

# *IPPC Permit Application for Phase III – Delimara Power Station*

*Form C*

## **IPPC Form C Report**

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## Table of Contents

Glossary .....	viii
<b>C1 About the installation.....</b>	<b>1</b>
1.1 Installation and its activities .....	1
1.1.1 Current configuration.....	1
1.1.2 Proposed Conversion .....	2
1.2 Non-Technical Summary .....	15
1.3 Why application is being made.....	17
1.4 Site Maps and Reports.....	23
1.4.1 Site report .....	23
1.4.2 Site location.....	25
1.4.3 Location of various activities.....	27
<b>C2 Proposed techniques.....</b>	<b>39</b>
2.1 Environmental Management system.....	39
2.2 Proposed Activities .....	41
2.2.1 Proposed changes .....	41
2.2.2 Start-up and shut-down .....	43
2.2.3 Flow diagram summarising the proposed installation activities.....	45
2.3 Raw materials .....	48
2.4 ODS and F-gases.....	50
2.5 Maintenance.....	51
2.6 Energy consumption and efficiency.....	52
2.7 Water .....	53
2.8 Risk Assessment .....	54
2.9 Training .....	55
2.10 Cessation.....	56
2.11 Multi-operator installations.....	57
<b>C3 Proposed emissions.....</b>	<b>58</b>
3.1 Waste .....	58
3.1.1 Waste characterisation .....	58
3.1.2 Waste management, storage and handling .....	58
3.1.3 Waste re-use, recycle and disposal .....	59
3.2 Emissions to groundwater .....	63
3.3 Emissions to sewer .....	64
3.4 Emissions to sea.....	66
3.5 Rainwater.....	71

3.6	Emissions to air .....	73
3.7	Odour emissions .....	75
3.8	Emissions to land .....	76
3.9	Noise emissions .....	78
3.10	Monitoring .....	79
3.11	Summary .....	81
<b>C4</b>	<b>Impact on the environment.....</b>	<b>83</b>
4.1	Environmental effects.....	83
4.2	Effects on other sites .....	86
5.1	Environmental statement .....	87
<b>C6</b>	<b>Statutory consultees .....</b>	<b>90</b>
6.1	Local council.....	90
6.2	Other sites.....	90
6.3	Port Authority .....	90
<b>C7</b>	<b>Planning status.....</b>	<b>91</b>
7.1	Planning statuses .....	91
<b>C8</b>	<b>Technically competent person.....</b>	<b>92</b>
<b>C9</b>	<b>Expenditure plan .....</b>	<b>93</b>
9.1	Expenditure plan .....	93
	<b>Appendix I.....</b>	<b>94</b>
	<b>Appendix II.....</b>	<b>95</b>
	<b>Appendix III.....</b>	<b>96</b>
	<b>Appendix IV.....</b>	<b>97</b>
	<b>Appendix V.....</b>	<b>98</b>
	<b>Appendix VI.....</b>	<b>99</b>
	<b>Appendix VII .....</b>	<b>100</b>
	<b>Appendix VIII .....</b>	<b>101</b>



## Table of Figures

Figure 1 – Flowchart showing the supply route of LNG to the D3 engine hall .....	4
Figure 2 – Diagram showing the gas supply to the proposed engine system .....	5
Figure 3 – Map showing the location of air emissions resulting from nine different pressure relief valves located along the gas supply route .....	7
Figure 4 – Map showing the location of the storage tanks and other areas associated with D3's operations.....	9
Figure 5 – Diagram showing the exhaust emissions released by each engine at different locations within the chimney abatement system .....	13
Figure 6 – Map showing the location of the activities proposed in Section 1.3.....	22
Figure 7 – Map of the Maltese islands showing the south-eastern location of the Delimara Power Station (DPS). .....	25
Figure 8 – Diagram showing the site boundary of the DPS. ....	25
Figure 9 – Map showing the current location of D3 engines within the DPS facility .....	26
Figure 10 - Scale drawing of the gas supply route from D4 infrastructures to D3 .....	27
Figure 11 – Map of proposed DPS delineation of D1, D2, D3 and D4 and infrastructures associated with D3 .....	28
Figure 12 – D3PG's tie-in points with Enemalta and Electrogas Malta .....	29
Figure 13 – Ex-hazardous area classification layout.....	32
Figure 14 – Ex-hazardous area classification engine hall 1 plan .....	33
Figure 15 – Ex-hazardous area classification layout engine hall 1, section A-A .....	34
Figure 16 – Ex-hazardous area classification layout engine hall 1, section B-B.....	35
Figure 17 – Ex-hazardous area classification layout engine hall 2 .....	36
Figure 18 – Ex-hazardous area classification layout engine hall 2, section A-A .....	37
Figure 19 – Ex-hazardous area classification layout engine hall 2, section B-B.....	38
Figure 20- Flowchart showing the proposed activities at D3 by D3PG .....	47
Figure 21 – Map showing the location of D3's waste storage sections .....	61
Figure 22- Flow diagram of waste streams generated from D3 .....	62

