PUGET SOUND ENERGY

Puget Sound Energy
P.O. Box 97034
Bellevue, WA 98009-9734
PSE.com

September 15, 2017

**BY U.S. MAIL AND EMAIL**

Mr. Ralph Munoz
Reviewing Engineer
Puget Sound Clean Air Agency
1904 3rd Avenue, Suite 105
Seattle, WA 98101-3317

**Re: Supplemental Information for Tacoma LNG Notice of Construction Application**

Dear Ralph:

Puget Sound Energy ("PSE") is submitting this supplement with additional information regarding the May 22, 2017 Notice of Construction (NOC) application for the Tacoma LNG facility. This supplement includes an updated emission calculation spreadsheet and dispersion modeling results including related electronic files. These updates are based on the changes to the flare burner design and sulfur content of incoming natural gas, conservatively estimated percentages of $H_2S$ and other reduce sulfur compounds in the flared gas presented in our August 11, 2017 letter. This supplement also addresses updated Toxic Air Pollutant (TAP) emission factors and alternative metrological data for the dispersion modeling that you have suggested and we have discussed with you.

## Flare Emissions

As discussed in our August 11, 2017 letter, the proposed flare would have multiple burners (two large high-heat input burners with low-$NO_X$ technology, and two low heat input burners). In addition, the sulfur concentration of the feed gas has been updated to a conservative value that is based on our analysis of reported measurements for Williams Northwest Pipeline gas, and the addition of odorants by Williams and PSE. As such, the emissions factors have changed since we submitted our original application on May 22, 2017. For your convenience we have updated our emission calculations spreadsheet (also attached in electronic format, as requested).

A description of the four burners and six waste gas cases was provided in our August 11, 2017 letter. Three additional waste gas cases have been added, thereby expanding those scenarios described in our August 11, 2017 letter to include the blow down and purge of the LNG bunkering arm and truck loading hoses. These low-flow gases would be combusted by a small, "cold burner". One purge case relates to both ship bunkering and truck loading occurring simultaneously. The second purge case relates to only one of these type of transfer activity types occurring, but not both. To calculate emissions from the small cold burner, we estimated the number of purges that could result from each transfer activity.

For ship bunkering, transfer would occur twice per week and so there is a maximum of 2 loading arm purges weekly and 104 annually. The loading hose purge consists of a mixture of methane and nitrogen in the first 30-45 minutes (rich gas) and the remaining 30-45 minutes of the purge consists mostly of nitrogen (lean gas). To be conservative and for simplicity, we assume that the rich and lean gas purges of ship bunkering arms would last an entire hour each. For purposes of air permitting and ambient impacts modeling, we calculated emissions based on the worst-case scenario possible during that averaging (e.g., 1-hour, 3-hour, 8-hour and 24-hour). Annual emissions are based on 2 hours per week of rich and 2 hours per week of lean loading arm purging (total of 208 hours). These assumptions considerably overstate the duration of actual purge time and the resulting flare emissions.

The number of truck loading purges varies by the number of truckloads of LNG that are moved off site as there is one purge for each truck load event. The purging of the truck loading rack hoses takes about 5 minutes per truck loading event. [1] The facility anticipates only loading, on average, two LNG tankers per day and so actual emissions would be limited to 10 minutes of truck loading rack hose purging per day. For purposes of air permitting and ambient impacts modeling, we calculated emissions based on the theoretical physical capacity of the equipment, i.e., 10 minutes of truck loading rack hose purging per hour for short term averaging periods (e.g., 1-hour, 3-hour, 8-hour and 24-hour) and 62.5 minutes of truck loading rack hose purging per day for annual emissions (total 380 hours). Keep in mind that these assumptions considerably overstate the duration of the actual purge time and the resulting flare emissions.

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[1] Because purging of truck loading hoses lasts only 5 minutes per truck, the single-stage nitrogen purge process for trucks is simpler than the 2-stage (rich gas / lean gas nitrogen) purge process that lasts for 1 hour for the marine vessel bunkering arm.

## Facility-Wide Emissions Summary

The facility would operate year-round, with the exception of 7 days per year when liquefaction and vaporization would be shut down for maintenance. During this annual maintenance period, the ground flare would operate at a relatively low level and facility-wide emissions would be significantly less than during normal operation. Emission calculations for this permit application conservatively assume 8,760 hours per year facility operation and do not take credit for reduced emissions during annual maintenance.

