Tacoma LNG Supplementary SEIS Questions

On June 22, 2018, Puget Sound Energy (PSE) was provided with supplementary questions regarding the Tacoma LNG project. Each question is reproduced below in italics followed by PSE's answer.

Questions regarding the provided response documents

Question 1: Gas Compositions

On page 7 and 8 of the PSE Response to SEIS, we noted that the amount of Nitrogen in the produced LNG is more than twice than in the used Feed Natural Gas.
Could you please check or confirm these data?

In PSE's May 25, 2018 response to the SEIS request for information, two different questions were addressed in relation to the liquefier operation, both of which had to do with material composition. First, PSE provided information on the feedstock natural gas imported via the Northwest Pipeline. Second, PSE provided information on the composition of LNG. The answers reflected two different sets of considerations. The Northwest Pipeline composition data reflect the average actual composition of the natural gas transported from British Columbia in 2017. These are actual, measured values. By contrast, the values for the LNG composition reflect what was used in order to evaluate the worst gas nitrogen content in the incoming gas. This does not correlate to what is normally seen in the pipeline, as demonstrated by the difference between the actual pipeline nitrogen levels and the worst case pipeline nitrogen projections.

Question 2: Overall Mass Balance

On page 12 and 13 of the PSE Response to SEIS, the following mass balance was provided.

Table 1 Comparison of NG input

Energy Input/Output: Based on 250,000 gal/day	***Natural Gas Input***	***LNG Output***
MMBtu / Day	*22,745*	*21,363*
Pounds / Day	*1,012,995*	*907,013*
Tonne / year	*163,119*	*146,054*

These data are consistent with our calculations. We have two additional comments. Please see following Table 2.

Table 2 Mass Balance

	Input, output		CO^2	CH_4	C content	
	lb/day	tonne/yr	tonne/yr	tonne/yr	tonne/yr	Comments
Input NG						
Natural gas	1,012,995	163,119			122,706	
Total NG Input	**1,012,995**	**163,119**			**122,706**	A
Products						
LPG, estimated	50,957	8,205			6,723	B
LNG	907,013	146,054			108,648	
Total Products	**957,970**	**154,259**			**115,371**	
Emissions						
CO_2 Pretreatment	10,611	1,709	5,370		1,465	
CO_2 Sep. (non-combustion)	5,633	907	907		247	C
Flaring (combustion)	36,609	5,895	18,527		5,053	
Fugitives CH_4	23	3.77		3.77	3	
Vaporizing Heater	1,664	268	842		230	
Total Emissions	**54,540**	**8,782**	**25,646**	**4**	**6,997**	
Total Product + Emissions	**1,012,510**	**163,041**	**25,646**	**4**	**122,368**	
Total NG Input - Product + Emissions	**485**	**78**			**337**	D

Comments:
A: Carbon content based on gas composition and LNG composition provided by PSE.
B: How much LPG is produced as product? LPG production is not mentioned in the Response but was identified as a possibility.

Natural gas liquids (NGL) quantity is dependent on the feed gas composition and facility operating parameters that manage LNG quality. Depending on variations in these two factors, when the plant is operating at full production (average of 250,000 gpd), NGL production could vary between a low of approximately 280 gpd of NGL to a high of approximately 795 gpd (4,248 lb/day) of NGL. On a carbon content basis, these equate to a low of approximately 1,259 lb/day and a high of approximately 3,536 lb/day.

C: In the FEIS report page 103 the value is 10,703 tonne/year. Could you clarify this? Is this value a permitting maximum? It does not appear to match the mass balance.

We believe you are referring to the "Enclosed Ground Flare" table in Appendix D-2 of the FEIS. The value, 10,703 short tons per year CO2, represents the vent gas CO2 estimates made for the FEIS. However, this flare system has been completely redesigned and the emissions output has changed. Please refer to Section 1.3.4.3 of the BID for a detailed description of the redesigned enclosed ground flare and Attachment F Table 1 of the BID for a summary of the flare waste gas parameters consistent with the current design.

