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Data Gap: 127

Provide the total number of employees needed for construction of the proposed Project, and identify the proportion that would be expected to require onshore housing.

Response to Data Gap: 127

During the installation phase of the Project, (lasting three to five months) the Project is expected to require 200 to 300 employees for construction of the deepwater port. The potential population and housing-related impacts during the installation phase were addressed in the DPLA, Volume II, Sections 8.3.1 and 8.3.3.

It is possible that a number of employees would reside offshore and would work and live on-board either the large pipelay vessel or the anchor handling tug supply (AHTS) vessel. It is also possible, however, that a portion of the projected total employees—estimated at 150 or half of the total number of construction-period workers (high end of range)—would require onshore temporary housing accommodations. The expected numbers of persons (onshore workers) would be associated with the staging area and yard and would be involved in loading supplies and equipment to vessels.

Assuming a worst-case scenario (for host community planning purposes), the impact section modeled a potential increase of 450 persons requiring housing over the five-month period. This estimate includes an average of three persons per household (450 = 150 x 3). While it is possible that fewer persons may require onshore housing, it is prudent to expect this amount for planning purposes to provide stakeholders with a realistic upper-bound demand estimate. In addition to available temporary housing and rental units, the host area of metropolitan Fort Lauderdale also has a sufficient hotel room inventory to accommodate the relatively small number of persons that would require onshore housing during the installation period. As shown in Section 8.2.5.3 of Volume II of the DPLA (page 8-17), the hotel room inventory rose to 33,057 in 2004, and average annual hotel occupancy ranged between 65% and 73% from 1995 to 2004.

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Data Gap: 128

To fully evaluate the use of an open-loop LNG vaporization system as an alternative, assume that both the TRVs and the SRS would use and open-loop vaporization system. To present and assess the potential impacts of a shell-and-tube (open-loop) LNG vaporization system alternative, please provide the following information:

1. *A general description of how the SRS and TRV would be configured for an open-loop LNG vaporization system. Include a discussion of seawater intake and discharge systems (diffusers, if necessary), as well as the intake and discharge characteristics (temperature, velocity, daily volume); and*
2. *Discuss the potential impacts on resources that would be affected by an open-loop LNG vaporization system, including but not limited to water quality (including thermal impacts), biological resources (including entrainment and impingement effects), and air quality. Use of existing analyses from published documents (e.g. Gulf Gateway – Docket # 14294), where appropriate, would be acceptable to the USCG.*
3. *To quantify the thermal impacts, please use the CORMIX computer model simulation to assess the open-loop water discharge from a TRV and the SRS.*

Response

In Data Gap 128, the USCG requests of the Applicant: "*To fully evaluate the use of an open-loop LNG vaporization system as an alternative, assume that both the TRVs and the SRS would use and open-loop vaporization system.*" However, as indicated in the September 2006 DPLA (Volume I, Section 1, page 1):

> *TRVs that service the port would be drawn from the existing or future global fleet of specialized LNG carriers compatible with* Calypso*'s unloading buoy system.*

Consequently, TRVs will not be owned or controlled by the Project and the vaporization system they use cannot be specified by the Project. However, for the exercise of comparing open- versus closed-loop vaporization systems for the entire *Calypso* Project, general TRV modifications that would be required to incorporate open-loop vaporization, and the associated potential impacts, are provided in this response.

1. This section provides a general description of how the SRS and TRV would be configured for an open-loop LNG vaporization system, including a discussion of seawater intake and discharge systems and intake and discharge characteristics (temperature, velocity, daily volume). It is important to note that the maximum gas sendout for the port (SRS and TRV combined) is limited by the maximum, physical flow capacity of the Calypso U.S. Pipeline, which is approximately 2 billion cubic feet per day (bcfd). The SRS and TRV would be capable of vaporizing at rates of 1.5 and 1.0 bcfd, respectively, but would not be able to vaporize at a combined rate greater than 2 bcfd.

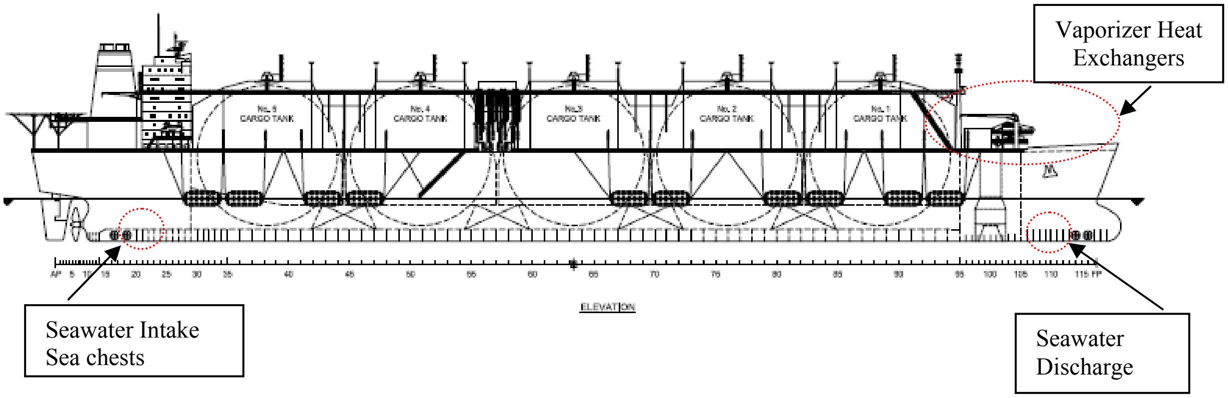
SRS Open Loop

Utilizing open-loop technology, the SRS at the *Calypso* deepwater port would pump seawater from fixed intakes on the vessel's hull below the waterline. The warm seawater would be passed through the vaporizer heat exchangers to provide the heat necessary to change the LNG into its natural gas phase.

Seawater is drawn in through the SRS's sea chests near the stern of the vessel. Seawater is pumped from the vessel's engine room, to the LNG vaporizers at the forward part of the vessel and then led overboard. The total seawater intake for a send-out of 1.5 bcfd would be 36,000 cubic meters per hour (m^3/h) or 228 million gallons per day (mgd).

