EXH. RJR-31
DOCKETS UE-220066/UG-220067 et al.
2022 PSE GENERAL RATE CASE
WITNESS: RONALD J. ROBERTS

BEFORE THE
WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION

WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION, Complainant, v. PUGET SOUND ENERGY, Respondent.	Docket UE-220066 Docket UG-220067
In the Matter of the Petition of PUGET SOUND ENERGY For an Order Authorizing Deferred Accounting Treatment for Puget Sound Energy's Share of Costs Associated with the Tacoma LNG Facility	Docket UG-210918

FIRST EXHIBIT (NONCONFIDENTIAL) TO THE PREFILED TESTIMONY OF

RONALD J. ROBERTS

ON BEHALF OF PUGET SOUND ENERGY IN SUPPORT OF THE MULTIPARTY SETTLEMENT FOR TACOMA LNG

AUGUST 26, 2022

BEFORE THE POLLUTION CONTROL HEARINGS BOARD
STATE OF WASHINGTON

ADVOCATES FOR A CLEANER TACOMA; SIERRA CLUB; WASHINGTON ENVIRONMENTAL COUNCIL; WASHINGTON PHYSICIANS FOR SOCIAL RESPONSIBILITY; STAND.EARTH, and THE PUYALLUP TRIBE OF INDIANS, a federally recognized Indian Tribe, Appellants, v. PUGET SOUND CLEAN AIR AGENCY; PUGET SOUND ENERGY, INC., Respondents.	**PCHB No. P19-087c** **PREPARED DIRECT TESTIMONY OF DR. SHARI BETH LIBICKI ON BEHALF OF PUGET SOUND ENERGY, INC.** [AMENDED WITH EXHIBIT NUMBERS]

INTRODUCTION

Q: PLEASE STATE YOUR NAME, OCCUPATION, AND BUSINESS ADDRESS.

A: My name is Dr. Shari Beth Libicki. I am a Principal at Ramboll US Corporation where I am a senior member of the company's air quality practice. I also serve as an Adjunct Professor in the Department of Chemical Engineering at Stanford University. My business address is 2200 Powell St Suite 700, Emeryville, CA 94608.

Q: FOR WHOM ARE YOU TESTIFYING IN THIS CASE?

A: I am testifying on behalf of Puget Sound Energy, Inc. ("PSE"), but the expert opinions that I express herein are my own.

Q: PLEASE DESCRIBE YOUR EDUCATIONAL EXPERIENCE.

A: I earned my BSE in Chemical Engineering from the University of Michigan (1979), my MS in Chemical Engineering from Stanford University (1981), and my PhD in Chemical Engineering from Stanford University (1985).

Q: PLEASE DESCRIBE YOUR BACKGROUND AND PROFESSIONAL EXPERIENCE.

A: I have over 30 years of environmental and air quality experience, drawing on my chemical engineering background, with particular expertise in estimating air emissions and dispersion from refineries and other heavy industries. I have conducted extensive air quality regulatory assessments for New Source Review ("NSR")/Prevention of Significant Deterioration ("PSD") permitting, as well as state minor source permitting, including evaluations of emissions impacts and the application and assessment of Best Available Control Technology ("BACT"). For state programs, I have extensive experience in estimating the impacts of toxic air pollutants. I have conducted and managed air dispersion modeling studies for the past 30 years, and my modeling experience has ranged from simple air dispersion models, such as SCREEN, intermediate complexity models such as the AERMOD modeling suite, all the way to using the results of regional air quality models, such as Comprehensive Air Model with Extensions ("CAMx"). I have conducted air studies using computational fluid dynamics ("CFD"), and I have evaluated the impact of buildings and obstructions on air dispersion using CFD models. I have worked with meteorologists to understand the different types of meteorological data sets that are available and broadly evaluated the applicability of meteorological data sets to air dispersion modeling, including understanding how different meteorological data sets impact results.

Since 1989, I have been employed at Ramboll (and its predecessor company, ENVIRON), in positions of increasing responsibility applying scientific theories and chemical engineering principles of mass transport to air emissions and dispersion estimation. Ramboll is an international scientific and engineering consultancy. While at Ramboll, I have conducted numerous studies on the generation (*i.e.*, where is it coming from?), fate (*i.e.*, does it transform?) and transport (*i.e.*, how does it get there?) of environmental contaminants, with an emphasis on airborne contaminants. I have designed and operated ambient air monitoring systems and analyzed data from those monitoring systems. I have conducted air dispersion modeling studies for numerous purposes, including PSD permits, minor source permitting, and air toxics assessments.

