B.02.02 PROPOSED ACTIVITIES Non Confidential Document

B.02.02.01 DESCRIPTION OF THE PROPOSED INSTALLATION ACTIVITIES

The proposed installation activities have been outlined in section B.01.02 to B.01.04. A detailed description of the main systems within the LNG Terminal and Storage Facility, Regasification Plant and CCGT is described in this section.

The sequence of system descriptions below follows the sequence from the most upstream point, the LNG carrier vessel, downstream to the different termination points of providing gas to DPP3 and power out of D4. A high level process flow diagram (PFD) for the overall LNG offloading and regasification system are shown in drawing ENEM-URS-FS-00-DR-ME-00050 and for the CCGT in drawing ENEM-URS-FS-00-DR-ME-00051 in section B2.2.3 of this application.

Reference drawings;
47067567-1018 Site Block Plan
47067567-1019 Overall Site Layout and Cable, Pipe Route and TP Layout
ENEM-URS-FS-00-DR-ME-00050 LNG Terminal & Regasification Process Flow Diagram
ENEM-URS-FS-00-DR-ME-00051 CCGT Process Flow Diagram
ENEM-URS-FS-00-DR-ME-00052 Typical Berthing Arrangement
ENEM-URS-FS-00-DR-ME-00066 Chemical & Service Tank Locations Sheet 1 of 2
ENEM-URS-FS-00-DR-ME-00067 Chemical & Service Tank Locations Sheet 2 of 2
ENEM-URS-E0-00-DR-ME-00106 External Tie in points
2779-77-CI-DR-000401 Regasification Facilities Stormwater Drainage Works
47067567-1022 Detailed Layout Area B- Regas Compound
MT1001-UZ-CLD103-444911146 CCGT General Layout Arrangement Drawing
21023-BAE-79430-MO-DW-0003 Anchor Pattern Drawing

1. LNG Terminal and Storage facility:

Reference MARIN report:

Nautical and Rick Studies for the Delimara LNG Terminal in Marsaxlokk Port, Malta
27689-1-MSCN Item 1: Wave climate study
27689-2-MSCN Item 2: Wave penetration study
27689-3-MSCN Item 3: Moored ship response study
27689-4-MSCN Item 4: Real time manoeuvring simulation
27689-5-MSCN Item 5: Nautical risk assessment study
27689-6-MSCN Item 6: Nautical quantitative risk assessment (QRA) report
27689-7-MSCN Item 7: Additional metocean analysis
27689-8-MSCN Item 8: Additional moored ship response calculations storm mooring

a. LNG Storage: LNG will be stored in a floating storage unit (FSU) which is to be a permanently moored converted LNG carrier, the originally named Wakabu Maru IMO No. 8125868 with dimensions 283m x 44.8 m. During the conversion process from an LNGC to an FSU the vessel is being renamed Armada LNG Mediterrana it will retain the same IMO number, will be re-certified by Class and have Malta Flag State. It has a gross storage capacity of 125,877 m^3. The LNG containment system consists of five independent insulated Moss type tanks made of aluminium alloy and designed for operating at cryogenic temperatures. There is a secondary barrier designed for holding maximum envisaged potential leakage from the tanks. The design of the spherical tanks presents a high degree of protection against failure or fracture during the operational lifetime of the FSU. The FSU will be fully crewed at all times under the full control of the vessel's Captain.

The FSU will be Class certified such that she can sail under her own engines from Singapore to Malta and then be moored at the jetty for 18 years without dry docking. On arrival in Malta the FSU will be safely moored to the jetty, connected to the storm mooring system, demobilised, such that the steam driven propulsion system is taken out of service, and will complete a number of stringent commissioning tests.

The main activities included in the demobilisation of the FSU are; the existing main boilers will be isolated, andthe propulsion system, including the steam turbine and turning gear, will be taken out of service with the propulsion shaft physically locked. In addition the main boilers' discharge stack will be taken out of use as the new auxiliary boilers' discharge stack is fully independent of the existing main boiler stack.

Should the vessel have to move from the jetty after she is demobilised, she will either winch off onto the storm moorings or, if necessary, disconnect from the storm mooring system and be taken by tug to an alternative anchoring location. Before the FSU is demobilised it must arrive in Malta, be safely moored to the jetty and connected to the storm mooring system, and complete a number of stringent commissioning tests.