This seawater is used as a heat source and is passed through one side of the vaporizing heat exchanger. LNG is fed to the other side of the exchanger where the heat required for vaporization is transferred. The temperature of the seawater is lowered in this process by approximately 13 degrees Fahrenheit (°F; 7.2 degrees Celsius [°C]), and this cooler water is discharged near the bow of the SRS. The boilers would not be required for an open-loop vaporization system.

Figure 128-1
General Location of Seawater Intakes and Discharges - SRS



Dimensions of the inlet sea chest boxes and their associated strainer grids will be sized to ensure that water velocity through the strainers will not exceed 0.49 feet per second (ft/s).

The discharge of cooled seawater from open loop operations would result in two plumes of water approximately 13°F (7.2°C) cooler than the ambient water. Each discharge would produce up to 114 mgd.

If the same glycol-water loop is assumed for the SRS vaporization system as indicated in the DPLA, then the increased seawater pumping to achieve open-loop vaporization will require an additional 5 megawatts (MW) of electrical power from the dual-fuel generators which would increase the air emissions from the generators. This assumption was used to calculate the air emissions provided below in the response to question 2 of Data Gap 128.

TRV Open Loop

AS stated previously and indicated in the September 2006 DPLA (Volume I, Section 1, page 1):

> *TRVs that service the port would be drawn from the existing or future global fleet of specialized LNG carriers compatible with* Calypso*'s unloading buoy system.*

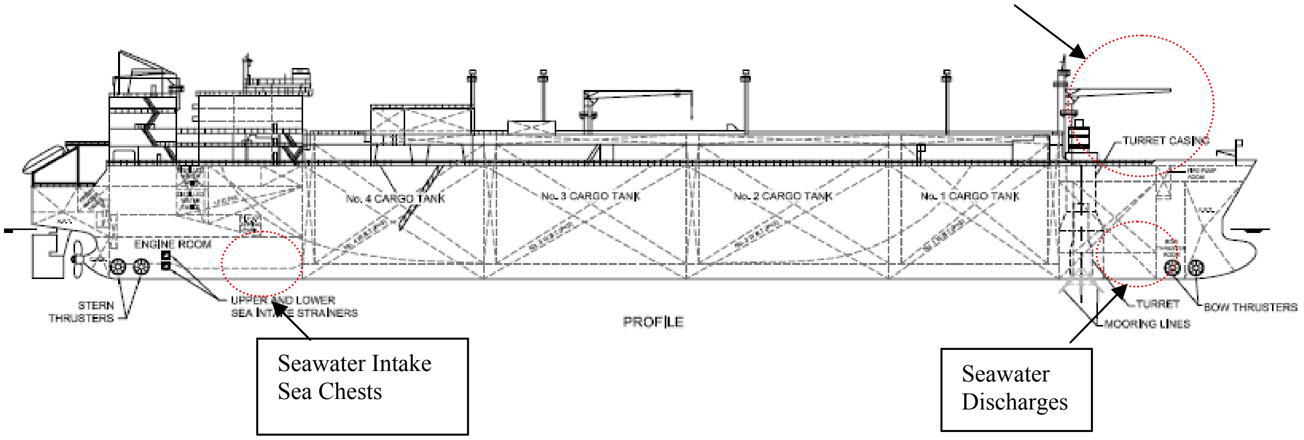
Consequently, TRVs will not be owned or controlled by the Project and the vaporization system they use cannot be specified by the Project. However, for the exercise of comparing open- versus closed-loop vaporization systems for the entire *Calypso* Project, general TRV modifications that would required to incorporate open-loop vaporization are provided in this section.

It is assumed that the same open-loop vaporization technology would be applied to the TRVs as described above for the SRS, and the seawater demand for 1.0 bcfd send-out would be 24,000 m^3/h or 152 mgd.

Dimensions of the inlet sea chest boxes and their associated strainer grids would be sized to ensure that water velocity through the strainers will not exceed 0.49 ft/s.

The discharge of cooled seawater from open-loop operations would result in two plumes of water approximately 13°F (7.2°C) cooler than the ambient water. Each discharge would produce up to 76 mgd.

Figure 128-2
General Location of Seawater Intakes and Discharges - TRV



If the same glycol water loop is assumed for the TRV vaporization system as indicated in the DPLA, then the increased seawater pumping to achieve open-loop vaporization would require an additional 3.25 MW of electrical power from the dual-fuel generators which would increase the air emissions from the generators.

2. The potential impacts on resources that would be affected by an open-loop LNG vaporization system would be primarily limited to water quality (including thermal impacts), biological resources (including entrainment and impingement effects), and air quality (due to differences in emissions). Seabed impacts during operations would be identical between the SRS and TRV operating either open- or closed-loop vaporization systems, thus there would be no differences in impacts to sediment, marine habitat, cultural resources, and geological resources between the two types of systems. A discussion of the impacts that would be associated with each resource area is provided in the sections that follow.

Water Usage and Water Quality

Water Usage for Open-Loop Vaporization

The primary difference in water quality impacts between the SRS and TRV operating with open- versus closed-loop LNG vaporization systems would be related to the total volume of seawater used during port operations. Vaporization rates would be similar between vessels operating in open- versus closed-loop vaporization. SRS and TRV seawater use volumes for engine cooling and ballast provided in the response to Data Gap 29 would be similar, independent of vaporization technology. As indicated in the response above to question 1 of Data Gap 128, using seawater as the heat source for vaporization rather than boilers would require a significant increase in the peak daily seawater use of up to 228 mgd for the SRS and 152 mgd for the TRV at their respective peak vaporization rates of 1.5 and 1.0 billion cubic feet per day (bcfd). The maximum seawater usage for the port would be 304 mgd at a combined (SRS and TRV) vaporization rate of 2 bcfd. This limitation is due to the maximum, physical flow capacity of the Calypso US pipeline of approximately 2 bcfd. The average seawater usage for the port would be 167 mgd at a combined vaporization rate of 1.1 bcfd, which is the average expected gas delivery rate over the life of the project.

