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June 14, 2022

Ms. Yvette M. Fields, Director
Office of Deepwater Port Licensing and Port Conveyance
U.S. Maritime Administration
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Washington, DC 20590
Via E-mail to Yvette.Fields@dot.gov

Captain Jerry Butwid
Chief, Office of Operating and Environmental Standards (CG-OES)
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Washington, D.C. 20593-7509
Via E-Mail to Jerry.F.Butwid@uscg.mil

Subject: Delfin LNG LLC Deepwater Port Project, USCG-2015-0472
General Update and Explanation of Design Refinements

Dear Ms. Fields and Captain Butwid:

On April 11, 2022, Delfin LNG LLC (Delfin) provided the U.S. Maritime Administration (MARAD) and U.S. Coast Guard (USCG) a written summary of the current status of the Delfin LNG Deepwater Port project. Subsequently, on May 10, 2022, we participated in a virtual meeting with MARAD and USCG that included a PowerPoint presentation and general discussion of the status of our project. During that meeting, MARAD suggested we provide a letter to the agencies summarizing our project status including the results of our Front End Engineering Design (FEED) work.

The purpose of this letter is to provide the agencies with a project update and additional information concerning the project engineering refinement. While Delfin received a favorable Record of Decision (ROD) from MARAD on March 13, 2017, we are now prepared to move forward with the actions needed for MARAD to issue the Deepwater Port license to the project. We look forward to working with the agencies to this end in the coming months.

This letter focuses on aspects of the Deepwater Port related to design and environmental impacts. Delfin has also developed and grown the company, its organization and corporate matters. Therefore, Delfin is in the process of preparing an update of financing-related information to satisfy the related conditions in the ROD for the issuance of the Delfin Deepwater Port License. We also intend to proceed in the coming months with USCG-led efforts related to navigational safety zones and the port operations manual, as well as needed actions with other agencies.

On October 11, 2020, Delfin LNG announced the completion of its Front End Engineering Design (FEED) for the Floating Liquefied Natural Gas Vessels (FLNGVs) for the Delfin LNG project developed jointly by Delfin, Samsung Heavy Industries, and Black and Veatch. In preparing the FEED for the Delfin Deepwater Port project, our design goal was to develop a mooring system and FLNGV design using the best available technology consistent with the concepts evaluated in the MARAD/USCG Final Environmental Impact Statement (FEIS) for the Port Delfin LNG Project Deepwater Port (November 28, 2016). Accordingly, the principal design concepts used in the Delfin Deepwater Port license application and FEIS have been further developed and refined through FEED consistent with standard engineering processes.

The engineering refinements to the Delfin LNG FLNGVs were developed with a goal of minimizing air emissions, water use and other environmental impacts and providing an equal or lesser level of environmental impacts as analyzed in the 2016 FEIS for the Delfin LNG project. The information presented below reflects the results of our engineering refinement process and demonstrates that Delfin has succeeded in maturing our proposed Deepwater Port project consistent with the FEIS. The information below demonstrates that overall project emissions have been reduced below that analyzed in the FEIS. Construction impacts and seabed disturbance are within the parameters of that examined in the FEIS, while pile driving noise has been reduced by 25% with a reduction in mooring system pilings from four to three now proposed with use of the Submerged Swivel and Yoke (SSY) system. The purpose of this document is to provide a description of the refinement of key elements of the design through the FEED process.

SYSTEM COMPARISON TABLE

The following table outlines the main refinements to the design in FEED compared to that considered in the FEIS on a system by system basis.