While the above tests are ongoing and until all commissioning is complete and certification in place the FSU will remain mobilised. This is allowed for under the FSU's Bureau Veritas (BV) classification for up to an initial twelve month period

Phase 1 FSU operation defines when the FSU is initially temporarily mobilised with working propulsion until the relevant FSU tests and certification are complete, and Phase 2 FSU operation is with the Vessel's propulsion system demobilised. Phase 1 is expected to last a number of weeks but is set up to one year in case of commissioning delays over winter of the storm mooring system

b. Operating Regime (Storm moorings system commissioned, propulsion system decommissioned and new auxiliary boilers in operation)
   - During normal operations, whilst moored at the jetty the new auxiliary boilers will be kept cold.
   - The main exception to this will be during a STS operation, estimated to occur every six to eight weeks, when steam is required to operate the BOG compressors for loading of the LNG. During this time one of the auxiliary boilers will be fired to produce this operational steam requirement.

- When inclement weather is forecast a planned disconnection event will be started, and both of the auxiliary boilers will be fired to manage the BOG. The FSU will be disconnected from the jetty, the auxiliary service diesel generator will be started and the FSU will winch herself off the jetty into the storm mooring location.
- In a disconnection event requiring the FSU to leave the harbour, tugs shall tow her to a safe anchorage.
- The FSU needs four to six hours to pressurise the boilers, which coincides with the amount of time needed to stop cargo, inert, warm up and disconnect the fixed arm / send out BOG hoses & Utility lines. During any disconnection event (estimated three times a year for four days each occurrence) both auxiliary boilers will be fully operational.
- When connected to the jetty all the FSU's electrical power requirements will be met via the shore electrical power connection.

c. Mooring system (Vessel cold ironed, main boilers and propulsion system decommissioned): The MARIN Nautical Risk Study Section 3 Moored Ship Response Study as concluded that the proposed berthing configuration is effective for significant wave heights to 2.5m. Refer to document reference 27689-3-MSCN Item 3: Moored ship response study appended of this application. Based on the conclusions of these studies, the following mooring equipment will be installed:

   i. FSU moorings: sixteen lines will moor and secure the FSU to the mooring dolphins, which will be connected via quick release hooks (QRH) on the mooring dolphins. Each mooring line will be rated with a maximum breaking load of 150 T. A total of eight mooring dolphins will be installed, four to the North and four to the South. The outer two will generally be allocated for use by the visiting LNG Cargo vessel. A typical mooring arrangement is presented in drawing ENEM-URS-FS-00-DR-ME-00052.
   ii. LNG carrier vessel mooring: A total of circa 10 sets of quick release hooks will be installed in the starboard side of the FSU. These shall be used for mooring the visiting LNG Carrier alongside the FSU. In addition, as stated above, the two outermost mooring dolphins may also be used for mooring the visiting LNG Carrier.
   iii. A load monitoring system shall be installed on the mooring dolphins in order to remotely monitor the tension of the different lines. If the tension of any of the lines exceeds the pre-defined safety threshold, the alarm system will be activated.
   iv. A storm mooring system consisting of 2x4 fully submerged offshore anchors will be installed so that in extreme inclement weather conditions the vessel can be moved off the jetty to avoid potential damage to the jetty and/or the vessel. In this scenario the FSU will be disconnected from the shore in a planned manner and using winches installed on the vessel deck will be pulled 70m off the jetty for the duration of the inclement weather. This operation is expected to be required two or three times per year for a period of four days per event. During these disconnection events DPS3 can

operate four engines on diesel, ie circa 50% load, however DPS4 will not be in operation. Refer to reference 21023-BAE-79430-MO-DW-0003 appended to this application. The design of the storm moorings has been carried out using the Metocean data developed by MARIN and Arcadis as utilised in the Nautical Risk Studies. When the FSU is disconnected and restrained by her storm moorings both of the auxiliary boilers will be operational in order to manage and consume BOG. On average the FSU will be able to manage five to seven days of BOG generation before the Pressure Relief Valves (PRV) will operate to prevent over pressure of the tanks.

v. Fender system: Berthing fenders will be installed on the three jetty berthing dolphins for ship-to-shore LNG transfer operations. Fenders will also be installed on the FSU during ship to ship transfer operations providing a soft and stable mooring in both cases.

d. Ship-to-ship (STS) LNG transfer system: This system will utilise flexible hoses for both the LNG and boil-off gas (BOG) transfer operations from the LNGC to the FSU and will include permanent saddles to support these hoses as well as other ancillary equipment. Emergency release couplings will be installed on each LNG/BOG transfer lines. The transfer hoses along with the required ancillary equipment will comply with BS EN 1474 and will follow LNG STS Transfer Guidelines SIGTTO recommendations. Flexible hoses are considered industry standard for STS operations where the transfer of cryogenic liquids is over a relatively short term connections duration (circa 24hrs), as is the case in these operations.