Water Quality of Discharge

The maximum discharge from open-loop vaporization on both the TRV (152 mgd) and SRS (228 mgd) would be at a temperature of 7.2ºC less than ambient. CORMIX modeling was performed to quantify the plume dimensions associated with these discharges (see the response below to question 3 of Data Gap 128). Simulation results show that under normal operating conditions (i.e., both vessels oriented parallel to the direction of current flow) the plume temperature differential would decrease below 1ºC within distances of less than 10 meters from the discharge port. Under the worst-case condition (discharge oriented directly downstream of current flow, an orientation unlikely to occur during operations at the port), the temperature differential of the discharge plume would drop below 1ºC within a distance of about 45 meters. Maximum plume dimensions at the location where the 1ºC temperature differential is reached had a half width of about 10 meters and a thickness of about 10 meters. Results also show that for all simulations dilutions at a distance of 100 meters ranged from 15.4 to 380.7, with temperature differentials ranging from 0.02 to 0.45ºC. Therefore, discharges would meet all required temperature regulatory criteria.

Biological Resources

The primary impacts on biological resources during operation of open-loop vaporization systems for both the TRV and SRS at *Calypso* would be due to entrainment losses of ichthyoplankton in the volume of seawater used for vaporization. Peak seawater intake velocities would be less than 0.49 ft/s; therefore, impacts on biological resources due to impingement are not expected for either open- or closed-loop vaporization systems.

A modified version of the empirical transport model (Boreman, Goodyear, and Christensen 1981) was used to predict entrainment losses to target species larvae based on the calculation of *conditional mortality* rates from open- and closed-loop alternatives. Determination of ichthyoplankton biomass for relative impact assessment of entrainment was based on the water volume flowing through a "source waterbody," defined as a 12-kilometer by 25-meter window with a current speed of 1.21 meters per second (the 50th percentile current velocity based on metocean data near the project area – see Figure 3 in Volume 1, Appendix C, Attachment 3 of the September 2006 DPLA. Based on these dimensions and flow rate, approximately 8,285,279 mgd of water flows past the port. The approach considered larval data collected during the February 2007 *Calypso* survey. Results of the comparative impact analysis for target taxa are presented in Table 128-2.

Results of the comparative analysis presented above indicate that based on February 2007 densities for target species found near the *Calypso* deepwater port site, impacts to standing stock larval populations would be negligible from either the open-loop or closed-loop alternatives, primarily due to the small seawater usage as compared to the volumetric size of the source waterbody.

Table 128-2 Estimated Entrainment Impacts to Target Species From Closed- and Open-Loop Vaporization Alternatives

Taxon	Number per M gallons	Daily Entrainment		Number in Source Water body [c]	Percent loss from entrainment	
		Closed [a]	Open [b]		Closed	Open
Menippe mercenaria (stone crab)	236.7	11,101	71,957	1,961,125,603	0.00057	0.00367
Panulirus argus (Carribean spiny lobster)	298.7	14,009	90,805	2,474,812,918	0.00057	0.00367
Thunnus sp.(tuna)	60.2	2,823	18,301	498,773,812	0.00057	0.00367
Katsuwonus pelamis (skipjack tuna)	409.5	19,206	124,488	3,392,821,861	0.00057	0.00367
Euthynnus alleteratus (little tunny)	61.7	2,894	18,757	511,201,731	0.00057	0.00367
Coryphaena hippurus (dolphinfish)	27.7	1,299	8,421	229,502,236	0.00057	0.00367

Table 128-2 Estimated Entrainment Impacts to Target Species From Closed- and Open-Loop Vaporization Alternatives

Taxon	Number per M gallons	Daily Entrainment		Number in Source Water body [c]	Percent loss from entrainment	
		Closed [a]	Open [b]		Closed	Open
Epinephelus sp. (grouper)	49.2	2,307	14,957	407,635,740	0.00057	0.00367

Notes:
(a) Based on peak daily water usage volume for the entire port operating using closed-loop LNG vaporization and open-loop engine cooling - 46.9 million gallons per day.
(b) Based on peak daily water usage volume using open-loop LNG vaporization and open-loop engine cooling – 304 million gallons per day.
(c) Based on "source waterbody" volume estimate of 8,285,279 million gallons per day.

Air Quality

Tables 128-3 and 128-4 have been prepared to show a comparison between the *Calypso* LNG Project air emissions for open-loop and closed-loop LNG vaporization and to define the carbon dioxide (CO_2) emissions for both cases. Tables 128-3 and 128-4 provide summaries of stationary/operational emissions for closed-loop and open-loop vaporization, respectively. Table 128-5 provides a comparison of emissions between closed- and open-loop systems.

The following are the assumptions used for calculating emissions from the closed-loop gas vaporization process:

SRS Boilers:	Four (4) boilers each with 277 million British thermal units per hour (mmBtu/hr) operating for 8,760 hours per year (hr/yr).
SRS Engines:	Four (4) engines each with 8550kW each operating for 8,760 hr/yr.
TRV Boilers:	Two (2) boilers each with 332 mmBtu/hr operating for 8,760 hr/yr.
TRV Engines:	Two (2) engines each with 7600 kW operating for 8,760 hr/yr.
LNGC Boilers:	Two (2) boilers each with 9.48 mmBtu/hr operating for 3,294 hr/yr.

For the open-loop gas vaporization system, the following assumptions were used:

SRS Boilers:	None.
SRS Engines:	Four (4) engines each with 9,800 kW each operating for 8,760 hr/yr.
TRV Boilers:	None.
TRV Engines:	Two (2) engines each with 9,225 kW operating for 8,760 hr/yr.
LNGC Boilers:	Two (2) boilers each with 9.48 mmBtu/hr operating for 3,294 hr/yr.

The emissions have been recalculated using the revised SRS and TRV engine sizes that would be required for the open-loop vaporization process.

Secondary/operational and mobile emissions are the same for both the processes. The emission factors and detailed sample calculations are provided in the Air Emissions Inventory (Appendix E, Attachment C-11 of the DPLA Application dated September 2006).

The CO_2 emission factors for SRS and TRV engines and boilers have been obtained from U.S. Environmental Protection Agency (EPA) AP 42 *Compilation of Air Pollutant Emission Factors*. The emission factors for the LNG carrier (LNGC) boilers have been obtained from Climate Leaders Greenhouse Gas Inventory Protocol (June 2003), USEPA Direct Emissions from Stationary Combustion, Appendix B, Table B-5.