As described in our August 11, 2017 submittal, a “flare holding scenario” applies when the vaporizer is running (maximum 10 days per year) or any other time the facility is not liquefying. Liquefaction cannot occur while vaporization is occurring and vice versa. When neither liquefaction nor vaporization is occurring, the flare operates in the holding mode. Thus the maximum liquefaction operating scenario consists of 8,760 hours per year of liquefaction and no vaporization/reinjection. The maximum vaporization operating scenario consists of 8,520 hours per year of liquefaction and 240 hours per year of vaporization. Therefore, in order to conservatively estimate emissions, we calculated the emissions for each of the two operating scenarios. We then took the highest annual emission rate for each pollutant between the two scenarios to calculate the worst-case annual total. The emissions would be highest for all pollutants except $PM_{10}$/$PM_{2.5}$ when the facility is liquefying. Therefore, for the purposes of the emissions calculations for the ground flare, we conservatively assume that liquefying operations would occur every hour of the year (8,760 hours per year) for all pollutants except $PM_{10}$/$PM_{2.5}$. For $PM_{10}$/$PM_{2.5}$, we assume liquefying operations occur for 8,520 hours per year and vaporizing operations occur for 240 hours per year.

The ship bunkering and truck loading operations and fugitives are independent of the facility’s liquefaction and vaporization operating modes, so emissions from the small cold burner and the fugitives are added to both facility-wide totals.

The resultant potential-to-emit for the project (excluding exempt units) is provided in Table A-11 of Attachment A and summarized below.

**Table 1: Potential Annual Emissions Summary**

| Pollutant | Vaporizer (tpy) | Enclosed Ground Flare (tpy) | Fugitives (tpy) | Facility-Wide Total | | |
|---|---|---|---|---|---|---|
| | | | | Liquefying Only (tpy) | Vaporizing 10 Days (tpy) | Worst-Case (tpy) |
| $PM_{10}/PM_{2.5}$ | 0.055 | 1.2 | 0 | 1.2 | 1.2 | 1.2 |
| $SO_2$ | 0.017 | 9.1 | 0 | 9.1 | 8.9 | 9.1 |
| $NO_x$ | 0.086 | 3.7 | 0 | 3.8 | 3.8 | 3.8 |
| CO | 0.29 | 12 | 0 | 12 | 12 | 12 |
| VOCs | 0.040 | 45 | 4.2 | 49 | 43 | 49 |
| Lead | 3.6E-06 | 8.0E-05 | 0 | 8.0E-05 | 8.2E-05 | 8.2E-05 |
| Total HAPs | 0.037 | 3.2 | 3.4E-05 | 4.0 | 4.0 | 4.0 |

tpy = tons per year
HAP = Hazardous Air Pollutant
TAP = Toxic Air Pollutant

## Toxic Air Pollutants

As a new source, the Tacoma LNG Project is required to conduct an evaluation for all TAPs identified in WAC 173-460-150, as adopted in Regulation III, Section 2.07. Each listed TAP has an established Small-Quantity Emission Rate (SQER) and an Acceptable Source Impact Level (ASIL). If the TAP emission rate from a source is above its SQER, further determination of compliance with the ASIL is required.

As requested on our September 8, 2017 call, LAI reviewed the TAP emission factors provided for a natural gas boiler from a recent air permitting application received by PSCAA. Table 2 contains our notes on the applicability of these emission factors to the proposed Tacoma LNG facility.

**Table 2: Review of TAP Emission Factors Supplied by PSCAA**

| Pollutant | Emission Factor[a] | Reference[a] | Notes |
|---|---|---|---|
| Acetaldehyde | 5.79E-03 | Average of CATEF (median value) and AB2588 | Pollutant is added to PSE's emission inventory using the maximum value in these references (see Table 3). |
| Acrolein | 2.70E-03 | AB2588 | Pollutant is added to PSE's emission inventory with this emission factor. |

| Pollutant | Emission Factor[a] | Reference[a] | Notes |
|---|---|---|---|
| Ammonia | 1.17 | Average of WebFIRE and AB2588 | Pollutant is added to emission inventory. We could not verify value provided, so we used the value from the reference (see explanation below). |
| Arsenic | 2.04E-04 | WebFIRE | We could not verify value provided. WebFIRE contains a value of 2.00E-04 from AP-42, which is the value we continue to use in our emission inventory. |
| Benzene | 4.16E-03 | Average of WebFIRE, CATEF (median value), AB2588 and SDAPCD | We could not verify value provided, so we used values found from the references (see the explanation below). |
| Carbon dioxide | 1.20E+05 | WebFIRE | Not applicable. $CO_2$ is not a TAP. |
| Carbon monoxide (CO) | 39.2 | Cleaver Brooks emissions data | This Cleaver Brooks emission factor is not applicable to the LNG Facility's proposed burner. Our emission inventory continues to use manufacturer-provided data (see explanation below). |
| Dichlorobenzene | 1.20E-03 | SDAPCD | This value is the same as AP-42, and does not represent a change to PSE's previous emission inventory. |
| Ethylbenzene | 6.90E-03 | AB2588 | Pollutant is added to PSE's emission inventory with this emission factor. |
| Formaldehyde | 0.058 | Average of WebFIRE, CATEF (median value), AB2588 and SDAPCD | This value is less than AP-42. Our inventory continues to use AP-42 to be conservative. |
| Hexane | 0.902 | Average of AB2588 and SDAPCD | This value is less than AP-42. Our inventory continues to use AP-42 to be conservative. |
| Hydrocarbons (VOCs) | 4.48 | Cleaver Brooks emissions data | This Cleaver Brooks emission factor is not applicable to the LNG Facility's proposed burner. Our emission inventory continues to use manufacturer-provided data (see explanation below). |
| Mercury | 2.60E-04 | WebFIRE | This value is the same as AP-42, and does not represent a change to PSE's |