I have prepared dozens of air permit applications for a wide variety of industrial sources, including steel mills, refineries, waste disposal and treatment systems, aluminum smelters, container glass manufacturing plants, and power generation systems. In my permitting work, I have estimated emissions from, addressed BACT for, and conducted dispersion modeling from many of the same components that exist at Tacoma LNG, including process components that emit fugitive VOCs, enclosed ground level flares, and process heaters. I have prepared major and minor source applications, including PSD permit applications.

I have done permitting work in a number of states, including Washington, where I have done minor and major source permitting. I have extensive permitting experience in California, which has some of the strictest permitting regimes in the nation. I have done permitting work within the Puget Sound Clean Air Agency's (the "Agency") jurisdiction.

In addition to my consulting work, I am an Adjunct Professor at Stanford University, where I have taught courses for over 20 years. I currently teach a course on the science and engineering that support environmental rules and regulation.

I was appointed to the Regional Targets Advisory Committee ("RTAC") by the Executive Director of the Air Resources Board ("ARB"). The RTAC was charged with providing recommendations on factors to be considered and methodologies to be used in the ARB vehicle emissions greenhouse gas target setting process, as required under California's SB 375.

I was appointed to the Department of Defense's Science Advisory Board ("SAB") of the Strategic Environmental Research and Development ("SERDP"). The SAB has the authority to make recommendations to the SERDP Council regarding technologies, research, projects, programs, activities, and funding. The SAB is composed of between six and fourteen members who are jointly appointed by the Secretary of Defense and the Secretary of Energy in consultation with the Administrator of the United States Environmental Protection Agency (EPA).

I have provided consulting services to various government entities, including the California Air Resources Board, the South Coast Air Quality Management District, the Bay Area Air Quality Management District, the Sacramento Metropolitan Air Quality Management District, the California Air Pollution Control Officers Association, and other semi-governmental authorities, such as the Bay Area Rapid Transit authority, and several Ports, including the Port of Los Angeles and the Port of San Francisco. The single largest project that I have ever had was for the City of Richmond evaluating a modernization project at the Chevron Refinery. I have also consulted for non-governmental organizations such as the Environmental Defense Fund.

I have testified as an expert witness in the area of air quality in state and federal courts and before the Pollution Control Hearings Board.

OPINION 6: TACOMA LNG IS NOT A MAJOR SOURCE OF CRITERIA POLLUTANT EMISSIONS UNDER THE PSD PROGRAM, NOR UNDER THE TITLE V PROGRAM.

Q: PLEASE SUMMARIZE YOUR OPINION ABOUT WHETHER TACOMA LNG IS A MAJOR SOURCE.

A: Tacoma LNG is not a major source under the PSD program or the Title V program, regardless of whether the 100-ton or 250-ton threshold applies. The largest PTE of any criteria air pollutant emitted by Tacoma LNG is 49 tpy of VOC emissions. Given the constraints on PTE (*i.e.*, the permit's requirement for 99% destruction of VOCs and the flare's 34 MMBtu/hr (LHV) maximum capacity), Tacoma LNG cannot be a major source of VOCs regardless of how feed gas changes in the future. Even if wildly unrealistically high assumptions are made about the VOC content of the waste gas input into the flare, the VOC emissions from the flare would still be below the 100 tpy threshold. Dr. Sahu has not done any work to calculate PTE, nor to demonstrate how emissions could be high enough to exceed either major source threshold. Finally, I disagree with Dr. Sahu's claims that additional emissions should have been included in the PTE calculations. PTE does not account for emissions from emergency conditions or presumed future violations of permit conditions.

Q: IS TACOMA LNG A MAJOR SOURCE OF EMISSIONS?

A: No, Tacoma LNG is not a major source under the PSD program, nor under the Title V program. As I just noted, I do not believe Tacoma LNG is a fuel conversion plant under the applicable EPA guidance. The Agency has similarly stated that it does not believe Tacoma LNG fits the definition of a fuel conversion plant under PSD.[85] If Tacoma LNG is not a fuel conversion plant, then the facility does not fall into one of the 28 PSD source categories listed in the table above, and it would have to have a PTE greater than or equal to 250 tpy for one or more individual non-GHG criteria pollutants or their respective precursors to qualify as a PSD major source.

However, the question of whether Tacoma LNG is a fuel conversion facility is immaterial to its source determination under the PSD program: the facility's emissions, as calculated in the NOC permitting process, are well below the 100 tpy level that applies to the 28 designated source categories. As shown in the table and graph below, the largest PTE of any criteria air pollutant emitted by Tacoma LNG is 49 tpy of VOC emissions, which is only one fifth of the general PSD permitting emissions level of 250 tpy and less than half of the 100 tpy level that would apply if Tacoma LNG was in one of the 28 designated source categories.[86]

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[85] *See* Deposition of Steve Van Slyke, December 7, 2020, at 86:13–20.