During STS transfer auxiliary gas fired steam boilers will be operational to provide steam to the cargo handling equipment, ie the cargo compressors, heater and LNG vaporisers which are all driven and heat by steam. During this time cooling water will be required to support the boilers, the system will utilise an Impressed Current Anti Fouling (ICAF) system for the marine/biological growth prevention system. No chemicals will be used to treat this water and the subsequent discharge will not exceed inlet plus 8 degC. The anodes are consumed and will require replacing every two to three years. A minimal amount of boiler blowdown will also be discharged to marine water during this operational scenario.

It is foreseen that the FSU will be re-filled every circa six to eight weeks over two 24hr periods by an LNG Carrier resulting in an estimated 13 to 18 ship-to-ship LNG transfer operation per year. The reason for the two STS transfer activities per load is that the FSU and majority of compactible LNGCs will be of a similar size, and since the FSU is the sole source of LNG storage it will not be allowed to 'run dry'. Thus LNGC will initially off-load the majority of her cargo over a 20 to 24 hour period, she will then de-moor, leave the harbour and wait out to sea whilst sufficient LNG is converted to NG, burnt in the respective power plants and sufficient space is available in the FSU to take the rest of the LNGC cargo. The turn-around time for the double loading of LNGC is expected to be in the region of five days.

e. Auxiliary gas fired steam boilers: During ship to ship transfer steam driven equipment is required for the unloading operations. The Steam is produced by 2 x 100% auxiliary gas fire boilers each rated 16.25MW thermal gross and fuelled by BOG. These boilers are only operational during STS transfer event and/or in the event of a disconnection event and thus will only be run for an estimated maximum of 32days per year, (16 days each boiler).

f. Ship-to-shore LNG transfer system: Transfer of LNG and BOG from the FSU to the Regasification compound is achieved through three flexible hoses and one hard arm. The hard arm will be for the permanent transfer of LNG to shore, two of the hoses will be dedicated to the transfer of BOG and the third hose will a hybrid line which could be used for either LNG or BOG during periods of maintenance to the hard arm. The ship to shore lines are connected to a common onshore manifold and on to the regasification facility through suitable cryogenic pipework along the jetty access arm. The common manifold separates BOG from LNG through isolation valves. All LNG/BOG transfer hoses will include a Power Emergency Release Couple (PERC) and other safety systems as per BS EN 1474.

g. Electrical supply: The FSU will have permanent shore power supplied via a ship to shore cable. This cable will provide all the needs of the FSU during all normal operations. In the event of a failure of this supply, or in the case when the FSU is disconnected from its mooring, power will be supplied from an on-board auxiliary service diesel generator, with a back-up emergence generator to support all safety systems on board. The auxiliary service generator will be rated at 2MW electrical (5MWth) and the emergency generator will be rated at 150kW electrical (482kWth).. The emergency generator will be tested for one hour every month and the auxiliary service generator will run during storm mooring disconnection events, ie circa four days per year. Neither of them will be operational during normal operating events. In addition there will be the existing diesel genset rated at 1.2MWe which will be kept as a spare.

h. The existing on-board sewage treatment plant will be maintained and will treat all domestic sewage water generated in the FSU before discharge into a holding tank. The treated effluent quality shall have a BOD5 value below 40ppm, suspended solid concentration below 50ppm and free chlorine concentration of 2ppm.. For further details refer to section B3.3.1

i. Instrument and service air system: The FSU will include a dedicated on-board instrument and service air system, no ship to shore air supply will be provided. Since a loss of control air could cause an emergency shutdown of the FSU, this system will include the appropriate level of redundancy.

j. Ship to shore services points for nitrogen, potable water and firefighting water will be provided on the jetty. These will not be permanently connected to the FSU, but only connected via flexible hose as and when necessary to top up the vessels supplies.

k. The jetty will also support an access gangway, a crane and firefighting equipment.