| Pollutant | Emission Factor[a] | Reference[a] | Notes |
|---|---|---|---|
| | | | previous emission inventory. |
| Methane | 2.3 | WebFIRE | Not applicable. Methane is not a TAP. |
| Naphthalene | 4.55E-04 | Average of AB2588 and SDAPCD | This value is less than AP-42. Our inventory continues to use AP-42 to be conservative. |
| Nitrogen dioxide ($NO_2$) | 1.13 | 10% of $NO_x$ | PSE's emission inventory previously used the same assumption and continues to do so. |
| Nitrogen oxides ($NO_x$) | 11.3 | Cleaver Brooks emissions data | This Cleaver Brooks value is not applicable to the LNG Facility's proposed burner. Our emission inventory continues to use manufacturer-provided data (see explanation below). |
| Nitrous oxide | 0.64 | WebFIRE | Not applicable. Nitrous oxide is not a TAP. |
| Particulate matter (PM) | 10.4 | Cleaver Brooks emissions data | This Cleaver Brooks value is not applicable to the LNG Facility's proposed burner. Our emission inventory continues to use manufacturer-provided data (see explanation below). |
| Propylene | 0.53 | AB2588 | Pollutant is added to PSE's emission inventory with this emission factor. |
| Sulfur dioxide ($SO_2$) | 1.67 | 100% of fuel sulfur - AP-42[1] | This value is the same as AP-42, and does not represent a change to PSE's previous emission inventory. |
| Toluene | 0.015 | Average of WebFIRE, AB2588 and SDAPCD | We agree to use this factor in our revised emission inventory using the maximum value in these references (see Table 3). |
| Xylenes | 0.02 | AB2588 | Pollutant is added to PSE's emission inventory with this emission factor. |

[a] Email from Ralph Munoz on September 8, 2017.

If the emission factor that you provided is greater than AP-42, we have updated our inventory with the higher emission factor. As noted above, several TAPs were not listed in AP-42 and were added to the emission inventory for the natural gas combustion sources. For the flare, please note that benzene, ethylbenzene, toluene, and xylenes emission factors are still based on the flare inlet gas composition and flare destruction efficiency. We could not verify all of the emission factor values provided in your September 8, 2017 email. In these cases, we used the value found in the reference listed for the emission factor. Also, to be conservative, we used the maximum value from the references that you listed instead of the average value. Table 3 shows the maximum emission factors found in each of the references that you provided.

**Table 3: Emission Factors Updated in the TAP Emission Inventory**

| Pollutant | CATEF[a] | WebFIRE[b] | SDAPCD[c] | AB2588[d] | Maximum |
|---|---|---|---|---|---|
| Acetaldehyde | 8.47E-03 | -- | -- | 3.10E-03 | **8.47E-03** |
| Acrolein | -- | -- | -- | 2.70E-03 | **2.70E-03** |
| Ammonia | -- | 3.20E+00 | -- | 3.20E+00 | **3.20E+00** |
| Benzene | 2.15E-03 | 2.10E-03 | 2.10E-03 | 5.80E-03 | **5.80E-03** |
| Ethylbenzene | -- | -- | -- | 6.90E-03 | **6.90E-03** |
| Propylene | -- | -- | -- | 5.30E-01 | **5.30E-01** |
| Toluene | -- | 3.40E-03 | 3.40E-03 | 2.65E-02 | **2.65E-02** |
| Xylenes | -- | -- | -- | 1.97E-02 | **1.97E-02** |

[a] California Air Toxics Emission Factors (median value) for natural gas boilers.
[b] EPA's Web Factor Information Retrieval System (WebFIRE) database, External Combustion Boilers, Industrial, Natural Gas, 10-100 Million Btu/hr.
[c] San Diego Air Pollution Control District emission factor tables, Boilers, Natural Gas Fired, 0.3-100 MMBTU/hr, Low NOx Burners.
[d] Maximum South Coast Air Quality Management District and Ventura County Air Pollution Control District's default emission factors for AB2588 reporting, External Combustion, Natural Gas, 10-100 MMBTU/HR.

Table 4 shows the updated TAP emission estimates as compared to *de minimis* value and SQER for each pollutant (further details on the emission calculations are provided in the attached file). TAP emissions have been recalculated with emission factors in Table 3. Twelve TAPs have emissions greater than the *de minimis* level and require review for the Tacoma LNG Project under Chapter 173-460 WAC. The Best Available Control Technology (BACT) for TAPs (tBACT) in Section 4 of the May 22, 2017 application and August 11, 2017 response letter is applicable to these TAPs. Additional analysis for $H_2S$ is provided below. The ambient air quality assessment update for the six TAPs with emissions greater than the SQER is provided in the following section.

