Briefing for PWSRCAC Board of Directors – January 2022

ACTION ITEM

Sponsor:	Austin Love and the Terminal Operations and Environmental Monitoring Committee
Project number and name or topic:	# 5057 – Review of the EPA 2020 National Emissions Standards for Hazardous Air Pollutants for Organic Liquids Distribution (NESHAP-OLD) Air Quality Rule

1. **Description of agenda item:** This agenda item requests Board acceptance of a report by John Beath Environmental titled "2020 Updates to 40 CFR 63, Subpart EEEE – National Emissions Standards for Hazardous Air Pollutants for Organic Liquids Distribution (Non-Gasoline): A Review of the Appeal by Alyeska Pipeline Service Company." This agenda item also requests the Board provide approval for Council staff to send a letter to the EPA supporting Alyeska's appeal of the 2020 NESHAP-OLD Air Quality Rule. A presentation summarizing the key results of the report will be provided by John Beath Environmental and Council staff will provide a briefing regarding the letter to the EPA.

2. **Why is this item important to PWSRCAC:** This agenda item is important because it pertains to the emissions of air pollutants from the Valdez Marine Terminal (VMT) known as hazardous air pollutants (HAPs). HAPs can be harmful to human health and include carcinogenic compounds such as benzene, among nearly 200 other compounds that are known to cause varying health-related harm. In its efforts to encourage the environmentally safe transportation of crude oil through Prince William Sound, the Council should work to limit the harm caused by HAPs emitted from the VMT. To effectively do that, there needs to be accurate reference documents available to the Council that describe this issue well and are based on well-researched facts. This project was intended to provide such reference documents. The overall purpose of the report by John Beath Environmental is to inform the Council as to whether they should support Alyeska in their appeal of the 2020 NESHAP-OLD Rule and to submit the Council's determination to the EPA or the United States Court of Appeals in their decision regarding Alyeska's appeal. Background information regarding the rule and Alyeska's appeal is included below in the "Summary of policy, issues, support, or opposition" section.

3. **Previous actions taken by the Board on this item:** The Council has been integrally involved in related NESHAP-OLD rule work in the past, but that work was mostly focused on the emissions of HAPs from the Ballast Water Treatment Facility, whereas the focus of this project is the emissions of HAPs from the crude oil storage tanks at the Valdez Marine Terminal. Therefore, only limited action has been taken by the Board on this tank-focused iteration of the Council's involvement regarding NESHAP-OLD.

Meeting	Date	Action
Board	1/28/2021	Approval of Proposed FY2022 Projects to Begin in FY2021: Approval of the following list of projects to commence in FY2021 along with corresponding budget modifications, and delegation of authority to the Executive Committee to authorize contracts as indicated: a) Approve Project 8013 – AIS/Radar Whitepaper in the amount of $35,000 to commence in FY2021. Authorize a budget modification from the contingency fund in the amount of $35,000. b) Approve Project 5057 – APSC'S Appeal of EPA Air Quality Rule (NESHAP-OLD) in the amount of $60,000 to commence in FY2021. Authorize a budget modification from the contingency fund in the amount of $60,000. Delegate authority to the Executive Committee to approve a contract for this work up to $60,000.

4. **Summary of policy, issues, support or opposition:** The EPA finalized its rulemaking that amended standards found in the 2004 NESHAP-OLD on July 20, 2020. The proposed changes affect the current air toxics Organic Liquids Distribution (OLD) standards that are in place for regulating HAPs emitted by the storage and transfer of crude oil at the VMT.

On October 7, 2020, Alyeska filed an appeal with the United States Court of Appeals asking that certain parts of the updated NESHAP-OLD Rule not go into effect. Alyeska claimed that the updated NESHAP-OLD Rule reflects substantial changes to the regulations governing the emission of HAPs from the Valdez Marine Terminal that will not result in any significant improvement in local air quality. On January 28, 2021, the United States Court of Appeals ruled to hold Alyeska's appeal in abeyance, to allow the involved parties to resolve their appeal of the July 2020 NESHAP-OLD Rule directly with the EPA. At this time, Alyeska's appeal is subject to the EPA's "petition for reconsideration" process.

Alyeska questioned the overall air quality benefit of the updated NESHAP-OLD Rule for emissions from the VMT. Alyeska claimed that the current, existing control system already captures 99.94% of all tank vapors at the VMT, while the HAPs reduction goal for the updated NESHAP-OLD rule is 95%. To comply with the rule as written, Alyeska claimed they would have to reengineer significant parts of the VMT to operate without conservation venting.

John Beath Environmental's report evaluated the merits of Alyeska's appeal of the 2020 NESHAP-OLD Rule by evaluating five key topics:

- Current amount of HAPs released from the VMT
- Amount of HAPs released from the VMT if the NESHAP-OLD rule was applied
- Health risks of HAPs currently released from the VMT to Valdez citizens
- Engineering concerns associated with implementing the NESHAP-OLD Rule
- Current HAPs controls written in the VMT's air quality permit

The results from John Beath Environmental's independent evaluation of those five topics support the key argument in Alyeska's appeal: imposing the 2020 NESHAP-OLD Rule at the VMT would not result in overall, local, air quality benefits.

The Board may also be interested in knowing that on November 10, 2020 ADEC Commissioner Jason Brune sent a letter to the EPA in support of Alyeska's Petition for Rulemaking and Reconsideration.

5. **Committee Recommendation:** During their December 9, 2021 meeting, the Terminal Operations and Environmental Monitoring Committee took the following action:

- Recommend sending a letter to the EPA supporting Alyeska's appeal of the 2020 NESHAP-OLD Air Quality Rule

As of December 9, John Beath Environmental had not provided a second draft of the report for committee review. The committee deferred action on accepting the report until they could read the second draft. The second draft was provided on December 12, and the plan is for the committee to review it and vote via email to accept or reject the report as final. The outcome of that committee email-vote will be provided to the Board.

Note, prior to taking the above action, during their December 9 meeting, the committee was informed that the second draft of the report would be subject to a round of copy editing by Council staff, working with John Beath Environmental, before being made publicly available.

6. **Relationship to LRP and Budget:** Project 5057 is in the approved FY2022 budget and annual work plan.

5057--APSC Appeal of EPA Air Quality Rule

As of December 10, 2021

FY-2022 Budget	
Original	$60,000.00
Modifications	($14,950.00)
Revised Budget	$45,050.00
Actual and Commitments	
Actual Year-to-Date	$28,410.00
Commitments (Professional Services)	$10,790.00
Actual + Commitments	$39,200.00
Amount Remaining	$5,850.00

7. **Action Requested of the Board of Directors:**

- Accept the report “2020 Updates to 40 CFR 63, Subpart EEEE – National Emissions Standards for Hazardous Air Pollutants for Organic Liquids Distribution (Non-Gasoline): A Review of the Appeal by Alyeska Pipeline Service Company” by John Beath Environmental as meeting the terms and conditions of contract number 5057.21.01, and for distribution to the public
- Have Council staff prepare and send a letter to the EPA supporting Alyeska’s appeal of the 2020 NESHAP-OLD Air Quality Rule

8. **<u>Alternatives:</u>**

- Do not accept the report or accept the report with recommended revisions.
- Do not send the letter or send it with recommended revisions.

9. **<u>Attachments:</u>** Draft report by John Beath Environmental titled “2020 Updates to 40 CFR 63, Subpart EEEE – National Emissions Standards for Hazardous Air Pollutants for Organic Liquids Distribution (Non-Gasoline): A Review of the Appeal by Alyeska Pipeline Service Company,”.

2020 Updates to 40 CFR 63, Subpart EEEE - *National Emissions Standards for Hazardous Air Pollutants for Organic Liquids Distribution (Non-Gasoline)*

A Review of the Appeal by Alyeska Pipeline Service Company

Prepared by John Beath Environmental, LLC

Prepared for Prince William Sound Regional Citizens' Advisory Council, Contract # 5057.21.01

The opinions expressed in this PWSRCAC-commissioned report are not necessarily those of PWSRCAC.

PWSRCAC
P.O. Box 3089
130 S. Meals Ste 202
Valdez, AK 99686
www.pwsrcac.org

Revised Draft Issued:
December 12, 2021

Prince William Sound Regional Citizens' Advisory Council

2020 Updates to 40 CFR 63, Subpart EEEE - *National Emissions Standards for Hazardous Air Pollutants for Organic Liquids Distribution (Non-Gasoline):* A Review of the Motion to Stay by Alyeska Pipeline's Valdez Marine Terminal

December 2021

John Beath
Lead Technical Engineer, P.E. Texas

Sarah Backes
Project Manager

John Beath Environmental, LLC
148 S. Dowlen #86
Beaumont, TX 77707
www.beath.us

Table of Contents

List of Tables

List of Figures

Appendices

List of Abbreviations

ACC	American Chemistry Council
AFPM	American Fuel & Petrochemical Manufacturers
Alyeska	Alyeska Pipeline Service Company
API	American Petroleum Institute
BPD	Barrels per Day
CAA	Clean Air Act
CCAT	California Communities Against Toxics
CFR	Code of Federal Regulations
D.C.	District of Columba
EPA	Environmental Protection Agency
EU	Emissions Unit
HAP	Hazardous Air Pollutant
FR	Federal Register
g	gram
JBE	John Beath Environmental
M^3	Cubic meter
MACT	Maximum Achievable Control Technology
NAAQS	National Ambient Air Quality Standards
NAICS	North American Industrial Classification System
NEI	National Emissions Inventory
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NSPS	New Source Performance Standards
OLD	Organic Liquids Distribution
OHAP	Organic Hazardous Air Pollutant
PIANO	Paraffins, Iso-paraffins, Aromatics, Naphthenes, and Olefins (laboratory characterization)
PRD	Pressure Relief Device
PTE	Potential to Emit
PWSRCAC	Prince William Sounds Regional Citizens' Advisory Council
SIP	State Implementation Plan
SSM	Startup, Shutdown, and Malfunction
TAPS	Trans Alaska Pipeline System
TPY	Tons per Year
µm	Micrometer
USD	United States Dollar
VCS	Vapor Collection System
VMT	Valdez Marine Terminal
VOC	Volatile Organic Compound

ABSTRACT

John Beath Environmental, LLC, an environmental consulting company with significant experience in compliance programs associated with controlling air emissions from petroleum storage tanks, conducted a technical review of representations made by Alyeska Pipeline Services Company (Alyeska) in its public correspondence with the United States Environmental Protection Agency (EPA) related to the 2020 finalized amendments to Title 40 to the Code of Federal Regulations (CFR), Part 63, Subpart EEEE - *National Emission Standards for Hazardous Air Pollutants: Organic Liquids Distribution (Non-Gasoline) (also referred to as the OLD MACT)*. Alyeska's position is that the updates to the OLD MACT would negatively impact operations at its Valdez Marine Terminal - resulting in an inappropriate capital expenditure; and that existing operations without these changes pose an acceptable risk to the health of the potentially impacted population living in the vicinity of the terminal.

Overall, the review concluded that existing controls are sufficiently protective for potentially impacted residents nearby, and as such, the change to alternative tank controls potentially required by the changes to the EPA regulation would be less protective (resulting in more emission), and also would be unacceptable in the cost required to implement it.

The review was conducted by developing an independent air emissions inventory for the terminal to assess the emissions of volatile organic compounds (including that subset of the emissions that have been designated by EPA as hazardous air pollutants) from operations as they are today (without additional controls); and also, the emissions that would be estimated if the controls required by the new regulatory provisions were to be implemented. That review concluded that the conversion of the existing configuration (fixed roof crude oil storage tanks routing to vapor collection during normal operations and safety pressure relief venting to atmosphere) to a configuration where the tanks were retrofitted with internal floating roof tanks and no vapor collection would actually increase emissions.

To further assess the impacts from current operations, the review also used emissions estimates for all the site activities quantified in the facilities emissions inventory and associated air permitting to conduct a health effects screening analysis by using dispersion modeling tools and leveraging related EPA health effects work related to storage tank emissions elsewhere. Results of that comparison to screening thresholds supported a judgement that emissions from the VMT's current configuration result in acceptable concentration levels in areas where nearby residents live.

Finally, to assess whether the current regulatory provisions applicable to site operations reflected the best practices specified across the oil and gas sector, a review was conducted of work practices related to tank operations that are under active discussion between Alyeska and EPA. These provisions are similar to those recently imposed by EPA for various other industry sectors (e.g., refineries and ethylene plants). That review concurred with EPA that it would be appropriate to add work practices that describe required vapor control during tank degassing and cleaning.

EXECUTIVE SUMMARY

At the request of the Prince William Sound Regional Citizens' Advisory Council (PWSRCAC), this report was developed by John Beath Environmental, LLC (JBE), with the objective to independently and fairly verify Alyeska Pipeline Service Company's (Alyeska) claims related to health and safety, technical feasibility, and economic feasibility presented in its public correspondence with the United States Environmental Protection Agency (EPA) related to the 2020 finalized amendments to Title 40 to the Code of Federal Regulations (CFR), Part 63, Subpart EEEE - *National Emission Standards for Hazardous Air Pollutants: Organic Liquids Distribution (Non-Gasoline)*.

40 CFR 63, Subpart EEEE, also referred to as the OLD MACT, establishes national emission limitations, operating limits, and work practice standards for organic hazardous air pollutants (OHAPs) emitted from non-gasoline organic liquids distribution operations at major sources of hazardous air pollutants (HAP) emissions.

EPA has required various forms of air emissions control for sources of higher vapor pressure volatile organic compounds (VOCs) from oil-related substances for decades. These controls have been in two basic forms: (1) vapor recovery; and (2) vapor suppression. Vapor suppression techniques for storage tanks have always included two forms of floating roof covers: one that is referred to as external because emissions that pass through it go directly to the atmosphere; and a second variant approach that adds a fixed roof cover to the tank above the internal floating roof.

For low vapor pressure organic liquids (such as diesel, fuel oil, and kerosene) industry practice has been to provide a fixed-roof tank where breathing losses are controlled using a pressure relief vent (called a conservation vent) that is designed to open if the tank pressure rises a small amount - to avoid potentially damaging a tank not designed to be a pressure vessel. If a higher vapor pressure material must be stored in that tank, a common solution to control the vapors has been to add a vapor collection system, and then to treat or combust the collected vapors in a separate vapor handling system.

In order to store crude oil, Alyeska's terminal at Valdez has added a complex version of vapor control. The system collects vapors from tank overpressure directly, and that also collects vapors where tank pressure is falling but has been supplemented with a source of "blanket" gas to offset vapor leaving the tank. This blanketing operation is necessary to avoid the possibility of damaging the tank (via a cave-in) due to vacuum forces during pressure loss. But because it is possible for the under-pressure and over-pressure vapor collection systems to react too slowly or ineffectively for short periods of time, the conservation vents are capable of releasing overpressure to the atmosphere as an additional safety layer of protection.

The need to control VOCs results from a combination of concerns for the environment and nearby potential receptors (those who could be impacted by the emission). Emissions of VOCs contribute to the formation of ozone that can produce general health effects. But more significant in the potential risk is exposure to specific hazardous air pollutants (HAPs) that are part of the emitted VOC mixture that can produce toxic effects. In formulating the Subpart EEEE regulation, EPA chose to target a small subset of HAPs referred to as OHAPs that are known to be present in certain organic liquid petroleum products such as crude oil.

The March 12, 2020, finalized amendments included the following key changes:

- Clarification that the rule standards are applicable during periods of startup, shutdown, and malfunction;
- Requirement to electronically report performance test results;
- Addition of new operational requirements for flares used as control devices;
- Addition of new provisions for bypass authorizations;
- Removal of an exemption for pressure relief devices; and
- Adoption of a work practice standard for tank degassing.

Alyeska is challenging three parts of the rule that apply to operations at the Valdez Marine Terminal (VMT) as summarized in Figure ES-1.

Figure ES-1. Summary of Challenges by Alyeska to EPA Pertaining to the 2020 Updates to the OLD MACT

	"Safety Device Exemption" Repeal	Bypass Provision	"Tank Degassing" Standards
Definition:	The "Safety Device Exemption" repeal refers to the addition of the language in bold to 40 CFR §63.2346(i): *Safety device. Opening of a safety device is allowed at any time that it is required to avoid unsafe operating conditions.* ***Beginning no later than July 7, 2023, this paragraph no longer applies.***	The "bypass provision" prohibits operators from filling storage tanks during periods when pollution controls are bypassed, such as during planned maintenance.	Tank "degassing" refers to the process of removing organic gases from a stationary tank or pipeline.
The Challenge:	Alyeska challenged this provision on safety, engineering, and economic feasibility as well as laid the claim the current configuration at VMT already achieves the level of HAP control the 2020 OLD MACT seeks to regulate.	Alyeska challenged this provision to the finalized rule because Alyeska was unable to provide comment on the adequacy of the bypass allowances included in sections 40 CFR §63.2378(e)(3) and (4) because these provisions were absent in the Proposed Rule but added in the finalized version.	In the 2020 finalized rule, EPA adopted a new work practice standard for degassing tanks but excluded tanks with capacities greater than 50,000 barrels. As the crude oil storage tanks at VMT are greater than 50,000 barrels, Alyeska challenged the work practice standard.
Proposed Resolution:	Alyeska has proposed work practice standards for open venting to atmosphere	Alyeska has proposed work practice standards to comply with the bypass provisions	Alyeska proposed amendments to 40 CFR §63.2346(a)(6) and Tables 2/2b to include VMT-size crude storage tanks within the new work practice standard.

The main objectives of this project are twofold. First, this report seeks to document and, where possible, validate each of Alyeska's claims related to health and safety, technical feasibility, and economic feasibility presented in its public correspondence with EPA related to the 2020 updates to the OLD MACT. Second, the report seeks to document how the implementation of the 2020 OLD MACT would influence the emittance of HAPs from the VMT was evaluated. Each step within this process is outlined below with a summary of results and key findings.

Independent Evaluation of HAP Air Releases from the VMT

In order to confirm that overall impacts from site operations were acceptable, JBE elected to independently quantify HAP emissions based on the current VMT configuration. Calculated sources from the VMT include the following:

- Crude oil storage tanks routed to vapor recovery system
- Crude oil storage tank conservation vents, venting to atmosphere
- Power boilers
- Waste gas combustors
- Stationary reciprocating internal combustion engines
- Tank Bottoms Processing (TBP) system
- Marine loading
- Fugitives from equipment leaks

Table ES-1 provides an emissions comparison of the JBE calculated HAP estimate for the sources noted above, and those sources as represented in VMT's 2016 Title V Air Permit Renewal Application. Table ES-2 provides a further breakdown of emissions from the crude oil storage tanks.