The results in Table 128-5 show that air emissions are lower for the open-loop gas vaporization system. A comparison between these systems shows that for the open-loop system:

- the nitrogen oxide (NO_X) emissions decreased by 251.52 tons per year (tpy);
- carbon monoxide (CO) by 76.26 tpy;
- sulfur dioxide (SO_2) by 4.03 tpy;
- particulate matter of less than 10 microns (PM_{10}) by 55.23 tpy;
- volatile organic compounds (VOC) by 30.94 tpy; and
- particulate matter (soot [PM_T]) by 51.34 tpy.

The greenhouse gas CO_2 was 1,157,351 tpy for the closed-loop gas vaporization process and 281,644 tpy for the open-loop process with a net reduction of 875,707 tpy or approximately 75%.

Table 128-3 Summary of Stationary/Operational Emissions Closed-Loop Gas Vaporization (Primary Sources/PSD Analysis)

Pollutant	SRS (a)			TRV (b)			LNG Discharging (c)			Thermal Oxidizer (d)		Total Emissions (e)	
	lb/hr	Annual hours	tpy	lb/hr	Annual hours	tpy	lb/hr	Annual hours	tpy	lb/hr	tpy	1-hr (lb/hr)	tpy
NO_X	51.14	8,760	224.01	65.41	8,760	286.49	6.86	3,294	11.3	10.47	0.82	133.88	522.62
CO	27.7	8,760	121.31	43.31	8,760	189.68	0.62	3,294	1.03	56.98	4.44	128.64	316.46
SO_2	0.81	8,760	3.57	0.47	8,760	2.03	29.38	3,294	48.38	0.01	0.001	30.67	53.98
PM_{10}	9.78	8,760	42.83	7.16	8,760	31.34	1.25	3,294	2.05	1.23	0.1	19.42	76.32
VOC	10.88	8,760	47.66	11.96	8,760	52.36	0.09	3,294	0. 16	9.24	0.72	32.17	100.9
PM_T	11.7	8,760	51.25	10	8,760	43.81	1.25	3,294	2.05	1.23	0.1	24.18	97.21
NH_3	2.11	8760	9.24									2.11	9.24
CO_2	165745	8760	725962	93848	8760	411051	3208	3294	5284			262801	1142297

** Emission factors for the pollutants and detailed sample calculations are provided in the Air Emission Inventory. (Appendix E, Attachment C-11 of *Calypso*'s Air Permit Application). For carbon dioxide, emission factors were obtained from the following sources: (1) SRS and TRV Boilers: Section 1.4 "Natural Gas Combustion," EPA AP 42, *Compilation of Air Pollutant Emission Factors*, (2) SRS and TRV Engines: Section 3.4 "Stationary Dual Fuel Engines Combustion," EPA AP 42, *Compilation of Air Pollutant Emission Factors*, (3) LNGC Boilers: Climate Leaders Greenhouse Gas Inventory Protocol (June 2003), USEPA Direct Emissions from Stationary Combustion, Appendix B, Table B-5.

Notes:

(a) Annual emissions from four SRS engines (8,550 kilowatts each) and four SRS boilers (277 million British thermal units per hour [mmBtu/hr] each). All SRS engines and boilers are operating for 8,760 hours per year on natural gas. The SRS engines have selective catalytic reduction (SCR) + oxidation catalyst control. The four SRS boilers have low NO_X burners and flue gas recirculation (FGR).

(b) Annual emissions from two TRV engines and two TRV boilers burning natural gas with low NO_X burners and FGR operating at 8,760 hours per year.

(c) Annual emissions from two LNG carrier boilers during discharging operations. They constitute 183 trips a year with 18 hours per trip resulting in 3,294 hr/yr.

(d) Thermal oxidizer operating for 156 hr/yr with a heat input of 154 mmBtu/hr.

(e) Total 1-hour and annual emissions from four SRS engines and four SRS boilers, two TRV engines and two TRV boilers, LNG carrier (pumping operations) and thermal oxidizer.

Key:

CO = carbon monoxide.
CO_2 = carbon dioxide.
FGR = flue gas recirculation.
hr = hour.
lb = pound(s).
LNG = liquefied natural gas.
NH_3 = ammonia.
NO_X = oxides of nitrogen.
PM_{10} = particulate matter of 10 microns or less.
PM_T = particulate matter (soot).
PSD = Prevention of Significant Deterioration.
SCR = selective catalytic reduction.
SO_2 = sulfur dioxide.
SRS = storage and regasification ship.
tpy = tons per year.
TRV = transport and regasification vessel.
VOC = volatile organic compounds.

Table 128-4 Summary of Stationary/Operational Emissions for Open-Loop Gas Vaporization (Primary Sources/PSD Analysis)

	SRS [(a)]			TRV [(b)]			LNG Discharging ©			Thermal Oxidizer [(d)]		Total Emissions [(e)]	
Pollutant	**lb/hr**	**Annual hours**	**tpy**	**lb/hr**	**Annual hours**	**tpy**	**lb/hr**	**Annual hours**	**tpy**	**lb/hr**	**tpy**	**1-hr (lb/hr)**	**tpy**
NO_X	10.36	8,760	45.38	48.77	8,760	213.6	6.86	3,294	11.3	10.47	0.82	76.46	271.1
CO	12.95	8,760	56.73	40.64	8,760	178	0.62	3,294	1.03	56.98	4.44	111.19	240.2
SO_2	0.17	8,760	0.76	0.08	8,760	0.36	29.38	3,294	48.38	0.01	0.001	29.64	49.5
PM_{10}	1.68	8,760	7.37	2.64	8,760	11.57	1.25	3,294	2.05	1.23	0.1	6.8	21.09
VOC	5.61	8,760	24.58	10.16	8,760	44.5	0.09	3,294	0. 16	9.24	0.72	25.1	69.96
PM_T	3.89	8,760	17.02	6.1	8,760	26.7	1.25	3,294	2.05	1.23	0.1	12.47	45.87
NH_3	2.42	8760	10.59									2.42	10.59
CO_2	40566	8760	177679	19093	8760	83627	3208	3294	5284			62867	266590

** Emission factors for the pollutants and detailed sample calculations are provided in the Air Emission Inventory. (Appendix E Attach. C-11 of the Air Permit Application) For Carbon Dioxide, the emission factor were obtained from the following sources: (1) SRS and TRV Boilers: Section 1.4 Natural Gas Combustion EPA AP 42, Compilation of Air Pollutant Emission Factors., (2) SRS and TRV Engines: Section 3.4 Stationary Dual Fuel Engines Combustion EPA AP 42, Compilation of Air Pollutant Emission Factors, (3) LNGC Boilers: Climate Leaders Greenhouse Gas Inventory Protocol (June 2003), USEPA Direct Emissions from Stationary Combustion, Appendix B, Table B-5.