**Table 4: Project Emissions Compared to *De Minimis* and Small-Quantity Emission Rates**

| Pollutant | CAS Number | Averaging Period | Emission Rate | *De Minimis*[a] | SQER[a] | Review Required? |
|---|---|---|---|---|---|---|
| | | | (pounds per averaging period) | | | |
| 1,4-Dichlorobenzene | 106-46-7 | year | 0.39 | 0.872 | 17.4 | -- |
| 3-Methylchloranthrene | 56-49-5 | year | 5.9E-04 | 0.00153 | 0.0305 | -- |
| 7,12-Dimethylbenz(a)anthracene | 57-97-6 | year | 0.0052 | 0.000135 | 0.00271 | Yes |
| Acetaldehyde | 75-07-0 | year | 2.8 | 3.55 | 71 | -- |
| Acrolein | 107-02-8 | 24-hr | 0.0041 | 0.000394 | 0.00789 | Yes |
| Ammonia | 7664-41-7 | 24-hr | 41 | 0.465 | 9.31 | Yes |
| Arsenic | 7440-38-2 | year | 0.065 | 0.00291 | 0.0581 | Yes |
| Benz(a)anthracene | 56-55-3 | year | 5.9E-04 | 0.0872 | 1.74 | -- |
| Benzene | 71-43-2 | year | 0.66 | 0.331 | 6.62 | Yes |
| Benzo(a)pyrene | 50-32-8 | year | 3.9E-04 | 0.00872 | 0.174 | -- |
| Benzo(b)fluoranthene | 205-99-2 | year | 5.9E-04 | 0.0872 | 1.74 | -- |
| Benzo(k)fluoranthene | 207-08-9 | year | 5.9E-04 | 0.0872 | 1.74 | -- |
| Beryllium | 7440-41-7 | year | 0.0039 | 0.004 | 0.08 | -- |
| Cadmium | 7440-43-9 | year | 0.36 | 0.00228 | 0.0457 | Yes |
| Carbon monoxide | 630-08-0 | 1-hr | 3.2 | 1.14 | 50.4 | Yes |
| Chrysene | 218-01-9 | year | 5.9E-04 | 0.872 | 17.4 | -- |
| Cobalt | 7440-48-4 | 24-hr | 1.3E-04 | 0.000657 | 0.013 | -- |
| Copper | Cu | 1-hr | 5.4E-05 | 0.011 | 0.219 | -- |
| Dibenzo(a,h)anthracene | 53-70-3 | year | 3.9E-04 | 0.00799 | 0.16 | -- |
| Dichlorobenzene | 106-46-7 | year | 3.9E-01 | 0.872 | 17.4 | -- |
| Ethylbenzene | 100-41-4 | year | 0.13 | 3.84 | 76.8 | -- |
| Formaldehyde | 50-00-0 | year | 24 | 1.6 | 32 | Yes |
| Hexane | 110-54-3 | 24-hr | 3.1 | 4.6 | 92 | -- |
| Hydrogen sulfide | 2148878 | 24-hr | 0.27 | 0.0131 | 0.263 | Yes |
| Indeno(1,2,3-cd)pyrene | 193-39-5 | year | 5.9E-04 | 0.0872 | 1.74 | -- |

| Pollutant | CAS Number | Averaging Period | Emission Rate | *De Minimis*[a] | SQER[a] | Review Required? |
|---|---|---|---|---|---|---|
| Lead | 7439-92-1 | year | 0.16 | 10 | 16 | -- |
| m,p-Xylene | 106-42-3 | 24-hr | 0.029 | 1.45 | 29 | -- |
| Manganese | 7439-96-5 | 24-hr | 5.8E-04 | 0.000263 | 0.00526 | Yes |
| Mercury | 7439-97-6 | 24-hr | 4.0E-04 | 0.000591 | 0.0118 | -- |
| Naphthalene | 91-20-3 | year | 0.20 | 0.282 | 5.64 | -- |
| Nitrogen dioxide | 10102-44-0 | 1-hr | 0.10 | 0.457 | 1.03 | -- |
| o-Xylene | 95-47-6 | 24-hr | 1.2E-04 | 1.45 | 29 | -- |
| Propylene | 115-07-1 | 24-hr | 0.78 | 19.7 | 394 | -- |
| Selenium | 7782-49-2 | 24-hr | 3.7E-05 | 0.131 | 2.63 | -- |
| Sulfur dioxide | 2025884 | 1-hr | 2.1 | 0.457 | 1.45 | Yes |
| Toluene | 108-88-3 | 24-hr | 0.039 | 32.9 | 657 | -- |
| Vanadium | 7440-62-2 | 24-hr | 0.0035 | 0.00131 | 0.0263 | Yes |

[a] WAC 173-460-150
[b] For comparison with the *de minimis* and SQER, only the in-stack portion of $NO_x$ that is $NO_2$ is quantified. The U.S. Environmental Protection Agency's (EPA's) default value of 10% for the $NO_2$ to $NO_x$ ratio is used to estimate total $NO_2$.