Figure 23 – Map of the waste water connections and discharge points that will be used during D3’s operations.....	65
Figure 24 – Flow diagram depicting the process of generating evaporated water and demineralised water 67	
Figure 25 – Map showing the location of DPS water outfall point with accurate UTM coordinates..	68
Figure 26 – Diagram of the water and steam cycle for D3 .....	69
Figure 27 – Map of the source of emissions to sea .....	70
Figure 28 – Rainwater scheme map for D3 plant .....	72
Figure 29 – Summary of the emissions generated by processes and facilities at D3 .....	81
Figure 30 – Summary of emissions generated by the D3 engine hall .....	82

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## Table of Tables

Table 1 – List showing the current and proposed new engine specifications .....	2
Table 2 – List of storage day tanks that are currently present at D3. The layout of such tanks can be observed in Figure 4.....	8
Table 3 – Summarised list shown the exhaust emissions of the current and proposed engines at D3 11	
Table 4 – List of proposed changes in operation and the reason why they are being made .....	17
Table 5 – List of commissioned units throughout the years since the inception of DPS in 1991.....	23
Table 6 – Detailed list of the tie-in points between D3PG and other site operators .....	30
Table 7 – List of raw materials used by D3PG .....	48
Table 8 – Energy consumption, efficiency and generation of four different types of engines .....	52
Table 9- Waste generated at D3 and the projected changes following conversion .....	58
Table 10 – Waste management, location and capacity data .....	58
Table 11 – List of potential waste contractors may change in the future depending on prices tendered .....	59
Table 12 – Chimney emission values for D3 plant.....	73
Table 13 – Air emissions caused by the proposed auxiliary boiler .....	74
Table 14 – Noise levels recorded in 2012 at different locations within D3.....	78
Table 15 – List of permit obligations and their estimated costs.....	93



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## *Glossary*

ATEX – Explosive Atmosphere

BAT – Best-Available Technology

BFT – Bag Filters Tower

BREF – Best-Available Technologies Reference Document

C1 – Cooling unit 1

C2 – Cooling unit 2

CCGT – Combined Cycle Gas Turbine

CEMS – Continuous Emissions Monitoring System

CEP – Condensate Extraction Pump

CGR – Compact Gas Ramp

CHP – Combined Heat & Pressure

CO – Carbon monoxide

COMAH – Control of Major Accident Hazards

D1/DPS1 –Phase 1 of Delimara Power Station

D2/DPS2 – Phase 2 of Delimara Power Station

D3/DPS3 – Phase 3 of Delimara Power Station

D3PG – Delimara 3 Power Generation

D4/DPS4 – Phase 4 of Delimara Power Station

DF – Dual Fuel

DM – DeMineralised water

DO – Diesel Oil

DPS – Delimara Power Station

EB – Exhaust Boiler

EGM – ElectroGas Malta Ltd.

EIA – Environmental Impact Assessment

EIS – Environmental Impact Statement

ELV – Emission Limit Values

EMS – Environment Management System

EPH – Extractable Petroleum Hydrocarbons

ESD – Emergency Shutdown Valve

FGD – Fuel Gas Desulphurisation

FOT – Fuel Oil Treatment

FWG – Fresh Water Generators

GHG – Green House Gas

GPRS – Gas Pressure Reduction Station

H&S – Health and Safety

HAZID – Hazard Identification

HAZOP – Hazard and Operability

HFO – Heavy Fuel Oil

HP – High Pressure

HRSG – Heat Resistance Steam Generator

ID Fan – Induced Draft Fan

IED – Industrial Emissions Directive

IPPC – Integrated Pollution Prevention and Control

LCP – Large Combustion Plants

LNG – Liquefied Natural Gas

LP – Low Pressure

NG – Natural Gas

NO<sub>x</sub> – Oxides of Nitrogen

NTS – Non-Technical Summary

O<sub>2</sub> – Oxygen

ODP – Outline Decommissioning Plan

PAH – Polycyclic Aromatic Hydrocarbons

PM – Particulate Matter (dust)

PPA – Power Purchase Agreement

RFO – Residual Fuel Oil

SBC – Sodium BiCarbonate

SCR – Selective Catalytic Reduction

SEA – Strategic Environmental Assessment

SF<sub>6</sub> – Sulphur hexafluoride

SG – Single Gas

SO<sub>x</sub> – Oxides of Sulphur

SVOC – Semi-Volatile Organic Carbons

TP# - Tie-in point #

VOC – Volatile Organic Carbons



## **C1 About the installation**

### **1.1 Installation and its activities**

The proposed scheme involves the conversion of the D3 (Phase 3) block within the Delimara Power station (DPS) – Figure 10. Its combined heavy fuel oil (HFO) cycle internal combustion engine system will be transformed to firing a combination of natural gas, designated as the main fuel and diesel as an emergency fuel.

At present, a total of eight four stroke 500rpm Wartsila 18V46 engines comprise this system, with each engine currently contributing to an output of 17.1MW. Combustion flue gas produced by the eight engines is at present used by eight exhaust-heat recovery boilers for generating steam at 12.5 bar which is then delivered to a 13 MW Dresser-Rand Steam Turbine (type TC 56130 Frame 30 Condensing Turbo – Generator Set).