Table ES-1. HAP Emissions Summary for Permitted Sources at VMT

Emission Source	HAP Emissions, VMT 2016 Permit Application[1] (tpy)	HAP Emissions JBE Calculation (tpy)	Notes
Boilers/Waste Gas Combustors 1-6	5.9	3.1	During normal operations, the crude oil storage tanks route here
Generators/Engines 8A-15	0.0	0.0	Negligible
Loading	10.9	12.2	Uncontrolled maintenance allowance
Fugitives	0.4	0.1	
Tank Bottoms Processing System	0.5	0.3	
Tank Conservation Vents	n/a	0.1	
Total	**17.7**	**15.8**	

ES-2. VOC and HAP Emissions from Crude Oil, Fixed Roof Storage Tanks

Fixed Roof Crude Oil Storage Tanks, Pressure Rise Method Vent Calculation Method 2				
Parameter	JBE Calculation		Alyeska Claim in Motion to Stay	
	VOC Annual Emissions (tpy)	HAP Annual Emissions (tpy)	VOC Annual Emissions (tpy)	HAP Annual Emissions (tpy)
Emissions from Tanks at Vapor Recovery	31.24	0.46	n/a	n/a
Emissions from Conservation Venting to Atmosphere	5.74	0.09	49.32	1.97
Emissions Total:	**36.98**	**0.55**	**49.32**	**1.97**

Key Takeaways on "As Configured" Emission of HAP

- Alyeska representations are appropriate and conservative in the representation of HAP emissions from the VMT.
- Based on JBE's emission calculations, HAPs emitted from the conservation vents are approximately 0.1 tons per year (tpy), and in a typical year likely less than what was represented by Alyeska in the Petition for Rulemaking, Reconsideration, and Stay.

[1] Title V Air Permit Renewal Application dated July 14, 2016, Permit Number AQ0082TVP02.

- Alyeska and JBE's estimation of HAPs varies due to the difference in crude speciation and in the method used to calculate emissions from storage tanks.

Health Risk Evaluation

To evaluate the health risks to residents of Valdez, Alaska and surrounding communities posed by uncontrolled releases of HAPs from the conservation vents and the other residual sources of emissions at the VMT, the site-wide emission totals by HAP of concern (i.e., benzene, n-hexane) were used as a data input to EPA's SCREEN3, which is a simplified air emissions dispersion model developed to estimate the airborne concentrations of specified chemical constituents at user-specified distances downwind of the point of origin of emissions sources. Complex air dispersion models have been developed for this purpose that provide more accurate estimates, but these require a significant amount of site-specific data to be collected. Complex terrain that includes buildings, hills, etc., can make predicting the downwind dispersion pattern more complicated and lead to the need for a more complex model; but in this case, the downwind pathway is over water, so this capability is less important. The simpler (and conservative) models like EPA SCREEN3 utilize a simple dispersion pattern that spreads out uniformly with distance called a Gaussian plume model. This approach is more conservative (and therefore predicts higher concentrations) because it gives only very limited decreases in concentration for terrain deflection. SCREEN3 uses preset meteorological data and site emission rates to predict worst-case concentrations at specified points downwind.

A screening modeling approach that demonstrates acceptable impacts can be the end of analysis; but if the screening thresholds are exceeded using the screen model, it is common practice to follow-up with a more complex model to refine the results. As described below, the use of a complex model was not deemed necessary in this situation.

JBE elected to evaluate benzene concentrations because the limits for benzene are the most stringent of all the HAPs of interest at VMT. Two cases for benzene were run: (1) a sitewide benzene evaluation; and (2) tank conservation vents alone as a way to evaluate the conservation vent emission contribution as part of the total sitewide emissions. SCREEN3 output results as well as short and long-term Effects Screening Level (ESL) benchmark values are provided in Table ES-3.

The maximum 1-hour concentration of 6.8 microgram per cubic meter ($\mu g/m^3$) occurs at approximately 1,304 meters from VMT's property line; with a dominant wind direction coming from the south, this places the maximum concentration over the water. At 5,000 meters, which is the approximate shoreline of the city of Valdez, the benzene concentration is well below both the short-term and long-term ESL value of 4.5 $\mu g/m^3$ and 170 $\mu g/m^3$, respectively. [2]

[2] ESL values based on those established by The Texas Commission on Environmental Quality (TCEQ) Toxicology Division (TD).

ES-3. SCREEN3 Output Results for Benzene Emitted from VMT

Parameter	Sitewide Benzene	Benzene from Tank Conservation Vents Only	Units
Distance for max 1 hr concentration	1304	709	meters
Maximum 1 hr concentration	6.8	0.03	µg/m^3
Concentration at 1000 m	6.5	0.03	µg/m^3
Concentration at 5000 m	1.8	0.02	µg/m^3
Concentration at 10000 m	1.2	0.01	µg/m^3
Benchmark Values:			
Short-term ESL Health, Benzene		170	µg/m^3
Long-term ESL Health, Benzene		4.5	µg/m^3

As a second health effects evaluation methodology, JBE sought to use modeling performed by others. Since no modeling by Alyeska was made available, non-site-specific EPA modeling efforts were considered to see if they could be adapted. EPA performed dispersion modeling for emissions from terminals potentially impacted by the OLD MACT, but VMT was not modeled because there were no values in the 2004 NEI source data for it. As a suitable benchmark, the emission modeling performed for the refinery sector rule for crude oil storage tanks was consulted. In 2015, EPA released its complex hazard evaluation and established “allowable” emissions for specific HAPs emitted from crude oil storage tanks at refineries based on its average refinery case. This analysis was performed on storage tanks specifically, and it coupled tank throughput with HAPs weight percent in crude oil to estimate emissions of HAPs.

JBE used its tank emissions data and these factors to form a comparison between actual estimated VMT crude oil tank emissions and the “allowable levels.” Two sets of calculations were performed for benzene and hexane, one using the HAPs weight percentages from the assay JBE obtained for this review, and another using the crude oil HAPs weight percentages EPA developed for its average crude oil. This second calculation was performed as a sensitivity case because it had higher weight percentages than the assay value.

Both the benzene and hexane analyses had estimated emissions well below the “allowable” level. These results, taken with the SCREEN3 dispersion modeling, support the position that a further reduction in HAPs emissions via additional control is not necessary for the VMT.

Alternative Design Assessment

Each critical claim related to safety, environmental, engineering, and economic considerations presented by Alyeska in reference to reconfiguring the existing crude oil tank farm to comply with the 2020 OLD MACT were evaluated. The claims related to control of the storage tank emissions are provided in Section 4 of the report.

The current configuration for controls used to limit emissions from the storage tanks at the terminal consists of a vapor collection system designed to collect vapors resulting from tank blanketing and operational pressure rise (e.g., as a result of vapor displacement or temperature rise) and route them to treatment or combustion equipment. This system also includes a set of conservation vents for each tank sized to prevent overpressure or vacuum inside the tank in the event of a failure by the vapor collection system to keep pressure in balance. For safety reasons, these safety vents relieve excess pressure (and associated vapors) to the atmosphere. Changes to the OLD MACT standards would require additional control of these conservation vent vapors, or the replacement of the vapor collection system with another control method. Other allowed control methods would be the use of an external floating roof, or the use of that floating roof inside a tank with a fixed cover (e.g., as the tanks are configured now).

Overall, each claim related to safety, environmental, and engineering were completely validated or partially validated by JBE's independent analysis.

Comparative Analysis Evaluating VMT HAP Emissions "As Configured" versus 2020 OLD MACT Implementation

HAP emissions from the crude oil, fixed roof storage tanks controlled by vapor recovery were calculated, inclusive of emissions from the tank conservation vents, venting to atmosphere. This calculation represents the VMT "as configured".

Next, HAP emissions from the crude oil storage tanks were calculated with the scenario that the tanks were converted from fixed roof to internal floating roof where no conservation venting occurs. This scenario represents VMT compliance with the 2020 OLD MACT standards.

Using vent calculation method, modeled as an uncontrolled storage tank, the VMT "as configured" emits 36% less HAPs than if the tank farm were retrofitted with internal floating roof tanks. Thus, the VMT "as configured" achieves greater HAP reduction than if it were reconfigured to comply with the March 12, 2020, finalized version of the 2020 OLD MACT.

Title V Air Permit Review

VMT's Title V Air Permit was reviewed to evaluate the level of regulatory obligation to manage releases of HAPs from the conservation vents, controls during planned maintenance, and work practices for emptying and degassing storage tanks. Based on a review of the current Title V and process knowledge, the VMT has strong work practice standards and operational restrictions in place to limit HAP emissions and ensure the environmental safety of plant personnel and the surrounding communities, such as Valdez, from the site.

To further enhance the control of HAPs from the VMT, the additional practices outlined below could be considered, noting the extent to which these practices are already in place (though not required by the Title V) is not known by JBE.

Consideration of additional practices:

- Root cause and corrective action analyses after release events to atmosphere

- Use of redundant prevention measures to minimize venting to atmosphere
- Election to vent to atmosphere only during a predetermined set of hours, on an annual basis
- Establish and permit elective work practice standards pertaining to the emptying and degassing of storage tanks
- Strongly consider routing to a control device or fuel gas system during degassing

The work practice standards proposed by Alyeska to EPA as an alternative compliance measure under the 2020 OLD MACT, should incorporate the recommendations above in order to align VMT practices with industry best practices.

Considerations for Future Research

The Title V Air Permit calculation for the uncontrolled tanker loading maintenance allowance is of note. The calculation is provided in the 2016 Title V Air Permit Renewal Application and shows the PTE of 388 tpy VOC and 10.9 tpy HAPs. It is unclear the number of maintenance events per year and the duration of each event. Without this additional information, the short-term emission of HAPs resulting from these activities is unknown. As the emission of HAPs is elevated during this scenario, future research into the hourly emission rate of HAPs and the corresponding emissions-related impacts on the Valdez community during maintenance could be warranted.

Conclusions

Based on a comprehensive review of each principal claim presented in Alyeska's public correspondence with EPA related to the 2020 updates to the OLD MACT, the findings of JBE's analysis conclude that Alyeska presented information in a conservative and appropriate manner. Alyeska's actions to negotiate reasonable and practical work practice standards pertaining to conservation venting and tank degassing, based on their representations are, therefore, considered well-founded. JBE's review sought to determine if operations at the VMT "as configured" pose an acceptable health effects impact risk to the community of Valdez compared to compliance with the 2020 updated OLD MACT as written as of March 12, 2020. This conclusion was based on the application of two independent screening evaluation methods.

1.0 INTRODUCTION

On July 7, 2020, the United States Environmental Protection Agency (EPA) finalized modifications to its direct final rule that was originally issued on April 23, 2008, and subsequently withdrawn on July 17, 2008. (Title 40 to the Code of Federal Regulations (CFR), Part 63, Subpart EEEE - *National Emission Standards for Hazardous Air Pollutants: Organic Liquids Distribution (Non-Gasoline)*. [3] The finalized revisions affect the current air toxics Organic Liquids Distribution (OLD) standards that are in place for hazardous air pollutants (HAPs) emitted by the storage and transfer of crude oil at the VMT. Based on the rule's modification to the safety device exemption, bypass provision, and work practice standards associated with tank degassing, Alyeska has objected to the rulemaking, arguing provisions of the rule would adversely affect the operation and maintenance of their facility and would not significantly improve local air quality. Alyeska challenged EPA's rulemaking in a September 3, 2020, Petition for Rulemaking, Reconsideration, and Stay to the 2020 finalized amendments to 40 CFR 63, Subpart EEEE.[4] Subsequently, Alyeska filed a series of appeals with the United States Court of Appeals in effort to stay certain provisions of the 2020 updated rule.[5] As of the date of this review document, Alyeska is in negotiations with EPA regarding alternative compliance measures.

This report was developed by John Beath Environmental, LLC (JBE), with the objective to independently and fairly verify Alyeska's claims related to health and safety, technical feasibility, and economic feasibility presented in its correspondence with EPA, including the September 2020 Petition for Rulemaking, Reconsideration, and Stay to the 2020 finalized amendments to 40 CFR 63, Subpart EEEE. The full rulemaking history is addressed in Sections 1.1 and 1.2.2 to this report.

1.1 Regulatory Background

The Clean Air Act (CAA), which was signed by President Nixon in 1970, established comprehensive federal law that regulates air emissions from stationary and mobile sources operating in the United States. The CAA was the first law of its kind to authorize the EPA to prescribe what are now known as national ambient air quality standards (NAAQS) to protect public health and to regulate emissions of criteria pollutants and HAPs; to use a state implementation plan (SIP) mechanism to implement the NAAQS; and to establish federal emission standards for emissions from selected classes of sources that are major contributors to air pollution.

From 1970 to 1990 several critical amendments were made to Sections 111 and 112 of the CAA which dictate New Source Performance Standards (NSPS) and National Emissions Standards for Hazardous Air Pollutants (NESHAP), respectively.

[3] 85 FR 40740 (July 7, 2020), https://www.govinfo.gov/content/pkg/FR-2020-07-07/pdf/2020-05900.pdf.

[4] Petition to Stay file on September 3, 2020, Pursuant to section 553(e) of the Administrative Procedure Act and section 307(d)(7)(B) of the Clean Air Act. Docket ID: EPA-HQ-OAR-2018-0074.

[5] October 7, 2020, Appeal documents: USCA Case #20-1342, Document #1865385.

In 1990, Section 112 of the CAA was amended to regulate technology-based standards for certain major sources and area sources. Under its provisions, a "*major source*" is described as stationary source or group of stationary sources emits or has the potential to emit (PTE) 10 tons per year (tpy) or more of a single HAP or 25 tons per year or more of a combination of HAPs.

The 1990 CAA Amendments listed 187 chemicals designated as HAPS based on EPA's assertion that they cause or may cause cancer or other serious health effects concerns. This list expanded this specified HAPS category from the seven designated pollutants identified in the 1970 CAA (asbestos, beryllium, mercury, radionuclides, inorganic arsenic, benzene, and vinyl chloride). As a clarification, storage tanks containing organic liquids (including crude oil storage tanks) emit a wide variety of chemicals into the air that are collectively referred to as volatile organic compounds (or VOCs). Certain of the HAPs designated by the CAA Amendments are commonly part of the collective VOCs emitted for organic liquid storage tanks (e.g., benzene, hexane, toluene, mixed xylenes, etc.).

The need to control VOCs results from a combination of concerns for the environment and nearby potential receptors (those who could be impacted by the emission). Emissions of VOCs contribute to the formation of ozone that can produce general health effects. But more significant in the potential risk is exposure to specific hazardous air pollutants (HAPs) that are part of the emitted VOC mixture that can produce toxic effects.

Further, an "*area source*" is described as any stationary source that is not a major source. For applicable sources, Section 112 of the CAA requires that EPA establish emission standards that require the maximum degree of reduction in emissions of HAPs; these emission standards are commonly referred to as *Maximum Achievable Control Technology* (MACT) standards. The MACT standards are published in Title 40 to the Code of Federal Regulations Parts 61 and 63 (40 CFR 61 and 63) which are officially titled National Emission Standards for Hazardous Air Pollutants (NESHAPs).

The 1990 Amendments to the CAA also established a federally mandated operating permit program for major sources of criteria pollutants, referred to today as Title V. A facility's Title V permit sets forth the emission limits for sources and certain source-specific compliance requirements. In addition, it provides a comprehensive listing of applicable regulations and operating limits that a facility must meet to maintain compliance with the CAA. A facility must apply to renew its operating permit every five years, and once that has been accomplished, the existing permit remains in effect until the regulatory agency issues a renewed permit. As such the facility is currently subject to its previously issued permit.

The OLD MACT establishes national emission limitations, operating limits, and work practice standards for organic hazardous air pollutants (OHAPs) emitted from non-gasoline organic liquids distribution operations at major sources of HAP emissions, such as the VMT.

In formulating the Subpart EEEE regulation, EPA chose to target a small subset of HAPs referred to as OHAPs that are known to be present in certain organic liquid petroleum products such as crude oil.

The current version of the subpart EEEE requirements includes:

- Clarification that rule standards are applicable during startup, shutdown, and malfunction;

- Requirement to electronically report performance test results;

- Addition of new operational requirements for flares used as control devices;
- Addition of new provisions for bypass authorizations;
- Removal of an exemption for pressure relief devices; and
- Adoption of a work practice standard for tank degassing.

1.2 Valdez Marine Terminal Background

Situated on 1,000 acres along the southern shore of Port Valdez, Alaska, the VMT is a critical link in the operation of one of the world's largest pipeline systems, the Trans Alaska Pipeline System (TAPS). TAPS has carried over 1.8 million barrels of oil per day in its peak years historically, but it averaged only 480,200 barrels per day in 2020[6]. The pipeline plays an essential role in supporting the United States energy supply and the local and statewide economies of Alaska. Since 1977, tankers at the VMT have loaded Alaska North Slope Crude cargo for delivery to the lower United States and rest of the world. An overview of terminal layout and key operations are provided in Section 1.2.1.

A history of VMT in relation to Alyeska's legal challenge to the 2020 updates to the OLD MACT is presented in Section 1.2.2.

1.2.1 Site Layout and Characteristics

The VMT is situated within the Prince William Sound south of Port Valdez, a small community of approximately 4,200 residents located in Valdez, Alaska.[7] As shown in Figure 1, the terminal borders the shore of Port Valdez fjord on one side and steep mountains on the other. Given the site topography, severe climate, and extreme seismic activity, the VMT's design is unique, and truly, there is no other terminal of its kind operating in the United States.

The VMT marks the southern terminus of the TAPS which transports crude oil over 800 miles via pipeline from the Alaska North Slope to the VMT. The VMT is critical to ensuring the energy needs of not only Alaska, but also some of the lower 48 states. Crude oil received via TAPS is temporarily stored in storage tanks at the VMT before being loaded in marine tankers and transported to Alaskan refineries, refineries located in the rest of the United States, and international market. The crude storage capability is essential to ensure that problems with marine transport availability do not result a costly shutdown of North Slope operations.

Major operations at the VMT include fourteen storage tanks with a working inventory of 6.6 million barrels of crude oil, a vapor recovery system to recovery storage tank vapors, two loading berths both

[6] Historic Throughput as reported by Alyeska Pipeline: https://www.alyeska-pipe.com/historic-throughput/.

[7] Population of Port of Valdez: https://www.valdezalaska.org/discover/history/.

equipped with vapor recovery arms, incoming tankers, ballast water treatment, thermal oxidation, and power generation and its associated boilers. Figure 2 provides a site layout with key operations labeled.

The finalized version of EPA's Subpart EEEE requirements covers required controls for emissions from loading operations, leaks from piping arrangements, and storage tanks in crude oil service at the terminal. This reviewed focused mainly on tank emissions because only those newly revised provisions are an area of active dispute.