l. In addition to storage of LNG on the FSU the following will also be stored on the vessel to allow for all operation scenarios;
   - Potable and firefighting water storage tanks
   - 2100 m^3 treated effluent and grey water holding tank.
   - 5x LNG FSU storage tanks, 125,000 m^3
   - 23 m^3 liquid N2 buffer tank.
   - Instrument and service air buffer tanks.
   - 2400 m^3 existing main diesel fuel tank.
   - 3.8 m^3 new service diesel gen-set tank.
   - Clean lube oil storage drums, 50x200litres
   - Lube oil sump tank 24.8 m^3
   - Waste lube oil tank 1 m^3
   - Boiler feedwater chemistry tanks; consisting of sodium phosphate and Diethylhydroxlamine

FSU Operational Modes

The following FSU operating modes have been identified during the commercial operation of the new facilities:

1. Normal operating conditions: The FSU will transfer LNG onshore to meet the NG demand from the NG off-takers, namely Delimara 3 and Delimara 4. At this operating scenario none of the FSU boilers will be in operation;

2. Ship-to-ship LNG transfer: . Every six to eight weeks an LNG visitor cargo (LNGC) will moor side by side to the FSU and will transfer LNG into the FSU tanks. It is considered that generally two LNG transfer operations will be required to transfer the whole LNG cargo. During the first operation, around 70 to 90 % of the LNGC will be transfer to the FSU. The LNGC will then de-moor and sail off until the FSU tanks have enough available storage capacity to complete the LNG transfer of the whole visitor cargo. During STS operation one of the auxiliary boilers will be running in order to fulfil the steam demands from the LD and HD BOG compressors. These compressors are required to evacuate the high BOG generation rate which typically takes place during STS transfer. During STS operation, onshore LNG transfer will continue to fulfil demand.

3. Storm FSU disconnection event: When stormy weather conditions are expected in Marsaxlokk harbour the FSU will leave the jetty and will winch herself onto the storm mooring system approximately 70m west of the normal jetty location. During this operating scenario, the FSU service gen-set will be in operation in order to fulfil FSU

electricity demands. In addition the two auxiliary boilers will be required to operate to control the pressure in the FSU tanks by firing excess BOG. If the FSU is required to leave the harbour, the storm mooring chains shall be let go and tugs shall pull the FSU out to an anchorage location. There is no LNG transfer to shore during disconnection events.

Table 1 FSU Operating modes includes the different operating cases and defines the airborne emission source and the estimated annual operating hours for each case. This table does not include emission from Delimara 3 GRS boilers. These will only operate when Delimara 3 is in operation which is expected to occur intermittently during high electricity demand hours.

There are three emergency diesel generators (EDG) in the new facilities:

1. An EDG will be installed in D4 power plant. This shall operate under emergency situations for a limited time in order to rump down the GTs in a safely manner.
2. An EDG will be installed in the Regasification plant besides the control building. This will operate in case there is an under voltage or a power fault in the low voltage bus-bar. This can occur during an emergency shut-down event or during a power fault event in the feeding lines.
3. The existing FSU EDG will be kept in operation and will operate during emergency disconnections in order to fulfil essential electricity demands.

The EDG functionality will be tested once a month for an hour at around 80% rated load totalling 12hr/yr.

The ground NVCC will have three pilot lights operating continuously. These pilots will provide the required heat input to fire the main flare in case of emergency depressurization. Each pilot light will consume 1.5Nm^3/h of natural gas which corresponds to 16.3kWth of net heat input.

Table 1 FSU Operating modes

Mode	Operating scenario	Airbone emission source (Gross heat input MWth)	Max. annual operating hr.
1	FSU arrival in harbour	2 xFSU main Boilers (58.5MWth each)	N/A
2	Normal operation only ship-to-shore LNG transfer	Delimara 4 (3x 144MWth) 3xNVCC pilot flares (18kWth each)	8059
3	Ship-to-ship LNG transfer	Delimara 4 (3x 144MWth) 1xFSU aux Boilers (16.25 MWth) 3xNVCC pilot flares (18kWth each)	530
4	FSU disconnection event	2xFSU Aux. boilers (16.25MWth each) FSU Service Diesel gen-set (5MWth) 3xNVCC pilot flares (18kWth each)	120
5	Emergency shut down	Delimara 4 CCGT (2.6MWth) Regas plant EDG (0.54MWth) FSU existing EDG(0.48MWth)	12*
		NVCC main flare at full load (226MWth)*	0*
		FSU Spare existing emergency diesel genset (3.2MWth) To be used if all other FSU gensets and ship to shore power connection fails	4*

* These are for testing purposes only and the NVCC is not included in this.