Project Greenhouse Gases Emissions Summary

Source	CO_2		CH_4[1]		N_2O		Total CO_2 Equivalent[b]
	Emission Factor (lb/MMBtu)	Emission Rate (MT/yr)	Emission Rate (lb/MMBtu)	Emission Rate (MT/yr)	Emission Factor (lb/MMBtu)	Emission Rate[a] (MT/yr)	(MT/yr)
Flare	--	27,110[2]		40 [2]	0.0002	0.033	28,131
Vaporizer	117	841		0.036	0.0002	0.0016	842
WPG	117.0	4183	0.002	0.0788	0.0002	0.0079	4,186
Regen	117.0	744	0.002	0.0140	0.0002	0.0014	744
Diesel Generator[6]	163.1	534	0.007	0.030	0.0013	0.006	536
Fugitives	--	--	3.8		--	--	95
Total	--	33,411	4	40.6	--	0.050	34,533

Calculations:

[a] Annual Emissions (tons/yr) = [Maximum Heat Input (MMBtu/yr)] x [Emission Factor (lb/MMBtu)] / [2,000 lbs/ton] x [0.907185 MT/ton]

	Vaporizer[3] (MMBtu/yr)	Flare[3,4] (MMBtu/yr)	WPG (MMBtu/yr)	Regen (MMBtu/yr)	Diesel (gal/hr)
Heat Input (MMBtu/yr) =	15,840	326,707	78,840	14,016	104.6

[b] Total CO_2 Equivalent Emissions = [CO_2 Emissions] + [CH_4 Emissions x CH_4 Global Warming Potential] + [N_2O Emissions x N_2O Global Warming Potential]

CH_4 Global Warming Potential = 25 [5]

N_2O Global Warming Potential = 298 [5]

Notes:

[1] Assume all VOC is CH_4.

[2] Based on maximum of liquefying cases plus maximum of LNG transfer cases calculated in Table 2 for CO_2 emissions from the flare.

[3] NOC Application Supplement dated September 9, 2017; Attachment A, Table 1.

[4] Maximum of liquefying cases plus maximum of LNG transfer cases on an annual basis.

[5] 40 CFR 98 (revised November 29, 2013).

[5] Diesel generator maximum 500 hours per year, fuel consumption at 100% power rating = 147.3 gallon per hour

Table 2. CO_2 Emissions from Flare

Flare Waste Gas Case[1]	CO_2 in Exhaust	
	(scfm)	(lb/hr)[a]
Liquefying Case 1	552	3,722
Liquefying Case 2	90	607
Liquefying Case 3	702	4,733
Liquefying Case 4	1,010	6,810
Liquefying Case 5	728	4,908
Holding	16	108
LNG Transfer A1	69	465
LNG Transfer A2/A3	35	236
LNG Transfer B	15	101

Calculations:

[a] CO_2 in Exhaust (lb/hr) = [CO_2 in Exhaust (scfm)] x [28.4 L/cf] x [1 mole/24.5 L] x [44.01 g/mole] / [454 g/lb] x [60 min/hr]

D: Net inputs – outputs are estimates based in information provided. Carbon and mass balance should be net zero.

Question 3: Construction Emissions
Please provide spreadsheet values for the construction emissions.

Additional clarification on construction emissions:

1. In order to calculate the upstream emissions of the used construction materials, please provide us with the weight of material used (tonnes). An example list is shown below.

Our best estimate of the mass of the construction materials is presented below.

Weight of Construction Materials

Input	**tonnes**
Steel	4,745
Rebar	1,666
Stainless Steel	290
Copper	26
Asphalt	7,570
Paint	5
Aggregate	80,110
Cement	1,716

2. Please provide us with total power consumption during construction period.

Total power consumption during construction is estimated as 10,512,000 kW-hours.