In the proposed conversion, four of these engines (1 to 4) will be exclusively limited to single fuel (SG) natural gas, whilst the remaining four (5 to 8) will have the capacity of working as dual fuel (DF) engines, opting for diesel in emergency situations and to ensure a backup of supply. An average of three of these engines will be continuously running during the operational stage of the facility, but this value is subject to change according to the demand of supply.

Since the latter engines are compression ignition engines, these will require 0.0044kg/s of diesel as pilot fuel for ignition when firing on natural gas. The aforementioned diesel consumption rate is continuous during the operation of the dual fuel engines. Single gas (SG) engines do not require diesel to be used as pilot fuel because they have a different ignition system that makes use of sparking plugs.

#### **1.1.1 Current configuration**

The current configuration of the DPS can be seen in Section 1.4.2. The power electrical generating plant consists of eight Wartsila 18V46 medium speed diesel engines capable of burning Heavy Fuel Oil (HFO) and gasoil, and a steam turbine which is operated by steam generated by boilers which recover heat from the exhaust of the diesel engines. The diesel engines were supplied by Wartsila. The current plant is 46.8% efficient at full load. The power plant incorporates 8 Selective Catalytic Reduction (SCR) units for NO<sub>x</sub> reduction, and 4 De-SO<sub>x</sub> units for SO<sub>x</sub> reduction, and filter bag units for particulate reduction. Finally exhaust gases are exhausted to atmosphere through 4 stacks. Fresh water required for this plant is produced by two evaporators operating off the waste heat of this plant.

The diesel engines and ancillary plant are housed in an engine room structure complete with sound proofing, weather protection, overhead crane/s and space for unloading and maintenance. The waste heat boilers and the post combustion emission control plant are sited outdoors.

Whilst firing HFO, the exhaust gases produced pass through an abatement system to reduce and control the emissions of oxides of nitrogen (NO<sub>x</sub>), oxides of sulphur (SO<sub>x</sub>) and particulates. The former is abated through selective catalytic reduction (SCR), whereby a solution of 40%

concentration urea (390L/h) is injected within each SCR that is connected to each engine. The abated exhaust gases then pass through a boiler that is used to generate steam. DM water for the steam cycle is produced from seawater pumped from a seawater inlet at Marsaxlokk bay. This steam is used for the generation of power in the steam turbine (high pressure steam) and for heating purposes (low pressure steam). Once this process is completed, the exhaust passes through one of four reactors for SO<sub>x</sub> reduction, where sodium bicarbonate (SBC) is injected, and then through a bag filter for the abatement of particulate matter. Currently, the reactor and bag filter abatement systems can be bypassed when not firing on HFO as the emission limits for SO<sub>x</sub> and particulates are adhered to in such a scenario. This does not apply to the SCR abatement system, because NO<sub>x</sub> emissions still need to be controlled when firing diesel or other low sulphur containing fuels.

### 1.1.2 Proposed Conversion

The proposed conversion revolves around eliminating the use of HFO and switching the eight diesel engines in Phase III to run on natural gas. Four of these eight engines (1 to 4) will be capable of running only on natural gas (NG) – single fuel (SG), whilst the remaining four (5 to 8) will be dual fuel (df) engines, running on NG as the main fuel or diesel in emergency situations.

#### 1.1.2.2 Comparison between current and converted engines

In the table below, a comparison of the current engine specifications with the proposed converted single fuel and dual fuel systems is made:

Table 1 – List showing the current and proposed new engine specifications

Parameter	Current engines	Single fuel engines	Dual fuel engines	
Engine type	W18V46	W18V50SG	W18V50DF	
Fuel type	Heavy fuel oil	Natural gas	Natural gas and diesel	
Ignition mode	Normal	Normal	Pilot diesel	
Number of Generator sets	8	4	4	
Engine speed	500 rpm	500 rpm	500 rpm	
Cooling method	Raw water	Raw water	Raw water	
Cooling circuit	2-circuit	2-circuit	2-circuit	
Rated thermal input	38,500 kW each	39,888 kW each	36,622 kW each	37,883 kW each
Engine power shaft (ISO 3046 standard)	17,075 kW	18,321 kW	16,638 kW (NG)	16,638 kW (Diesel)
Heat rate (at generator terminals, 100% load)	8,000 kJ/kWh	7,838 kJ/kWh	7,924 kJ/kWh (NG)	8,197 kJ/kWh (Diesel)
% Efficiency	44.35%	45.93%	45.43%	43.92%
Exhaust gas flow ± 5%	33 kg/s	30.8 kg/s	28.1 kg/s (NG)	32.7 kg/s (Diesel)
Exhaust gas	375°C	381°C	377°C	329°C (Diesel)