[86] For perspective, these emissions are half that of a commercial bakery. The Franz Bakery on Weller Street in Seattle emits 94.17 tons of VOCs per year. PSE-0113 (comparing emissions data from 2017 National Emissions Inventory).

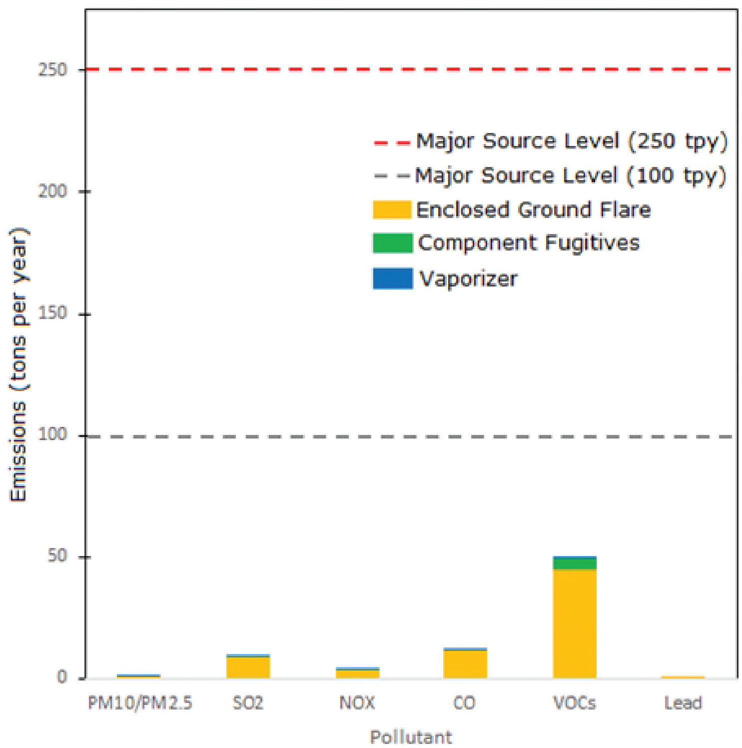
Assuming that Tacoma LNG is not a designated source, the 49 tpy of VOC is actually an overstatement in this context because fugitive emissions are excluded from the PTE calculation for purposes of comparison to the general PSD major source level for sources subject to the 250-ton threshold level.[87]

Because Tacoma LNG's PTE is below 100 tpy for each criteria pollutant, the facility is not a major source of criteria pollutants under Title V or PSD. Additionally, Tacoma LNG's PTE for the sum of HAPs is 0.37 tpy, which is well below the Title V major source levels of 10 tpy for any individual HAP or 25 tpy for any combination of HAP.

Tacoma LNG Criteria Air Pollutant Estimated Emissions[88]				
Pollutant	Vaporize (TPY)	Enclosed Ground Flare (TPY)	Component Fugitive Emissions (TPY)	Total (TPY)
$PM_{10}/PM_{2.5}$	0.055	1.2	0	1.2
SO_2	0.017	9.1	0	9.1
NO_X	0.086	3.7	0	3.8
CO	0.290	12	0	12
VOCs	0.040	45	4.2	49
Lead	3.6E-6	8.0E-5	0	8.2E-05
Total TAPs/HAPs	0.014	0.30	3.4E-5	1.03/0.37

[87] PSE-0307, WAC 173-400-720(4)(a)(vi) (adopting definitions in 40 C.F.R. 52.21(b) which, in the definition of "major source" states: "The fugitive emissions of a stationary source shall not be included in determining for any of the purposes of this section whether it is a major stationary source, unless the source belongs to one of the following categories of stationary sources…").
[88] RA-68, Final NOC Worksheet.

Tacoma LNG Criteria Air Pollutant Emissions Compared to PSD Major Source Level



Q: HOW RELIABLE ARE THESE EMISSIONS CALCULATIONS?

A: These calculations are appropriately conservative. Tacoma LNG's actual emissions will likely be even further below the major source levels than calculated because the emissions reported in the NOC Worksheet represent the worst-case facility-wide emissions. Landau calculated worst case by calculating emissions for each pollutant under various facility operating scenarios and then selecting the highest emissions for each pollutant across all scenarios. Thus, for example, Landau calculated emissions of each pollutant conservatively assuming that each of the liquefying cases would occur for every hour of the year (*i.e.*, 8,760 operating hours). Landau also calculated emissions of each pollutant assuming that vaporization would occur for the maximum amount of permitted hours (*i.e.*, 24 hours per day for 10 days, or 240 hours) and that the flare would be operating at the highest rate for the remaining hours of the year (*i.e.*, 8,520 hours). Landau then selected the highest emissions for each pollutant, even if the highest emissions for different pollutants occurred under different operating scenarios. This is conservative. Landau used the highest emitting scenario (*i.e.*, either maximum liquefying or maximum vaporizing + liquefying) for its PTE calculations. It then added the emissions from the small cold burner to address the maximum purge gas combustion that can occur throughout the year from ship and truck loading.[89] This methodology ensured that emissions estimates submitted to the Agency would encompass or accommodate the upper bound of Tacoma LNG's emissions.