Figure 1. Valdez Marine Terminal, Valdez, Alaska

Photo Credit: Alyeska Pipeline Services Company

Figure 2. Valdez Marine Terminal Site Layout

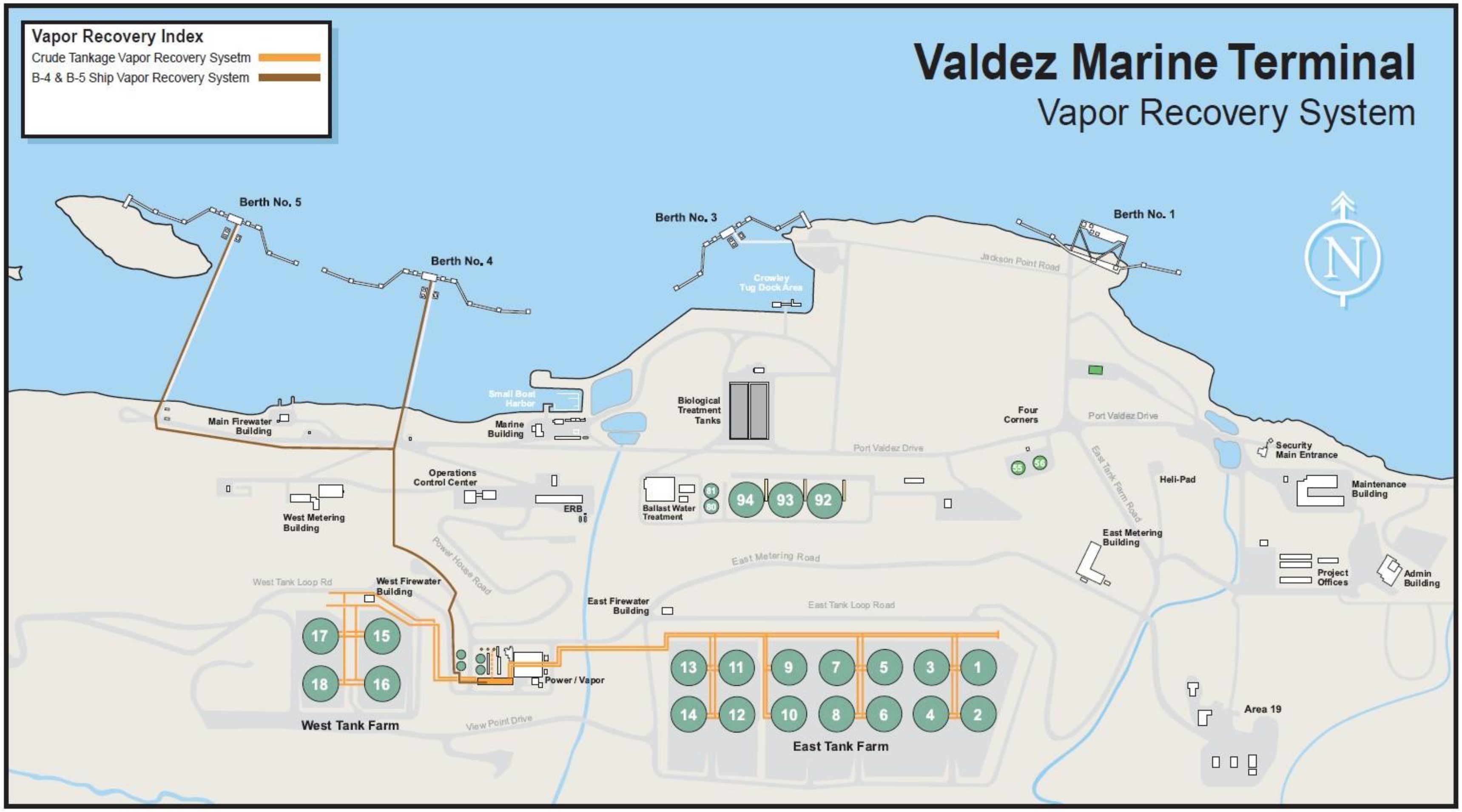


Photo credit: Alyeska Pipeline Service Company

1.2.2 Motion to Stay History

To date, Alyeska has taken two legal actions to challenge parts of EPA's 2020 updates to the OLD MACT. Alyeska's first appeal occurred on September 3, 2020, with Alyeska filing an administrative action with EPA called a "Petition for Rulemaking, Reconsideration, and Stay" asking EPA to stay portions of the updated rule.

Alyeska's second action was to file a challenge to the U.S. Circuit Court of Appeals for the District of Columba (D.C. Circuit), which is empowered by the CAA to decide challenges to federal air regulations. More specifically, Alyeska filed its Petition for Review in the D.C. Circuit on September 8, 2020. On September 9, 2020, Alyeska's petition was consolidated with the Petition of the American Fuel & Petrochemical Manufacturers (AFPM), American Petroleum Institute (API), and American Chemistry Council (ACC) and the Petition from California Communities Against Toxics (CCAT), Coalition for a Safe Environment and Sierra Club. On October 7, 2020, Alyeska filed a motion with the D.C. Circuit to stay the rule while the case is being heard. Ultimately, the D.C. Circuit ruled to move to hold the case in abeyance until at least April 12, 2021, to allow for discussion and consideration of the petitions for administrative reconsideration filed with EPA by the Petitioners. This ruling exclusively stayed only the portions to the rule challenged by Alyeska. As of the date of this report, Alyeska and EPA are in active negotiations, under the EPA's reconsideration process.

Alyeska is challenging three parts of the rule that apply to operations at VMT as summarized below.

1. **"Safety Device Exemption" Repeal:** Alyeska has challenged the repeal of the "safety device exemption" that allows facilities to open vents, or other pressure relief devices, at any time that it is required to avoid unsafe operating conditions. Alyeska argues the conservation vents installed on its crude oil storage tanks need to have the option to open and vent to atmosphere when the tank pressure reaches the set point of the conservation vents; this function is critical to the physical safety of site personnel and ensures the structural integrity of the tank(s). In the September 3, 2020, Petition for Rulemaking, Reconsideration, and Stay, Alyeska requested that EPA establish a work practice standard allowing for use of the conservation vents during system upsets that require venting of the tanks to maintain safe pressures inside, in lieu of repealing the "safety device exemption". On December 15, 2020, EPA granted Alyeska's request for reconsideration, meaning EPA will consider alternative work practice standards for the VMT.

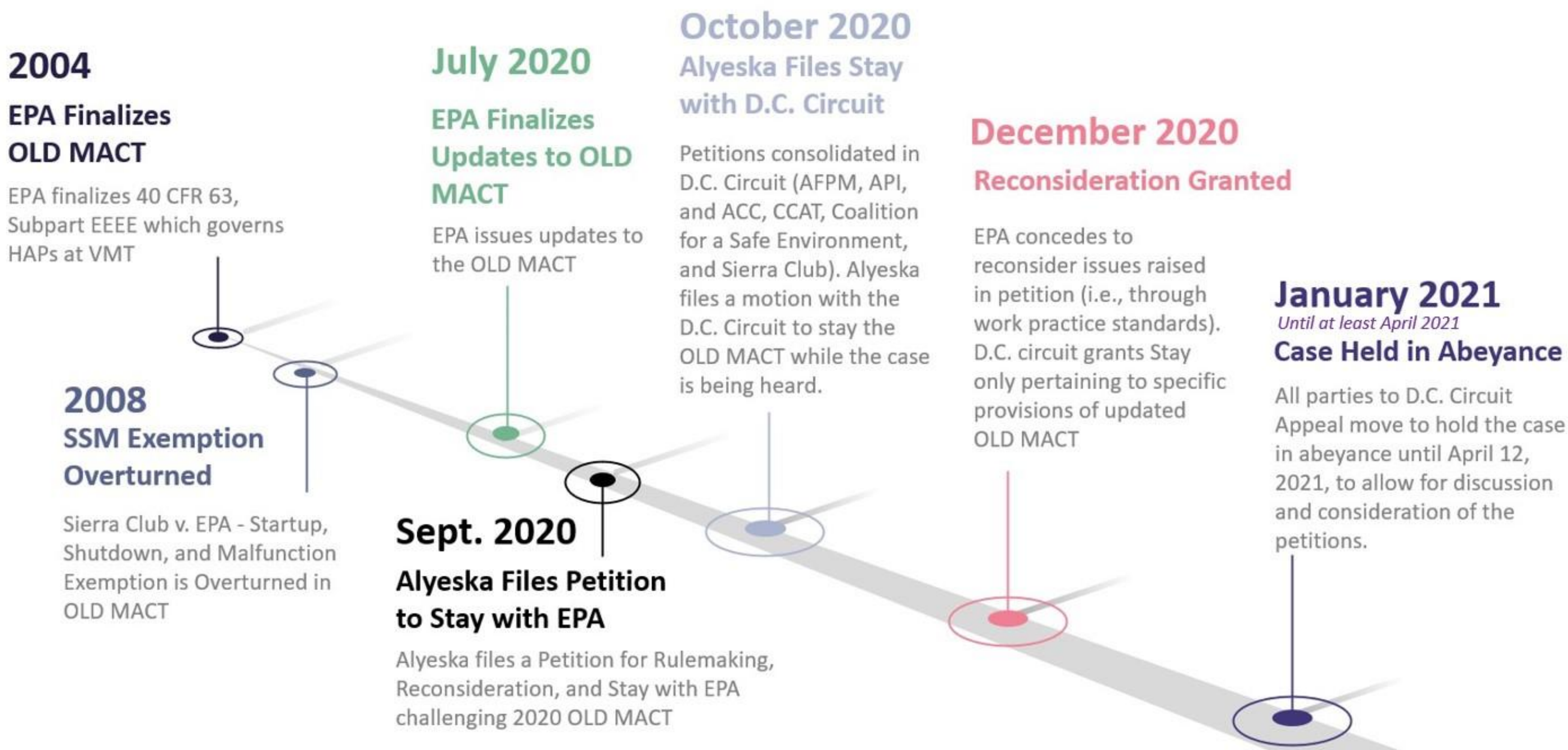
2. **"Bypass Provision":** The "bypass provision" that prohibits operators from filling storage tanks during periods when pollution controls are bypassed, such as during planned maintenance were absent from the Proposed Rule. Alyeska challenged this provision to the finalized rule because Alyeska was unable to provide comment on the adequacy of the bypass allowances included in sections 40 CFR §63.2378(e)(3) and (4) because these provisions were absent in the Proposed Rule but added in the finalized version. Alyeska has proposed work practice standards to comply with the bypass provisions. [8]

[8] The final EPA rule kept the 240-hour bypass allowance but added a requirement that the tanks not be filled during the event. EPA stated that this was necessary because of the Sierra Club decision.

3. **“Tank Degassing Standards”:** Tank “degassing” refers to the process of removing organic gases from a stationary tank or pipeline. The original 2004 OLD MACT did not include work practice standards for degassing as these practices occurred under SSM periods which were excluded. In the 2020 finalized rule, EPA adopted a new work practice standard for degassing tanks but excluded tanks with capacities greater than 50,000 barrels. As the crude oil storage tanks at VMT are greater than 50,000 barrels, Alyeska challenged the work practice standard requesting that the work practice standards be incorporated for tanks greater than 50,000 barrels. [provisions codified in 40 CFR §63.2346(a)(6) in an attempt to extend the recommended work practices to larger storage tanks so as to provide a clear and practical set of requirements]

Figure 3 provides a summary of important dates related to Alyeska’s rule challenge.

Figure 3. Alyeska's Legal Challenge to the 2020 OLD MACT - Timeline of Significant Events



1.3 Project Objectives and Scope

The main objectives of this project are to: (1) independently verify Alyeska's claims related to health and safety, technical feasibility, and economic feasibility presented in its public correspondence with EPA related to the 2020 updates to the OLD MACT; and (2) evaluate how the implementation of the 2020 OLD MACT would influence the emittance of HAPs from the VMT. The scope of work performed is summarized below with an indication as to what report sections cover these various issues.

- **Independent Evaluation of HAP Air Releases from the VMT:** HAP emissions from the vapor recovery system, storage tank conservation vents, and other sources not covered by the OLD MACT were quantified and compared to those values represented by Alyeska in the Petition for Rulemaking, Reconsideration, and Stay. JBE elected to perform this analysis in order to confirm that overall impacts from site operations were acceptable. The methodology used to estimate HAPs emitted from the VMT, calculation results, and value comparisons are provided in Section 2. Detailed calculations are presented in Appendices A through E.

- **Comparative Analysis Evaluating VMT HAP Emissions "As Configured" versus 2020 OLD MACT Implementation:** HAP emissions from the fourteen-crude oil, fixed roof storage tanks controlled by vapor recovery were calculated, inclusive of emissions from the tank conservation vents (modeled as an uncontrolled tank since the emissions from the vents are released to the atmosphere). Modeling controlled emissions merely means that the uncontrolled emissions are reduced by a control efficiency (a percentage such as 98% for a flare). Uncontrolled emissions are not reduced by a percentage since there is no treatment or combustion downstream of their release point. This calculation represents the VMT "as configured".

  Next, HAP emissions from the fourteen-crude oil storage tanks were calculated with the scenario that the tanks were converted from fixed roof to internal floating roof where no conservation venting occurs. This scenario represents VMT compliance with the 2020 OLD MACT standards. The results of this comparative analysis are presented in Section 4.2. Detailed calculations are presented in Appendices B and C.

- **Health Risk Evaluation:** The health risks to residents of Valdez, Alaska posed by the uncontrolled releases of HAPs from the conservation vents and residual uncontrolled sources at the VMT, not addressed by the OLD MACT were evaluated. HAP releases from VMT were modeled using EPA's SCREEN3 Model. The health evaluation is presented in Section 3 with calculations presented in Appendix E and EPA SCREEN3 Model Outputs provided in Appendix F.

- **Alternative Design Assessment:** The safety, environmental, engineering, and economic considerations presented by Alyeska in reference to reconfiguring the existing crude oil tank farm to comply with the 2020 OLD MACT were evaluated. The detailed assessment is provided in Section 4.

- **Title V Air Permit Review:** VMT's Title V Air Permit was reviewed to evaluate the level of regulatory obligation to manage releases of HAPs from the conservation vents, controls during planned maintenance, and work practices for emptying and degassing storage tanks. The Title V review is presented in Section 5.

Table 1. VMT Equipment-Level Subjectivity to the OLD MACT

EU IDs, Title V	Emission Unit Description	Subject to OLD MACT?
1-3	Power Boilers (3)	Yes
4-6	Waste Gas Combustors (3)	Yes
29-42	Crude Tanks (14)	Yes
43-46	West Tank Farm Tanks (4)	Yes
UI-45	Crude Tank VRU Piping Fugitives	Yes
8A, 9A	Emergency Generators (2)	No
10-16	Firewater Pumps	No
17	Soil Vapor Extraction	No
18-28	Tank Bottom Processing Equipment	No
47-48	Berths 1, 3	No
49-50	Berths 4, 5	No
57	Recovered Treatment Crude Oil Tank	No
59-61	Ballast Water Treatment Tanks (3)	No
62-74	Wastewater Treatment System	No
75-80	Air Stripping System	No
UI-1,2,46	Boilers (3)	No
UI-3 - 14	Heaters (12)	No
UI-20 – 36, I-21	Diesel Tanks (18)	No
UI-37	Gasoline Tank	No
UI-38- 41	Used Oil Tanks (4)	No
UI-42 – 43	Propane Tanks (2)	No
UI-44	Ballast Water Treatment Sludge Tank	No

2.0 EVALUATION OF HAZARDOUS AIR POLLUTANTS FROM VALDEZ MARINE TERMINAL

The evaluation of HAP emissions from the VMT included the quantification of emissions related to Alyeska's rule challenges – emissions from the crude oil tank farm (routes to vapor recovery) and crude oil storage tank conservation venting to atmosphere. Additionally, emissions from key emitters of HAPs were calculated. This includes the following: the power boilers (EU IDs 1 – 3), waste gas combustors (EU IDs 4 – 6), stationary reciprocating internal combustion engines (EU IDs 8A – 15), the Tank Bottoms Processing (TBP) system, marine loading, and leaks from piping components referred to as *fugitives*.

The term *fugitives* is short for fugitive emissions, the technical description given by EPA to leakage that happens continuously from various piping components such as valves, flanges, pumps, and compressors. Extensive study work by EPA developed estimates for the very slow leakage from seals used to control these leaks. Taken individually these emissions would be insignificant, but because of the number of components that are associated with major equipment like storage tanks, the sum of these emissions is an important part of the emissions inventory.

Other units and equipment with trace emissions of HAPs too small to be regulated by the facility air permit, as well as the wastewater treatment system (for which no configuration information was available) were not quantified. Additionally, emissions associated with tank cleaning (e.g., tank de-pressuring, liquid removal, and sludge removal) were not calculated.

Emissions were calculated in order to assess the following:

- Level of HAP control with VMT's current configuration
- Level of HAP control under alternative design scenario to meet the 2020 OLD MACT
- Site-wide emission rate of HAPs
- Benchmarking of VMT HAP emission rate compared to EPA health screening criteria for individual HAPs

2.1 Emissions from the Crude Oil Storage Tank Farm including Conservation Venting

JBE used the latest equations EPA specifies for use in estimating emissions from the fourteen crude oil storage tanks which route to a vapor collection system during normal operations and that have the potential to vent to atmosphere for safety purposes during unplanned events (e.g., power outages).

The proceeding sections outline the calculation methods used and provide an emissions summary. Detailed emission calculations and supporting data for VMT's current tank configuration are provided in Appendices A, B, and D.

Step 1 – Determine VOC Emissions from the Crude Oil, Fixed Roof Storage Tanks Including Venting

First emissions of VOC were calculated for the fourteen fixed roof storage tanks that store crude oil. The methodology used is contained in a JBE custom workbook that follows EPA's most recent guidance for the equations and associated factors found in AP-42 Chapter 7: Organic Liquid Storage Tanks, dated June 2020. [9] This JBE tool has been subjected to benchmarking with other commercially available tools developed by other consultants. In addition, the majority of this JBE tool was reviewed by the Argonne National Laboratory prior to being adopted as part of its transportation fuels emissions modeling tool set.[10]

Note, the Title V Air Permit applications for the VMT appear to have relied on EPA's Tanks 4.09d software which is no longer supported or recommended for use by EPA.

EPA has stated:

> "*The TANKS model was developed using a software that is now outdated. Because of this, the model is not reliably functional on computers using certain operating systems such as Windows Vista or Windows 7. We are anticipating that additional problems will arise as PCs switch to the other operating systems. Therefore, we can no longer provide assistance to users of TANKs 4.09d. The model will remain on the website to be used at your discretion and at your own risk. We will continue to recommend the use of the equations/algorithms specified in AP-42 Chapter 7 for estimating VOC emissions from storage tanks. The equations specified in AP-42 Chapter 7 (https://www.epa.gov/ttn/chief/ap42/ch07/index.html) can be employed with many current spreadsheet/software programs.*"[11]

Based in part on differences in calculation methodology, the estimation of VOCs and HAPs from Alyeska's VMT air permit application and JBE's independent evaluation vary.

This situation is not unique to VMT. Permits with specific reference to TANKS 4.09d are still widespread across the US. Historically, Title V and other permits have referred to specific dates for guidance documents or other tools incorporated by reference. Where this is done, it introduces a problem when the guidance document is revised, or the tool's use is abandoned by EPA as is the case here. If the emissions are estimated using an outdated method, they would potentially be less accurate. However, it may be unclear what would be the intention if on initial permit issue, the equipment was below a permit limit, but after an emission factor was revised in the updated guidance document, a permit exceedance could result.

Regardless of any permit limit ramifications, for the purposes of this review, the most accurate methods (usually the most recently developed ones) are clearly the best choice.

[9] AP-42 Chapter 7, June 2020 Final Revision: https://www.epa.gov/air-emissions-factors-and-quantification/final-revisions-ap-42-chapter-7-section-71-organic-liquid.

[10] https://greet.es.anl.gov/tool_rp_voc.

[11] EPA statement on use of Tanks 4.09d: https://www3.epa.gov/ttnchie1/software/tanks/.

The physical characteristics of the fixed roof storage tanks used in the tool were based on the following data sources:

1. September 3, 2020, Alyeska Petition for Rulemaking, Reconsideration, and Stay to the 2020 finalized amendments to 40 CFR 63, Subpart EEEE

2. July 14, 2016, Title V Air Permit Renewal Application to Permit Number AQ0082TVP02

3. 2020 Annual Point-Source Emissions Inventory[12]

The JBE tanks tool was also used to model open venting to the atmosphere by the conservation vents. The conservation vents were modeled as an uncontrolled storage tank. Venting times were based on the annual average vent time from 2005 to 2020 as provided in Table 1 - *Vapor Volume Capture Efficiency Compared to Uncontrolled Tank Venting* to Attachment 2 to the October 7, 2020, Motion to Stay filed in the D.C. Circuit. Using historic venting times, the average capture efficiency, and thus, the total average time the conservation vents were closed was 99.94%. This capture rate was used to estimate annual emissions from the vents – to represent a typical year.