temperature ± 15°C			(NG)	
Emissions before abatement	565 mg/Nm <sup>3</sup> SO <sub>2</sub> 75 mg/Nm <sup>3</sup> PM 2,000 mg/Nm <sup>3</sup> NO <sub>2</sub> 150mg/Nm <sup>3</sup> CO	9 mg/Nm <sup>3</sup> SO <sub>2</sub> 10 mg/Nm <sup>3</sup> PM 185 mg/Nm <sup>3</sup> NO <sub>2</sub> 208 mg/Nm <sup>3</sup> CO	9 mg/Nm <sup>3</sup> SO <sub>2</sub> 10 mg/Nm <sup>3</sup> PM 369 mg/Nm <sup>3</sup> NO <sub>2</sub> 186 mg/Nm <sup>3</sup> CO	12 mg/Nm <sup>3</sup> SO <sub>2</sub> 30 mg/Nm <sup>3</sup> PM 2,000 mg/Nm <sup>3</sup> NO <sub>2</sub> 57 mg/Nm <sup>3</sup> CO
Emissions after abatement	112.5 mg/Nm <sup>3</sup> SO <sub>2</sub> 15 mg/Nm <sup>3</sup> PM 150 mg/Nm <sup>3</sup> NO <sub>2</sub> 150 mg/Nm <sup>3</sup> CO	9 mg/Nm <sup>3</sup> SO <sub>2</sub> 10 mg/Nm <sup>3</sup> PM 75 mg/Nm <sup>3</sup> NO <sub>2</sub> 100 mg/Nm <sup>3</sup> CO	9 mg/Nm <sup>3</sup> SO <sub>2</sub> 10 mg/Nm <sup>3</sup> PM 75 mg/Nm <sup>3</sup> NO <sub>2</sub> 100 mg/Nm <sup>3</sup> CO	12 mg/Nm <sup>3</sup> SO <sub>2</sub> 30 mg/Nm <sup>3</sup> PM 150 mg/Nm <sup>3</sup> NO <sub>2</sub> 57 mg/Nm <sup>3</sup> CO

#### 1.1.2.3 Overall operations at Delimara Power Station

Enemalta is responsible to issue the dispatching order according to which the relevant producers (D3PG, Electrogas and Enemalta themselves) will be obliged to comply with. The plan is to have D4 offering the base-load supply whilst using D3 for peaking and times of high demand. Until D4 is in operation, D3 and the Malta-Sicily interconnector will be used as base load power station.

The present site is considered to be a COMAH Installation, regulated under the Seveso Directive, due to the high amounts of heavy fuel oil and diesel stored and present on site. In the converted stage, D3 does not meet the thresholds to be identified as a COMAH site, but will still be surrounded by two COMAH installations.

#### 1.1.2.4 Fuel supply

##### » Natural gas

In the proposed conversion, the supply of natural gas will originate from a further development that falls within the remit of the operators of D4 within the Delimara Power Station. This facility will store liquefied natural gas (LNG) in offshore storage tanks before re-gassing it and piping under 40 bars of pressure to D4's gas reduction station (GPRS) where it will be reduced to 7 barg and fed directly to D3. A simple flow diagram is presented below to illustrate the pressure differences. Figure 1 shows the gas supply route from the LNG storage to the GPRS to D3 and D4.