[89] RA-61(c), Attachment A - PSE LNG Emissions (rev. November 28, 2017).

Q: IN ARGUING THAT TACOMA LNG IS A MAJOR SOURCE OF VOCS, DOES DR. SAHU ASSUME THAT THE FLARE WILL EXCEED ITS PERMIT LIMITS?

A: Yes. Dr. Sahu assumes that the flare will not achieve the 99% VOC destruction efficiency required by the permit. Instead, he makes various assumptions about reduced VOC destruction efficiency and then generates artificially high potential emissions by applying lower destruction efficiencies to the highest flow flaring cases. For example, on page 15 of his pre-filed testimony, Dr. Sahu points to CB&I "heat emissions data sheets" that have information on each flaring case. He says that "LFG does not use 99% [destruction efficiency] in all of the cases it analyzed. It used 98% for numerous cases and 95% for one case." On page 12 of his pre-filed testimony, Dr. Sahu takes this one step further, and says that "uncontrolled VOC emissions from the flare are 4,500 tons per year" and "[i]f the DE were to be 95%, as I have noted was the case for at least one case by LFG itself, the PTE would be 4,500*(1-0.95) = 225 tons per year just from the flare alone." He does a similar calculation on the same page assuming a hypothetical 97% destruction efficiency to come up with 135 tons per year. He uses these higher numbers to argue that Tacoma LNG's VOC emissions are above the major source thresholds. Dr. Sahu's calculations appear to be based on a poor understanding of the underlying data.

Q: CAN YOU EXPLAIN WHY DR. SAHU'S ARGUMENT IS BASED ON A POOR UNDERSTANDING OF THE UNDERLYING DATA?

A: Yes. First some background is necessary. The various flaring cases represent different operations of the facility. There are liquefying cases, which are the cases with highest emissions (Cases 1, 3, 4 and 5) due to having much higher hydrocarbon flows to the flare while liquefying at full capacity. Then there are other cases that have much lower emissions due to much lower hydrocarbon flows to the flare. There is a turn-down case where the plant is liquefying at a reduced level (Case 2); a holding case, where the plant is not liquefying at all (Holding Case); and cases that represent purging of equipment with nitrogen after loading a ship or truck (Cases 9A1, 9A2 and 9B), all of which would only happen when the unit is either liquefying or holding.[90]

Attachment A to the permit application calculates VOC emissions for each scenario assuming operation for maximum permitted hours throughout the year and based on the 99% destruction required by the permit.[91] These total annual emissions were reported as follows:

[90] RA-68, Final NOC Worksheet at 32-34.
[91] RA-61(c), Attachment A - PSE LNG Emissions (rev. November 28, 2017); RA-132, NOC Order of (December 10, 2019).

	VOC TPY From Attachment A
Case 1	13.1
Case 2	3.3
Case 3	40.6
Case 4	41.7
Case 5	44.6
Holding	0.31
9A1	0.00015
9A2	0.0006
9B	0.00015

	VOC TPY From Attachment A
Case 1	13.1
Case 2	3.3
Case 3	40.6
Case 4	41.7
Case 5	44.6
Holding	0.31
9A1	0.00015
9A2	0.0006
9B	0.00015

As can be seen, emissions from the non-liquefying cases are very small, which represents the fact that the flows to the flare in those cases are very low (and that the hours of operation are limited for truck and ship loading activities).

The CB&I heat emissions data sheet lists destruction efficiency for the cases, but Dr. Sahu appears to misunderstand critical information about which cases are listed as 98% and 95% and fails to note that the key liquefying cases are listed as 99.5%. Cases 1, 3, 4, and 5 are listed as 99.5% destruction; Case 2, Holding Case, and Cases 9A1 and 9A2 are listed as 98%; and case 9B is listed as 95%.[92] Thus, the highest emissions cases (including Case 5, which is the basis for potential to emit) all are listed as 99.5% destruction efficiency.[93]

Dr. Sahu applies the lowest destruction efficiency in the heat emissions data (for Case 9B) to the highest hydrocarbon flows to the flare (Case 5) to create an artificially high emission estimate. In other words, he takes the highest hydrocarbon flow to the flare, which would be the case where the flare would be expected to have the highest destruction efficiency, and applies the lowest destruction efficiency. Dr. Sahu appears to not understand the context of these destruction efficiencies, as he used them incorrectly.