Step 2 – Determine North Slope Crude Oil Characteristics

Once VOC emissions are determined, crude speciation is required in order to speciate HAPs. In order to use the equations specified by AP-42, the chemical compounds present in the mixture (in this case crude oil) must be comprehensively described. This is called "speciation" by the air pollution control community. The reason a comprehensive speciation is necessary is that molecules from each compound in crude oil compete for the vapor space above the liquid in a storage tank. This vapor space concentration profile is used directly in order to divide overall predicted emissions (volatile organic compounds) into the portion for each compound present in the vapor space. If the characterization used were to include HAPs alone, the contribution of lighter compounds (e.g., C3 to C5) would not be taken into account. The more of these lighter compounds, the less HAPs in the vapor space. Conversely, if these compounds are not portrayed accurately, the HAPs emissions would be overstated.

To speciate the contents of the fourteen crude oil storage tanks at the VMT, a crude assay for Alaska North Slope Crude was used. A copy of the assay used is provided in Appendix A to this report.[13] The crude oil speciation was taken from PIANO (paraffins, iso-paraffins, aromatics, naphthenes, olefins) test results. Where speciation was not reported by the PIANO test results (e.g., for lighter components), surrogate data based on datasets published by American Petroleum Institute (API 4723) were used. The vapor pressure of Alaska North Slope Crude was estimated using a flash calculation tool designed by JBE that makes use of Antoine Coefficients to estimate compound physical properties at a specified temperature. A copy of the flash tool results are provided in Appendix D to this report for reference.

[12] Publicly available from Alaska Department of Environmental Conservation.

[13] Crude assay (i.e., PIANO data) was provided to JBE on 7-2-2021 by Eric Litman, M.S., Senior Environmental Scientist, NewFields Environmental.

Step 3 - Determine HAP Emissions from the Crude Oil, Fixed Roof Storage Tanks Including Venting

The JBE flash tool was used to estimate the percent of each constituent in the vapor phase based on partial pressure calculations, which are used to estimate the total HAP emitted from the storage tanks including venting. Based on a total VOC emission rate of 6.25 tpy and an estimated HAP concentration of crude oil vapor of 1.47%, JBE estimated a total HAP emission rate of 0.1 tpy from the conservation vents, well below the 1.97 tpy quoted by Alyeska in Table 1 to Attachment 2 to the October 7, 2020, Motion to Stay filed in the D.C. Circuit. The full flash tool calculation is provided in Appendix D.

Storage Tank Emissions Results, Current VMT Configuration

Emissions of VOCs and HAPs from the storage tanks (emitted at the vapor collection system, referred to as VCU) are shown in Table 2 and
Table 3, Table 4, and Table 5 provide a comparison between the JBE and Alyeska calculated values representing VOCs and HAPs emitted from the conservation vents to atmosphere during a typical year.

The emissions estimated include contributions resulting from two consequences of how tanks are operated. First, storage tank emissions can result from the displacement of vapor in the tank by incoming liquid petroleum product (e.g., crude oil). This happens because the liquid level in the tank rises with the delivered oil and as a consequence, the vapor above the liquid as it rises is displaced. These displaced vapors are referred to as “working” losses, because they result from the tank “working” to process the throughput of oil. Whether the tank is still (no incoming or outgoing liquid) or receiving product, or dispensing product, emissions also occur as a result of daytime heating (if any occurs). The associated vapor pressure rises as a function of the temperature in the tank, and this impact to emissions is referred to as “standing” losses.

Based on JBE’s independent emission calculations, the emissions of VOC and HAP represented in Alyeska’s Motion to Stay are conservative and are therefore considered as an acceptable representation.

Table 2. VOC Emissions from Crude Oil Storage Tanks

Parameter	VOC Emissions	Unit
Uncontrolled Working Loss	18,705,473	lb/yr
Uncontrolled Standing Loss	2,135,977	lb/yr
Tank Cleaning Loss[14]	0	lb/yr
Total Loss = VOC Emissions routed to VCU	**20,841,450**	**lb/yr**
VCU Control Efficiency	99.7	%
Actual VCU Emissions from Tanks	62,487	lb/yr
Actual VCU Emissions from Tanks (unit conversion)	**31**	**tpy**
** Tank cleaning not quantified*		

[14] Based on JBE review of VMT’s current Title V, it is unclear if tank cleaning emissions are incorporated to the sitewide PTE.

Table 3. HAP Emissions from Crude Oil Storage Tanks at Vapor Collection Emission Point

Parameter	JBE Calculated HAP Emissions (tpy)	Alyeska Calculated HAP Emissions (tpy)
HAP Emissions from the Crude Oil Storage Tanks at Vapor Recovery	0.46	n/a

Table 4. VOC Emissions from Conservation Vents

Parameter	JBE Calculated VOC Emissions (tpy)	Alyeska Calculated VOC Emissions (tpy)
VOC Emissions from the Crude Oil Storage Tank Conservation Vents	6.25	49.32

Table 5. HAP Emissions from Conservation Vents

Parameter	JBE Calculated HAP Emissions (tpy)	Alyeska Calculated HAP Emissions (tpy)
HAP Emissions from the Crude Oil Storage Tank Conservation Vents	0.10	1.97

Detailed Emission calculations for the fixed roof storage tank (as VMT is currently configured) are provided in Appendix B.

2.2.1 Alternative Conservation Vent Calculation Method: Pressure Rise Method

On October 19, 2021, Alyeska presented JBE with a sample calculation to estimate VOC from the storage tank conservation vents using an alternative calculation method. This method estimates vapor rate emissions using a derivation of the ideal gas law and is based on the pressure rise inside a tank using actual pressure readings at the time the vents are open and closed, tank temperature readings, and vapor space volumes based on the liquid level inside the tank.

An example pressure rise method calculation for Tank 7 from an event on March 23, 2019, resulted in a total of 0.13 tons of VOC emitted during the duration of 1.68 hours the vent was open. This equates to an emission rate during venting of 0.077 tons per hour. Applying this emission rate to the total average annual time the vents released from 2005 to 2020 (value of 318 minutes or 5.3 hours for each of the 14 tanks) results in VOC emissions of 5.74 tpy (0.077 tons per hour X 5.3 hours venting X 14 tanks). Said another way, the 14 tanks combine to release during a total of 4,452 minutes (74.2 hours) as an average for each year. This rate of VOC emissions is 8% less than the rate of 6.25 tpy calculated by modeling the vents as an uncontrolled storage tank. Table 6 provides numerical comparisons of both methods.

In JBE's opinion, the pressure rise method is the preferable calculation method because it relies on granular, actual datasets to accurately determine emissions for each individual venting event. As pressure, temperature, and the vapor space volume is unique to each venting episode, calculating events individually, and then summing for the total events in a year is preferable.

Table 6. VOC Emissions Comparison by Vent Calculation Method

Parameter	Duration of Open Venting to Atmosphere	VOC Emissions (tpy)
Single Emission Event, Tank 7, Using Pressure Rise Method	1.68 hours (101 minutes)	0.13
Annual Emissions, Single Tank, Using Pressure Rise Method	318 minutes	0.41
Annual Emissions, All 14 Crude Tanks Combined, Using Pressure Rise Method	318 minutes per tank, for a collective 4,452 minutes annually	5.74
Annual Emissions, All 14 Crude Tanks Combined, Using Uncontrolled Tank Method	318 minutes per tank, for a collective 4,452 minutes annually	6.25
Change in Emissions Due to Method Variation:		8%

2.2 Other Key Emitters of HAP Emissions

To better understand the site-wide Potential to Emit (PTE) HAPs at VMT, additional emitters of HAPs were evaluated. These include the following:

- Power boilers (EU IDs 1 – 3)
- Waste gas combustors (EU IDs 4 – 6)
- Stationary reciprocating internal combustion engines (EU IDs 8A – 15)
- Tank Bottoms Processing (TBP) system and associated units
- Marine loading
- Fugitives from equipment leaks

As defined by the EPA, "potential to emit" is "the maximum capacity of a stationary source to emit under its physical and operational design. Any physical or operational limitation on the source to emit an air pollutant, including air pollution control equipment and restrictions on hours of operation, or on the type or amount of material combusted, stored, or processed, shall be treated as part of its design if the limitation is enforceable by the (EPA) Administrator."[15]

Permitting authorities (e.g., EPA and state regulatory agencies) use the potential-to-emit concept as a way to establish permit limitations in many situations, seeking to set permit limits at protective levels that would cover reasonably expected operations without the need to re-establish the basis for permit limits for routine changes in operations. If limits are set based on operational capabilities, it follows logically that emissions at the point of permit limitation would be worst-case emissions (those that are the most

[15] April 1998 EPA Memo: Potential to Emit (PTE) Guidance for Specific Source Categories https://www.epa.gov/sites/default/files/2015-07/documents/lowmarch.pdf.

that would occur unless equipment was damaged, there was a significant weather event, or a fire or explosion). For this review, the use of permit limits associated with worst-case emissions was a very appropriate way to investigate the most impactful situations from the perspective of potential off-site health effects to nearby residents. Since lower screening thresholds are associated with chronic health effects (for long-term exposures), it is logical to use a worst-case emissions value as a conservative case to investigate impacts from long-term-exposure.

Units with limited emissions of HAPs, such as the wastewater treatment system were not quantified.

Overview of Approach

JBE used historic permit applications and the Title V Air Permit to recreate a HAP emissions workbook for the sources outlined above. Key aspects to this workbook are provided in Appendix E to this report. A summary of HAP emissions from the aforementioned sources is provided in

Table 8, including a comparison between the total HAPs provided in the VMT 2016 Title V Air Permit Renewal Application and the independent results calculated by JBE.

One primary reason for the discrepancy between the calculations is due to the different crude oil speciation between the permit application and JBE's analysis. The permit application states that the crude oil HAP speciation was based on an average of five samples taken in December 2006, and the crude vapor HAPs content was estimated "…based on construction permit methodology used for PS 3-5, 7 & 9 breakout tank ORLs." JBE estimated HAP concentrations as previously described in Section 2.1. The HAP concentrations from both sources are provided below.

Table 7. Comparison of Crude Speciation

Pollutant	Crude Vapor HAP wt% Permit Application	Crude Vapor HAP wt% JBE Calculation	Comments
1,3-Butadiene	0.201	n/a	Not listed in PIANO data
n-Hexane	1.685	0.978	
Benzene	0.306	0.272	
Toluene	0.213	0.161	
2,2,4-Trimethylpentane	0.005	n/a	Not listed in PIANO data
Ethylbenzene	0.001	0.010	
Xylenes	0.063	0.047	
Cumene	0.001	0.001	
Naphthalene	0.337	0.000	Concentration zero in PIANO data
Total HAPs	2.810	1.470	
Total Non-HAP Compounds	97.190	98.530	

Table 8. HAP Emissions Summary for Key Contributors (Non-Tanks)

Emission Source	HAP Emissions, VMT 2016 Permit Application (tpy)	HAP Emissions JBE Calculation (tpy)	Comments
Boilers/Waste Gas Combustors 1-6	5.90	3.10	
Generators/Engines 8A-15	0.00	0.02	Negligible
Loading	10.90	12.20	Uncontrolled maintenance allowance
Fugitives	0.40	0.10	
Tank Bottoms Processing System	0.50	0.30	
Tank Conservation Vents	n/a	0.10	
Total	17.70	15.80	

Limitations

HAP emissions from ballast water treatment is not included. Based on VMT's 2016 Title V Air Permit Renewal Application, the potential to emit HAPs due to ballast water treatment is 3.1 tpy.[16] Additionally, emissions from any unpermitted sources are not included. Within this category and of note, emissions from tank cleaning are not included because data to characterize these operations was not available in the permit application or other publicly available sources. An example for calculation of tank degassing emissions for an external storage tank containing gasoline in Chapter 7 of AP-42 (Section 7.1.5, Example 6) show results that are approximately 0.5 tons of VOC if vapor controls are used, and well above 4 tons if not. This should be a conservative point of reference since gasoline has a higher vapor pressure than crude oil. Therefore, tank cleaning does remain an issue of some potential significance, but Alyeska is negotiating work practices for degassing tanks with the EPA. Therefore, it is likely that controls imposed will adequately address this concern.

[16] 3.1 tpy includes 2.2 tpy for water treatment and an additional 0.9 tpy for thermal oxidization control.

3.0 HEALTH ASSESSMENT

The potential for health impacts from chemicals released from process equipment depends a number of factors, all of which must be understood to have a definitive answer on the risks of the releases. The key factors include the following:

- Amount of chemical released – pounds per hour, tons per year
- How and where the chemical is released – affects how the chemical is dispersed, deflected, or diluted before reaching a resident (e.g., a chemical released from a pipe at ambient temperature at ground level will be more concentrated at the property line than the same chemical released from a high stack at high temperatures)
- The prevailing weather conditions including inversions, wind direction, air pressure differential and temperature
- Where the residents are located – whether they live on the VMT property line or across Port Valdez, or whether they live full-time nearby, or only have short visits like visiting a park
- Type of health risk posed by the chemical – carcinogenic, immediate skin damage, impacts occur in a short time or over a lifetime
- Whether the exposed individuals are healthy results or if they have increased sensitivity due to age, medical issues, etc.
- The duration of the exposure (e.g., for just a year or two, or for an entire lifetime)

A complete health risk analysis involves a tremendous amount of detailed site information and computer modeling which is beyond the scope of this evaluation. Therefore JBE looked at two ways to compare the risks from this site-specific situation to other study results without the need to perform a comprehensive analysis from the ground up. First, JBE compared the emissions results we obtained for the site to the risk analysis EPA performed as a required part of the Residual Risk and Technology Review for the OLD MACT as it relates to uncontrolled releases. Then, as a second comparison, JBE used the emission results to perform a screening analysis using an EPA tool. To perform these comparisons the following data was used:

- Composition and Emission rate of HAPs released from the VMT;
- Allowable health risk levels for those chemicals; and
- Qualitative review of release discharge points as it relates to dispersion and proximity to residents.

In order to perform a health screening, first each source at the VMT was evaluated to determine whether it should be considered. A summary of this review is provided in Table 9.

Table 9. VMT Potential Sources of HAP

EU IDs, Title V	Emission Unit Description	Uncontrolled?	Subject to OLD MACT?	If Uncontrolled and Not Subject to OLD MACT, Significant HAP Source?
1-3	Power Boilers (3)	No, type of control	Yes	N/A
4-6	Waste Gas Combustors (3)	No, type of control	Yes	N/A
8A, 9A	Emergency Generators (2)	Yes	No	No – trace HAP, operate 100 hr/yr
10-16	Firewater Pumps	Yes	No	No – trace HAP, operate 156 hr/yr
17	Soil Vapor Extraction	No	No	N/A
18-28	Tank Bottom Processing Equipment	No	No	N/A
29-42	Crude Tanks (14)	No	Yes	N/A
43-46	West Tank Farm Tanks (4)	No	Yes	No – out-of-service
47-48	Berths 1, 3	Yes	No	No – out-of-service
49-50	Berths 4, 5	No	No	N/A
57	Recovered Treatment Crude Oil Tank	Yes	No	Not investigated - Insufficient data to estimate vapor pressure
59-61	Ballast Water Treatment Tanks (3)	Yes	No	No – removed or in standby
62-74	Wastewater Treatment System	Yes	No	Unknown, Limited Data Available to Access
75-80	Air Stripping System	No	No	N/A
UI-1,2,46	Boilers (3)	Yes	No	No – trace HAPs from <1 MMBTU/hr diesel boilers
UI-3 - 14	Heaters (12)	Yes	No	No – trace HAPs from <1 MMBTU/hr heaters
UI-20 – 36, I-21	Diesel Tanks (18)	Yes	No	No – trace HAPs from diesel storage
UI-37	Gasoline Tank	Yes	No	No – trace HAPs for 10k gallon storage tank
UI-38- 41	Used Oil Tanks (4)	Yes	No	No – trace HAPs from used oil storage
UI-42 – 43	Propane Tanks (2)	Yes	No	No – No HAPs in propane; no emissions
UI-44	Ballast Water Treatment Sludge Tank	Yes	No	No – only 1 -2 turnovers per year
UI-45	Crude Tank VRU Piping Fugitives	No	Yes	N/A

For key emitters of HAPs (in addition to the crude oil tank farm and conservation venting), JBE used historic permit applications and the Title V Air Permit to recreate a HAP emissions workbook. This workbook was used as the basis to determine site-wide HAP emission rates by pollutant which can be used as data input values into EPA's SCREEN3 model. SCREEN3 is an air dispersion model which provides maximum ground-level concentrations for point, area, flare, and volume sources, as well as concentrations due to inversion break-up and shoreline fumigation.[17]

EPA SCREEN3 utilize a simple air emissions dispersion pattern that spreads out uniformly with distance called a Gaussian plume model. In general, more sophisticated models predict the extent to which the spread of emissions may be reduced by atmospheric conditions (e.g., where the plume may rise and disperse vertically), or where it may be deflected more rapidly down to earth as a result of terrain interaction. Therefore, it is generally accepted that a screening approach using a Gaussian tool would yield the highest predicted concentrations and would therefore be an appropriate worst-case approach.

An analysis based on these screening dispersion results would seek to determine if the estimated concentrations exceeded levels above those established as health effects screening thresholds. The EPA SCREEN3 model produces results for a specific compound, and it the HAPS present in highest concentration in the crude oil, those with the highest volatility and those with the most toxic effects are selected as indicators of exposure issues, an appropriate demonstration of acceptable risk can be made.

For this analysis, estimated emission rates of HAPs were provided as inputs to the SCREEN3 model, and it was used to estimate ground-level concentrations for the specific HAP at different set distance points away from the emissions source. These output concentrations were then compared to effects screening levels (ESLs), as discussed below.

Effects Screening Levels (ESLs)

ESLs are chemical-specific air concentrations set at levels selected to limit the risk of health effects to an acceptable level. Short-term ESLs are based on data concerning acute human health effects, the potential for odors to be a nuisance, and effects on vegetation. Long-term ESLs are based on data concerning chronic human health and vegetation effects.

To assess health impacts, both short-term and long-term effects can be investigated. In most cases, long-term effects will involve a lower threshold and are more likely to pose a threat to a potentially exposed population. Screening levels are generally set conservatively to levels that are deemed to be protective of sensitive elements of the population, such as those with compromised respiratory systems, pre-existing cancer, etc. In setting these levels, lifetime exposure to the emissions source is assumed, and it is further assumed that a potentially exposed individual lives in that location for their entire lifetime. Short-term exposure limits may also be important, but where separation over a body of water occurs, they are unlikely to be significant for residents.

Another possibility for concern where these is a body of water can be recreational use (swimming and boating) or commercial use (fishing). In setting short-term exposure thresholds, exposure times are much

[17] EPA SCREEN 3 - https://www.epa.gov/scram/air-quality-dispersion-modeling-screening-models#:~:text=%2D22%2D1989)-,SCREEN3,break%2Dup%20and%20shoreline%20fumigation.

less since it is not expected that receptors would actually be on the water continuously throughout the day, and all year long.