2. Onshore LNG regasification facility (Ref layout drawing 47067567-1022):

   a. LNG receiving system: The LNG is transferred to shore via the FSU's submersible LNG pumps, from where it is piped along the jetty access arm to the onshore suction tank via cryogenic pipework. The suction tank will store small volumes of LNG prior to it being processed in the regasification compound. Any BOG generated in the LNG receiving system will be recovered and routed to the BOG system via a vapour line.

   b. BOG (Natural Gas) system: The BOG generated in the FSU tanks and transfer lines is recovered and transferred via flexible hoses to shore from where it is piped along the jetty access arm to the regasification compound where it is processed for use as fuel in the two power plants. The BOG equipment will consist of three BOG compressors and temperature conditioning units both designed to a redundancy of 3x100% capacity at normal operating conditions. A knockout drum upstream of the compressors shall collect any possible drain or droplet entrained from the different upstream systems protecting the compressors against erosion. The BOG (Natural Gas) is compressed to the operational pressures required by the CCGT such that it may be mixed with the degasified LNG and sent for use in the two power plants. The BOG conditioning unit consists of electric heaters and after-coolers both with by-pass lines which shall regulate the temperature to a level according to the requirements of the Natural Gas consumers.

   c. Emergency non visible combustion chamber (NVCC): This safety system provides over-pressure protection to the LNG compound. Pressure could build up within the LNG system in the unlikely event there is an excess of BOG production which cannot be consumed due to an emergency shut-down of the plant, an LNG line failure or a simultaneous shut-down of both power plants. As BOG is continually produced, for safety reasons if the BOG that cannot be consumed downstream it will need to be evacuated from the lines so as to avoid over pressurization of the pipes. In order to avoid the sudden release of large amounts of gas to the atmosphere and create explosive and hazardous environment, an emergency NVCC system will be installed. In addition the NVCC will be utilised in the event of an emergency evacuation of the natural gas pipes being required for instance in the event of a fire elsewhere on the site, in this scenario the gas can be safely burned in the NVCC rather than release to atmosphere.

      It is not envisage that the NVCC will be used during normal operations, it will be kept in its pilot light mode 3 x pilot flares (16.3kWth each), as it is for use in an emergency situation only, . Neither is there a requirement for increasing the gas flow through the equipment for any normal routine maintenance (refer to section B2.5 for further details) and thus continuous monitoring is not proposed. Refer to BAT conclusions; section B2.2.4, for confirmation that this is considered BAT acceptable. The amount of gas burnt in the NVCC however will be monitored and recorded. This information can be used to estimate the CO_2 and SOx emissions into the environment by considering that the any carbon and sulphur molecule contained in the gas will be fully oxidized in the NVCC. NOx emissions are less easy to calculate however they are expected to be low as the combustion process in the NVCC is pre-mixed with low flame temperature, and an estimate may be made based on the figures below from similar installations

During peak flaring rate operation and after steady state conditions have been established the following emission levels have been observed from a similar unit burning Natural Gas, averaged over a 20 minute period.

NOx 344 mg/Nm^3
CO 143 mg/Nm^3
Total Unburnt Carbon 13.2 mg/Nm^3
All levels corrected to 3% oxygen

d. Regasification plant: This will consist of two trains (2x100%) with a capacity of 75,840 Nm^3/hr of Natural Gas production at rated conditions and with a turndown capability of 20-100%. The following subsystems are included within the regasification plant:

   i. LNG pumps: Each regasification train will include two HP LNG pumps to pressurize the LNG for the rated medium to high load operations and one additional small scale pump for low load operations. Each train will be able to deliver 130 m^3/h of LNG from 5 barg to 42 barg at rated conditions For low load operation, the two small scale LNG pumps will come into operation allowing a minimum flow rate of 10m^3/h.

   ii. LNG vaporization: The selected technology for the LNG vaporisation is the Intermediate Fluid Vaporizer (IFV) technology. The basic concept of an IVF plant is that the IVF uses liquid propane as an intermediate heat transfer fluid (transferring heat from the water/glycol loop) in order to vaporize LNG. The use of the intermediate fluid propane is to prevent the freezing of the water/glycol mixture which would happen if it was used as the only vaporising fluid in the overall regasification process.