First off, the permit requires 99% destruction efficiency, which will be determined by testing, and then will be maintained by continuous parametric monitoring for temperature.[94] It is not appropriate to measure potential to emit by assuming the plant will violate a permit limit. Thus, Dr. Sahu's calculations are not the appropriate measure to begin with. However, even using Dr. Sahu's approach, it is possible as a thought experiment to use Attachment A to recalculate VOC emissions using the destruction efficiencies for each case on the heat data sheet instead of the 99% required by the permit. This eliminates the apparent poor

[92] It is also important to also note that the composition of Cases 9A1, 9A2 and 9B are only methane and nitrogen. So, there are no VOCs to destroy in those cases, and the destruction efficiency concept is not even relevant.
[93] PSE-0018, CB&I Heat Emission Data (April 5, 2018).
[94] RA-132, NOC Order of Approval, Conditions 12, 15, 21, 28.

understanding of the data that Dr. Sahu had in his generation of artificially high emissions. The results of my calculations are set forth in the table below.[95] I should note that I am not recalculating PTE based on this calculation, but rather, am correctly applying the DRE's that were incorrectly used by Dr. Sahu.

	DRE from CBI/LFG Heat Emissions Data Sheet	VOC TPY From Attachment A (at 99%)	VOC TPY recalculated at DRE from Heat Emission Sheet
Case 1	99.5%	13.1	6.6
Case 2	98%	3.3	6.6
Case 3	99.5%	40.6	20.3
Case 4	99.5%	41.7	20.8
Case 5	99.5%	44.6	22.3
Holding	98%	0.31	0.62
9A1	98%	0.00015	0.00003
9A2	98%	0.0006	0.0012
9B	95%	0.00015	0.00074

	DRE from CBI/LFG Heat Emissions Data Sheet	VOC TPY From Attachment A (at 99%)	VOC TPY recalculated at DRE from Heat Emission Sheet
Case 1	99.5%	13.1	6.6
Case 2	98%	3.3	6.6
Case 3	99.5%	40.6	20.3
Case 4	99.5%	41.7	20.8
Case 5	99.5%	44.6	22.3
Holding	98%	0.31	0.62
9A1	98%	0.00015	0.00003
9A2	98%	0.0006	0.0012
9B	95%	0.00015	0.00074

[95] PSE-0137, VOC Emission Estimates from Flare for Various Fuels, March 5, 2021.

Q: WHAT CONCLUSION HAVE YOU DRAWN FROM THIS ANALYSIS?

A: Even if Dr. Sahu were correct, and the destruction efficiencies from the heat emissions analyses were used to calculate potential to emit, the potential to emit from the flare (based on Case 5) would go *down* from 44.6 tons to 22.3 tons. The other annual emissions depicted are not relevant to potential to emit because they are lower than Case 5. In his example, Dr. Sahu focused on the 95% destruction, which was listed for Case 9B. For Case 9B, reducing the destruction efficiency from 99% to 95% destruction would increase emissions from 0.00015 to 0.00074 tons per year. These tiny fractions of a ton per year are <u>immaterial</u> to the potential to emit calculations. As noted above, Dr. Sahu instead applies 95% destruction to Case 5 to arrive at his 225 tons. This appears to be the result of his misunderstanding the source information. As I describe below, given the constraints on Tacoma LNG, it is not possible for the plant to be a major source of VOC emissions.

Q: IS IT POSSIBLE FOR TACOMA LNG TO BE A MAJOR SOURCE OF VOCS?

A: No.

Q: PLEASE EXPLAIN.

A: Tacoma LNG is subject to certain operational and emissions constraints that make it essentially impossible for Tacoma LNG to be a major source of VOCs.

Q: WHAT ARE THOSE CONSTRAINTS?

A: First, the flare has a maximum design capacity of 34 million BTU per hour (on a lower heating value basis).[96] This is set forth in the NOC application materials,[97] as well as the final specs for the flare,[98] and the deposition of the flare manufacturer.[99] As such, the flare is not designed to operate above that level. I understand that this was a representation during the permitting process and is therefore an enforceable condition pursuant to Condition 1 of the permit. This means that there is only so much heat content, and as a result, a limited mass of VOCs, that can be sent to the flare every hour, and as a result, for the entire year.

Q: WHAT OTHER CONSTRAINTS?

A: Second, the flare is required to achieve a 99% destruction of VOCs going to the flare.[100] This is an enforceable permit condition, so it also constrains potential to emit of the flare.

Q: ARE THERE FURTHER CONSTRAINTS?

