C2.3 BAT MEASURES - NEW PLANT EXTENSION

Comparison of Delimara extension proposal with BAT as specified in the BREF

Aspect of BAT	BAT conclusion	Proposal for Delimara extension
Particulate matter (BAT for storage and handling of fuel and additives)	The use of good design and construction practices and adequate maintenance	Storage facilities shall be designed to established construction and installation standards, e.g. • above ground atmospheric cylindrical tanks either to EN 14015: 2004, or API 650, or API 620, depending on required process parameters; • Unfired pressure vessels or heat exchangers to the appropriate standard such as EN13445, or ASME VIII Codes, or PD 5500. • Piping and piping parts to various manufacturing and design standards as applicable. • Fabrication materials to the appropriate standards as required in order to satisfy process conditions.
	Storage of lime or limestone in silos with well designed, robust extraction and filtration equipment.	Lime is not proposed to be used in this extension.

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Water Contamination (BAT for storage and handling of fuel and additives)	The use of liquid fuel storage systems that are contained in impervious bunds that have a capacity capable of containing 75 % of the maximum capacity of all tanks or at least the maximum volume of the largest tank. Tank contents should be displayed and associated alarms used and automatic control systems can be applied to prevent the overfilling of storage tanks.	The existing HFO & GDO storage facilities shall be used except for additional small transfer tanks. Additional liquid duel storage facilities shall be contained within appropriate bunded area in accordance with good construction recommendations and industry practices. The new urea and FO bunded areas will satisfy the 110% obligation. All tanks shall have both local and remote gauging facilities. The current and proposed tanks have alarms and automatic control systems to prevent overfilling of storage tanks.The new tanks high level alarms in the tanks will raise an alarm in the control room by the DCS (Distributed Control System) In the event of high-high alarms, pumps will be stopped so that risks of spillages are minimised.

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	Pipelines placed in safe, open areas aboveground so that leaks can be detected quickly and damage from vehicles and other equipment can be prevented. For non-accessible pipes, double walled type pipes with automatic control of the spacing can be applied (liquid and gaseous fuels).	Noted. Piping diagrams for the Fuel and oily water systems: 1. **Annex 18 - 2970-S2-F01-001: Fuel supply (LOT191)** 2. **Annex 19 - 2970-S2-K01-001: Oily water & sludge (188)** Corrosion protection details: Pipes are designed and assembled as per EN standards and are painted for proper corrosion protection. Urea solution handling pipes are made of stainless steel.
Fugitive emissions (BAT for storage and handling of fuel and additives)	Using fuel gas leak detection systems and alarms.	The same systems as installed in the existing plant shall be used for the extension.
Efficient use of natural resources	Using expansion turbines to recover the energy content of the pressurised fuel gases.	Flue gas heat recovery boilers are used to run a steam turbine to generate electricity and for process heating purposes.
	Preheating the fuel gas by using waste heat from the boiler or gas turbine.	See above.
Health and safety risk regarding ammonia	For handling and storage of pure liquefied ammonia: pressure reservoirs for pure liquefied ammonia >100 m^3 should be constructed as double wall and should be located subterraneously; reservoirs of 100 m^3 and smaller should be manufactured including annealing processes.	Not applicable, as urea is proposed to be used (not ammonia).

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	From a safety point of view, the use of an ammonia-water solution is less risky than the storage and handling of pure liquefied ammonia.	Not applicable, as urea is proposed to be used.
Fuel pre-treatment	For liquid fuels, the use of pretreatment devices, such as diesel oil cleaning units used in gas turbines and engines, are BAT. Heavy fuel oil (HFO) treatment comprises devices such as electrical or steam coil type heaters, de-emulsifier dosing systems, etc.	Noted. See remarks below.
	In order to ensure correct pumping and operating conditions, diesel engines need a continuous supply of cleaned and filtered fuel oil at the correct flow and viscosity (for HFO typically below: 730 cSt at 50 °C). For heavy fuel oil, HFO treatment plants similar to those for gas turbines are applied, but with the following differences: only centrifugal separators are used and electrical or steam coil type heaters for heating up the HFO to the appropriate temperature (in order to achieve the required injection viscosity typically 12 – 20 cSt for a good atomisation at the nozzle); and in normal cases, de-emulsifier dosing systems (for breaking up the oil emulsion) are not used, and neither are dosing systems, for raising the melting point of vanadium products.	Fuel oil shall be subjected to a process of filtration, centrifuging and heating as necessary to condition fuel as to the prime movers requirements. De-emulsifiers shall not be used. **Prime mover requirements:** This refers to the requirements of the diesel engines. **Viscosity control:** HFO is heated to achieve required viscosity. Control of this parameter is automatic. **Expected viscosity** at diesel engine inlet: 20-24 cSt.
Thermal efficiency	Electrical efficiency (at the alternator terminals) ranges from 40-45%	Efficiency is rated at 46%.

