system control HAP emissions further than via submerged loading. Not only is this true throughout the waters off the United States, but it is also true for all SPM buoy systems throughout the world. Nonetheless, TGTI has evaluated controlling the loading emissions with a vapor combustion unit (VCU) or a vapor recover unit (VRU) but has eliminated both control technologies from consideration because of the technical and operational infeasibility.

While both VCU and VRU technology have been well established at on shore terminals, the challenges facing implementation of these technologies at a source similar to the proposed SPM buoy system are significantly greater than compared to onshore facilities. In fact, there may be technical challenges that are not yet defined as the technologies identified have never been applied to a source like the proposed SPM buoy system.

5.3.3.1. Vapor Combustion Unit

A VCU captures vapors emitted during loading operations and routes them to a combustion device for control. While this control method reduces the emissions of VOC, it creates collateral emissions increases of pollutants from combustion. Given the location of the proposed SPM buoy system, there is not a suitable location for the VCU equipment. A VCU would require a separate platform or the means for captured vapors to be routed back to an onshore VCU.

Nonetheless, TGTI identified a VCU as a potential control technology because of its demonstrated ability to control emissions from land-based terminals. Though VCUs are demonstrated for land-based terminals, they have not been demonstrated as a control technology on sources similar to the proposed SPM buoy system. Application of VCU technology to the proposed SPM buoy system faces several inherent design challenges when compared to their application at land-based facilities, as identified below.

- Space Limitations
  - The proposed SPM buoy system is a single buoy floating roughly 14 miles offshore. The proposed SPM buoy system is not physically capable of housing equipment necessary for operation of a VCU. Modifications to the SPM buoy system to accommodate a VCU at the source is not a technically feasible option. Such modification would require the design and construction of a novel platform and vapor collection system that has not been demonstrated before. Such a platform would have to be located outside of the designated "swing circle" around the SPM buoy. The swing circle is the area around the SPM buoy in which the ship being loading is allowed to weathervane, or swing, around the SPM buoy during loading. This process is essential to the safety and design of the SPM buoy system as it allows the ship to optimally position itself around the SPM buoy to minimize the forces on the SPM buoy system. To allow for this movement pattern, a platform housing a VCU would have to be located safely outside of this circle, which is typically on the order of 1,500 to 2,000 ft in all directions. The vapor collection system would consist of a vapor collection line back to the SPM buoy, down to a subsea pipeline, then out to the VCU platform via this subsea pipeline. A vapor collection system of this manner has not been demonstrated in practice.
- Safety and Reliability Considerations Due to Variability in Operating Conditions

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- As described above, the vapor collection system that would be required for a VCU at the SPM buoy would be a new and unique system that is not currently in place at an SPM buoy system. The distance that the vapor collection line will have to travel underwater presents a reliability concern for the system. The long distance traversed by the vapor collection lines underwater increases the chances of condensed vapors in the vapor collection lines which would create both operational reliability and safety concerns. The other main concern is the constantly variable ocean conditions. Since the VCU equipment would have to be located on a floating platform, the natural motion of ocean waves will disturb the operation of the VCU and lead to unavoidable safety and reliability concerns.

Given the technical issues cited above, VCU control technology is not an "applicable" technology to the proposed SPM buoy system since it cannot reasonably be installed and operated on the source type under consideration. Therefore, VCU technology is eliminated from consideration as a technically infeasible control option for BTF MACT control.

5.3.3.2. Vapor Recovery Unit

A VRU captures vapors emitted during loading operations then routes them to VRU equipment to be absorbed and reintroduced into the process. The captured vapors are converted back into a liquid by using refrigeration, absorption, adsorption, and/or compression. Given the location of the proposed SPM buoy system, there is not a suitable location for the VRU equipment. A VRU would require a separate platform or the means for captured vapors to be routed back to an onshore VRU.

TGTI identified a VRU as a potential control technology because of its demonstrated ability to control emissions from land-based terminals. Though VRUs are demonstrated for land-based terminals, they have not been demonstrated as a control technology on sources similar to the SPM buoy system. Application of VRU technology to the proposed SPM buoy system faces several design challenges when compared to their application at land-based facilities, as identified below.

- Space Limitations
  - The proposed SPM buoy system is a single buoy floating roughly 14 miles offshore. The proposed SPM buoy system is not physically capable of housing equipment necessary for operation of a VRU. Modifications to the SPM buoy system to accommodate a VRU at the source is not a technically feasible option. Such modification would require the design and construction of a novel platform and vapor collection system that has not been demonstrated before. Such a platform would have to be located outside of the designated "swing circle" around the SPM buoy. The swing circle is the area around the SPM buoy in which the ship being loading is allowed to weathervane, or swing, around the SPM buoy during loading. This process is essential to the safety and design of the SPM buoy system as it allows the ship to optimally position itself around the SPM buoy to minimize the forces on the SPM buoy system. To allow for this movement pattern, a platform housing a VRU would have to be located safely outside of this circle, which is typically on the order of 1,500 to 2,000 ft in all directions. The vapor collection system would consist of a vapor collection line back to the SPM buoy, down to a subsea pipeline, then out to the VRU platform via this subsea pipeline. A vapor collection system of this manner has not been demonstrated in practice.

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- Safety and Reliability Considerations Due to Variability in Operating Conditions
  - As described above, the vapor collection system that would be required for a VRU at the SPM buoy would be a new and unique system that is not currently in place at an SPM buoy system. The distance that the vapor collection line will have to travel underwater presents a reliability concern for the system. The long distance traversed by the vapor collection lines underwater increases the chances of condensed vapors in the vapor collection lines which would create both operational reliability and safety concerns. The other main concern is the constantly variable ocean conditions. Since the VRU equipment would have to be located on a floating platform, the natural motion of ocean waves will disturb the operation of the VRU and lead to unavoidable safety and reliability concerns. Traditional VRU control technology uses a tall absorber tower that, because of the height, will experience large oscillations at the tip, even from relatively small movement at the base from waves.

Given the technical issues cited above, VRU control technology is not an "applicable" technology to the proposed SPM buoy system since it cannot be reasonably be installed and operated on the source type under consideration. Therefore, traditional VRU technology is eliminated from consideration as a technically infeasible control option for BTF MACT control.

5.3.4. Selected Control Technology

TGTI has concluded that the following meet MACT under 112(g) for HAP emissions from the proposed SPM buoy system:

> *Submerged loading onto vessels which have onboard and implement a VOC management plan that complies with the requirements of MEPC.185(59).*

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