Notes:

(a) Annual emissions from four SRS engines (9800kW each) operating for 8,760 hours per year on natural gas. The SRS engines have SCR + oxidation catalyst control.
(b) Annual emissions from two TRV engines (9225 kW each) operating at 8,760 hours per year.
(c) Annual emissions from two LNG carrier boilers (9.48mmBtu/hr each) during discharging operations. They constitute 183 trips a year with 18 hours per trip resulting in 3294 hr/yr.
(d) Thermal oxidizer operating for 156 hr/yr with a heat input of 154mmBtu/hr.
(e) Total 1-hour and annual emissions from four SRS engines, two TRV engines, LNG Carrier (pumping operations) and thermal oxidizer.

Key:

CO = carbon monoxide.
CO_2 = carbon dioxide.
hr = hour.
lb = pound(s).
LNG = liquefied natural gas.
NH_3 = ammonia.
NO_X = oxides of nitrogen.
PM_{10} = particulate matter of 10 microns or less.
PM_T = particulate matter (soot).
PSD = Prevention of Significant Deterioration.
SCR = selective catalytic reduction.
SO_2 = sulfur dioxide.
SRS = storage and regasification ship.
tpy = tons per year.
TRV = transport and regasification vessel.
VOC = volatile organic compounds.

Table 128-5 Total Emissions (including Both Mobile and Stationary Sources) Comparison for Closed-Loop and Open-Loop Gas Vaporization

Pollutants [(a)]	Closed-Loop Gas Vaporization (Existing Emissions) [(b)] (tpy)	Open-Loop Gas Vaporization [(c)] (tpy)	Percentage Reduction in Emissions (%)
NO_X	936.67	685.15	26.85
CO	410.94	334.68	18.56
SO_2	70.61	66.58	5.71
PM_{10}	83.88	28.65	65.84
VOC	113.07	82.13	27.36
PM_T	109.87	58.53	46.73
CO_2	1157351	281644	75.66

Notes:

(a) Detailed sample calculations are given in the Air Emissions Inventory Appendix E, Attachment C-11, of *Calypso*'s Air Permit Application.

(b) Total emissions are based on: SRS with four boilers (277mmBtu/hr each) and four engines (8,550 kW each), TRV with two boilers (332 mmBtu/hr each) and two engines (7,600 kW each), thermal oxidizer(154 mmBtu/hr) LNG carrier with two boilers (9.48mmBtu/hr each), secondary sources, and mobile/operational sources (based on Tables 3-3 [secondary sources] and 3-4 [mobile/operational sources] in Volume I, Appendix E, Attachment C-11 "Air Emissions Inventory" of *Calypso*'s September 2006 Deepwater Port License Application).

(c) Total emissions are based on: SRS with four engines (9,800 kW each), TRV with two engines (9225 kW each), thermal oxidizer (154 mmBtu/hr), LNG carrier with two boilers (9.48 mmBtu/hr each), secondary sources, and mobile/operational sources (based on Tables 3-3 [secondary sources] and 3-4 [mobile/operational sources] in Volume I, Appendix E, Attachment C-11 "Air Emissions Inventory" of *Calypso*'s September 2006 Deepwater Port License Application).

Key:
tpy = tons per year.
CO = carbon monoxide.
CO_2 = carbon dioxide.
hr = hour.
lb = pound(s).
LNG = liquefied natural gas.
NH_3 = ammonia.
NO_X = oxides of nitrogen.
PM_{10} = particulate matter of 10 microns or less.
PM_T = particulate matter (soot).
SO_2 = sulfur dioxide.
tpy = tons per year.

3. CORMIX modeling was performed to document potential thermal impacts associated with the cold water discharge related to the SRS and TRV operating with open-loop vaporization systems. Parameters used for the modeling were defined based on the description in the response above to question 1 of Data Gap 128. SRS discharge would be worst-case for the port, due to the much larger volume; therefore, simulations were performed only for the SRS. TRV impacts would be less than those predicted for the SRS, but TRV impacts can be conservatively assumed to be similar to the SRS. Due to the separation distance between the east and west buoys (2.6 nautical miles) and the strong south-to-north current flow in the vicinity of the port, there would be no interaction in discharge plumes between the two vessels.

   For the same reasons documented in the CORMIX modeling report provided in the September 2006 DPLA (Volume 1, Appendix C, Attachment 3), the CORMIX1 model is the only version that can be applied to simulate discharges at the port. CORMIX 1 only allows a single discharge port, therefore, only one of the two discharge ports can be simulated at the same time. However, simulation results show that under most situations the discharge plumes would reach near-ambient temperatures in a very short distance from the discharge port (mostly less than 10 meters, worst-case about 45 meters. See results discussion below). Due to the separation distance and angle between the two discharge ports located on opposite sides of the vessels, and the rapid dissipation of the plumes down-current, any interaction between the two discharge plumes would be unlikely.

Parameter values used for the analysis were as follows:

Ambient Conditions

Ambient Seawater Density. February, May, and August Stratification (Figure 1 in Volume 1, Appendix C, Attachment 3 of the September 2006 DPLA), as specified below:

Seawater Density Profiles (kg/m^3)

Location	February	May	August
Surface	1024.4	1023.7	1022.7
Bottom	1028.3	1028.3	1028.8

Ambient Current. Steady-state conditions, 10th (0.87 meters per second [m/s]), 50th (1.21 m/s), and 90th (1.65 m/s) percentiles of average hourly surface current speed (derived from Figure 3 in Volume 1, Appendix C, Attachment 3 of the September 2006 DPLA).