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Dust emissions	For de-dusting off-gases from new and existing combustion plants, BAT is considered to be the use of an electrostatic precipitator or a fabric filter.	Fabric filters are used. Fabric filters: >97% dust removal efficiency. The filtering performance stated by the manufacturer is enough to reach the dust emission limits set in the contract which are in accordance with BREF limits for diesel engine based plants. The abatement efficiency stated is expected to reduce with a cleaner fuels due to lower input concentration of pollutants concerned. The abatement performance is in accordance with BREF limits for diesel engine based plants using different kinds of fuel. Filter bags in Glass Fibre with ePTFE membrane and PTFE thread, type GORE High Durability Membrane. The reduction performed is: 1. Particulate matters before bag filter : approx. 1600mg/Nm^3 2. Particulate matters after the bag filter :≤50mg/Nm^3 at 15% O_2 3. Reduction: Min 97%, max design approx 99%. Each bag filter unit is equipped with 580 bags each 12m long . One bag filter house per 2 diesel engines. Goretex membrane material built in bag filters. Please refer to Annex 20: 3650_filter_bag_HD_fiberglass_ptfe:746
	For diesel engines running on HFO, BAT AEL is <50 mg/Nm^3 (Table 6.47).	Noted. BREF BAT value is at 15% O_2

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Heavy metals	Generally the application of high performance de-dusting devices such as ESPs or FFs.	Fabric filters are used.
Sulphur dioxide	As a first choice the use of low sulphur fuel (< 0.5%) or natural gas is considered as BAT. If these are not available FGD is considered as BAT.	FGD is used. FGD: 80% SO_2 removal efficiency. The SO_x emission limit to be reached is in accordance with TA LUFT limits for Diesel engine based plants. The $DeSO_x$ unit has been designed to achieve these required emission limits. "When liquid mineral fuels are used, only heating oils listed in Din 51603 Part1(version March 1998) with a sulphur mass contenent for light heating oil pursuant to the 3.BImSchV as currently applicable…… may be used or equivalent measures shall be applied." This infers that either heating oil with a max of 0.2%sulphur content shall be used (DIN 51603 pt. 1 light heating oil –current in 2007) or equivalent measures adopted to bring the emissions of sulphur oxide equivalent to fuel containing 0.2% Sulphur. Please refer to Annex 21: "DIN 51603 Light fuel Oil.

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	Wet scrubber (reduction rate 92 – 98 %), and the spray dry scrubber desulphurisation (reduction rate 85 – 92 %). Dry FGD techniques such as dry sorbent injection are used mainly for plants with a thermal capacity of less than 300 MWth. The wet scrubber has the advantage of also reducing emissions of HCl, HF, dust and heavy metals. Because of the high costs, the wet scrubbing process is not considered as BAT for plants with a capacity of less than 100 MWth.	Dry type FGD are used.
	Most of the DESOX references in diesel power plants so far are wet scrubbers using a NaOH (about 50 wt-%) water solution as the reagent.	Not applicable.

<table>
<tr><th>Aspect of BAT</th><th>BAT conclusion</th><th>Proposal for Delimara extension</th></tr>
<tr><td></td><td>The BAT conclusion for wet scrubbing desulphurisation is related to the application of a waste water treatment plant. The waste water treatment plant consists of different chemical treatments to remove heavy metals and to decrease the amount of solid matter from entering the water. The treatment plant includes an adjustment of the pH level, the precipitation of heavy metals and removal of the solid matter.

Associated emission levels:
<table><tr><th colspan="2">Emissions to water from a wet FGD waste water treatment plant (mg/l)</th></tr><tr><td>Solids</td><td>5 – 30</td></tr><tr><td>COD</td><td><150</td></tr><tr><td>Nitrogen compounds</td><td><50</td></tr><tr><td>Sulphate</td><td>1000 – 2000</td></tr><tr><td>Sulphite</td><td>0.5 – 20</td></tr><tr><td>Sulphide</td><td><0.2</td></tr><tr><td>Fluoride</td><td>1 – 30</td></tr><tr><td>Cd</td><td><0.05</td></tr><tr><td>Cr</td><td><0.5</td></tr><tr><td>Cu</td><td><0.5</td></tr><tr><td>Hg</td><td>0.01 – 0.02</td></tr><tr><td>Ni</td><td><0.5</td></tr><tr><td>Pb</td><td><0.1</td></tr><tr><td>Zn</td><td><1</td></tr></table>Table 4.71: Emission levels associated with the use of a BAT- FGD waste water treatment plant given as a representative 24 hour composite sample</td><td>Not applicable.</td></tr>
<tr><td>Nitrogen oxides</td><td>SCR is regarded as BAT.