Control technologies that have been evaluated for criteria pollutant BACT for $SO_2$ from the flare (discussed in our August 11, 2017 response letter) are also applicable for $H_2S$. The BACT cost-effectiveness evaluation provided in our August 11, 2017 response letter demonstrated the cost of desulfurization technology is disproportionately high compared to the emission reduction that can be achieved. Furthermore, the facility's $H_2S$ emission rate is less than 1% of the $SO_2$ emission rate. Therefore, desulfurization technology is also not cost effective for $H_2S$ removal from natural gas and flared gases. A tBACT analysis for the fugitive emissions was presented in Section 4.2 of the May 22, 2017 application and is applicable to fugitive emissions of $H_2S$.

## Updated Dispersion Modeling for Criteria Air Pollutants and Toxic Air Pollutants

The ambient air quality analysis was updated for the following changes:

1. Flare stack height increase to 105 feet,
2. Flare inside diameter decrease to 6 feet,
3. Updated emission estimates,
4. $H_2S$ and ammonia are added to the dispersion modeling analysis for TAPs, and

5. $NO_2$ concentrations compared to the EPA's more stringent 7.5 µg/$m^3$ interim Significant Impact Level (SIL) for $NO_2$.

The emission rates for each flare burner and waste gas case were updated for the new burner configuration and flared gas sulfur content. The emission rates for the combined operation of the burners for the operating scenarios described above are provided in Table 5, Table 6, and Table 7.

**Table 5: Short-Term Emission Rates for Each Flare Operating Scenario**

| Operating Scenario Number | Scenario Description | Modeling Source ID | $NO_x$ (lb/hr) | CO (lb/hr) | $SO_2$ (lb/hr) | $PM_{10}$/ $PM_{2.5}$ (lb/hr) |
|---|---|---|---|---|---|---|
| 1 | Liquefying Case 1 | LW1 | 2.4E-01 | 0.765 | 2.1E+00 | 7.6E-02 |
| 1 | Liquefying Case 2 | SW2 | 1.6E-01 | 4.9E-01 | 9.6E-01 | 1.9E-02 |
| 1 | Liquefying Case 3 | LW3 | 7.9E-01 | 2.5E+00 | 1.9E+00 | 2.6E-01 |
| 1 | Liquefying Case 4 | LW4 | 8.2E-01 | 2.6E+00 | 1.9E+00 | 2.7E-01 |
| 1 | Liquefying Case 5 | LW5 | 8.6E-01 | 2.7E+00 | 2.1E+00 | 2.8E-01 |
| 3 | Liquefying Case 1, Truck and Ship Loading A1 | LWSC1A1 | 3.9E-01 | 1.2E+00 | 2.1E+00 | 9.4E-02 |
| 3 | Liquefying Case 2, Truck and Ship Loading A1 | SWSC2A1 | 3.1E-01 | 9.3E-01 | 9.6E-01 | 3.7E-02 |
| 3 | Liquefying Case 3, Truck and Ship Loading A1 | LWSC3A1 | 9.4E-01 | 3.0E+00 | 1.9E+00 | 2.8E-01 |
| 3 | Liquefying Case 4, Truck and Ship Loading A1 | LWSC4A1 | 9.7E-01 | 3.1E+00 | 1.9E+00 | 2.8E-01 |
| 3 | Liquefying Case 5, Truck and Ship Loading A1 | LWSC5A1 | 1.0E+00 | 3.2E+00 | 2.1E+00 | 3.0E-01 |
| 3 | Liquefying Case 1, Truck or Ship Loading A2 | LWSC1A2 | 3.7E-01 | 1.1E+00 | 2.1E+00 | 9.2E-02 |
| 3 | Liquefying Case 2, Truck or Ship Loading A2 | SWSC2A2 | 2.9E-01 | 8.7E-01 | 9.6E-01 | 3.4E-02 |
| 3 | Liquefying Case 3, Truck or Ship Loading A2 | LWSC3A2 | 9.2E-01 | 2.9E+00 | 1.9E+00 | 2.7E-01 |
| 3 | Liquefying Case 4, Truck or Ship Loading A2 | LWSC4A2 | 9.5E-01 | 3.0E+00 | 1.9E+00 | 2.8E-01 |
| 3 | Liquefying Case 5, Truck or Ship Loading A2 | LWSC5A2 | 9.8E-01 | 3.1E+00 | 2.1E+00 | 2.9E-01 |
| 3 | Liquefying Case 1, Blow Down and Purge B | LWSC1B | 3.0E-01 | 9.3E-01 | 2.1E+00 | 8.3E-02 |
| 3 | Liquefying Case 2, Blow Down and Purge B | SWSC2B | 2.2E-01 | 6.6E-01 | 9.6E-01 | 2.5E-02 |
| 3 | Liquefying Case 3, Blow Down and Purge B | LWSC3B | 8.5E-01 | 2.7E+00 | 1.9E+00 | 2.6E-01 |
| 3 | Liquefying Case 4, Blow Down and Purge B | LWSC4B | 8.8E-01 | 2.8E+00 | 1.9E+00 | 2.7E-01 |
| 3 | Liquefying Case 5, Blow Down and Purge B | LWSC5B | 9.1E-01 | 2.9E+00 | 2.1E+00 | 2.8E-01 |
| 2, 5 | Flare Holding | FLAREH | 5.8E-02 | 1.7E-01 | 1.4E-03 | 6.8E-03 |
| 6 | Flare Holding, Truck and Ship Loading A1 | SWSCHA1 | 2.1E-01 | 6.2E-01 | 1.4E-03 | 2.5E-02 |
| 6 | Flare Holding, Truck or Ship Loading A2 | SWSCHA2 | 1.9E-01 | 5.5E-01 | 1.4E-03 | 2.3E-02 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 6 | Flare Holding, Blow Down and Purge B | SWSCHB | 1.1E-01 | 3.4E-01 | 1.4E-03 | 1.4E-02 |