Wind Speed. 50th (5.8 m/s) percentile of hourly average wind speed data (derived from Figure 4 in Volume 1, Appendix C, Attachment 3 of the September 2006 DPLA). Only the 50th percentile value was used because previous CORMIX results (Volume 1, Appendix C, Attachment 3 of the September 2006 DPLA) showed no discernable affects of wind speed on results, primarily due to the strong ocean currents present at the port location.

Manning's n Value. 0.02.

Waterbody Boundary. Unbounded.

Depth. 284 meters.

Effluent Characteristics

Effluent Velocity. SRS – 3.50 m/s.

Effluent Concentration. SRS – minus 7.2ºC intake to discharge differential

Effluent Density. February, May and August intake density change due to decreased temperatures of 7.2ºC relative to ambient at the intake port located 14 meters below the sea surface (calculated using the UNESCO Sea State equation), as specified below:

Discharge Seawater Density (kg/m^3)

Location	February	May	August
Discharge Density	1026.4	1025.9	1025.1

Heat Loss Coefficient. 0 (default value for a conservative pollutant discharge).

Discharge Characteristics

Nearest Bank. CORMIX maximum – 5,000 meters.

Port Diameter. SRS – 1.34 meters.

Port Height. SRS – 272.1 meters from bottom, resulting in discharge at 11.9 meters below surface.

Vertical Angle (Theta). SRS – minus 10 degrees.

Horizontal Angle (Sigma). SRS – 175 degrees (port side – discharge will also occur on the starboard side at an angle of 185 degrees, but the angle relative to current direction will be similar).

Mixing Zone Specification

Effluent Type. Conservative pollutant.

Water Quality Standard. 1ºC.

Mixing Zone. Site-specific regulatory mixing zone is not specified, use 100 meters for dilution comparisons.

Region of Interest. Smallest possible for 284-meter depth – 14,200 meters (50 times depth)

Based on the above-defined parameter values, nine base-case simulations were performed for all combinations of February, May, and August density profiles and the three defined current velocity values (10th, 50th, and 90th percentiles). Results of these simulations are provided in Table 128-6, which shows discharge plume characteristics at the 1ºC water quality standard and Table 128-7 for the 100-meter regulatory mixing zone boundary. Three additional simulations were run varying the horizontal discharge angle (sigma) in the down-current direction (125, 90, and 0 degrees) for the worst-case dilution set of parameters from the nine base-case simulations. These results are also shown in Tables 128-6 and 128-7.

CORMIX results show that under normal operating conditions (i.e., both vessels oriented parallel to the direction of current flow) the temperatures would increase to less than 1ºC below ambient within distances of less than 10 meters from the discharge port (Table 128-6). The worst-case condition of all simulations occurred when the discharge port was oriented in the same down-gradient direction as the current flow, which is an orientation unlikely to occur during operations at the port. For this worst-case condition the temperature of the discharge plume increased to less than 1ºC below ambient within a distance of about 45 meters from the discharge port. Increasing the horizontal angle to 90 degrees decreased this distance to about 17 meters. Maximum plume dimensions at the location where the 1ºC temperature differential was reached showed a plume half width of about 10 meters and a plume thickness of about 10 meters.

CORMIX results show that under normal operating conditions (i.e., both vessels oriented parallel to the direction of current flow) the dilutions at a distance of 100 meters from the discharge port range from 29 to 381 (Table 128-7), with temperatures ranging from 0.02 to 0.25 ºC. The worst-case condition of all simulations occurred when the discharge port was oriented in the same down-gradient direction as the current flow, which is an orientation unlikely to occur during operations at the port. For this worst-case condition the dilution at a distance of 100 meters was 15.4, with a temperature of 0.45ºC.

Maximum plume dimensions at a distance of 100 meters showed a plume half width of about 27 meters and a plume thickness of about 27 meters, but this occurred for the plume with the highest dilution (381).

When operating in open-loop vaporization mode, the SRS would also require operation of its marine biofouling control system (electrochemical chlorination), and would inject chlorine-produced oxidants (CPO) into the intake seawater. The SRS electrochemical chlorination system would have an injection dilution concentration of approximately 0.3 to 0.5 parts per million of sodium hypochlorite at intake. Chlorine production would be optimized according to manufacturer specifications to minimize residual CPO concentrations in discharge to the extent possible, and should remain near zero most of the time. However, based on documentation of discharges from Navy vessels operating similar biofouling systems, it is assumed that at times CPO concentrations may be as high as 100 parts per billion (ppb) (Uniform National Discharge Standards 2006).

Based on the results of the CORMIX simulation analysis, the entire range of predicted dilutions at the 100-meter mixing zone boundary was 15.4 to 380.7. Therefore, assuming dilution effects alone the maximum expected CPO concentrations at the 100-meter mixing zone boundary would range from approximately 0.3 to 6.5 ppb. The Florida Administrative Code (F.A.C. Chapter 62-302) specifies surface water criteria for all state waters, including coastal waters, and the listed criterion for chlorine in Class III Marine waters is 10 ppb. The U.S. EPA Quality Criteria for Water 1986, referred to as the Gold Book (U.S. EPA 1986), lists marine water quality thresholds for CPO as: 13 micrograms per liter (equivalent to ppb) for the acute criterion and 7.5 ppb for the chronic criterion. Therefore, based on the results of the CORMIX simulation analysis, if the SRS was operating in an open-loop LNG vaporization mode, the CPO concentrations at the 100-meter mixing zone boundary are not predicted to exceed Florida or U.S. EPA water quality criteria.

Sources:

Boreman, J. C.P. Goodyear, and S.W. Christensen, 1981, An Empirical Methodology for Estimating Entrainment Losses at Power Plants Sited on Estuaries. *Trans. Amer. Fish. Soc.* 110:253-260.

U.S. Environmental Protection Agency (U.S. EPA), 1986, Recommended Water Quality Standards, Environmental Protection Agency, Washington, D.C.

Uniform National Discharge Standards, 2006, Seawater Piping Biofouling Prevention Discharge Summary, available online at http://unds.bah.com/Req/Sew_pbio_sum.pdf.