However primary methods such as the ‘Miller concept’ (base engine optimised for low NOX), fuel injection retards, the addition of water (water injection directly into the combustion space or water-in-fuel emulsion or humidification of the combustion air) are also acceptable.</td><td>An SCR plant for each engine is used. SCR: 92% NO_x removal efficiency.</td></tr>
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	Catalyst lifetime of 40,000 to 80,000 operating hours can be reached by periodical washing.	On reduced catalyst reactivity, Enemalta have the option of either change or regenerate (wash) the catalyst. The SCR catalyst will not be washed on site; catalyst washing (regeneration) entails treatment at a specialised factory. Regeneration can be used to extend the lifetime of the catalyst, Catalyst composition: WO_3 +V_2O_5<10% (V_2O_5<3%), TiO_2~80%, Vitreous Fibres/SiO_2~10%. The expected lifetime of one catalyst layer without washing is 19,000hrs. No catalyst off-site washing facility has been identified as yet. A replacement catalyst will be kept sealed on site (stored). The washing / replacement of the catalyst is based on initial use of three layers in each SCR unit. When the combined activity of the three layers reaches the lower limit, a fourth layer is inserted - thus raising the combined activity. Only when the combined activity of all four layers reaches the lower limit, one layer is replaced. However this will depend on the recovered activity from the regenerated catalyst and catalyst degradation rate. The molar ratio shall be approximately 1. However, the actual ratio shall be known during the plant commissioning. Expected time required For SCR startup is 45min from cold /15min from warm
	NH_3/NO_X ratio: 0.8 – 1.0 NH_3 slip: <5 mg/Nm^3 Energy Consumption as % of electric capacity: 0.5%	

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Carbon monoxide	Good maintenance of engine. Primary measures aiming at complete combustion.	Noted.
Water contamination	Any surface run-off (rainwater) from the storage areas that washes fuel particles away should be collected and treated (settling out) before being discharged. Small amounts of oil contaminated (washing) water should be treated using oil separation wells.	Drains discharge into oil separators which are regularly monitored and maintained.
	The BAT conclusion for wet scrubbing desulphurisation is related to the application of a waste water treatment plant. The waste water treatment plant consists of different chemical treatments to remove heavy metals and to decrease the amount of solid matter from entering the water. The treatment plant includes an adjustment of the pH level, the precipitation of heavy metals and removal of the solid matter.	Not applicable.
Waste and residues	Utilisation and re-use is priority. There are many different utilisation possibilities for different by-products such as ashes. Each different utilisation option has different specific criteria. The quality criteria are connected to the structural properties of the residue and the content of harmful substances, such as the amount of unburned fuel or the solubility of heavy metals, etc.	Please refer to documents: **C3.1.1 DPS P3 07 Waste** **C3.1.3 DPS P3 08 Waste disposal ~ recovery**
	The end-product of the wet scrubbing technique is gypsum. It can be sold and used instead of natural gypsum (e.g. in the plasterboard industry). The purity of gypsum limits the amount of limestone that can be fed into the process.	Not applicable.

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Noise	The major sources of noise are various rotating machines, transformers and valves. Since increased distance from the source lowers noise, planning of land use both on a community level and within a specific industrial site is perhaps the best preventive measure to avoid noise problems. Inside the building, the same principle applies, i.e. the layout design should separate the working areas from noisy equipment.	Please refer to documents: **C3.7 DPS P3 14 Noise & Vibration Chapter EIA VOL I & C3.7 DPS P3 13 Noise Generated by New Plant**

Base load: plant/s run for 24 hours; **two-shift operation:** Plant/s run for 16 to 18 hours per day. Operation mode depending on electricity demand and availability of other plants. The catalyst elements will remain hot during the night shutdown as there would be no airflow through the exhaust ducts in this shutdown period. However some cooling is envisaged to occur and the urea cannot be injected in the SCR immediately as the engine is started. The time required for the reinstatement of the DeNox process is expected to be short and will be determined during the commissioning process. Enemalta intends to use both HFO and diesel for start-up. Diesel will be only used following prolonged shut down. Expected time required for SCR start-up is 45 minutes from cold and 15 minutes from warm.