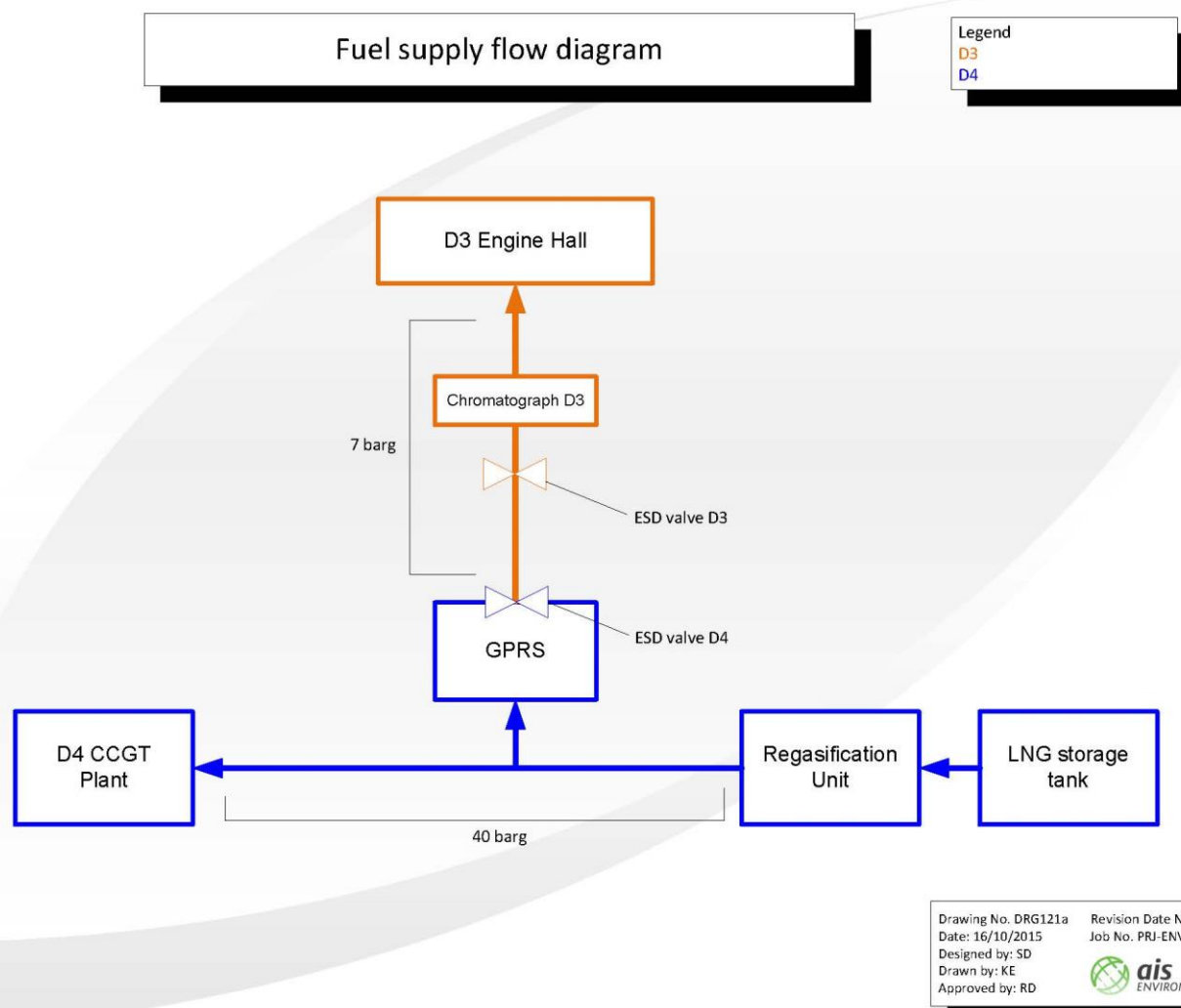


Figure 1 – Flowchart showing the supply route of LNG to the D3 engine hall

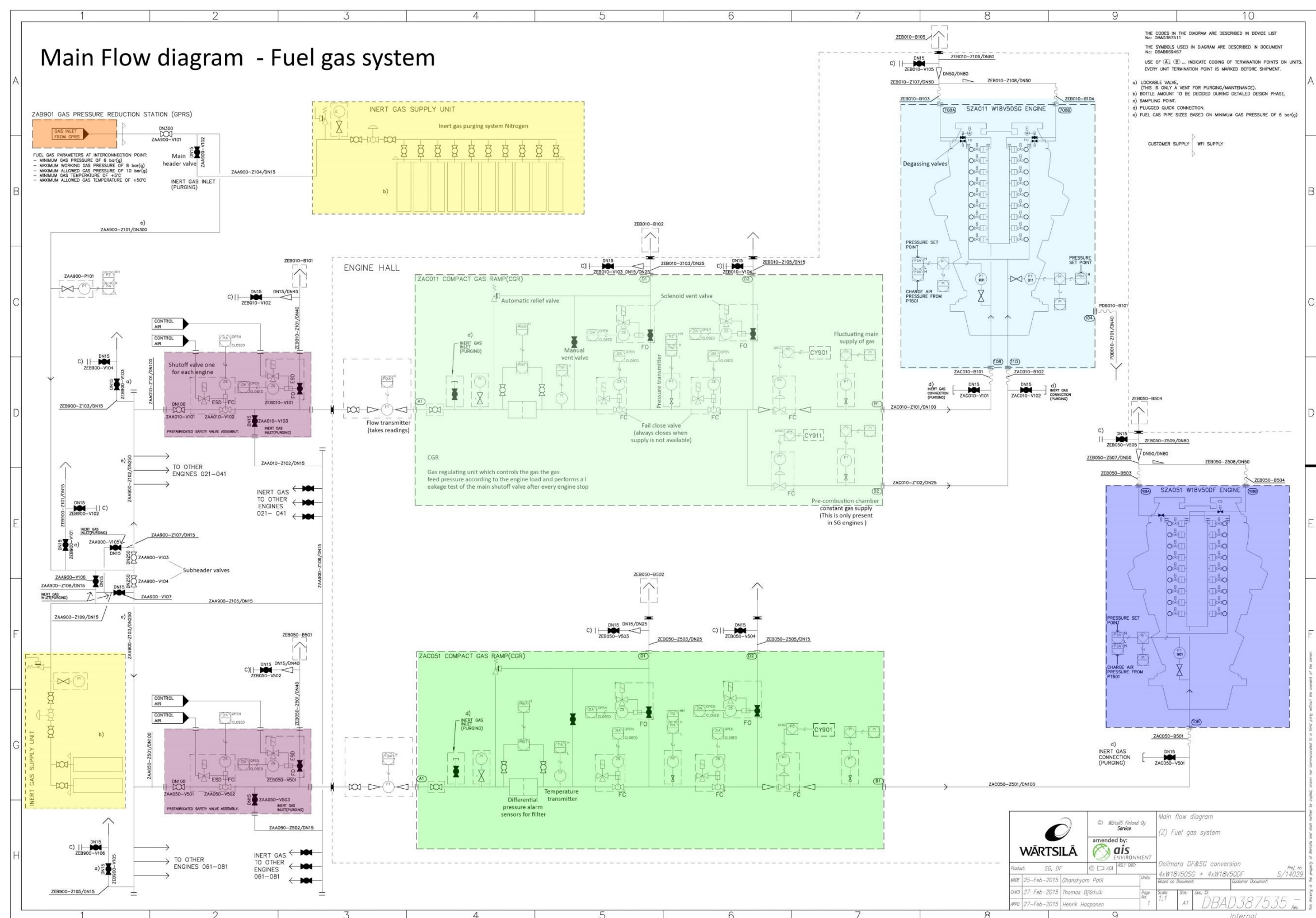


Figure 2 – Diagram showing the gas supply to the proposed engine system

The GPRS is capable of controlling sudden pressure surges from the LNG storage to either the D3 or D4 plant. When the gas supplied is not satisfying the requested specifications or in case of malfunction, the GPRS will automatically activate the Emergency Shut Down (ESD) valve, that is located just prior to the tie-in point to D3. A number of signals (previously agreed upon) will be transmitted from the GPRS (D4) to D3 to warn the operators about any specific conditions of the gas when necessary. Natural gas pipelines linking the GPRS to D3 are designed so that no condensation forms on the pipes in order to ensure that the temperature of the gas remains consistently in the range between 10-15°C above its dew point.

In addition to this, a second ESD valve, safety relief valve and a vent system will also be installed along the pipeline at the point where the fuel is moving towards D3. These systems will lie within the responsibility of D3PG. Moreover, the engine room contains a compact gas ramp (CGR) which acts as a gas regulating unit and controls the gas feed pressure according to the engine load.

A total of nine pressure relief valves (PRVs) are located along the gas supply route to reduce the possibility of gas leaking into the exhaust system every time that an engine is shut down and/or started (refer to Figure 3). This means that whilst the engine is being shutdown, the PRVs open to bring the gas pipe feeding the engine to atmospheric pressure. By doing so, NG will not be pressurised and will therefore not leak. This safety feature ensures that no gas passes through the engine combustion system and ends up in the exhaust path or the noise enclosure.

Whilst starting up an engine, some of the PRVs also need to be opened in order to re-pressurize the gas pipe feeding the engine. This process also ensures that any air ingress in the same gas pipeline is purged out. In fact, PRVs are also used for purging the pipeline with Nitrogen during maintenance periods.