The Texas Commission on Environmental Quality (TCEQ) Toxicology Division (TD) has taken a leadership role with respect to chemical toxicity determination and has derived ESLs for thousands of chemicals and maintains that data in their Toxicity Factor Database which can be accessed through their website.[18] The following table provides the HAPs of concern at the terminal and their associated ESLs.

Table 10. HAPs Emitted from VMT with Effects Screening Levels

Substance	Short-term ESL Health (ug/m3)	Long-term ESL Health (ug/m3)	HAP emissions (tpy)
benzene	170	4.5	2.9
ethylbenzene	26000	570	0.1
n-hexane	5600	200	10.5
o-xylene	2200	180	0.5
toluene	4500	1200	1.7

In order to translate emission rates into concentrations, the dispersion model estimates the concentrations that would result at various points downwind. The emissions used were estimated based on the potential-to-emit (PTE) for each of the sources in the emissions inventory. Since many of the sources have routinely operated below their design capabilities, it is expected that actual annual average emissions would be quite a bit lower than these values. For example, the storage tank throughput for the most recent ten years in history has been less than half of tank throughput design capability. As such, the modeled emissions represent a high value, not an expected average.

JBE elected to evaluate benzene concentrations first because the limits for benzene are the most stringent of all the HAPs of interest. Two cases for benzene were run: (1) a sitewide benzene evaluation; and (2) tank conservation vents alone as a way to evaluate the conservation vent emission contribution as part of the total sitewide emissions. The results of the benzene models are provided in Table 11.

Table 11. EPA SCEEN 3 Model Outputs for Benzene Releases from VMT

Parameter	Sitewide Benzene	Benzene from Tank Conservation Vents Only	Units
Distance for max 1 hr concentration	1304	709	meters
Maximum 1 hr concentration	6.8	0.03	µg/m^3
Concentration at 1000 m	6.5	0.03	µg/m^3
Concentration at 5000 m	1.8	0.02	µg/m^3
Concentration at 10000 m	1.2	0.01	µg/m^3
Effect Screening Level	4.5	170	µg/m^3

[18] https://www.tceq.texas.gov/toxicology/database/tox.

The model considers elevation and its effects on concentration at ground level. The vapors tend to be somewhat buoyant, and, as such, they will settle to the ground over some dispersed distance, resulting in a higher concentration at ground level at some point downwind, not at the base of the source. The screening model only accepts one height for the source, whereas a more complex model could handle various heights and multiple source locations. For these model analysis runs, the height of the tank conservation vents was selected to represent the average sitewide source height.

In the Table 11 results, the value of 1,304 meters indicates the point at which the model estimated the maximum concentration of benzene would occur. The two separate values are a consequence of modeling the entire emissions inventory (sitewide benzene result) and just the contribution from the conservation vents (column to the right of the sitewide result – 709 meters).

The sitewide concentrations are a worst-case annual result since they are based on PTE. They are conservative and expected to be well below an actual average annual concentration. The values for the conservation vents are based on the emission rate when they are venting, a very small number of hours per year. It is presumed that the predicted concentrations would occur only a few hours a year.

The city of Valdez is approximately 5,000 meters (m) from the marine terminal. The estimated benzene concentration at 5,000 meters from the source was estimated to be 1.8 micrograms per cubic meter ($\mu g/m^3$), well below both the short-term and long-term ESLs of 170 and 4.5 $\mu g/m^3$, respectively.

For the location of maximum concentration (located over water), a comparison to the short-term effects screening level based on the potential for recreational use is appropriate. The predicted value of 6.8 $\mu g/m^3$ is well below the screening value of 170 $\mu g/m^3$ for short-term exposures. The fact that the maximum concentration exceeds the long-term screening value is not an unacceptable result given the exposure scenario that applies to this location (since it is over water).

Because the ESL for benzene due to emissions from the terminal is approximately two orders of magnitude less than the ESLs for the other HAPs, once it was determined that the benzene concentrations at the city of Valdez were estimated to be well below the ESLs, it is deduced that the concentrations for the other HAPs of concern would be well below the ESL thresholds as well. Figure 4 provides a depiction of the site-wide release of benzene at multiple distance points from the terminal.

As a second health effects evaluation methodology, JBE sought to use modeling performed by others. Since no modeling by Alyeska was made available, non-site-specific EPA modeling efforts were considered to see if they could be adapted. EPA performed dispersion modeling for emissions from terminals potentially impacted by the OLD MACT, but the VMT was not modeled because there were no values in the 2004 NEI source data for it.

As a suitable benchmark, the emission modeling performed for the refinery sector rule for crude oil storage tanks was consulted. In 2015 EPA released its complex hazard evaluation and established "allowable" emissions for specific HAPs emitted from crude oil storage tanks at refineries based on its average refinery case. The 2015 EPA analysis was performed on storage tanks specifically, and it coupled tank throughput with HAPs weight percent in crude oil to estimate emissions of HAPs. JBE used its VMT tank emissions data and the factors from the EPA's "complex hazard evaluation" to form a comparison between actual estimated VMT crude oil tank emissions and the "allowable levels." Two sets of calculations were performed for benzene and hexane, one using the HAPs weight percentages from the crude oil assays JBE obtained for this review, and another using the crude oil HAPs weight percentages EPA developed for its average crude oil. This second calculation was performed as a sensitivity case because it had higher weight percentages than the assay value. Both analyses had estimated emissions well below the "allowable" level. Table 12 and Table 13 provide results of this analysis. The storage tank throughput value is based on the permit application representations by the terminal. This value corresponds closely to their current 2021 throughput.[19] Given the difference between screening results and the threshold levels, throughputs closer to the historical capability (even if not allowable under their current permit) would not be expected to result in threshold exceedances.

The results from using the EPA's 2015 "complex hazard evaluation" for HAPs from refineries, taken with the EPA SCREEN3 modeling results, support the position that a further reduction in HAPs emissions via additional control is not necessary at the VMT.

[19]Alyeska Pipeline Service Company Historic Throughput published values, https://www.alyeska-pipe.com/historic-throughput/.

Figure 4. VMT Site-wide Benzene Release at Multiple Distance Points from VMT from EPA's SCREEN3 Model

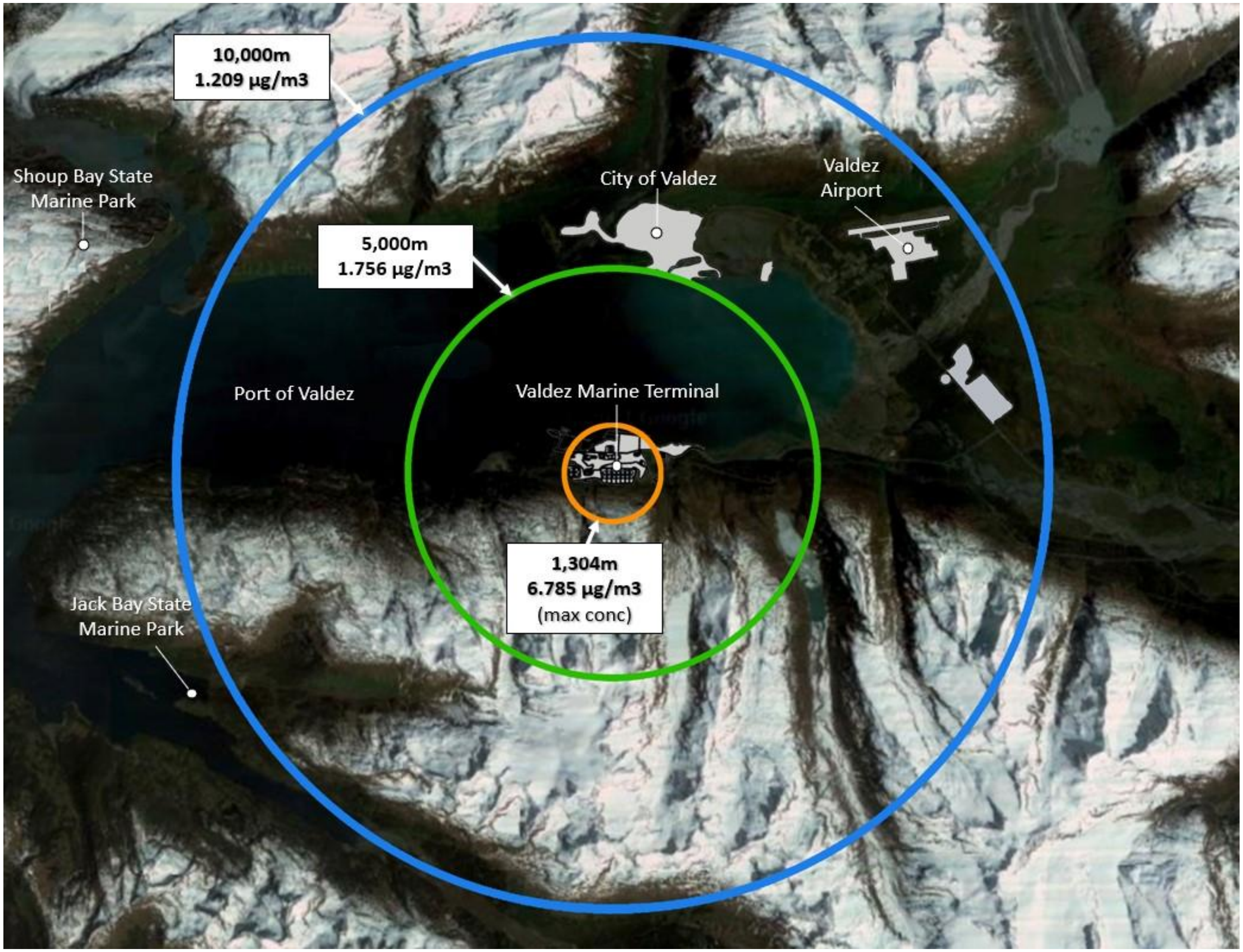


Table 12. VMT HAP Emission Benchmarking for Hexane and Benzene, Using Crude Oil Assays Obtained for this Review

Using Alaska North Slope Crude Assay (PIANO and API Surrogate Hybrid)					Benchmark Limits			
Single Tank Throughput (bbl/month)	Single Tank Throughput (MMbbl/yr)	All Tanks plus Venting VOC (tons/yr)	Fraction Hexane (%)	VMT Estimated Hexane (tons/yr)	Allowable Hexane (lb/MMBBL)	Throughput Crude Oil (MMbbl/yr)	Allowable Hexane (lb/yr)	Allowable Hexane (tons/yr)
980,830	11.8	37.5	0.98	0.4	83.7	164.8	13,795	6.9
Single Tank Throughput (bbl/month)	Single Tank Throughput (MMbbl/yr)	All Tanks plus Venting VOC (tons/yr)	Fraction Benzene (%)	VMT Estimated Benzene (tons/yr)	Allowable Benzene (lb/MMBBL)	Throughput Crude Oil (MMbbl/yr)	Allowable Benzene (lb/yr)	Allowable Benzene (tons/yr)
980,830	11.8	37.5	0.27	0.1	10.0	164.8	1,640	0.8

Table 13. VMT HAP Emission Benchmarking for Hexane and Benzene, Using EPA Crude Speciation

Using EPA Crude Assay (Very Conservative Speciation)					Benchmark Limits			
Single Tank Throughput (bbl/month)	Single Tank Throughput (MMbbl/yr)	All Tanks plus Venting VOC (tons/yr)	Fraction Hexane (%)	VMT Estimated Hexane (tons/yr)	Allowable Hexane (lb/MMBBL)	Throughput Crude Oil (MMbbl/yr)	Allowable Hexane (lb/yr)	Allowable Hexane (tons/yr)
980,830	11.8	37.5	6.2	2.3	83.7	164.8	13,795	6.9
Single Tank Throughput (bbl/month)	Single Tank Throughput (MMbbl/yr)	All Tanks plus Venting VOC (tons/yr)	Fraction Benzene (%)	VMT Estimated Benzene (tons/yr)	Allowable Benzene (lb/MMBBL)	Throughput Crude Oil (MMbbl/yr)	Allowable Benzene (lb/yr)	Allowable Benzene (tons/yr)
980,830	11.8	37.5	0.7	0.3	10.0	164.8	1,640	0.8

4.0 ALTERNATIVE DESIGN ASSESSMENT

Paragraph 40 CFR §63.2346(i) was updated in the 2020 finalized version of the OLD MACT to reflect the language provided below, where new language is provided in bold text.

> *Safety device. Opening of a safety device is allowed at any time that it is required to avoid unsafe operating conditions.* ***Beginning no later than July 7, 2023, this paragraph no longer applies.***

Historically, the conservation vents installed on the fourteen-crude oil, fixed roof storage tanks (EU IDs 29 through 42, as listed in the Title V) have operated under the safety device allowance. The conservation vents are designed to open and vent uncontrolled to atmosphere to prevent structural damage or catastrophic failure caused by under or over-pressurization of the tanks. The vents are designed to open when the internal pressure of any single crude oil storage tank is at or greater than 1.5-inch water column and to close when that tank's internal pressure is less or equal to 1.2-inch water column.[20] Emissions of VOCs and HAPs are released during open venting to the atmosphere.

In the Petition for Rulemaking, Reconsideration, and Stay, Alyeska claims that in order for the VMT to comply with the updated rule, given the removal of the "safety device exemption," the facility would have to choose one of two options:

1. Convert the fourteen-crude oil, fixed roof storage tanks to internal floating roof; or

2. Install a closed-vent system to capture vapors from the conservation vents during periods where open venting currently occurs.

Alyeska's claims related to health and safety, technical feasibility, and economic feasibility for the two alternative designs presented in the Petition for Rulemaking, Reconsideration, and Stay were evaluated and are discussed in this section. Additionally, other options not considered such as converting the fourteen-crude oil, fixed roof storage tanks to external floating roof tanks are discussed.

Claims pertaining to safety and technical feasibility, health impacts, and economic feasibility are discussed in Sections 4.1, 4.2, and 4.3, respectively.

Overview of Approach

Based on reviewing current literature, vendor specifications, historic permitting efforts, the current Title V Air Permit, and relevant files contained in the OLD MACT rulemaking docket, each claim was determined to be validated, partially validated, or invalidated.

[20] Pressure set points based on Specific Requirement 19 to Title V Air Permit Number AQ0082TVP03.

4.1 Evaluation of Alternative Design Claims Pertaining to Safety and Technical Feasibility

This section outlines each critical claim made by Alyeska in the Petition for Rulemaking, Reconsideration, and Stay and supporting documents pertinent to safety and technical feasibility for the alternative design considerations evaluated for determining compliance options for the 2020 OLD MACT with the "safety device exemption" language repealed. As compliance with the 2020 OLD MACT would require the elimination of opening conservation vents to the atmosphere, the following alternative designs were evaluated herein:

- Conversion of Crude Oil Tanks from Fixed to Internal Floating Roof;
- Removing Conservation Vents from Fixed Roof Atmospheric Tanks; and
- Conversion of Crude Oil Tanks from Fixed to External Floating Roof.

Table 14 summarizes the claims related to safety and technical considerations for converting the fourteen crude oil storage tanks from having fixed roofs to having internal floating roofs.

Table 15 outlines the safety and technical feasibility claims made related to why the fixed roof storage tanks must operate with emergency pressure relief venting.

Table 16 provides claims addressing the consideration to convert the storage tanks from fixed roof to external floating roof.

Note, the alternative design option to install a closed-vent system to capture vapors from the conservation vents during periods where open venting currently occurs was only evaluated based on economic feasibility which is addressed in Section 4.3. No significant safety or technical infeasibility was determined for this option by JBE, based on a review of the details presented in the Petition for Rulemaking, Reconsideration, and Stay and supporting documents.

Table 14. Alternative Design, Independent Validation: Conversion of Crude Oil Tanks from Fixed to Internal Floating Roof

Internal Floating Roof Design			
Risk Category	**Alyeska's Claim**	**Independent Verification Documentation**	**Data Source(s)**
Seismic Activity	(1) VMT sits in a highly active seismic zone with frequent earthquake activity. (2) The VMT resides in the Pacific Rim of Fire, which is one of the most active seismic zones on the planet. (3) Valdez is located in seismic zone 8.5	**Claim Verified:** Alaska's largest earthquakes, exceeding magnitude 8 and even 9, occur primarily in the shallow part of the subduction zone, where the crust of the Pacific Plate sticks and slips past the overlying crust. The VMT lies in this zone East of the Bering Sea, lying within the Gulf of Alaska. The occurrence of high seismic activity has been verified by data obtained by Alaska's Earthquake Center.	(1) https://earthquake.alaska.edu/earthquakes/about (2) https://earthquake.alaska.edu/earthquakes/reports/monthly-report (3) https://seismic.alaska.gov/download/ashsc_meetings_minutes/mp160.pdf
Seismic Activity	(4) Fixed roof tank design with internal support structures is technically favored as compared to internal floating roof tanks due to seismic activity at the terminal location.	**Claim Verified:** A 2011 paper on actual earthquake events in Japan details the failure of internal floating roofs by (1) Direct damage to roof causing sinking of the inner floating roof (2) Pontoon fractures, and (3) Indirect damage by liquefaction of soil (up to 3 days after earthquake) (Footnote 1). Design methods for floating roof tanks with seismic consideration were identified. As much consideration is given to special design cases, this supports the extreme cost stated by Alyeska to convert the tanks to IFR. (Footnote 2) Evidence of severe damage during earthquakes for single deck floating roof types. Damage included fire (Footnote 3). Continued on Next Page	(1) On Damage of Oil Storage Tanks due to the 2011 off the Pacific Coast of Tohoku Earthquake (Mw9.0), Japan. S. Zama, H. Nishi, K. Hatayama, M. Yamada, H. Yoshihara & Y. Ogawa. National Research Institute of Fire and Disaster, Japan https://www.iitk.ac.in/nicee/wcee/article/WCEE2012_0238.pdf (2) The Twelfth East Asia-Pacific Conference on Structural Engineering and Construction A Simplified Method for Seismic Analysis of Tanks with Floating Roof by using Finite Element Method: Case Study of Kharg (Southern Iran) Island Tanks Mahmood Hosseinia, Amirhosseini Soroorb, Ali Sardarc, Farshid Jafariehd. (3) Design Recommendations for Storage Tanks and Their Supports with Emphasis on Seismic Design (2010 edition). https://www.aij.or.jp/jpn/databox/2011/storagetanks2010edition.pdf

Table 14 Continued. Alternative Design, Independent Validation: Conversion of Crude Oil Tanks from Fixed to Internal Floating Roof