lb/hr = pounds per hour

**Table 6: Criteria Pollutant Annual Emission Rates for Each Flare Operating Scenario**

| Operating Scenario Number | Scenario Description | Modeling Source ID | $NO_x$ (tpy) | $SO_2$ (tpy) | $PM_{10}$/ $PM_{2.5}$ (tpy) |
|---|---|---|---|---|---|
| 1 | Liquefying Case 1 | LW1 | 1.0E+00 | 9.1E+00 | 3.3E-01 |
| 1 | Liquefying Case 2 | SW2 | 7.2E-01 | 4.2E+00 | 8.1E-02 |
| 1 | Liquefying Case 3 | LW3 | 3.5E+00 | 8.3E+00 | 1.1E+00 |
| 1 | Liquefying Case 4 | LW4 | 3.6E+00 | 8.5E+00 | 1.2E+00 |
| 1 | Liquefying Case 5 | LW5 | 3.7E+00 | 9.0E+00 | 1.2E+00 |
| 3 | Liquefying Case 1, Truck and Ship Loading A1 | LWSC1A1 | 1.1E+00 | 9.1E+00 | 3.3E-01 |
| 3 | Liquefying Case 2, Truck and Ship Loading A1 | SWSC2A1 | 7.3E-01 | 4.2E+00 | 8.2E-02 |
| 3 | Liquefying Case 3, Truck and Ship Loading A1 | LWSC3A1 | 3.5E+00 | 8.3E+00 | 1.1E+00 |
| 3 | Liquefying Case 4, Truck and Ship Loading A1 | LWSC4A1 | 3.6E+00 | 8.5E+00 | 1.2E+00 |
| 3 | Liquefying Case 5, Truck and Ship Loading A1 | LWSC5A1 | 3.8E+00 | 9.0E+00 | 1.2E+00 |
| 3 | Liquefying Case 1, Truck or Ship Loading A2 | LWSC1A2 | 1.1E+00 | 9.1E+00 | 3.4E-01 |
| 3 | Liquefying Case 2, Truck or Ship Loading A2 | SWSC2A2 | 7.5E-01 | 4.2E+00 | 8.5E-02 |
| 3 | Liquefying Case 3, Truck or Ship Loading A2 | LWSC3A2 | 3.5E+00 | 8.3E+00 | 1.1E+00 |
| 3 | Liquefying Case 4, Truck or Ship Loading A2 | LWSC4A2 | 3.6E+00 | 8.5E+00 | 1.2E+00 |
| 3 | Liquefying Case 5, Truck or Ship Loading A2 | LWSC5A2 | 3.8E+00 | 9.0E+00 | 1.2E+00 |
| 3 | Liquefying Case 1, Blow Down and Purge B | LWSC1B | 1.0E+00 | 9.1E+00 | 3.3E-01 |
| 3 | Liquefying Case 2, Blow Down and Purge B | SWSC2B | 7.2E-01 | 4.2E+00 | 8.2E-02 |
| 3 | Liquefying Case 3, Blow Down and Purge B | LWSC3B | 3.5E+00 | 8.3E+00 | 1.1E+00 |
| 3 | Liquefying Case 4, Blow Down and Purge B | LWSC4B | 3.6E+00 | 8.5E+00 | 1.2E+00 |
| 3 | Liquefying Case 5, Blow Down and Purge B | LWSC5B | 3.7E+00 | 9.0E+00 | 1.2E+00 |
| 2, 5 | Flare Holding | FLAREH | 2.5E-01 | 6.1E-03 | 3.0E-02 |
| 6 | Flare Holding, Truck and Ship Loading A1 | SWSCHA1 | 2.6E-01 | 6.1E-03 | 3.1E-02 |
| 6 | Flare Holding, Truck or Ship Loading A2 | SWSCHA2 | 2.8E-01 | 6.1E-03 | 3.4E-02 |
| 6 | Flare Holding, Blow Down and Purge B | SWSCHB | 2.6E-01 | 6.1E-03 | 3.0E-02 |