   iii. Water/Glycol system: A water/glycol heating closed circuit loop will be provided in order to exchange heat with D4's gas turbine air intakes. The cold water/glycol fluid absorbs heat from the inlet air thus providing a power enhancement to the gas turbines as the mass flow rate through the gas turbines is increased due to cooling down, resulting in a density and thus efficient increase. The water/glycol fluid is then returned to the regasification compound where the heat is used to vaporise the propane which in turn vaporised the LNG and which in the process cools down the water/glycol fluid ready for returning to D4. The propane and water glycol loops are closed cycle systems, only a minimum amount of losses are expected through the operational lifetime. In order to make up for these losses, a 5m^3 glycol water solution buffer tank and a 1.2m^3 propane tank is included, refer to drawing ENEM-URS-FS-00-DR-ME-00067 for location of these storage tanks.. The water/glycol loop transfers heat from the air intake of CCGT for use in the regasification process of the LNG and in return transfers the cooling from this regasification process to the CCGT air intake to improve the efficiency of the CCGT, it is a highly efficient way of using the heating and cooling from the two processes for the benefit of the other.

e. Gas pipework delivers gas to D3 CCGT at below 40barg, the pipe working being rated at maximum 60barg pressure to protect against over pressure. The gas pipework to D3 delivers gas at 7barg; the pipework is design for maximum pressure of 16 barg.

f. Delimara 3 gas receiving station (GRS): The NG from the regasification compound will be routed to Delimara 3 GRS where the NG will be filtered from particles, pre-heated and throttled in various pressure control valves to the level of pressure required by the power plant. The gas will be heated via 2x100% boilers rated at 420kWth each, they will burn natural gas and will only be operational when the regas plant is supplying Delimara 3 with gas.

   NG fiscal metering, chromatographs and emergency shut-down valves will be also installed. The outlet flange from the D3 GRS will be the interface point for gas delivery to the Enemalta facility (Delimara 3 Power Generation Ltd) and is one of the limits of the responsibility of this new plant.

g. Stormwater runoff shall be collected in a series of gullies and pipes and discharged to Marsaxlokk bay as shown on drawing 2779-77-CI-DR-000401 appended to this application. All areas that have a potential for oil contamination risk, such as the transformer area and emergency diesel generator area, will have a complete sealed secondary containment from which any oil spillage will be removed via mobile equipment, thus there is no requirement for an oil interceptor within the regas compound.

h. Sewage will discharge to a cesspit and the sludge will be emptied as required via a tanker. The cesspit will be design as a water retaining structure; it will be suitably ventilated to avoid the build-up of any gasses; the surrounding area will be impermeable and concrete paved to falls. The Cesspit parameters are as below
   - Personnel: 5 persons
   - Forecast quantity of sewage waste: 50lt / person / day
   - Cesspit Volume: 15,00m^3
   - Cesspit operational volume: 11 m^3 / 11.000 lit
   - The cesspit will need to empty every 44 days (one and a half month).

In additional to supplying NG to the two power plants, the regasification plant will also have connections to the existing facilities for the following services;

- Demin Water
- Cooling Water inlet and outlet
- Firefighting (fresh water)
- Potable water
- HV, MV and LV electrical supplies

Refer to drawing ENEM-URS-E0-00-DR-ME-00106 for a list and location of these interface point

3. CCGT power plant (Ref Layout drawing MT1001-UZ-CLD103-444911146):
The power plant will consist of a new Siemen's gas-fired combined cycle SCC-800 3 x 1 multi-shaft type for condensing applications designed for base load operation. The net power output at rated conditions shall be 205MWe. A description of the main systems is presented below:

   a. Gas turbine generator system: The power plant will include three heavy duty SGT-800 gas turbine/generators (GTGs). These GTGs are optimized for combined cycle operation as having high efficiency and considerably high exhaust temperature for the bottoming steam cycle. The working principle of the gas turbine (GT) is common to any other state-of-the-art CCGT. Air is entrained, cooled in the water/glycol-to-air coil coolers and filtered for particle removal within the combustion air intake system. This system incorporates a silencer for noise attenuation. The compressed air then flows to the 30 annular-type dry low emissions (DLE) burners where NG is injected and mixed with the air, and the combustion process is sparked. A fuel-lean, staged combustion process is developed within the DLE burners accomplishing low level of NOx and CO emissions. The DLE technology guarantees compliance with EU directive 2010/75/EU and the Maltese LN 11/2013 without the necessity of using any post-combustion emission abatement technology. The hot combustion gases are finally expanded in the Gas Turbine generating mechanical shaft work which is in turn converted into electricity in the generator. A speed reduction gearbox is coupled between the GT and the AC Generator to reduce the speed from around 6600rpm to 1500rpm. The stack emissions during open cycle operation (Gas Turbines only in operation) will be the same as during CCGT operation (HRSG operating) with the exception that the temperatures will be higher and thus the discharge more buoyant. Due to the greater buoyancy of the gas discharge the impact on dispersion will be less.