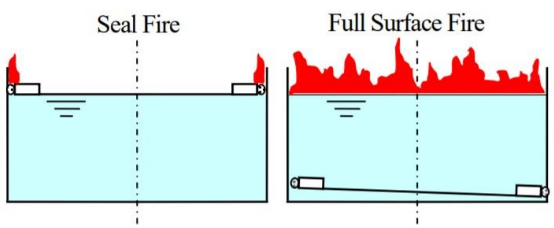
Internal Floating Roof Design			
Risk Category	**Alyeska's Claim**	**Independent Verification Documentation**	**Data Source(s)**
Seismic Activity	(4 Continued) Fixed roof tank design with internal support structures is technically favored as compared to internal floating roof tanks due to seismic activity at the terminal location.	**Liquid Sloshing by Roof Type** **Fixed:** When the sloshing wave reaches to roof plates in the fixed roof tank, the sidewall-to-roof joint is subjected to internal pressure. This pressure causes circumferential compression force in this joint, and the bifurcation buckling with a high circumferential wave number may occur. The sidewall-top roof joint is usually designed to be weak from the viewpoint of the frangible roof joint. When an over pressurization occurs due to an ignition of flammable vapors existing inside tank, the sidewall-to-roof joint is expected to fail before failure occurs in the sidewall-to-bottom joint. This is a design concept of the frangible roof joint. **Internal Floating:** When the floating roof loses its buoyancy, it will sink into oil. "The floating roof tank was considered to be safer than the fixed roof tank, because only a seal fire might occur, and a full surface fire as shown in Fig. 8 could not occur. **However, when the floating roof sinks, the full surface fire possibly occurs. The full surface fire will be extinguished when oil burns out in a large AST. It will take several days."** (Footnote 4)	(4) Earthquake Damages and Disaster Prevention of Aboveground Storage Tanks Shoichi Yoshidaa. EPI International Journal of Engineering pISSN 2615-5109 Volume 1, Number 2, August 2018, pp. 87-93 eISSN 2621-0541. DOI: 10.25042/epi-ije.082018.14  Figure 8. Fire in floating roof tanks

Table 14 Continued. Alternative Design, Independent Validation: Conversion of Crude Oil Tanks from Fixed to Internal Floating Roof

Internal Floating Roof Design			
Risk Category	**Alyeska's Claim**	**Independent Verification Documentation**	**Data Source(s)**
Personal Safety	Internal Floating Roofs (IFRs) require more maintenance in comparison to Fixed-Roof Tanks (FRTs) due to IFRs requiring additional seals. "An internal roof structure must move up and down past the 61 roof support columns during tank filling and tanker loading. The floating roof must seal to the columns in a way that prevents vapor migration into the head space. The internal floating roof would require 61 seals, one for each column, as well as a roof-to-shell seal. Each of the 61-floating roof-column interfaces must have equal slip to ensure the roof rides evenly atop the liquid. Any deviation would result in loss of seal between the floating roof and the tank shell. A loss of this seal would result in vapor migration into the tank head space and could submerge the floating roof, requiring complete drain down and manned entry to remedy." "The internal floating roof solution is very challenging in design, installation, and maintenance. It has not been done to our knowledge in any tank with this number of columns. Workers would be required to enter the tanks more frequently to perform maintenance, which presents additional risk to worker safety."	**Partial Claim Verification:** The design basis for requiring 61 roof support columns was verified with U.S. EPA guidance documents (Footnote 1). Based on vendor data, a seal would be required for each column (Footnote 2). "A loss of this seal would result in vapor migration into the tank head space and could submerge the floating roof, requiring complete drain down and manned entry to remedy". Based on engineering process knowledge, this scenario is plausible. However, JBE could not independently verify that the loss of column seal would often lead to roof submergence. Thus, the anticipated increase in maintenance due to this scenario is minimal. Confirmed this is a minimal risk with board member of API (Aboveground Storage Tanks Group).	(1) Verification for number of roof support columns: Emission Factor Documentation for AP-42 Section 7.1 Organic Liquid Storage Tanks, Final Report. U. S. Environmental Protection Agency Office of Air Quality Planning and Standards Emission Factor and Inventory Group. https://www3.epa.gov/ttn/chief/old/ap42/ch07/s01/bgdocs/b07s01_1997.pdf (2) Peripheral and other seals are designed to remain in full contact with the mating tank components throughout the entire travel span of the IFR. Baker Tank Company / Altech. IFR General Design Specifications. https://www.bakeraltech.com/products/general-design-specifications.htm

Table 14 Continued. Alternative Design, Independent Validation: Conversion of Crude Oil Tanks from Fixed to Internal Floating Roof

Internal Floating Roof Design			
Risk Category	**Alyeska's Claim**	**Independent Verification Documentation**	**Data Source(s)**
Snow Load	Annual snow fall in Valdez typically exceeds 300 inches, including a maximum of 561 inches in winter 1989/1990.	**Claim Verified:** Valdez, sitting in a fjord in Prince William Sound, is considered the snowiest town in the United States, averaging 300 inches per year. Further, the winter of 1989-1990 is the snowiest winter ever recorded in Valdez with an accumulated total 656.07 inches of snowfall. A one-day record was set on January 16, 1990, with 45.7 inches of snowfall in just 24 hours. (footnote 1)	(1) Snowfall confirmed using mapping tool at the National Weather Service. https://www.weather.gov/aprfc/Snow_Depth
Snow Load	"The tanks support some of the highest snow loads of any crude oil tanks in North America, up to 200 pounds per square feet. By comparison, the vast majority of Lower 48 tanks' design snow load is 50 pounds per square feet or less, and a significant majority is 20 pounds per square feet or less. The fixed roofs are supported by 61 internal columns and a framework of girders and rafters to accommodate the extreme snow loads in Valdez and prevent collapse of the roofs. The tank walls support only a very small portion of the roof snow loads. (IFRs are) Impractical due to number of legs in tank needed to support fixed roof".	**Claim Partially Verified:** Internal floating roof vendors with a load capacity of up to 1,000 lb/ft2 were identified. However, vendor material review indicates, this technology is limited to tanks of much smaller size than those at the VMT. Vendor Matrix Applied Technologies has a Matrix Full Contact IFR that can withstand snow loads up to 500 lb/ft2, but this design is not available for tanks with a diameter over 100 ft. Whether or not any vendor has the ability to apply this type of design to a tank as large as the crude tanks at VMT is undetermined. Several vendors were contacted that were not able to meet this design criteria.	(1) Matrix Applied Technologies Vendor Spec Sheets for Full Contact Internal Floating Roof Tanks https://www.matrixappliedtech.com/services/internal-floating-roofs/

Table 14 Continued. Alternative Design, Independent Validation: Conversion of Crude Oil Tanks from Fixed to Internal Floating Roof

Internal Floating Roof Design			
Risk Category	**Alyeska's Claim**	**Independent Verification Documentation**	**Data Source(s)**
Use of Tank Vapors as Fuel Source	"Retrofit of the crude tanks with an internal floating roof ("IFR") design would eliminate most of the vapor supply to the VMT power plant because IFR tanks do not generate excess vapors. The need for onsite power generation was a principal reason that the VMT was designed with fixed roof tanks and a vapor collection system." "Currently, over 75% (heat input basis) of the boilers' fuel consists of vapors captured from the 14 tanks and vapors generated while loading crude onto marine tanker vessels. The balance of the fuel burned in the boilers comes from diesel." "Retrofit of the crude tanks with an internal floating roof ("IFR") design would eliminate most of the vapor supply to the VMT power plant because IFR tanks do not generate excess vapors."	**Claim Verified:** With IFR tanks less vapor is available for capture/re-use as a combustion source because the floating roof suppresses vapors. (footnote 1) JBE performed an independent calculation to estimate and compare the vapors from a fixed roof and internal floating roof system, with findings as follows: •Alyeska's Valdez Marine Terminal (VMT) handles approximately 500,000 barrels per day of North Slope crude oil. This oil is stored in fourteen, 510,000-barrel fixed roof tanks equipped with vapor recovery. Vapors from the crude oil tanks may be used in the facility's power boilers as fuel gas for onsite power generation, which offsets the need for supplemental diesel to be purchased (vapors may also be routed to thermal oxidizer or used for tank blanketing based on JBE's understanding of the facility configuration). •Each fixed roof storage tank has an uncontrolled emission rate of approximately 802 tons per year VOC. At 99.7% vapor recovery rate, the uncontrolled emissions total 2.4 tons VOC per year per tank. Therefore, about 800 tons VOC per year per tank, or 11,194 total tons per year of VOC are recovered and used to power the boilers. •An internal floating roof storage tank would emit approximately 4.2 tons per year per tank uncontrolled. The total vapors able to be recovered would be about 59 tons per year total. This is a 99.5% decrease in vapors available, which, for the purposes of supplying fuel to the boiler system, would have to be made up for through supplemental/purchased fuel. (footnote 2)	(1) AP 42 Tanks Section for Design Guidance: https://www3.epa.gov/ttn/chief/ap42/ch07/final/ch07s01.pdf (2) JBE developed tank emission workbook

Table 14 Continued. Alternative Design, Independent Validation: Conversion of Crude Oil Tanks from Fixed to Internal Floating Roof

Internal Floating Roof Design			
Risk Category	**Alyeska's Claim**	**Independent Verification Documentation**	**Data Source(s)**
Supplemental Fuel Required in Boilers in IFR System	"The nearby city of Valdez is very small with limited power capacity. So the designers of the VMT had to also include onsite power for the facility. **Liquid fuel (diesel) is expensive and environmentally unfavorable, so the designers decided that fixed roof tanks with a vapor collection system that routed the vapors to the onsite power generation facility as fuel was the best solution.** The power generation facility also provides the flue gas vital to avoiding explosive conditions in the tank." "Currently, over 75% (heat input basis) of the boilers' fuel consists of vapors captured from the 14 tanks and vapors generated while loading crude onto marine tanker vessels. **The balance of the fuel burned in the boilers comes from diesel**."	**Claim Verified:** For VOCs and HAPs, combusting vapors from the crude oil storage tanks compared to diesel is not significantly different in terms of air emissions from the boilers; however, the emissions of other criteria pollutants are more significantly impacted - most notably SO_2 which increases when using diesel. Emissions of NO_X and CO are also elevated when combusting diesel compared to tank vapors. Emission factors for diesel can be obtained from AP-42 and/or WEBFIRE. Emissions from the tank vapors are estimated using speciation data within the JBE tanks workbook(s).	(1) AP 42 Chapter 1.3 - https://www3.epa.gov/ttn/chief/ap42/ch01/final/c01s03.pdf (2) JBE developed tank emission workbook
Fire	"The onsite power plant also provides inert gas (stack gas) to the VMT tanks as required to ensure that tank pressure does not drop below a safe pressure level causing the conservation vents to draw oxygen into the tanks, which would create an explosive atmosphere in the tanks."	**Claim Verified:** Based on *The Engineer's Guide to Plant Layout and Piping Design for the Oil and Gas Industries*, "Inert gas systems are used to prevent the creation of flammable conditions inside equipment containing a flammable product, an example being the vapor space of storage tanks." (footnote 1) Proper design configuration to minimize risk of explosive atmosphere was reviewed in both *The Engineer's Guide to Plant Layout and Piping Design for the Oil and Gas Industries* and *Plant Design and Operations*; the configuration at VMT is in line with best practices/industry standard in regard to utilizing an inert gas system to stabilize pressure within the crude oil tank farm (footnote 1 and 2).	(1) Geoff Barker, Chapter 4 - Piping and equipment basis for selection, Editor(s): Geoff Barker, The Engineer's Guide to Plant Layout and Piping Design for the Oil and Gas Industries, Gulf Professional Publishing, 2018, Pages 105-141, ISBN 9780128146538. (2) Ian Sutton, Chapter 1 - Safety in Design, Editor(s): Ian Sutton, Plant Design and Operations (Second Edition), Gulf Professional Publishing, 2017, Pages 1-34, ISBN 9780128128831

Table 15. Alternative Design, Independent Validation: Removing Conservation Vents from Fixed Roof Atmospheric Tanks

Conservation Vent Design			
Risk Category	**Alyeska's Claim**	**Independent Verification Documentation**	**Data Source(s)**
Pressure Differential/Release	"Conservation vents are required for safe operation of fixed roof tanks."	**Claim Verified:** Based on tank design guidance documents and engineering process knowledge, fixed roof tanks are designed to either freely vent or equipped with a pressure/vacuum vent (such as the conservation vents on the VMT crude tanks which acts as a pressure relief device (PRD)). With a PRD installed, the tank operates at a slight internal pressure to prevent the release of vapors during changes in temperature, pressure, or liquid level. Emergency/safety vents such as the conservation vents provide increased vent flow capacity in the event of excessive pressure in the tank.	(1) AP 42 Chapter 7: Liquid Storage Tanks - https://www3.epa.gov/ttnchie1/ap42/ch07/final/ch07s01.pdf
Pressure Differential/Release	The valves allow vapors to release to the atmosphere if pressure within the tank increases to +1.5 inches of water column. This venting protects against failure of the tank frangible joint between the tank shell and roof. Conservation vents are a specific mandated aspect of the design criteria of API 650 tanks and are common to all atmospheric tanks.	**Claim Verified:** Based on API Standard 650 for atmospheric tanks, Section 5.8.5, conservation vents are a specific mandated aspect of the design criteria of API 650 tanks. Further, API Standard 650, Appendix F instructs on how to calculate the maximum operating pressure allowable in order to provide a safe margin between the maximum operating pressure and the failure pressure, for tanks with a roof-to-shell attachment. (footnote 1)	(1) API 650: Welded Tanks for Oil Storage, API Standard 650 11th Ed, June 2007, Addendum 3: August 2011, Errata October 2011, Effective Date: February 1, 2012.

Table 15 Continued. Alternative Design, Independent Validation: Removing Conservation Vents from Fixed Roof Atmospheric Tanks

Conservation Vent Design			
Risk Category	**Alyeska's Claim**	**Independent Verification Documentation**	**Data Source(s)**
Pressure Differential/Release	"Because the VMT crude oil storage tanks are not pressure vessels, but instead are API 650 atmospheric tanks, their structural integrity is particularly sensitive to pressure changes within the vapor space of the tanks." "Due to the great surface area exposed within a fixed roof tank, even a small pressure differential above or below atmospheric level creates a large force on the tank surfaces. To protect the tanks from over- or under-pressurization, the VMT tank roofs were fitted with 10 to 11 conservation vents per tank that provide pressure safety relief."	**Claim Verified:** Based on API Standard 650 for atmospheric tanks, Section 5.8.5.1, "Tanks designed in accordance with this Standard and having a fixed roof shall be vented for... conditions resulting from operational requirements, including maximum filling and emptying rates, and atmospheric temperature changes and emergency conditions." (footnote 1) Based on *Managing Storage Tank Pressure and Overfill Prevention*, to properly manage pressure within a tank system, there are layers of vapor control. Within the first layer for out-breathing, vapors are routed to vapor recovery, during normal operations. To avoid rupture of the tank, in an emergency case, the second layer consists of venting to atmosphere. The first layer for inbreathing may include tank blanketing or oxygen in-pulling from the outside of the tank; the second layer should include emergency venting to atmosphere to avoid tank implosion. Bottom line - emergency venting for the type of crude oil tanks operating at VMT require emergency venting to atmosphere to avoid tank rupture or implosion. Further, API 2000 requires an emergency vent on the top of the roof for the "fire case"(unless a frangible roof option is selected). In a worst-case scenario, without proper venting, the tank can lift off the ground. (footnote 2)	(1) API 650: Welded Tanks for Oil Storage, API Standard 650 Eleventh Edition, June 2007, Addendum 3, August 2011, Errata, October 2011 Effective Date: February 1, 2012. (2) Managing Storage Tank Pressure and Overfill Prevention, Michael Calaway and Magnus Johansson, 2018. https://www.emersonautomationexperts.com/2018/safety/managing-storage-tank-pressure-overfill-prevention/

Table 15 Continued. Alternative Design, Independent Validation: Removing Conservation Vents from Fixed Roof Atmospheric Tanks

Conservation Vent Design			
Risk Category	**Alyeska's Claim**	**Independent Verification Documentation**	**Data Source(s)**
Cause of Emergency Release	The underlying causes of pressure imbalances that trigger opening of a conservation vent include power outages, maintenance, and malfunctions of the vapor collection and distribution system. For example: electrical equipment associated with the vapor controls can experience a malfunction that shuts down the vapor control system; or equipment associated with the VMT onsite power generation can experience a malfunction that leads to a facility-wide power outage and the vapor control system loses power; or a vapor line valve to a tank may not function properly due to mechanical or electrical issues with the valve. Regardless of the cause, safe operation of the VMT tanks requires the ability to open the conservation vents when pressure levels are too high or low."	**Claim Verified:** Based on engineering process knowledge, the listed examples of emergency scenario(s) upon which the conservation vents may be opened is in line with the types of unplanned events at a marine terminal. The need to open the conservation vents during emergency situations is discussed elsewhere within this table. Design configuration review is based on information provided in VMT's Title V Air Permit. Emergency considerations were reviewed as discussed in the United Nation's *Safety Guidelines and Good Industry Practices For Oil Terminals* and in Emerson's *Managing Storage Tank Pressure and Overfill Prevention.* (Footnotes 1, 2, and 3)	(1) Plant configuration review based on Title V Air Permit AQ0082TVP03 (2) United Nations, Safety Guidelines and Good Industry Practices For Oil Terminals, 2015. (3) Managing Storage Tank Pressure and Overfill Prevention, Michael Calaway and Magnus Johansson, 2018. https://www.emersonautomationexperts.com/2018/safety/managing-storage-tank-pressure-overfill-prevention/

Table 16. Alternative Design, Independent Validation: Conversion of Crude Oil Tanks from Fixed to External Floating Roof

External Floating Roof Design			
Risk Category	**Alyeska's Claim**	**Independent Verification Documentation**	**Data Source(s)**
Technical Feasibility/Tank Integrity	External floating roof tanks are used at many facilities. In this design, the roof rides on the tank liquid adjusting to changes in liquid level and removing all head space. A seal between the roof and the tank shell reduces vapor escape to the atmosphere. The topside of the external floating roof is open to the atmosphere. Such a tank is impractical in Valdez, Alaska where average snowfall is over 300 inches per year.	**Claim Verified:** External floating roofs may lose buoyancy and sink due to cold weather-related issues noted as: (1) due to damage to its floatation pontoons; (2) snow causing the roof to sink; (3) frost leading to the failure of a flange joint on the storm water drain; (4) heavy rain/snow accumulation resulting in tilting. (footnote 1) Based on the details above and a case study noted in footnote 2, a substantial load such as the heavy snow fall experienced by the VMT crude storage tanks would result in roof sink. Thus, external floating roofs are not a technically feasible option for crude storage at the VMT. (footnote 2)	(1) Moshashaei, Parisa & Alizadeh, Seyed Shamseddin & Khazini, Leila & Asghari-Jafarabadi, Mohammad. (2017). Investigate the Causes of Fires and Explosions at External Floating Roof Tanks: A Comprehensive Literature Review. Journal of Failure Analysis and Prevention. 17. 1-9. 10.1007/s11668-017-0333-0. (2) D. Ritsu, T. Masamitsu, An abnormal load was put on the roof, and it sank into the naphtha. Sinking of a floating roof due to inundating of pontoons and retained rainwater on the roof at a floating roof naphtha tank. Place Kurashiki, Okayama, Japan Location Refinery, (1987) - Electronic Source: http://www.shippai.org/fkd/en/cfen/CC1000167.html

The elements presented in Table 14 discuss why the proposed internal roof design would pose unacceptable risks from seismic activity, unacceptable personal safety considerations, would not be suitable from the perspective of handing snow loading, would complicate site fuel requirements and could add to site fire risks. Earthquake activity in the region is well documented as are the potential impacts earthquakes could have on the robust internals necessary to support an internal floating roof of the size required for the terminal's crude oil storage tanks. By adding complex equipment inside the tank, the clear potential for internal maintenance is introduced, and the safety risk posed by tank internal maintenance operations is well-documented as well.

The fact that it could not be confirmed that a tank of this size could be designed with an internal floating roof in such a way that it could withstand the predicted potential snow loading is a significant problem with EPA's proposed control system in this setting. It could be argued that because of these issues, the technology is not "available," a long-standing EPA design criteria for when an enhanced control method could be prescribed. Finally, the improvements possible related to emissions as the terminal currently operates versus what would happen if the modifications were implemented are limited if any, and emissions from some pollutants related to the operation of the boilers could actually be increased. A comparison between the current operations and the emissions from the floating roof tank is discussed in the next section.