A: Yes, the final key constraint is that operationally, only so much of the waste stream going to the flare can be made up of VOCs. During the liquefaction

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[96] Note that the permit used the equivalent higher heating value (HHV) of 37.2 MMBtu/hr.
[97] *See* RA-21, Attachment A to Tacoma LNG NOC Application at Tab 8 Flare5 (Case 5 – Potential Emissions from Enclosed Ground Flare Burners).
[98] *See* A-PTI0255, LFG/APTIM Final Flare Proposal and Pricing at 2 (Dec. 6, 2017).
[99] *See* Deposition of Louis Kalani, January 20, 2021, at 99:8–19.
[100] RA-132, NOC Order of Approval, Condition 15.

process, to concentrate methane in the LNG, and to avoid freezing heavier hydrocarbons in the liquefaction process, non-methane hydrocarbons are removed from the incoming natural gas and either sent to the flare or to the heavies storage vessel. However, when pulling non-methane hydrocarbons from the incoming natural gas, methane is also removed and sent to the flare. As such, the flare gas cases always include methane and ethane, as well as heavier hydrocarbons. It is impossible, using the methods employed at Tacoma LNG, to pull heavier hydrocarbons from the incoming feed gas and not pull a substantial amount of methane and ethane in the process. It is akin to skimming fat from soup and trying to leave all of the soup behind in the pot. Some soup will come with the fat.

Thus, the waste gas sent to the flare includes methane and ethane, as well as heavier hydrocarbons. In fact, in every liquefying case, methane is the most prevalent single hydrocarbon in the stream. Neither methane nor ethane are VOCs by definition, so it is just the other hydrocarbons that are VOCs counted toward the major source threshold.

In the maximum flaring case evaluated by Landau (Case 5), VOCs made up approximately 58 percent of the waste stream by weight.[101] The remainder of the stream was predominantly methane and ethane, as well as some non-VOCs like CO_2.

[101] RA-21, Attachment A to Tacoma LNG NOC Application at Gas Data Tab (Liquefying Case 5).

Q: CAN VOCS IN THE WASTE GAS STREAM TO THE FLARE EXCEED THE 58% VOC BY WEIGHT ESTIMATED BY LANDAU?

A: According to CB&I, flaring Case 5 was developed to have a higher percentage of hydrocarbons, and a higher percentage of heavier hydrocarbons than is ever expected to be seen. In fact, Mr. Stobart has indicated that Case 5 was purposefully developed to overestimate the amount of heavy hydrocarbons that could be sent to the flare by assuming an incoming gas composition with a decreased level of methane and increased concentrations of heavier hydrocarbons, some of which would be VOCs. The case was also developed assuming 275,000 gallons of LNG per day, notwithstanding that the permit limits LNG production to 250,000 per day, thus providing an additional 10 percent contingency. And CB&I layered an additional 10 percent flow contingency on top of that. As a result, Case 5 already was designed to overstate heavier hydrocarbons (and thus, VOCs) to the flare, which makes Case 5 conservative for use in potential to emit. Thus, 58 percent VOC by weight, at the maximum heat input, appears to be a very conservative estimate (overstatement) of emissions for purposes of potential to emit.[102]

[102] Declaration of Matthew Stobart, ¶¶ 16-22 (March 29, 2021) (Attached hereto as Attachment C).

Q: IF CB&I WERE WRONG, AND THE WASTE GAS SENT TO THE FLARE COULD BE 100% VOCS, COULD TACOMA LNG BE A MAJOR SOURCE OF VOCS?

A: No. But it is important to remember that CB&I has indicated that it is impossible to send 100% VOCs to the flare because methane and ethane will always be pulled off into the flare gas along with heavier hydrocarbons. In addition, according to Mr. Stobart, there will always be some non-VOCs, such as CO_2 in the gas.

Q: PLEASE EXPLAIN WHY YOU BELIEVE THAT TACOMA LNG CANNOT BE A MAJOR SOURCE OF VOCS.

A: It is possible to consider a thought experiment to show that Tacoma LNG's emissions cannot exceed the major source threshold given the constraints I have just discussed. Accordingly, as a thought experiment, I evaluated how many tons of VOCs would be emitted if the flare combusted 100 percent VOCs at the maximum design capacity at the large warm burner[103]of 34 MMBtu/hr (LHV), and the 99% VOC destruction required by the permit. In other words, I evaluated the facility's PTE if the inlet gas was comprised of 100 percent VOCs—which, as explained, is simply not possible given that heavier hydrocarbons cannot be

[103] I have focused on flare emissions because worst case potential to emit for VOCs is based on full-time operation of the flare. Further, I have focused on the large warm burner of the flare because emissions from the large warm burner represent the potential to emit on the warm side, and emissions from the small cold burner are negligible (a small fraction of a ton).

removed from feed gas without pulling out methane and ethane—hence why this is purely a thought experiment.