tpy = tons per year

**Table 7: Toxic Air Pollutant Annual Emission Rates for Each Flare Operating Scenario**

| Operating Scenario Number | Scenario Description | Modeling Source ID | Ammonia (lb/hr) | Arsenic (tpy) | Cadmium (tpy) | 7,12-Dimethylbenz (a)anthracene (tpy) | Hydrogen Sulfide (lb/hr) |
|---|---|---|---|---|---|---|---|
| 1 | Liquefying Case 1 | LW1 | 3.2E-02 | 8.7E-06 | 4.8E-05 | 7.0E-07 | 1.1E-02 |
| 1 | Liquefying Case 2 | SW2 | 7.8E-03 | 2.1E-06 | 1.2E-05 | 1.7E-07 | 5.2E-03 |
| 1 | Liquefying Case 3 | LW3 | 1.1E-01 | 3.0E-05 | 1.6E-04 | 2.4E-06 | 1.0E-02 |
| 1 | Liquefying Case 4 | LW4 | 1.1E-01 | 3.1E-05 | 1.7E-04 | 2.4E-06 | 1.0E-02 |
| 1 | Liquefying Case 5 | LW5 | 1.2E-01 | 3.2E-05 | 1.8E-04 | 2.6E-06 | 1.1E-02 |
| 3 | Liquefying Case 1, Truck and Ship Loading A1 | LWSC1A1 | 3.6E-01 | 8.8E-06 | 4.8E-05 | 7.0E-07 | 1.1E-02 |
| 3 | Liquefying Case 2, Truck and Ship Loading A1 | SWSC2A1 | 3.3E-01 | 2.2E-06 | 1.2E-05 | 1.7E-07 | 5.2E-03 |
| 3 | Liquefying Case 3, Truck and Ship Loading A1 | LWSC3A1 | 4.3E-01 | 3.0E-05 | 1.6E-04 | 2.4E-06 | 1.0E-02 |
| 3 | Liquefying Case 4, Truck and Ship Loading A1 | LWSC4A1 | 4.4E-01 | 3.1E-05 | 1.7E-04 | 2.5E-06 | 1.0E-02 |
| 3 | Liquefying Case 5, Truck and Ship Loading A1 | LWSC5A1 | 4.4E-01 | 3.2E-05 | 1.8E-04 | 2.6E-06 | 1.1E-02 |
| 3 | Liquefying Case 1, Truck or Ship Loading A2 | LWSC1A2 | 1.6E+00 | 8.8E-06 | 4.9E-05 | 7.1E-07 | 1.1E-02 |
| 3 | Liquefying Case 2, Truck or Ship Loading A2 | SWSC2A2 | 1.5E+00 | 2.2E-06 | 1.2E-05 | 1.8E-07 | 5.2E-03 |
| 3 | Liquefying Case 3, Truck or Ship Loading A2 | LWSC3A2 | 1.6E+00 | 3.0E-05 | 1.6E-04 | 2.4E-06 | 1.0E-02 |
| 3 | Liquefying Case 4, Truck or Ship Loading A2 | LWSC4A2 | 1.6E+00 | 3.1E-05 | 1.7E-04 | 2.5E-06 | 1.0E-02 |
| 3 | Liquefying Case 5, Truck or Ship | LWSC5A2 | 1.6E+00 | 3.2E-05 | 1.8E-04 | 2.6E-06 | 1.1E-02 |

| Operating Scenario Number | Scenario Description | Modeling Source ID | Ammonia (lb/hr) | Arsenic (tpy) | Cadmium (tpy) | 7,12-Dimethylbenz (a)anthracene (tpy) | Hydrogen Sulfide (lb/hr) |
|---|---|---|---|---|---|---|---|
| | Loading A2 | | | | | | |
| 3 | Liquefying Case 1, Blow Down and Purge B | LWSC1B | 3.6E-01 | 8.7E-06 | 4.8E-05 | 7.0E-07 | 1.1E-02 |
| 3 | Liquefying Case 2, Blow Down and Purge B | SWSC2B | 3.3E-01 | 2.1E-06 | 1.2E-05 | 1.7E-07 | 5.2E-03 |
| 3 | Liquefying Case 3, Blow Down and Purge B | LWSC3B | 4.3E-01 | 3.0E-05 | 1.6E-04 | 2.4E-06 | 1.0E-02 |
| 3 | Liquefying Case 4, Blow Down and Purge B | LWSC4B | 4.4E-01 | 3.1E-05 | 1.7E-04 | 2.4E-06 | 1.0E-02 |
| 3 | Liquefying Case 5, Blow Down and Purge B | LWSC5B | 4.4E-01 | 3.2E-05 | 1.8E-04 | 2.6E-06 | 1.1E-02 |
| 2, 5 | Flare Holding | FLAREH | 2.9E-03 | 7.8E-07 | 4.3E-06 | 6.3E-08 | 7.5E-06 |
| 6 | Flare Holding, Truck and Ship Loading A1 | SWSCHA1 | 3.3E-01 | 8.1E-07 | 4.5E-06 | 6.5E-08 | 7.5E-06 |
| 6 | Flare Holding, Truck or Ship Loading A2 | SWSCHA2 | 1.5E+00 | 8.8E-07 | 4.9E-06 | 7.1E-08 | 7.5E-06 |
| 6 | Flare Holding, Blow Down and Purge B | SWSCHB | 3.3E-01 | 7.9E-07 | 4.4E-06 | 6.4E-08 | 7.5E-06 |