Table 15 addresses the implications posed by the elimination of conservation vents because they do not (by themselves) meet the requirement that all emissions for the tank must be controlled. From a safety perspective, it is clear that the operation of a fixed-roof tank without safety relief would not comply with industry tank design guidelines. This means effectively that adoption of the requirements as the regulation is currently written would mean that a fixed roof tank could only be used if the conservation vent system itself had a vapor recovery process, and only if that could be done to meet all design guidelines including fire relief. A design that provides adequate fire relief may not be readily available at present for a tank of this size. If the alternative control method (a floating roof tank approach) introduces more safety concerns and increases emissions over the current configuration, the need for a special stipulation seems well-supported.

Table 16 reviews the vapor control implications related to the operation of an external floating roof tank, making the mostly obvious point that the operation of this control option in the terminal's setting in Valdez is clearly impractical from a snow loading perspective.

4.2 Evaluation of Alternative Design Claims Pertaining to Human Health Impacts

JBE used its tank emission tools to compare HAP emissions from the VMT's current storage tank configuration and the alternative design scenario where the fourteen-crude oil, fixed roof storage tanks are converted to internal floating roofs,. The same methodologies described in Section 2.1 of this report were used to estimate emissions from tanks modeled as internal floating roof tanks. As described in Section 2.1, emissions of VOC were calculated using the methods outlined in AP-42 Chapter 7: Organic Liquid Storage Tanks, dated June 2020. [21] To speciate HAPs, a crude assay for Alaska North Slope Crude was used; a copy of the assay is provided in Appendix A. Using this speciation data, HAP emissions were estimated using a flash tool developed by JBE. Supporting calculations and data from the flash tool are provided in Appendix D. An emissions comparison for VMT's current configuration and the alternative design scenario for internal floating roofs is provided in Table 17 and Table 18.

The emissions from the fixed roof tanks (current configuration) were modeled using two approaches. For the emissions from the vapor control system, the traditional storage tank emissions methods of AP-42 for a fixed roof tank. Separately, the data provided by Alyeska for the single conservation vent opening event was used to estimate emissions that would from this based on the event frequency this data suggested. These two sets of results were added to form a total fixed roof tank emission value.

The emissions from the potential internal floating roof tanks were assumed to be without vapor recovery because the regulation does not require this for this control method. Emissions from a floating roof tank result from two mechanisms: standing losses and working losses.

The standing losses come from emissions that leak through the seal between the storage tank internal wall. These emissions occur whether the tank liquid level is static or changing. The emissions travel through small gaps between the seal and the tank internal wall that invariably open up over time. Tank operators periodically inspect the tanks for these gaps and when they reach a certain dimension, the seal must be repaired to close those gaps. The driving force for these emissions is daily temperature rise.

The working losses result when the tank liquid level drops. As it does, the interior wall of the tank above the liquid level and the tank seal is coated with a thin layer of organic liquid that clings to it from its previous condition in contact with the liquid before this area was exposed to the tank internal vapor space. Tank vapors in this area will exceed the set point of the pressure/vacuum vents for the tank (typically it would have them) at some point and vapor emissions to the atmosphere would result. It should be noted that if the tank level stays the same or it drops as the tank is dispensing liquid for loading (downstream of the tank), there would be no working losses because no newly coated tank wall surface is exposed.

Based on JBE's calculation estimates, the VMT's current configuration which includes venting to atmosphere for safety purposes emits less HAPs than if the tanks were to be converted to internal floating roof and no longer vent to atmosphere.

[21] AP-42 Chapter 7, June 2020 Final Revision: https://www.epa.gov/air-emissions-factors-and-quantification/final-revisions-ap-42-chapter-7-section-71-organic-liquid.

Table 17. VOC Emissions Comparison for Alternative Design Scenario

Scenario 1: Vent Emissions Modeled as Uncontrolled Tank		
Parameter	VOC Emissions, VMT "As Configured"	VOC Emissions, Alternative Design Scenario - Convert Crude Oil Tanks from Fixed Roof to Internal Floating Roof
	(tpy)	(tpy)
VOC Emissions from Tanks without Venting:	31.24	59.9
VOC Emissions from Conservation Venting to Atmosphere:	6.25	-
Total VOC Emissions:	**37.49**	**59.9**
Difference in Emissions:	**37%**	
Scenario 2: Vent Emissions Modeled using Pressure Rise Method		
Parameter	VOC Emissions, VMT "As Configured"	VOC Emissions, Alternative Design Scenario - Convert Crude Oil Tanks from Fixed Roof to Internal Floating Roof
	(tpy)	(tpy)
VOC Emissions from Tanks without Venting:	31.24	59.9
VOC Emissions from Conservation Venting to Atmosphere:	5.74	-
Total VOC Emissions:	**36.98**	**59.9**
Difference in Emissions:	**38%**	

Table 18. HAP Emissions Comparison for Alternative Design Scenario

Scenario 1: Vent Emissions Modeled as Uncontrolled Tank		
Parameter	HAP Emissions, VMT "As Configured"	HAP Emissions, Alternative Design Scenario - Convert Crude Oil Tanks from Fixed Roof to Internal Floating Roof
	(tpy)	(tpy)
HAP Emissions from Tanks without Venting:	0.46	0.88
HAP Emissions from Conservation Venting to Atmosphere:	0.1	-
Total HAP Emissions:	**0.56**	**0.88**
Difference in Emissions:	**36%**	
Scenario 2: Vent Emissions Modeled using Pressure Rise Method		
Parameter	HAP Emissions, VMT "As Configured"	HAP Emissions, Alternative Design Scenario - Convert Crude Oil Tanks from Fixed Roof to Internal Floating Roof
	(tpy)	(tpy)
HAP Emissions from Tanks without Venting:	0.46	0.88
HAP Emissions from Conservation Venting to Atmosphere:	0.09	-
Total HAP Emissions:	**0.55**	**0.88**
Difference in Emissions:	**37%**	

4.3 Evaluation of Alternative Design Claims Pertaining to Economic Feasibility

A high-level review of the economic claims made by Alyeska in relation to costs associated with implementing alternative design considerations to meet the compliance standards presented in the 2020 OLD MACT are presented in this section. In the opinion of JBE, the costs presented by Alyeska for each alternative option are of an appropriate order of magnitude. Consequently, Alyeska's claim that the overall high cost for conversion to internal floating roof control is economically infeasible was judged to be justifiable but is limited based on JBE's inability to access the details of these calculations. Those calculations are presumed to be in engineering and cost studies that were referenced by Alyeska in their Petition to Stay. Those studies were requested for this review but not provided by Alyeska. The scope of this review did not include an effort to independently develop these calculations.

4.3.1 Economic Feasibility to Convert Fixed Roof Tanks to Internal Floating Roof

Summary of Costs Presented by Alyeska

Based on a referenced 2011 study, updated in 2016, Alyeska reported an estimated probable cost to convert its fourteen fixed roof storage tanks to internal floating roofs of approximately $300 million (now escalated to 2021 USD)[22]. A breakdown of the cost basis provided in the petitions is as follows:

- Engineering/Design: $40.3 million
- Materials: $42.8 million
- Construction/Implementation: $119 million
- Escalation: $92.4 million[23,24]

The estimated cost includes the following:

- Installing the internal floating roofs themselves
- Floating roof decks
- Pontoons and seals
- Wind girders
- Instrumentation
- Paint/coating
- Replacement of the fire foam system in each tank
- New vapor recovery and destruction system at the loading berths due to loss of the storage tanks as a source of vapor balancing during ship loading
- Additional diesel as a result from loss of the storage tanks as a source of fuel for the terminal power boilers

[22] Cost estimate is Class 5 (accuracy of +100%/-50% meaning costs could be $150 million to $600 million)

[23] Attachment 8, Declaration of Michael J. Malvick, Alyeska Engineering VI Lead to USCA Case #20-1342, Document #1865385, Filed 10-7-2020.

[24] All values provided in 2021 USD.

- Additional controls on the boilers as a result of burning liquid fuels

Limitations

At the time of this report, JBE did not have access to the underlying cost data including the original 2011 study or the updated 2016 study referenced in Attachment 8 to the October 7, 2020, Motion to Stay filed in the D.C. Circuit. As such, the assessment of determining whether 300 million (2021 USD) is a reasonable estimate is qualitatively based on historic project knowledge of JBE staff obtained by working on similar projects in the oil and gas sector, and this opinion is not supported by any detailed calculations performed by JBE under the scope of this review.

Economic Opinion

Without documentation to support the analysis performed by Alyeska or the analysis performed as part of the OLD economic review, the actual cost to construct what would be required to comply with the rule cannot be reliably determined. JBE's best impression is that the cost would be significantly higher than the US average if for no other reason than the remote location and harsh environmental conditions to construct an industrial project. Thus, based on the collective historic project experience of the JBE team, the estimated cost of 300 million (2021 USD) for the conversion of fourteen fixed roof storage tanks to internal floating roof tanks is reasonable given the following: extremely large tank size of 62 feet in height with 250 feet diameter each; seismic activity considerations; additional external force considerations due to annual snow load; seasonal construction timing; remote location; and enhanced timeline to avoid gap in compliance schedule per rule timeline.

As a comparative benchmark, Table 4 to the National Impacts of the 2020 Risk and Technology Review Final Rule for the Organic Liquids Distribution (Non-Gasoline) Source Category, and Economic Impact and Small Business Analysis for the Final Organic Liquids Distribution (Non-Gasoline) (OLD) Risk and Technology Review (RTR) NESHAP was reviewed. This table is shown below for reference. In a July 2019 EPA memorandum, it is stated that the cost of 2.47 million 2016 USD represents the total average cost for a facility to potentially implement the 2020 OLD MACT updates. [25] Based on the remote location of the VMT, severe weather climate, seasonal construction season, large tank size, and shortened project timeline to meet compliance dates, the implementation of the March 12, 2020, OLD MACT updates as written would greatly exceed the EPA estimated cost of 2.47 million 2016 USD (equals 2.82 million 2021 USD).[26]

[25] EPA Docket No. EPA-HQ-OAR-2018-0074, July 11, 2019, Economic Impact and Small Business Analysis for the Proposed Organic Liquids Distribution (OLD) Risk and Technology Review (RTR) NESHAP. Larry Sorrels, Economist U.S. EPA/OAQPS/HEID/AEG (C439-02).

[26] 2016 USD adjusted to 2021 USD using an inflation rate of 14.3% based on the US inflation calculator. https://www.usinflationcalculator.com/.

Table 19. Excerpt from EPA's National Impacts of the 2020 Risk and Technology Review to OLD MACT

Table 4 - Summary of Costs of Final Amendments by Equipment Type, in Millions[27] [2016 USD]				
Equipment type	Capital cost	Total annualized cost (without annual recovery credits)	Annual recovery credits[28]	Total annualized cost (with annual recovery credits)
Storage tanks	2.28	0.29	0.17	0.12
Tank Degassing	0	0.42	N/A	0.42
Flares	0.19	0.36	N/A	0.36
Deletion of 240-hr exemption for control device maintenance during transfers (Transfer racks)	0	0.88	N/A	0.88
Total	*2.47*	*1.95*	*0.17*	*1.78*

4.3.2 Economic Feasibility to Install a Closed-Vent System on Existing Conservation Vents

Summary of Costs Presented by Alyeska

Currently, during normal operations, the crude oil storage tanks utilize a closed vent system to route to a vapor collection system; venting is only uncontrolled during emergency, unplanned events. Alyeska considered two design options for evaluating the possibility of installing a redundant capture system to collect vapors from the conservation vents during periods where open venting currently occurs.

Option 1 involves the installation of a redundant closed vent system on each tank that would be used when there was a problem with a valve that controls the flow of vapors from a tank to the main closed vent system. New equipment includes piping to each tank with tie ends to existing vapor collection system, motorized valves, and an external rack system (operated to withstand seismic events, snow loading, and thermal expansion/contraction). Option 1 uses existing compressors. Note, this option would not address problems that occur downstream from the tanks such as the compressors that move the vapors to the control devices or the control devices themselves. Further, during power outages, venting to atmosphere would still occur.

A breakdown of the cost basis for Option 1, provided in the petition, is as follows:

- Engineering/Design: $3.3 million

[27] Table 4 to National Impacts of the 2020 Risk and Technology Review to OLD MACT. https://www.federalregister.gov/documents/2020/07/07/2020-05900/national-emission-standards-for-hazardous-air-pollutants-organic-liquids-distribution-non-gasoline.

28 This estimate reflects the total annualized costs without product recovery as a credit.

- Materials: $7.4 million
- Construction/implementation: $35.3 million
- Contingencies/escalation: $13.9 million

Option 2 includes the installation of a redundant vapor recovery system while incorporating a new vent collection system (option one), but more involved with the addition of tank flange connections, two compressors, one incinerator, high- and low-pressure knockout drums (2 each), two pumps, vent gas coolers, major and utility piping, pipe rack supports, instrumentation, control valves, and a structure for the new compressors and pumps. Alyeska proposed a total cost of $125 million (2021 USD), broken down as follows:

- Engineering/Design: $6.8 million
- Materials: $34 million
- Construction/implementation: $54.4 million
- Contingencies/escalation: $28.5 million

Limitations

As previously stated, JBE did not have access to the underlying cost data including the original 2011 study or the updated 2016 study referenced in Attachment 8 to the October 7, 2020, Motion to Stay filed in the D.C. Circuit. As such, the assessment of determining whether the cost estimates for Option 1 and Option 2 are reasonable are qualitatively based on historic project knowledge of JBE staff obtained by working on similar projects in the oil and gas sector.

Economic Opinion for Option 1

Option 1 creates a new low-pressure header that would tie into the existing vapor collection system. This option would eliminate venting caused when a vapor valve to a specific tank malfunctioned but would not change venting to atmosphere caused by a power outage. As this option would only reduce a portion of the venting to atmosphere, evaluating the cost on a ton pollutant removed per dollar spent was estimated.

The total time the conservation vents currently route to atmosphere is inconsistent year on year due to the unplanned nature of the release events. As such, the total emission of HAPs from the vents also varies. Thus, the worst-case emissions from Table 1 - *Vapor Volume Capture Efficiency Compared to Uncontrolled Tank Venting* to Attachment 2 to the October 7, 2020, Motion to Stay filed in the D.C. Circuit were used for this estimate. Table 1 provides emissions from 2005 to 2020, with year 2014 having the highest emission rate at 9.44 tpy of HAPs released from the vents. The reasoning for venting to atmosphere is not provided in the Motion to Stay or the supporting documents to the motion. As such,

the portion of venting that typically occurs due to power outage versus valve malfunction is unknown. Conservatively, then, the total estimated cost of Option 1 is divided by the total HAP emission of 9.44 tpy. This equates to an expenditure of over $6 million per ton HAP removed in a worst-case year. Based on the estimated cost to implement the 2020 OLD MACT revisions shown in
Table ***19*** to this report, established economic feasibility thresholds established by EPA through the Prevention of Significant Deterioration (PSD) program, and an informal sense of the cost breakpoint at which economic infeasibility is realized, Option 1 is not economically feasible for the level of HAP control gained.

Economic Opinion for Option 2

Option 2 essentially provides a full-time backup vapor collection system and would reduce all conservation venting except for periods caused by a complete power outage. This option includes the header system described in Option 1, but instead of utilizing the existing compressors and other components of the vapor system, Option 2 would add new compressors and an additional incinerator. As this option is technically feasible and has no apparent safety issues, the feasibility comes down to whether the costs are reasonable for the level of control gained.

As described previously, the total time the conservation vents currently route to atmosphere is inconsistent year on year due to the unplanned nature of the release events. Thus, as done for the Option 1 analysis, the worst-case emissions for venting as provided in Table 1 - *Vapor Volume Capture Efficiency Compared to Uncontrolled Tank Venting* to Attachment 2 to the October 7, 2020, Motion to Stay filed in the D.C. Circuit was used for this estimate. Conservatively, year 2014 was used as this year has the highest HAP emission rate from 2005 to 2020. The total estimated cost of Option 2 is divided by the total HAP emission rate of 9.44 tpy. This equates to an expenditure of over $13 million per ton HAP removed in a worst-case year. Based on the estimated cost to implement the 2020 OLD MACT revisions shown in Table 19 to this report, established economic feasibility thresholds established by EPA through the PSD program, and an informal sense of the cost breakpoint at which economic infeasibility is realized, Option 2 is not economically feasible for the level of HAP control gained.

5.0 TITLE V AIR PERMIT REVIEW

For this analysis, draft Title V Air Permit Number AQ0082TVP03 issued May 31, 2017, was reviewed. At the time of review, this was the most current version of the Title V available. The focus of the Title V review centers on the following:

- Level of regulatory obligation to manage releases of HAPs from the conservation vents;
- Controls during planned maintenance; and
- Work practices for emptying and degassing storage tanks.

Additionally, the control of HAPs through measures to reduce VOCs is addressed.

Regulatory Obligation to Manage Releases of HAPs from the Conservation Vents

Each of the fourteen fixed roof storage tanks (EU IDs 29 through 42, as listed in the Title V) is equipped with a conservation vent (also referred to as a pressure relief device (PRD)). To prevent structural damage caused by under or over-pressurization of the tanks, the conservation vents are designed to open and vent to atmosphere.

When tank pressure reaches the set point of the conservation vents, venting begins; this occurs when the internal pressure of any single crude oil storage tank is at or greater than 1.5-inch water column. During venting, vapors are released to the atmosphere to ensure the pressure or vacuum does not reach the structural threshold of the tank. Venting ends when that tank's internal pressure is less or equal to 1.2-inch water column, which provides indication that that vent valves have all closed. The conservation vents are designed to close once pressure returns to the set range; no manual closure or other manual action is required.

The Title V requirements governing the operation of the conservation tanks are provided in Table 20. Following this table, a discussion on the adequacy of environmental oversight on the conservation vents is provided.

Table 20. Title V Permit Number AQ0082TVP03 Requirements for Conservation Vents

Permit Section	Requirement Number	EU ID(s)	Regulatory Citation(s)	Permit Language
Section 3 - State Requirements	19	29 - 42	18 AAC §50.040(j) and §50.326(j); 40 CFR §71.6(a)(1)	The Permittee shall not cause or allow EU IDs 29 through 42 to vent to atmosphere. For purposes of this permit, venting begins when the internal pressure of any crude oil storage tank is at or greater than 1.5-inch water column. Venting ends when that tank's or the last tank's (if multiple tanks are venting) internal pressure is less or equal to 1.2 inch water column, which indicates that vent valves have all closed.
Section 3 - State Requirements	19.2	29 - 42	18 AAC §50.040(j) and §50.326(j); 40 CFR §71.6(a)(1)	Operate and maintain at least one pressure-sensing device on each crude oil storage tank in a manner that provides accurate, reliable readings of the tank's internal pressure.
Section 3 - State Requirements	19.3	29 - 42	40 CFR §71.6(a)(1) and (3)	Continuously monitor the pressure of each crude oil storage tank. Perform and document annual verification of system condition and operability of all crude tank pressure recorder/controllers.
Section 3 - State Requirements	19.5	29 - 42	40 CFR §71.6(a)(3) and (c)(6)	Report in accordance with Condition 70 for any venting to the atmosphere from the crude oil storage tanks, EU IDs 29 through 42.
Section 4 - Federal Requirements	37.2	29 - 42	40 CFR §71.6(a)(1); 40 CFR 63.2346(i), Subpart EEEE	Opening of a safety device is allowed at any time that it is required to avoid unsafe operating conditions.