For the thought experiment, I evaluated this possibility by looking at the major VOC components of the gas stream (*e.g.*, propane, butane, pentane, etc.) and calculated the mass of VOCs of each component that would be emitted by the flare if the stream were made up of 100 percent of that component, and still subject to the maximum heat input capacity of the flare. For example, I calculated how much propane would go to the flare if the entire stream were made of propane and the flare reached its maximum capacity of 34 MMbtu/hr. Undertaking this calculation is simple because each component, like propane, has a certain heating value per pound. Propane has a heat content of 19,919 btu/lb. So, it would take burning 1,707 lb/hr of propane to get to 34 MMbtu/hr. With 99% destruction in the flare required by permit, this equates to 75 tons of VOC emissions per year, if the flare operates this way all 8,760 hours of the year. Thus, even in this thought experiment, VOC emissions would be well less than the 250-ton major source threshold (and would still be below the 100-ton threshold if it applied, even accounting for fugitive emissions). But, it is important to note that this is strictly a thought experiment. There is no possible way for the operations of Tacoma LNG to yield this level of VOCs to the flare.

Similarly, if the entire gas stream going to the flare was butane (another VOC), emissions from the flare would be 76 tons per year of VOCs, which also is below the major source threshold. I have undertaken the same evaluation for each VOC between propane (C3) and decane (C10), including the branched alkanes and created a table of the results (PSE-0137). While none of these VOCs outside of the first few could possibly be present in significant quantities, the result relative to the major source threshold would be the same for all of them, or any combination of them. No single VOC or combination of VOCs could exceed 85 tons per year under this impossible scenario, where the stream contains no methane and ethane, and still maxes out the heat capacity of the flare. Thus, in the thought experiment, which could not happen in reality, it is simply not possible for Tacoma LNG to emit more than 250 tons per year of VOCs. And, even if Tacoma LNG were subject to the 100-ton threshold, the thought experiment demonstrates that Tacoma LNG cannot practically be a major source given that that Landau calculated fugitive emissions were 4.2 tons per year.

Given that (1) Case 5 is made up of 58% VOCs, which is likely to be an overstatement given how CB&I created Case 5, and (2) Case 5 assumes 34 MMBtu/hr of heat input, even though this too overstates the likely maximum heat input that will operationally be sent to the flare given how CB&I created Case 5, the 44.8 tons of VOC emissions calculated for the permit PTE is a very conservative potential to emit. Based on the information I have about Tacoma LNG and the calculations I performed in this thought experiment, I am confident that this facility's PTE does not exceed 100 tpy under any feed gas composition scenario.

Q: IS THE RESULT THE SAME IF CONSIDERING FUTURE POTENTIAL FEED GAS CHANGES?

A: Yes, given the constraints on potential to emit (99% destruction of VOCs and 34 MMBtu/hr maximum flaring capacity), Tacoma LNG cannot be a major source of VOCs regardless of how feed gas changes in the future.

Q: THE TRIBE HAS ALLEGED ERRORS WITH THE ESTIMATION FUGITIVE OF VOCS FROM TACOMA LNG. IF LANDAU HAD MADE THE ALLEGED ERRORS, WOULD TACOMA LNG BE A MAJOR SOURCE OF VOCS?

A: As a threshold matter, the estimation of the quantity of fugitive emissions is irrelevant to determining whether Tacoma LNG is a major source, because—as discussed earlier—fugitive emissions are properly excluded from this calculation for a source subject to the 250-ton major source threshold. Additionally, Dr. Sahu's criticisms of the fugitive emission methodology utilized by Landau is without merit. First, as noted earlier, for fugitive component emissions, it was proper for a control factor to be applied to account for the inspection and maintenance program (*i.e.*, LDAR). This practice is accepted by permitting agencies,[104] and was accepted by the Agency.[105] Second, and as discussed earlier, the emission factors for fugitive emissions from process components used to estimate VOC emissions were highly conservative as applied to Tacoma LNG because the facility's gases and liquids contain substantial amounts of methane and ethane. These are not VOCs but were counted as VOCs for the purposes of Landau's fugitive emissions calculations in the NOC. However, hypothetically, if fugitive emissions at Tacoma LNG were to even quadruple, the total VOC emissions would still be far below the PSD major source level of 100 tpy (if they were to count toward the calculation of emissions for this purpose).

Q: THE TRIBE ALSO ALLEGES THAT THE FLARE'S DESTRUCTION EFFICIENCY IS LOWER THAN 99 PERCENT. IF THAT IS CORRECT, WOULD TACOMA LNG BE A MAJOR SOURCE OF VOCS?