      It should be noted that the Gas Turbines meet emission requirements between 70% to 100% of their maximum load and thus apart from start-ups and shut downs each Gas Turbines will not be operated below 70% of its open cycle load and thus in order to be fully flexible and to meet all dispatch requirements (above the minimum of 70% of one GT in open cycle), various combinations of operating modes including 1 to 3 GTs in open cycle and 1 to 3 GTs in combined cycle have been considered as outlined graphically below.

      Open cycle operation will be necessary during the initial period (estimated at four to six months) of commissioning the steam cycle and then after that every five years for two weeks during the steam turbine major overhaul. In addition there are a few dispatch conditions that would require one or more of the GTs operating in open cycle; however these should also be very infrequent as the plant is considered as a base load plant at full output.

b. Heat Recovery Steam Generator (HRSG): The GT outlet flue gas at a temperature of around 520 degC is diverted through dedicated HRSGs where the thermal energy is partly recovered via a series of heat exchangers arranged to produce superheated steam at two different pressure levels, high pressure (HP) and intermediate pressure (IP). The HRSGs are natural circulation, drum type. HP and IP steam generated in the HRSG(s) will be routed to a common manifold and subsequently expanded in the steam turbine. The flue gases are then vented to atmosphere through the main stacks 75meter high stacks at a high enough temperature to disperse in compliance with the EU 2008/50/EC directive Regulation 3 of LN 11 of 2013 (IED) and LN 478 of 2010. The flue gases will be discharged to the atmosphere at around 95°C with a velocity of 17.5m/s. All three main stacks incorporate a silencer.

   Should additional abatement equipment be required at a later date then space has been allowed for in the HRSG construction for future retrofitting of a Selective Catalytic Reduction (SCR) system if required, as advised in section B20204/B of this submission.

c. HP/IP steam system: HP / IP steam generated within the HRSG is piped to the steam turbine (or steam turbine bypass during start-up) then to the cold condenser system. This system also distributes and conditions steam for the CCGT internal uses, for instance the ST gland steam supply, de-aeration feed-water tank steam supply and the condenser vacuum ejector steam supply.

d. Steam Turbine generator system: The HP and IP steam will be expanded in a SST-900 Steam Turbine (ST) which will drive an AC generator. The ST will comprise of a steam admission system, gland steam system and the lube oil system; the metallic acoustical enclosure for noise attenuation is designed for outdoor service. At rated conditions, it's expected that the gross power output of the ST is 66MWe, to give the total net output of 205MW at reference conditions for the complete CCGT.

e. Condensate feed-water system: The ST outlet steam is condensed in a seawater-cooled condenser, where the main condensate is collected and pumped to the feed-water tank via a heat exchanger. In the feed water tank the condensate is heated and de-aerated by means of recirculated hot feed water extracted from the LP economizer. The feed water tank serves to compensate for variations in the water supply of the water/steam cycle and to accumulate volume changes in the cycle. From the feed water tank, the feed water is pumped back to the HRSG by HP and LP feed-water pumps. There is a blow-down system from the feed water system, as described in point h below and no additional additives other than those described in point i will be used.

f. Seawater main cooling system: The CCGT condenser cooling water demand will be met with once-through seawater pumped from the existing Enemalta seawater intake at Delimara site. Two new electrics pumps will be installed in the existing pump house, downstream of the existing dosing and screen equipment, in order to accommodate the CCGT condenser cooling demand. The condenser outlet will be routed to the existing Enemalta seawater outfall. The chemical dosing of the seawater intake will continue to be operated and maintained by Enemalta and is not part of this submission. No additional dosing of the incoming cooling water will be required other than that applied by Enemalta upstream of the EGM intake point. The once through cooling flow from the Main CW pumps is 15,500m^3/hr.

The outfall will connect to the existing Enemalta seal weir and discharge through the Enemalta existing outfall. There will be a be a monitoring point upstream of this mixing chamber to periodically, as required, sample the discharge prior to mixing with the existing facilities flow.

g. Auxiliary seawater cooling system: This system will absorb the heat generated in the CCGT main auxiliary systems such as the lube oil system and generator cooling systems. A new line of filtered seawater will be supplied to the CCGT for that purpose. Two new (2x100%) pumps will be installed in the existing Delimara seawater intake pump house to accommodate the CCGT auxiliary seawater demand. The chemical dosing of the seawater intake will continue to be operated and maintained by Enemalta and is not part of this submission; the auxiliary sea water demand for this new facility will be taken from downstream of the current dosing and screening system. The flow though the auxiliary CW pumps is 1,160m^3/h.