Table 128-6 CORMIX Results for Temperature Differential of One Degree Celsius (1°C)

Density Gradient	Current Velocity (m/s)	Wind Speed (m/s)	Theta (degrees Vertical)	Sigma (degrees Horizontal)	X Distance (meters)	bh Half Width (meters)	bv Thickness (meters)	Y Distance (meters)	Z Depth (meters)	S Dilution	Temperature Differential (degrees Celsius)
February	0.87	5.8	-10	175	-5.83	3.67	3.65*	2.16	267.01	7.20	1.00
May	0.87	5.8	-10	175	-5.80	3.66	3.64*	2.15	266.96	7.20	1.00
August	0.87	5.8	-10	175	-5.75	3.65	3.62*	2.14	266.93	7.20	1.00
February	1.21	5.8	-10	175	-0.88	2.98	2.95*	1.81	268.02	7.20	1.00
May	1.21	5.8	-10	175	-0.91	2.98	2.97*	1.81	268.00	7.20	1.00
August	1.21	5.8	-10	175	-0.93	2.98	2.94*	1.80	267.98	7.20	1.00
February	1.65	5.8	-10	175	8.28	9.60	9.60	0.22	272.10	7.20	1.00
May	1.65	5.8	-10	175	8.28	9.60	9.60	0.22	272.10	7.20	1.00
August	1.65	5.8	-10	175	8.28	9.60	9.60	0.22	272.10	7.20	1.00
Additional Simulations Varying Discharge Angle (Sigma) in Downstream Direction for Worst-Case Results from Above (Feb, 1.21 m/s)											
February	1.21	5.8	-10	125	14.61	2.62	2.58*	8.38	270.00	7.20	1.00
February	1.21	5.8	-10	90	17.26	2.54	2.51*	7.03	270.62	7.20	1.00
February	1.21	5.8	-10	0	44.59	2.43	2.35*	0.00	268.08	7.20	1.00

Note: X-Y-Z COORDINATE SYSTEM - ORIGIN is located at the bottom and below the center of the port: 5000.00 meters from the RIGHT bank/shore.
X Distance (meters) - X-axis points downstream.
Y Distance (meters) - Y-axis points to left.
Z Depth (meters) - Z-axis points upward.

Key:
bh Half Width (meters) = top-hat half-width, measured horizontally in Y-direction.
bv Thickness (meters) = top-hat thickness, measured vertically.
Dilution S = hydrodynamic average (bulk) dilution, physical dilution S is defined as initial concentration C0 over dilution at a point C, so S= C0/C.
m/s = meters per second.

Table 128-7 CORMIX Results at a Distance of 100 Meters From the Discharge Port

Density Gradient	Current Velocity (m/s)	Wind Speed (m/s)	Theta (degrees Vertical)	Sigma (degrees Horizontal)	Travel Time (seconds)	X Distance (meters)	bh half width (meters)	bv thickness (meters)	Y Distance (meters)	Z Depth (meters)	S Dilution	Temperature Differential (degrees Celsius)
February	0.87	5.8	-10	175	161	100	12.88	10.60	3.28	261.37	47.70	0.15
May	0.87	5.8	-10	175	237	100	13.60	9.70	3.21	261.59	46.00	0.16
August	0.87	5.8	-10	175	131	100	14.67	8.24	3.11	262.24	42.20	0.17
February	1.21	5.8	-10	175	104	100	5.29	5.29	2.69	263.56	28.90	0.25
May	1.21	5.8	-10	175	196	100	5.30	5.30	2.67	263.43	29.10	0.25
August	1.21	5.8	-10	175	145	100	9.69	9.75	2.64	263.71	46.10	0.16
February	1.65	5.8	-10	175	61	100	27.07	27.02	0.22	272.10	380.70	0.02
May	1.65	5.8	-10	175	61	100	27.07	27.02	0.22	272.10	380.70	0.02
August	1.65	5.8	-10	175	61	100	27.07	27.02	0.22	272.10	380.70	0.02
Additional Simulations Varying Discharge Angle (Sigma) in Downstream Direction for Worst-Case Results from Above (Feb, 1.21 m/s)												
February	1.21	5.8	-10	125	256	100	4.26	4.26	12.90	266.64	19.70	0.37
February	1.21	5.8	-10	90	152	100	4.15	4.15	11.89	267.60	19.10	0.38
February	1.21	5.8	-10	0	159	100	3.64	3.64	0.00	265.38	15.40	0.47

Note: X-Y-Z COORDINATE SYSTEM - ORIGIN is located at the bottom and below the center of the port: 5000.00 meters from the RIGHT bank/shore.
X Distance (meters) - X-axis points downstream.
Y Distance (meters) - Y-axis points to left.
Z Depth (meters) - Z-axis points upward.

Key:
bh Half Width (meters) = top-hat half-width, measured horizontally in Y-direction.
bv Thickness (meters) = top-hat thickness, measured vertically.
Dilution S = hydrodynamic average (bulk) dilution, physical dilution S is defined as initial concentration C0 over dilution at a point C, so S= C0/C.
m/s = meters per second.

129

Data Gap: 129

What is the height of the suction pile that would protrude above the sea floor be provided in the EIS. Appendix I, Mooring Documents and Drawings indicates that the suction piles would protrude up to 3.5 feet above the sea floor. Please confirm that this value is correct.

Response to Data Gap: 129

During installation of suction anchors, the final position will depend on the soil heave inside the anchors. The numbers given on the attached drawing (about 1.0 meter or 3.5 feet) are representative of protrusion normally experienced.