The legal authority for EPA to regulate PRDs that vent to atmosphere is addressed under Sections 112(d)(2) and (3) and 112(h) to the CAA. To evaluate EPA's current view on work practice standards for PRDs that vent to atmosphere, reviewing other MACT standards helps determine the industry standard for HAP minimization. Based on the final rule language for both the Refinery Sector Rule (40 CFR 63, Subpart CC) and the Ethylene MACT (40 CFR 63, Subpart YY), EPA's current view on work practice standards is evident. Work practice standards for operating PRDs that vent to atmosphere include the following:

- Continuous monitoring;[29]
- Notification system(s), with operator notification being key;[30]
- Root cause analysis completed after release event; [31]
- Corrective action analysis;[32]
- Redundant prevention measures; [33]
- Release reporting; and,
- Election to reduce atmospheric venting to a predetermined set of hours per year.

Based on JBE's current understanding of operations, the following work practice standards are currently in practice at the VMT:

- A definitive pressure range for when venting to the atmosphere occurs has been established. This is critical for (1) knowing exactly when venting starts and ends, and (2) being able to accurately report potential deviations from an established work practice standard. Title V Specific Requirement 19 fully addresses this.
- Monitoring is continuous and recorded through Alyeska's PI system. Monitors identify the pressure release event and record the time and duration of each release. Title V Specific Requirements 19.2 and 19.3 specify this. [34]
- Release reporting is required by Title V Specific Requirement 19.5.

[29] see 40 CFR §63.1107(h)(3)(i) for example

[30] Ibid

[31] see 40 CFR §63.1107(h)(3)(iii) through (v) for example

[32] see 40 CFR §63.1107(h)(6) and (7) for example

[33] see 40 CFR §63.1107(h)(3)(ii) for example

[34] Continuous monitoring verified by Alyeska personnel on 10-19-21 call with PWSRCAC and JBE.

While it is clear that the VMT incorporates continuous monitoring, notification systems, and release reporting into their work practices for the conservation vents, there are several unknowns based on JBE's review of public datasets reviewed as part of this project. Each of these unknowns, related to the conservation vents, is summarized below.

- Whether operators are immediately notified upon venting and the exact operator procedure for when venting starts is unknown.
- Unknown if root cause and corrective action analyses are incorporated into Alyeska's current practices (though not regulatory required).
- Unknown if reductant prevention measures are in place to minimize venting to the maximum extent possible.

Moving to a stricter standard, Alyeska could elect to incorporate the following additional practices (if not already in place): conduct root cause and corrective action analyses after release events, evaluate the use of redundant prevention measures, and/or elect to vent to atmosphere only during a predetermined set of hours on an annual basis.

Controls During Planned Maintenance

Periods of planned routine maintenance of a control device used to control storage tanks, during which the control device does not meet the emission limits specified in Title V Specific Requirement 37.1, must not exceed 240 hours per year. The emission limits as provided in condition 37.1 are shown below for reference.

- Reduce emissions of total organic HAP (or, upon approval, TOC) by at least 95 weight-percent or, as an option, to an exhaust concentration less than or equal to 20 ppmv, on a dry basis corrected to 3 percent oxygen for combustion devices using supplemental combustion air, by venting emissions through a closed vent system to any combination of control devices meeting the applicable requirements of Condition 38; OR
- Comply with the requirements of Condition 38.4 for routing emissions to a fuel gas system or back to a process.

Other than limiting the number of hours planned routine maintenance operations can be uncontrolled, the Title V does not further address this topic. Table 21 provides the Title V regulatory requirements pertaining to controls during planned maintenance.

Table 21. Title V Permit Number AQ0082TVP03 Requirements for Controls During Planned Maintenance

Permit Section	Requirement Number	EU ID(s)	Regulatory Citation(s)	Permit Language
Section 4 - Federal Requirements	37.15	29 - 42	40 CFR §71.6(a)(1); and §63.2378(c), Subpart EEEE	Periods of planned routine maintenance of a control device used to control storage tanks, during which the control device does not meet the emission limits in Condition 37.1, must not exceed 240 hours per year.
Section 4 - Federal Requirements	37.16	29 - 42	40 CFR §71.6(a)(1); and §63.2378(d), Subpart EEEE	If you elect to route emissions from storage tanks to a fuel gas system or to a process, as allowed by Condition 38.2, to comply with the emission limits in Condition 37.1, the total aggregate amount of time during which the emissions bypass the fuel gas system or process during the calendar year without being routed to a control device, for all reasons (except SSM or product changeovers of flexible operation units and periods when a storage tank has been emptied and degassed), must not exceed 240 hours.
Section 4 - Federal Requirements	38.8(k)(ii)	29 - 42	40 CFR §63.998(d)(2)(i) & (ii);	Storage vessel and transfer rack records. An owner or operator shall keep readily accessible records of the information specified in Conditions 38.8.k(i) and 38.8.k(ii), as applicable. (ii) A record of the planned routine maintenance performed on the control system during which the control system does not meet the applicable specifications of Condition 38.3.a or 38.5.a, as applicable, due to the planned routine maintenance. Such a record shall include the information specified in Conditions 38.8.k(ii)(A) through 38.8.k(ii)(C). This information shall be submitted in the Periodic Reports as specified in Condition 38.9.b(iii). (A) The first time of day and date the requirements of Condition 38.3.a or 38.5.a, as applicable, were not met at the beginning of the planned routine maintenance, and (B) The first time of day and date the requirements of Condition 38.3.a or 38.5.a, as applicable, were met at the conclusion of the planned routine maintenance. (C) A description of the type of maintenance performed.

Work Practices for Emptying and Degassing Storage Tanks

Practices for emptying and degassing storage tanks are not explicitly addressed in the Title V. The only mention of "tank degassing" occurs in reference to the hours performed for periods when a storage tank has been emptied and degassed being exempt from the 240 hours per year storage tank emissions can route to a fuel gas system or process to comply with achieving the OHAP emission limitations specified in Title V Specific Requirement 37.1.

The most recent example of EPA regulating the practice of "tank degassing" occurs in the 2020 updates to the Ethylene MACT (40 CFR 63, Subpart YY). Language excerpted from 40 CFR §63.1103(e)(10) is provided for context below.

> *"During storage vessel shutdown operations…until the vapor space concentration in the storage vessel is less than 10 percent of the lower explosive limit (LEL), …the owner or operator must determine the LEL using process instrumentation or portable measurement devices and follow procedures for calibration and maintenance according to manufacturer's specifications.*
>
> - *Remove liquids from the storage vessel as much as practicable.*
> - *Comply with one of the following: Reduce emissions of total organic HAP by 98 weight-percent by venting emissions through a closed vent system to a flare……. through a closed vent system to any combination of non-flare control devices……or to a fuel gas system or process.*
> - *Maintain records…including, if appropriate, records of existing standard site procedures used to empty and degas (de-inventory) equipment for safety purposes."*

Reducing HAPs via the Reduction of VOCs

The term "organic" in volatile organic compounds (VOC) means the pollutant is based on tetravalent carbon. "Volatile" simply means the chemical evaporates to some extent at standard temperature and pressure (due to a high vapor pressure at room temperature). At a given temperature and pressure, a substance with high volatility is more likely to exist as a vapor, while a substance with low volatility is more likely to be a liquid or solid. VOCs are a concern because when they are released into the atmosphere, they react with nitrogen oxides (NO_X) to form ozone. Ozone is known to cause adverse human health effects, but also to reduce agricultural crop and commercial forest yields.[35]

Many HAPs are also classified as a VOC; however, since not all VOCs are hazardous, not all hazardous materials are VOCs. The current list of HAPs contains 187 compounds.[36] Table 22 shows a list of potential chemical compounds emitted from operations at the VMT and provides their designation as a VOC and/or HAP.

[35] Effects of Ground Level Ozone: https://www.iowadnr.gov/Environmental-Protection/Air-Quality/Air-Pollutants/Effects-Ozone.

[36] EPA List of HAPs: https://www.epa.gov/haps/initial-list-hazardous-air-pollutants-modifications.

Table 22. Overlap of VOCs and HAPs Present at VMT

Pollutant	CAS Number	HAP?	VOC?
1,3-Butadiene	106-99-0	Yes	Yes
n-Hexane	110-54-3	Yes	Yes
Benzene	71-43-2	Yes	Yes
Toluene	108-88-3	Yes	Yes
2,2,4-TMP	540-84-1	Yes	Yes
Ethylbenzene	100-41-4	Yes	Yes
o-Xylene	95-47-6	Yes	Yes
Cumene	98-82-8	Yes	Yes
Naphthalene	91-20-3	Yes	Yes
Formaldehyde	50-00-0	Yes	Yes
1,1,1-Trichloroethane	71-55-6	Yes	Yes
Acenaphthene	83-32-9	Yes	*
Acenaphthylene	208-96-8	Yes	*
Anthracene	120-12-7	Yes	*
Benz(a)anthracene	56-55-3	Yes	*
Benzo(b,k)fluorathene	207-08-9	Yes	*
Benzo(g,h,i)perylene	191-24-2	Yes	*
Chrysene	218-01-9	Yes	*
Dibenzo(a,h)anthracene	53-70-3	Yes	*
Fluoranthene	206-44-0	Yes	*
Fluorene	86-73-7	Yes	*
Indeno(1,2,3-cd)pyrene	193-39-5	Yes	Yes
Phenanthrene	85-01-8	Yes	*
Pyrene	129-00-0	Yes	Yes

** Semi-volatile organic compounds (SVOCs) are a subgroup of VOCs that tend to have a higher molecular weight and higher boiling point temperature.*

The current Title V governing operations at the VMT regulates the emission of HAPs by regulating VOCs. The regulation of VOCs in the current Title V are summarized below for reference.

- Working loss and breathing loss vapors from the crude oil storage tanks (EU IDs 29 – 42) are collected and combusted in either the power boilers or the waste gas incinerators (EU IDs 1 - 6).[37]

- VOC emissions from the tank bottoms processing (TBP) system are limited to 18.5 tons of VOC per consecutive 12-month period (EU IDs 18-28, Specific Requirement 20). This equates to a limit

[37] Specific Requirement 19.1 to Title V Air Permit No. AQ0082TVP03.

of HAPs of 0.52 tons over the consecutive 12-month period. This limit was introduced to avoid PSD for VOC. This limit is achieved by limiting the following:

  - Hours of operation for both the TBP and associated boilers limited to 4,368 hours per 12-month consecutive period;
  - Processing rate through the TBP system is limited to 130,000 bbl (not including water) per consecutive 12-month period;
  - Controlling VOCs by combusting hydrocarbon vapors emitted from the TBP system in the internal combustion engines with catalytic converters or by reducing vapors using a carbon adsorption bed system (EU ID 28);
  - Only routing emissions to the dryer when dryer temperatures are above 100F; and
  - Maintaining the TBP system process under negative pressure, relative to atmospheric pressure when in operation.

- The VMT elects to treat VOCs from ballast water by routing the exhaust from the wastewater air strippers (EU IDs 75 – 78) to one of two regenerative thermal oxidizers (EU IDs 79 and 80).[38] Based on the construction year of VMT's thermal oxidizers, 2008, it is expected the VOC capture rate for the oxidizer is 95% or greater.[39] An equal rate of capture for HAPs would be expected.

- Emissions of VOC and HAP from the loading berths must be captured at a rate of at least 98 weight-percent (EU IDs 47 – 50). Other than under a maintenance allowance, no marine loading can occur without routing emissions through the VMT vapor collection system. [40]

Conclusion of Findings

Based on a review of the current Title V and process knowledge, emissions of HAPs from the VMT are overall low compared to operations from other industrial sectors in the United States. The VMT has strong work practice standards and operational restrictions in place to ensure the environmental safety of plant personnel and the surrounding communities, such as Valdez, to the site.

To further enforce the regulation of HAPs from the VMT, the additional practices outlined below could be considered, noting the extent to which these practices are already in place (though not required by the Title V) is not known by JBE.

- **Conservation Vents on Crude Oil Storage Tanks**: Consideration of additional practices:

  - Root cause and corrective action analyses after release events
  - Use of redundant prevention measures

[38] Specific Requirement 28 to Title V Air Permit No. AQ0082TVP03.

[39] Regenerative thermal oxidizer vendor literature on VOC capture rate: http://www.gcesystems.com/regenerative-thermal-oxidizers.html.

[40] Specific Requirement 36.5 to Title V Air Permit No. AQ0082TVP03.

- Election to vent to atmosphere only during a predetermined set of hours, on an annual basis

- **Emptying and Degassing Storage Tanks**: Consideration of additional practices:
  - Establish and permit elective work practice standards pertaining to the emptying and degassing of storage tanks
  - Strongly consider routing to a control device (e.g., one that is brought to the site as a portable package unit) or fuel gas system during degassing

Last, the PTE calculation for the uncontrolled tanker loading maintenance allowance is of note. The calculation is provided in the 2016 Title V Air Permit Renewal Application and shows the PTE of 388 tpy VOC and 10.9 tpy HAPs. It is unclear the number of maintenance events per year and the duration of each event. Without this additional information, the short-term emission of HAPs is unknown. As the emission of HAP is elevated during this scenario, future research into the hourly emission rate of HAPs to the Valdez community during maintenance could be warranted.

6.0 CONCLUSIONS

In summary, the claims made by Alyeska related to health and safety, technical feasibility, and economic feasibility presented in its public correspondence with EPA related to the 2020 updates to the OLD MACT were independently validated within this report and the supporting appendices. Overall, it is the opinion of JBE that Alyeska, in their appeal of the 2020 OLD MACT rule, appropriately represented the environmental impacts incurred due to operations at VMT. Further, Alyeska has demonstrated that its current configuration already achieves the level of HAP reduction the 2020 OLD MACT updates seek. Conclusions are provided below, organized by main objective identified in Section 1.3 to this report.

- Independent Evaluation of HAP Air Releases from the VMT: HAP emissions from the vapor recovery system, storage tank conservation vents, and other sources not covered by the OLD MACT were quantified and compared to those values represented by Alyeska in the Petition for Rulemaking, Reconsideration, and Stay. The emissions developed by JBE were slightly less than those presented by Alyeska in the Motion to Stay and in the air permit applications submitted historically. Thus, Alyeska's overall representation of HAPs released from the VMT is complete, accurate, and conservative.

- Comparative Analysis Evaluating VMT HAP Emissions "As Configured" versus 2020 OLD MACT Implementation: HAP emissions from the fourteen fixed roof storage tanks controlled by vapor recovery were calculated, inclusive of emissions from the tank conservation vents using JBE created tank emission tools. Next, HAP emissions from the fourteen storage tanks were calculated for the scenario that the tanks were converted from fixed roofs to internal floating roofs, where no conservation venting occurs – to represent one scenario of VMT compliance with the 2020 OLD MACT. Upon comparison, JBE's calculations demonstrate that VMT's current configuration emits less HAPs than a configuration where the fourteen fixed roof storage tanks are converted to internal floating roofs. Thus, the suggestion by Alyeska to request EPA to allow a work practice standard for the conservation venting to atmosphere is reasonable.

- Health Risk Evaluation: The health risks to residents of Valdez, Alaska posed by the uncontrolled releases of HAPs from the conservation vents and residual uncontrolled sources at the VMT, not addressed by the OLD MACT were calculated in a JBE created workbook. HAP releases from VMT were modeled using EPA's SCREEN3 Model with a focus on benzene. As demonstrated in Section 3, the benzene concentration released by the VMT, in its current as-built configuration, is below appropriate short and long-term health limits. Overall, the health risk for HAP exposure to Valdez and surrounding communities is low and does not pose unacceptable long term adverse human health impacts based on the SCREEN3 model results.

- Alternative Design Assessment: The safety, environmental, engineering, and economic considerations presented by Alyeska in reference to reconfiguring the existing crude oil tank farm to comply with the 2020 OLD MACT with internal floating roof or external floating roof tanks were evaluated. Neither of these two alternatives include the requirement for vapor recovery to the floating roof itself because this is not required by the regulation. Vapor recovery for an external floating roof tank is not feasible.

This report concludes the alternative design assessments presented by Alyeska offer no added benefit in regard to safety, environmental, or engineering aspects as compared to the current configuration of the VMT.

- **Title V Air Permit Review:** The VMT's Title V Air Permit was reviewed to evaluate the level of regulatory obligation to manage releases of HAPs from the conservation vents, controls during planned maintenance, and work practices for emptying and degassing storage tanks. EPA's regulatory approach to control of emissions from storage tanks has undergone a large measure of review over the past thirty years, but no real changes to the approach have evolved from all of that study and review (including several EPA risk review analyses for various sectors that use storage tanks). The terminal's Title V permit implements the provisions form those storage tank regulations in much the same ways as for many other refineries, terminals and chemical plants across the U.S. Therefore, the facility's existing operating provisions as listed in the Title V permit were deemed suitable to their current situation.

  Recent experimental use of optical inspection methods is evolving (and has been adopted in California for certain situations) and may gain regulatory acceptance in the future; most likely as screening methods to layer on to existing control requirements. As these develop, they would be potentially applicable to the current terminal configuration as well as a floating roof scenario, but they would likely not alter the basic design considerations for why either of these would be selected.

  The Title V review resulted in the following findings:

  - **Consideration of the additional practices**:
    - Root cause and corrective action analyses after release events to atmosphere
    - Use of redundant prevention measures to minimize venting to atmosphere
    - Election to vent to atmosphere only during a predetermined set of hours, on an annual basis
    - Establish and permit elective work practice standards pertaining to the emptying and degassing of storage tanks
    - Strongly consider routing to a control device or fuel gas system during degassing

Future Recommendations for Research

The emission calculation for the uncontrolled tanker loading maintenance allowance is of note. The calculation is provided in the 2016 Title V Air Permit Renewal Application and shows the PTE of 388 tpy VOC and 10.9 tpy HAPs. It is unclear the number of maintenance events per year and the duration of each event. Without this additional information, the short-term emission of HAPs is unknown. As the emission of HAP is elevated during this scenario, future research into the hourly emission rate of HAPs to the Valdez community during such maintenance could be warranted.

The potential contribution of the recovered oil storage tank associated with the ballast water system should be investigated. Insufficient data was available to estimate emissions independently (they are listed as 7 tpy in the terminal's 2020 emissions inventory.

The emission rate of HAPs from the ballast water treatment or other wastewater treatment was not independently verified by JBE due to a lack of data including system configuration, flowrates, sampling data and this should be investigated also to better inform the worst-case emissions calculations.

Additional Limitations

JBE's work for this project was to review the implications of the potential application of a Federal regulation. This work should not be treated as a design, an agency deliverable, or any form of direct support to the Alyeska's environmental compliance program. The majority of the work steps were performed by engineers with considerable work experience in the oil and gas sector that are registered professional engineers in various other states. JBE was selected in a competitive process based on the very strong experience of our proposed team, since our team members have worked on various projects individually in a number of US states. The ability to perform an independent review of work performed anywhere is important, and it is often the case that the best resources to perform such a review benefit from a national perspective, and as such, may not be located in the state where facilities to be evaluated happen to be.

This page intentionally left blank.