System	**2016**	**2022**	**Remark**
Mooring	Tower Yoke Mooring System (TYMS)	Submerged Swivel and Yoke (SSY)	SSY evaluation presented in Alternatives Analysis in the DWPLA. TYMS presented as a tentative selection at feasibility stage.
Hull	Barge shaped hull 356 x 65 x 32	Barge shaped hull 335 x 62 x 32	
Cargo Storage	Membrane containment system. 8 x 26,250 m3	Membrane containment system. 8 x 22,500 m3	Total cargo capacity reduced by approx. 15%.
Liquefaction	Approx. 3.3 mtpa. Single Mixed Refrigerant. Integrated HHC removal. HHC mixed with fuel and used onboard	Approx. 3.3 mtpa. Single Mixed Refrigerant. Integrated HHC removal. HHC mixed with fuel and used onboard	LNG expander added downstream of liquefaction to supplement power generation and improve overall efficiency
Pre-treatment	AGR, Hg and H2O removal. Single train.	AGR, Hg and H2O removal. Single train.	
Refrigerant Compression Drives	Aeroderivative gas turbines with low NOx technology	Aeroderivative gas turbines with low NOx technology	
Power Generation	Aeroderivative gas turbines with low NOx technology	Waste heat recovery on refrigerant compression drives combined with a steam turbine generator	Cogeneration of power added to improve efficiency and lower Greenhouse Gas (“GHG”) emissions
Essential Generators	Dual Fuel Diesel Generators	Dual Fuel Diesel Generators	
Process Cooling	Direct Air Cooling	Direct Air Cooling	
Utility Cooling	Seawater based cooling system for essential generators	Air cooled	
Process Heat	Waste heat recovery on power gas turbines	Waste heat recovery on refrigerant compression drives (gas turbines)	Process heat medium changed from hot oil to steam

Auxiliary Boiler	None	Dual fuel boiler	Boiler added to assist start-up and commissioning (process heat)
Thermal Oxidizer	Oxidizer for incinerating waste streams	Oxidizer for incinerating waste streams	
Diesel Oil Tanks	Approx. 2,260 m3	Approx. 6,930 m3	Tanks are sized based on fuel consumption for the transit from shipyard to site. No increase in operational diesel inventory on site (GoM).
Fresh Water Generation and Tanks	Reverse Osmosis Approx. 860 m3	Reverse Osmosis Approx. 2,200 m3	
Ballast Water Tanks	Approx. 127,000 m3	Approx. 121,000 m3	
Flare	Warm (wet) Cold (dry) and LP Pilot flame	Warm (wet) Cold (dry) and LP Pilot flame	
Inert Gas for Cargo Tanks	Inert Gas Generator	Nitrogen Generator	Synergies with topsides N2 system
Drain Systems	Closed drains Open drains with drain pans to capture released hydrocarbons and rainwater, washwater and other fluids for routing to oily water tank and treatment package. Capacity based on collecting the first ½ inch of rainfall.	Closed drains Open drains with drain pans to capture released hydrocarbons and rainwater, washwater and other fluids for routing to oily water tank and treatment package. Capacity based on collecting the first ½ inch of rainfall.	

In addition an increase in the design lifetime of the FLNGV and its equipment from 20 to 25 years on site is implemented consistent with the extended term of the natural gas export authorization through 2050 issued by DOE in December of 2020.

MOORING SYSTEM SELECTION

At the feasibility stage, Delfin evaluated in detail two options for the disconnectable mooring. One option was the Tower Yoke Mooring System (TYMS) that would consist of a four-pile fixed platform with a rotating swivel and disconnectable mooring assembly attached to each FLNGV. The other option was the Submerged Swivel and Yoke (SSY) Mooring System consisting of a three-pile base on the seabed with a submerged rotating swivel and a yoke system connecting the mooring chains. See Chapter 2.7.2 in Section 2 Alternatives Analysis of Vol. II of the DWP License Application for a description of the detailed evaluation of the TYMS and SSY systems that was undertaken. The two options are depicted below:

Figure 1 *Tower Yoke Mooring System*

Figure 2 *Submerged Swivel Yoke Mooring System*

The TYMS was tentatively deemed the preferred selection at the feasibility stage in 2015 due to the SSY system being less mature at the time. However, as stated in Chapter 2.7.2.3 of the Alternatives Analysis report, no other disconnectable mooring solutions were excluded at that stage of the project and the issue was to be investigated further during FEED.

During the course of FEED in 2020, Delfin determined that the SSY mooring system has now established a track record of being a safe, reliable and cost effective mooring system for FLNGVs. Given this new track record and the operational advantages of the SSY approach, as well as the reduced environmental impacts, Delfin has selected the SSY mooring system for use on the project.