A: What the Tribe thinks the flare can do is not relevant here. Condition 15 of the NOC Order of Approval requires that Tacoma LNG's flare achieve a minimum destruction efficiency of 99% for VOCs. As discussed earlier, PTE includes enforceable permit limits, of which the 99% destruction efficiency is one. The flare's VOC destruction efficiency will be verified by source testing and must continue to operate at or above the temperature for which it is verified to have a

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[104] *See* RA-98, TCEQ Air Permit Technical Guidance for Chemical Sources: Fugitive Guidance, APDG 6422 (June 2018). https://www.tceq.texas.gov/assets/public/permitting/air/Guidance/NewSourceReview/fugitive-guidance.pdf; RA-79, EPA, Protocol for Equipment Leak Emission Estimates (1995).
[105] RA-68, Final NOC Worksheet.

99% destruction efficiency, as required by Conditions 21 and 28 of the permit. This is a standard method to ensure consistent destruction of thermal devices. Therefore, the enforceability of the 99% destruction efficiency of VOCs is inherent in Tacoma LNG's PTE VOCs, regardless of the Tribe's unfounded allegations about the flare's destruction efficiency.

Q: DR. SAHU BELIEVES THAT EMISSIONS FROM THE FLARE BYPASS SHOULD HAVE BEEN INCLUDED IN TACOMA LNG'S PTE CALCULATIONS. DO YOU AGREE?

A: No. The Agency appropriately calculated Tacoma LNG's PTE. Regulatory agencies do not include in PTE emissions prohibited by a permit that arise as the result of a malfunction that is not reasonably foreseeable. Emissions from the flare bypass are both prohibited by the permit and would result only from a malfunction that I understand is not reasonably foreseeable.

Waste gases from the Tacoma LNG process are not permitted to bypass the flare. Condition 10 and 11 of the permit require that waste gases be routed to the enclosed ground flare and that the flare be continuously operating at all times. Condition 11 further requires that all processes routed to the flare must be shut down if the flare is not in service. There is no provision that allows the waste gases to be sent to the bypass vent. Condition 46i requires that all gases vented to the bypass be recorded.[106] These are enforceable permit conditions, subject to penalties. Accordingly, it is appropriate to exclude flare bypass venting, which would result in unpermitted emissions, when calculating the facility's PTE, consistent with EPA guidance[107] and with the definition of "potential to emit" in Washington State regulations.

The flare bypass vent was installed as a safety precaution at the facility but is not ever planned to be used. In his deposition, Mr. Stobart states regarding the vent: "[i]t's a safety device, that vent, and it will never be used for anything other than that."[108] He later notes that the flare vent would be used in a "shutdown mode" where the entire system will be shut down.[109] It is analogous to the installation of fire prevention systems. A facility may install these systems as a safety measure, but a regulatory agency would not require a calculation of emissions resulting from a fire in a facility's PTE.

[106] Under Condition 46(i), Tacoma LNG is required to keep a written log showing any instance of flare bypass, which must include the date, time, duration, and estimated amount of waste gases released to the atmosphere. The Agency will have full information about Tacoma LNG's bypass events, if any actually occur, and can enforce violations of the permit against Tacoma LNG.
[107] U.S. EPA Memorandum. "State Implementation Plans: Policy Regarding Excess Emissions During Malfunctions, Startup, and Shutdown." September 20, 1999, https://www3.epa.gov/ttn/naaqs/aqmguide/collection/t5/excesem2.pdf; U.S. EPA Letter to Mr. William O'Sullivan, Director, Division of Air Quality, New Jersey Department of Environmental Protection. February 14, 2006.
[108] Deposition of Matthew Stobart, 131:15-16 (Feb. 16, 2021).
[109] Deposition of Matthew Stobart, 383:6-12 (Feb. 18, 2021).

Q: DR. SAHU BELIEVES THAT EMISSIONS FROM THE PROCESS HEATERS WERE IGNORED IN TACOMA LNG'S PTE CALCULATIONS. DO YOU AGREE?

A: No. As part of the permit process, Landau calculated emissions from the two process heaters. These calculations are included within Attachment A to the permit application.[110] The emissions from the water propylene glycol heater were calculated to be 0.20 tons per year of VOCs and the emissions from the regeneration pretreatment heater were calculated to be 0.035 tons per year of VOCs.[111] Thus, Dr. Sahu is incorrect that the permit did not calculate potential to emit from these heaters. Furthermore, the emissions are immaterial to the PTE calculation.

OPINION 7: IT IS APPROPRIATE TO USE THE SUM OF BACKGROUND DATA AND MODELED CONCENTRATIONS FOR COMPARISON TO THE NAAQS/WAAQS.

[110] RA-61(c), Attachment A - PSE LNG Emissions (rev. November 28, 2017).
[111] *Id.*