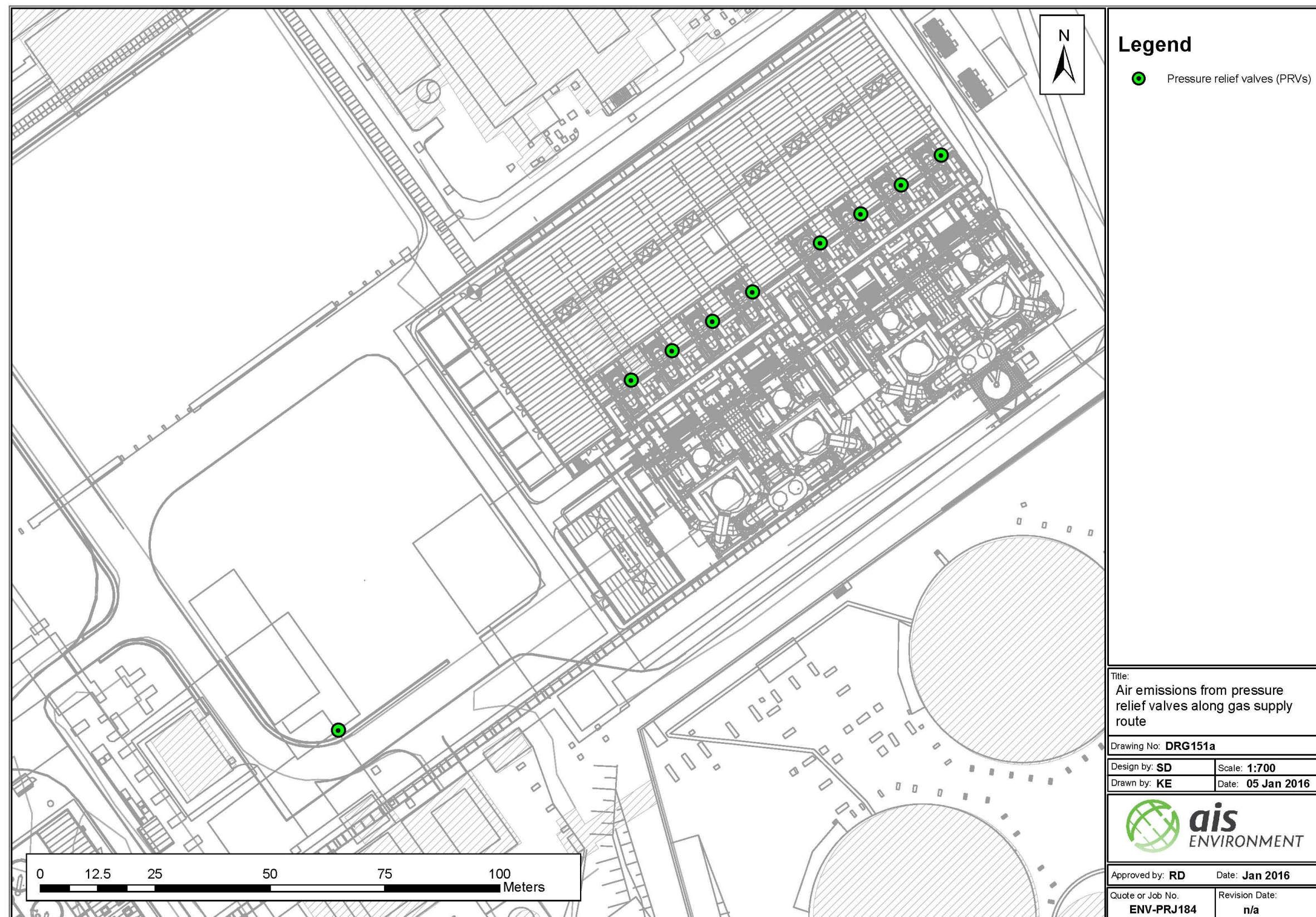


Figure 3 – Map showing the location of air emissions resulting from nine different pressure relief valves located along the gas supply route

» Diesel

Diesel is supplied to D3 by Enemalta. Enemalta owns 4 diesel oil (DO) tanks with a capacity of 8,598m<sup>3</sup> each. D3 will store DO and other raw materials in day tanks of varying capacities. The following table highlights the storage day tanks that are currently present on site. Please refer to Figure 4 for further information on the current layout of such tanks. Most of these tanks will continue to be operational, whilst others will not. None of the enlisted inactive tanks are currently being proposed for decommissioning:

*Table 2 – List of storage day tanks that are currently present at D3. The layout of such tanks can be observed in Figure 4*

Storage day tank	Capacity	Status after conversion
Diesel day tank	140m <sup>3</sup>	Active
Lubricating oil tank	175m <sup>3</sup>	Active
Lubricating oil maintenance tank	25m <sup>3</sup>	Active
HFO service tank	2x125m <sup>3</sup>	Inactive
HFO buffer tank	2x125m <sup>3</sup>	Inactive
Compressed air tank	5 tanks	Active
Urea storage tank	2x125m <sup>3</sup>	Active
Urea mixing tank	2x65m <sup>3</sup>	Active
Auxiliary boiler gasoil tank	3m <sup>3</sup>	Active
Steam turbine oil tank	25m <sup>3</sup>	Active
Anti-scale compound tank (FWGs)	2x100m <sup>3</sup>	Active