The SSY mooring system is currently deployed for the following operational LNG projects:

- Hilli Episeyo, FLNG vessel in operation offshore Cameroon
- Golar Nanook, FSRU vessel in operation offshore Brazil

Figure 3 SSY mooring system on FLNG offshore Cameroon

Figure 4 SSY mooring system on FSRU offshore Brazil

The SSY system has operational advantages over the TYMS, including an expected quicker re-connect time after any necessary hurricane evasion. The submerged design also provides more protection for the abandoned equipment in the event of a hurricane, and thus reduces risk of damage to the mooring or gas transfer system. Another advantage of the SSY over TYMS is the reduced seabed disturbance, construction time and noise from having to drive three piles instead of four during the installation of the system. The FLNGV will be able to remain connected to the SSY system in all winter storm conditions as well as the conditions experienced and expected at the Delfin DWP site during the majority of the named tropical storms in the area.

The four previously proposed TYMS units would be replaced by four SSY units at the same locations. On an environmental impact basis, Delfin expects the construction, operation and decommissioning of the SSY units will be less than that of the TYMS units. In particular, Delfin notes the following:

- The SSY units only require installing three rather than four 96" diameter piles proposed as part of the TYMS units. This results in 25% less pile driving noise.
- The SSY units can be installed within the same 75 X 75 foot seabed footprint as the original TYMS units resulting in no additional seabed disturbance.
- The SSY units will be disconnectable and allow FLNGV departure and storm evasion on a similar or shorter time line to that of the TYMS units.
- The SSY units are expected to allow for quicker reconnect and start-up after storm evasion and thereby improve the facility uptime.

POWER GENERATION SYSTEM

Incorporating waste heat recovery from the refrigerant compression gas turbine drives in combination with steam turbine power generation has been included in Delfin's post-FEED design refinements and effectively results in a combined-cycle power generation system. This measure reduces the GHG emissions from power generation onboard the FLNGVs and saves fuel. While simple-cycle power generation historically has been the main arrangement on many offshore floating assets, a change to combined-cycle to reduce emissions and save fuel costs is emerging as a new standard in the offshore industry.

In alignment with Delfin's project objectives to minimize the impact on the environment, the combined-cycle power generation system uses air cooling for the steam condensation. The steam exhaust from the Steam Turbine Generator (STG) is condensed in an array of Air Cooled Condensers (ACC) located on the aft deck of the vessel.

The electrical power generated using the waste heat from the refrigerant compression drives is approximately 30 megawatts (MW) in normal operation and eliminates the need for the dedicated gas turbine power generation that was included in the design at the feasibility stage of engineering. The reduction in GHG emissions by implementing combined-cycle power generation is in the order of 100,000 CO2 equivalent tons per year per FLNG vessel, as detailed further below. The refined design of the power generation system of Delfin's FLNGVs is illustrated below.