   An intermediate demineralized water loop will be included as intermediate transfer fluid to avoid any ingress of seawater into the auxiliary CCGT systems. The outlet seawater stream from the cooler will be routed to the outfall.

   There is a demin water plant polishing plant which may be used should the incoming demin feed from Enemalta not have sufficient quality for the steam cycle. It will consist of activated carbon and mixed media filters to extract parts of copper, iron, silica, organic substances and free irons should it be required. Any effluent (backwash etc) will be routed to the neutralisation tank prior to discharge through the CW outlet. The activated carbon and mixed media filters will need to be replaced periodically; the waste media will be disposed of off-site at a suitably licensed disposal facility.

h. Blow-down system: The main function of this system is to collect and discharge excess water from the HP/IP drums and feed-water tank containing the tank/drum levels during especially during start-up. Water from the steam, feed-water and HRSG drainage system located in the HRSG area is also collected. All these drains are then routed to an atmospheric tank where steam flashing occurs. The flashed steam is recycled and re-routed to the steam cycle whereas the drain water is discharged. A continuous blow-down shall be required to control the water quality of the steam cycle.

The boiler blow down will be routed to the neutralisation basin where it will be tested and if required neutralised prior to discharge via the CW outfall. Where required the PH levels will be adjusted using one of two dosing skids of hydrochloric acid (HCl) and sodium hydroxide (NaOH). There is not sludge generation in the neutralization process.

i. Water chemical dosing system: The main functions of the chemical dosing system are maintaining the pH value, dissolved oxygen and total suspended solids of the water / steam cycle within required limits. An appropriate control of the chemistry of the feed-water and steam will prevent corrosions of metallic surfaces, deposition of solids and erosion of the ST blades, ST vanes and other piping elements. Different reagents are dosed into the feed-water such as ammonia, sodium hydroxide and sodium phosphates.

j. Continuous Emission Monitoring System (CEMS): This system will monitor and log the emissions released from each HRSG exhaust stack. The CEMS will consist of sample probes, filter, sample line (umbilical), a calibration gas system, and a series of gas analysers which reflect the parameters being monitored and store. The gas analysis is realized with an extractive system where representative samples are taken from the stack with a sampling probe and conveyed to the analyser through a sample line and a gas conditioning system. The CEMS system will comply with ISO 14956, EN 14181 and EN 15267 and will be fully calibrated as part of the commissioning process prior to operations.

   Sampling probes will be installed in both main and bypass stacks. The monitoring system will be switchover between the two depending on the actual operating scenarios. Both will be fully calibrated.

k. Service Air System: A compressed air distribution system will be installed comprising of 2 x 100% compressors, buffer tanks, degreasers and filter and associated valves and piping. The system is required in order to operate and control the various hydraulic values around the installation.

l. Emergency Diesel Generator: An emergency diesel generator shall be installed such that in the event of a trip and incoming power failure the plant will be able to shut down safely. The EDG does not provide back start capability. The location is as shown on drawing ENEM-URS-FS-00-DR-ME-00066. The EDG system comprises of a fully stand-alone diesel generator in full conformity with ISO 8528 rated at 800kW. In normal operations this EDG will not be operation, there is however a requirement for monthly testing to 80% capacity for one hour. The associated diesel tank shall have 100% full secondary bunding.

m. Oil Separator: The CCGT shall collect any drainage from potential oil contamination risk areas, ie transformer compounds, and treat the water prior to discharge. The oil separator shall be GRP construction from FM Environmental (Malta) and shall be model AquaBHDCE5006, Class1 EN-858 and will conform to Environment Agency

PPG3 standards. The treated effluent from the oil separator will discharge into the CCGT stormwater system which will discharge to sea through the existing Enemalta outfall as shown on drawing MT1001-UZ-CLD103-115172843 through manhole SW53. Details and CE Declaration of Conformity for this oil separator are provided as supplementary information to this submission.

The CCGT plant will also have connections to the existing facilities for the following services;

- Demin Water
- Cooling Water inlet and outlet
- Fire fighting (fresh water and sea water)
- Potable water
- HV, MV and LV electrical supplies

Refer to drawing ENEM-URS-E0-00-DR-ME-00106 for list and location of these interface points