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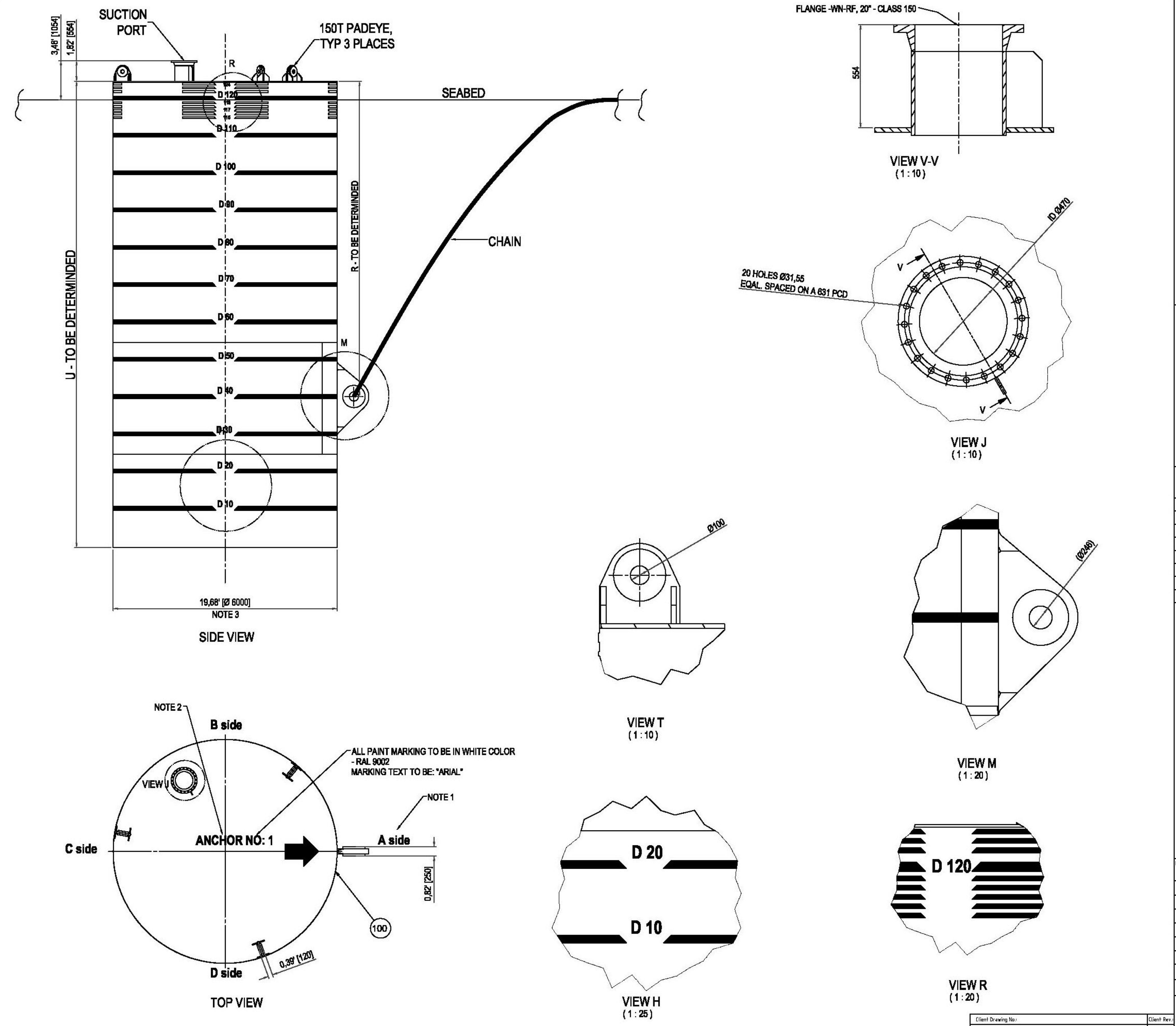

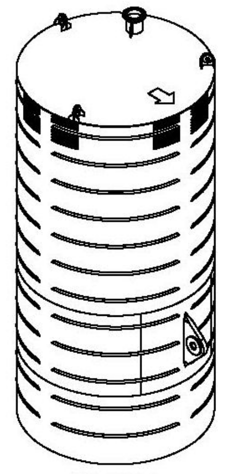

ISO VIEW

NOTE :

1: Side referes to painting on side of Anchor

2: Paint anchor location No from the table above

3: Anchor diameter to be determined during detailed design

ANCHOR NO.	ANCHOR LENGTH V	TOP OF ANCHOR TO PADEYE R	ANCHOR WEIGHT
1	TBD	TBD	TBD
2	TBD	TBD	TBD
3	TBD	TBD	TBD
4	TBD	TBD	TBD
5	TBD	TBD	TBD
6	TBD	TBD	TBD
7	TBD	TBD	TBD
8	TBD	TBD	TBD

Project: Calypso Deepwater Port Project

Rev.	Date	Reason for issue/Ref. DCN No.	Traced by	Checked	Approved
5	25.07.06	INFORMATION	PDa	VAa	JPK
4	14.07.06	INFORMATION	PDa	VAa	JPK
3	07.07.06	INFORMATION	PDa	VAa	JPK
2	14.02.06	INFORMATION	PDa	VAa	JPK
1	07.02.06	INFORMATION	PDA	VAa	JPK

Date: 30.01.06
Design: AB/PDa
Format: A1
Scale: 1:25
Reference dwg.:

APL

STL Mooring
STL Suction Anchor for TRV
Arrangement

DWG.No.: 1368-APL-W-XD-MS-0001
Rev.: 5

Replacement for
Replaced by
Unit No.

Client Drawing No: 11199502-410-DRW-10-121-00
Client Rev.: 0

Figure 129-1. STL Suction Anchor for TRV

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130

Data Gap: 130

Clarify whether Calypso Deepwater Port would include the use of helicopters. If so provide a discussion of the use of helicopters associated with the construction, operation, and decommissioning of the proposed port. Should helicopters be associated with the construction, operation, or decommissioning of the proposed port; please provide a discussion of the noise associated with the use of the helicopters and the associated impacts and mitigation measures, as appropriate.

Response to Data Gap: 130

The use of helicopters in the construction or decommissioning of the proposed port is not expected. During operations, the use of helicopters is not expected for the TRVs that would call on the port.

The SRS, which will normally remain stationed at the port, will require transport of personnel and material. The primary means for that transport is by boat when weather permits. The alternative means for that transport is by helicopter.

The SRS has a helicopter deck specified in its design. The basis for that deck specification is a particular helicopter which, while not necessarily the only model helicopter that may call on the SRS, illustrates the noise to be expected from such aircraft. The helicopter is a Bell 412EP, and is certificated as a Stage 2 helicopter as prescribed in Federal Aviation Regulation Part 36, Subpart H, and Appendix H-Part D - Noise Levels. It is the intent to conform to the relevant regulations on noise for aircraft that serve the SRS.

The external noise level for the Bell 412 EP is reported by the manufacturer to be:

Flight condition	EPNdB (Effective Perceived Noise, in dB)
Takeoff	92.8
Flyover	93.4
Approach	95.6