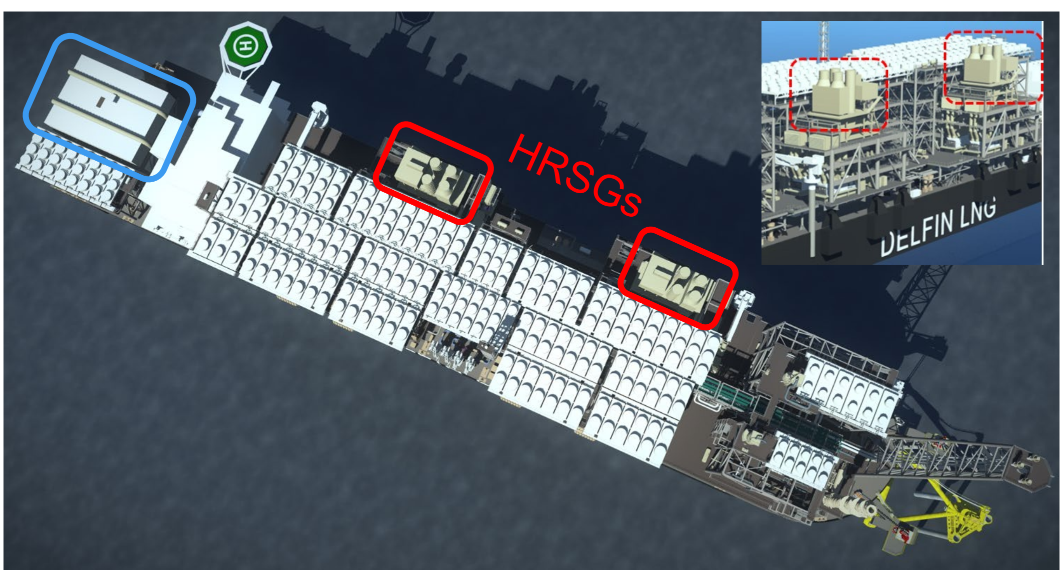

Figure 5 ACC and HRSG Location on the FLNGV

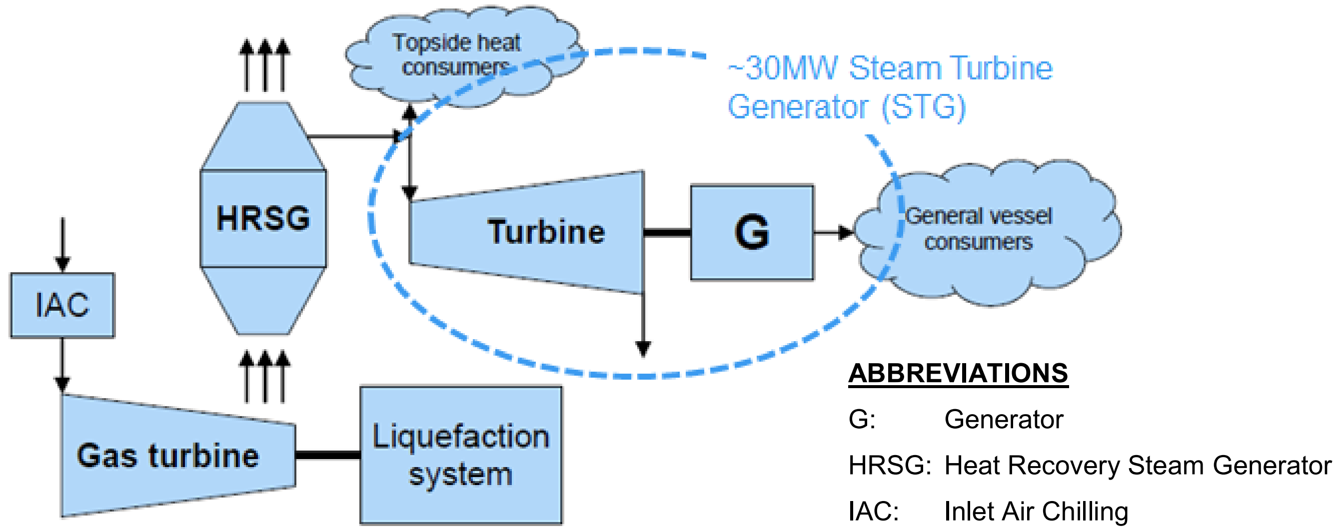

Figure 6 Schematic of the combined-cycle power generation

COOLING SYSTEM

The feasibility stage design included sea water cooled essential generators. The essential generators were primarily intended for use when the vessel is in transit to site or when sailing during hurricane avoidance events. During testing of the essential generators when connected to the mooring and performing normal liquefaction operation, the generators would be cooled by means of sea water.

In the refined design resulting from FEED, the essential generators are also used to supply supplemental power during normal liquefaction and offloading operations. For the sake of eliminating the use of sea water to cool the essential generators, a dedicated array of air fin coolers is installed at the aft deck (in front of accommodation, starboard side) of the vessel.

All other process equipment and utilities are cooled by air, in line with the feasibility stage design concept.

AIR EMISSIONS

The projected air emissions from the FLNGV equipment are listed in the following table. The projections reflect the maximum emissions when all the machinery is being operated at 100% of its respective capacity or throughput. As such, the projections take into account equipment uptime, varying ambient conditions, and various operational scenarios.

Taking into account the refined engineering and operational scenarios, the overall emissions will decrease on an aggregate annual average basis compared with those evaluated in the 2016 Environmental Impact Statement. Additional details will be submitted as part of the air permit application process

With respect to GHG emissions (CO2 equivalent), Delfin's refined engineering has achieved substantial reductions based on incorporating waste heat recovery from the refrigerant compression gas turbine drives in combination with steam turbine power generation. This measure reduces the GHG emissions from power generation onboard the facility and saves fuel gas usage.