lb/hr = pounds per hour
tpy = tons per year

Updated air quality dispersion modeling results for criteria pollutants are summarized in Table 8. The modeled ambient concentrations are still less than the cause or contribute threshold levels for all pollutants and averaging periods. Therefore, this project is not expected to cause or contribute to a violation of the NAAQS or WAAQS. As a result, no further modeling analysis is required.

**Table 8: Criteria Pollutant Modeling Results**

| Criteria Pollutant | Averaging Period | NAAQS/ WAAQS ($\mu g/m^3$) | Threshold Value[a] ($\mu g/m^3$) | Modeled Concentration[b] ($\mu g/m^3$) | Scenario |
|---|---|---|---|---|---|
| CO | 8-hour | 10,000 | 500 | 11 | Vaporizing + Transfer Case A2 |
| | 1-hour | 40,000 | 2,000 | 25 | Vaporizing + Transfer Case A2 |
| $SO_2$ | Annual | 52 | 1 | 0.35 | Liquefying Case 1 |
| | 24-hour | 260 | 5 | 3.9 | Liquefying Case 1 |
| | 3-hour | 1,310 | 25 | 12 | Liquefying Case 1 |
| | 1-hour | 200 | 30 | 26 | Liquefying Case 1 |
| $PM_{10}$ | Annual | -- | 1 | 0.017 | Liquefying Case 3 |
| | 24-hour | 150 | 5 | 1.2 | Vaporizing + Transfer Case A2 |
| $PM_{2.5}$ | Annual | 12 | 0.3 | 0.017 | Liquefying Case 3 |
| | 24-hour | 35 | 1.2 | 1.2 | Vaporizing + Transfer Case A2 |
| $NO_2$ | Annual | 100 | 1 | 0.043 | Liquefying Case 2 |
| | 1-hour | 188 | 7.5 | 5.9 | Vaporizing + Transfer Case A2 |

[a] Cause or contribute threshold value from WAC 173-400-113, Table 4a. The 1-hour $NO_2$ threshold value reflects the EPA's Interim 1-hour $NO_2$ Significant Impact Level.
[b] Highest first high value for all receptors.

The first-tier ambient concentration screening analysis is summarized in Table 9. This screening analysis includes all TAPs with expected emission rates that exceed the SQER (as presented in Table 4). As shown in Table 9, the maximum modeled ambient concentrations for each TAP are less than their respective ASILs. As a result, no further modeling analysis is required.

**Table 9: Toxic Air Pollutant Modeling Results**

| Pollutant | CAS Number | Averaging Period | ASIL[a] (μg/m$^3$) | Modeled Concentration (μg/m$^3$) | Scenario |
|---|---|---|---|---|---|
| 7,12-Dimethylbenz(a)anthracene | 57-97-6 | year | 0.0000141 | 0.000000040 | Liquefying Case 3 |
| Ammonia | 7664-41-7 | 24-hr | 70.8 | 1.2 | Vaporizing + Transfer Case A2 |
| Arsenic | 7440-38-2 | year | 0.000303 | 0.00000044 | Liquefying Case 3 |
| Cadmium | 7440-43-9 | year | 0.000238 | 0.0000024 | Liquefying Case 3 |
| Hydrogen sulfide | 2148878 | 24-hr | 2 | 0.021 | Liquefying Case 1 |
| Sulfur dioxide | 2025884 | 1-hr | 660 | 26 | Liquefying Case 1 |

[a] WAC 173-460-150

* * *

PSE believes that this supplement addresses all remaining technical information requests that you have provided to date, and that PSE's NOC application is now complete.

Please do not hesitate to contact me (or Bill Steiner of Landau Associates at (503) 347-3162 if I am not available) if you have any questions regarding this submittal or any further questions regarding the application.

Sincerely,

Keith Faretra

Attachments

Attachment A – Updated Emission Calculations (electronic)

Attachment B – Dispersion Modeling Input and Output Files (DVD)

cc (by email):

Jim Hogan

Lorna Luebbe

Bill Steiner

Tom Wood