Other air emissions components (NOx, CO) have likewise been incrementally reduced with the refined design. All of the refinements proposed as part of the additional engineering have been based on keeping project environmental impacts within the parameters of those evaluated in the Environmental Impact Statement.

Source	**2016**	**2022**	**Remark**
Refrigeration drives (gas turbines)	3 x 54,989 lb CO2e/hr 3 x 43.2 lb NOx/hr 3 x 26.3 lb CO/hr	4 x 42,704 lb CO2e/hr 4 x 33.5 lb NOx/hr 4 x 20.4 lb CO/hr	Configuration refinement from 3 off gas turbines to 4 off smaller ones
Power generation (gas turbines)	3 x 31,031 lb CO2e/hr 3 x 24.4 lb NOx/hr 3 x 14.9 lb CO/hr	N/A	Power generation gas turbine deleted from design upon introducing combined cycle power generation
Essential generators (Dual fuel engines)	3 x 9,982 lb CO2e/hr 3 x 80.4 lb NOx/hr 3 x 50.2 lb CO/hr	3 x 13,146 lb CO2e/hr 3 x 88.5 lb NOx/hr 3 x 55.3 lb CO/hr	2016: essential gens only in operation for hurricane avoidance 2022: in operation for hurricane avoidance and single engine part time during normal operation
Emergency generator (diesel engine)	3 x 1,843 lb CO2e/hr 3 x 14.8 lb NOx/hr	2 x 3,845 lb CO2e/hr 2 x 30.9 lb NOx/hr	Configuration refinement from 3 off diesel

	3 x 9.26 lb CO/hr	2 x 19.3 lb CO/hr	generators to 2 off larger ones
Fire water pump	2 x 3,072 lb CO2e/hr 2 x 24.7 lb NOx/hr 2 x 15.4 lb CO/hr	4 x 1,225 lb CO2e/hr 4 x 9.9 lb NOx/hr 4 x 6.2 lb CO/hr	Configuration refinement from 2 off diesel driven pumps to 4 off smaller ones

FLNGV OPERATIONAL WITHDRAWALS

The estimated average daily water intake requirement for FLNGV connected at site are listed in the following table. Overall the total average water intake is expected to be the same or lower than assumed for the Final Environmental Impact Statement issued in 2016.

Service	2016	2022	Remark
Desalination System	1.0 mgd	1.0 mgd	Assumed 35% recovery rate
Ballast System	2.1 mgd	2.1 mgd	Same production rate and number of LNGC loadings
Cooling Water for Essential Generator (testing at site)	0.001 mgd	N/A	Refined design uses air cooling for all systems
Fire Water Pump Testing	0.03 mgd	0.03 mgd	
IGG Scrubber Water	0.001 mgd	N/A	Refined design uses N2 for tank inerting
Water Curtain	0.1 mgd	0.1 mgd	

FLNGV OPERATIONAL DISCHARGES

The estimated average daily operational discharges per FLNGV are listed in the following table.

Source	2016	2022	Remark
Ballast water	2.4 mgd	2.1 mgd	
Machinery rooms bilge water	0.007 mgd	0.007 mgd	
Sewage treament discharge	0.003 mgd	0.003 mgd	
Slop tank discharge	0.007 mgd	0.007 mgd	
Essential generator cooler discharge	0.001 mgd	N/A	Refined design uses air cooling for all systems
IGG scrubber discharge	0.0006 mgd	N/A	Refined design uses N2 for tank inerting
RO reject water discharge	0.64 mgd	0.64 mgd	
Fire water test	0.03 mgd	0.03 mgd	
Water curtain	0.09 mgd	0.09 mgd	

We hope this update provides you with sufficient detail regarding the current status of the Port Delfin Project and its refined design. Please feel free to contact the undersigned or our counsel, Patrick Nevins of Latham & Watkins at (202) 637-3363 or Patrick.Nevins@LW, if you have any questions or require additional information.

Respectfully submitted,

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