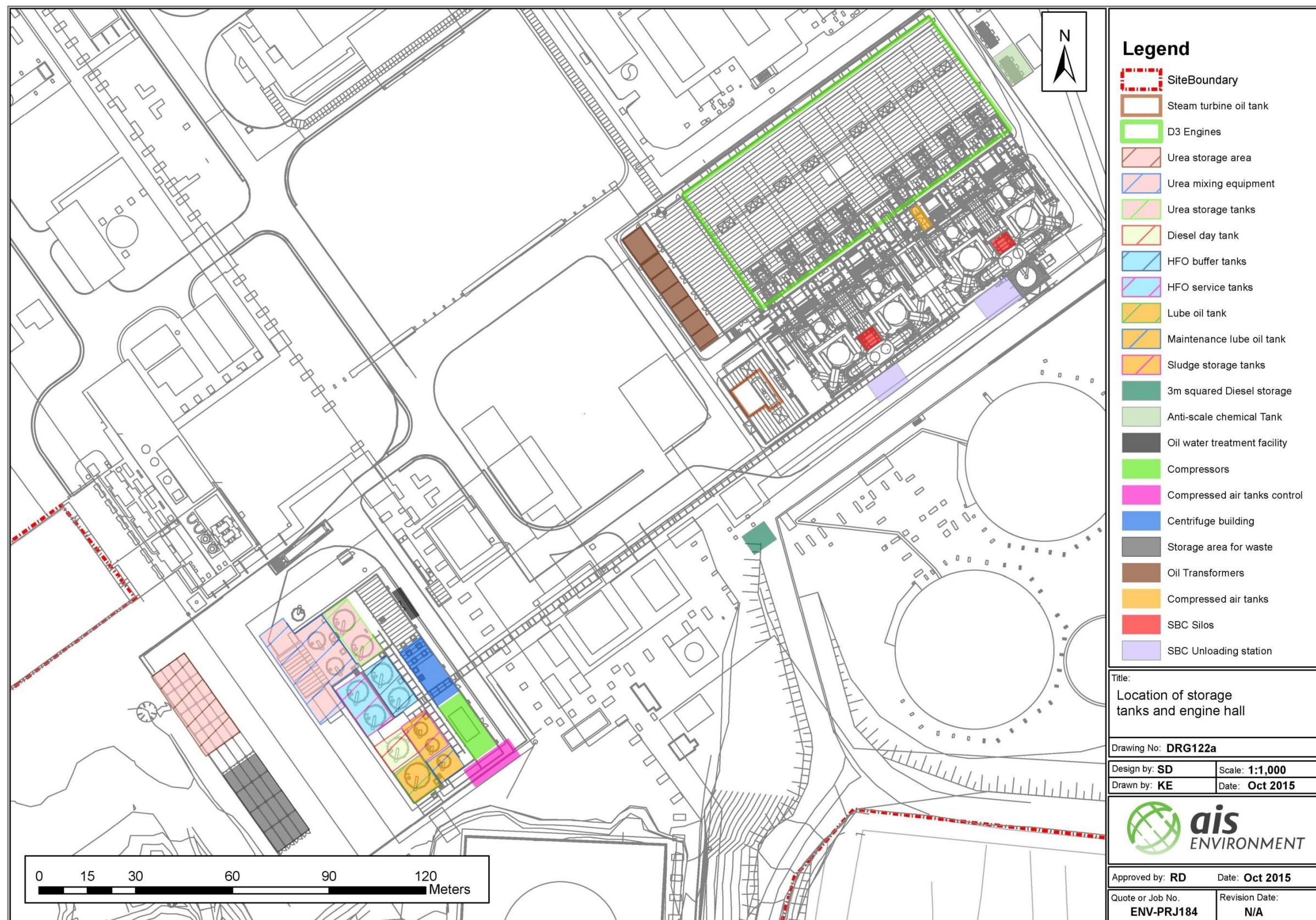


Figure 4 – Map showing the location of the storage tanks and other areas associated with D3's operations.

#### 1.1.2.5 *Emergency situations*

When the NG supply fails, the DF engines automatically transfer to diesel mode operation using liquid fuel oil (LFO), which is also known as diesel or gasoil. Periodical switching to diesel will not be required to ensure that such an automated system remains in check.

The emergency situations described in Section 1.1.2 occur in cases where:

- » There is shortage in supply of NG
- » NG engine system or D3 plant is malfunctioning or being repaired
- » NG supplied is not to specification

For further information please refer to an extract taken from the Industrial Emissions (Large Combustion Plants) Regulations L.N. 11 of 2013 Article 13 describing Emergency situations:

“(1) Permits for combustion plants within the scope of these regulations, shall include conditions on procedures relating to malfunction or break down of abatement equipment.

(2) In the case of a break down or malfunction of any abatement equipment, the operator shall operate the plant using low polluting fuels and if this is not enough to achieve the relevant limit values, the operator shall reduce or close down operations if a return to normal operations is not achieved within twenty-four hours.

(3) The competent authority shall be notified within forty-eight hours of the occurrence of such break down or malfunction.

(4) In no circumstance shall the cumulative duration of unabated operations in any twelve month period exceed one hundred and twenty hours. The Director of Environment Protection and any officials to whom this role is delegated may allow exceptions to the limits of twenty-four hours and one hundred and twenty hours above, in cases where in his judgment:

- (a) there is an overriding need to maintain energy supplies; or
- (b) the plant with the break down would be replaced for a limited period by another plant which would cause an overall increase in emissions.

(5) The Director of Environment Protection and any officials to whom this role is delegated may allow a suspension for a maximum of six months from the obligation to comply with the emission limit values provided for in regulations 4 and 5 for sulphur dioxide in respect of a combustion plant which to this end normally uses low-sulphur fuel, in cases where the operator is unable to comply with these limit values due to an interruption in the supply of low sulphur fuel resulting from a serious shortage.

(6) The Director of Environment Protection and any officials to whom this role is delegated may allow a suspension for a maximum of six months from the obligation to comply with the emission limit values provided for in regulations 4 and 5 for sulphur dioxide in cases where a plant which normally uses only gaseous fuel, and which would otherwise need to be equipped with a waste gas purification facility, has to resort exceptionally, and for a period not exceeding ten days except where there is an overriding need to maintain energy supplies, to the use of other fuels because of a sudden interruption in the supply of gas.



(7) In the cases mentioned in sub-regulations (5) and (6), the operator shall inform the Director of Environment Protection in writing of the need to apply for the exemptions provided for in these two sub-regulations as soon as the cases in question arise. In doing so the operator shall forward all the relevant technical information deemed necessary by the competent authority. The competent authority shall at its discretion issue a temporary derogation according to the provisions of the above mentioned sub-regulations in accordance with the notification referred to in Schedule XII. The competent authority shall publish this notification together with all the information forwarded to it by the operator on the subsequent issue of the Gazette.”

#### 1.1.2.6 Atmospheric emissions

The atmospheric emissions from the proposed converted engines will be lower than those experienced in the current HFO system.

The sulphur content of natural gas is considerably lower than that in HFO. Gasoil to be used as an emergency fuel is also low on sulphur content: 0.1% sulphur specifications of diesel oil. When comparing the current SO<sub>x</sub> emissions (before abatement) to those being projected for NG, the difference in magnitude is approximately 60-fold. The current FGD system reduces the SO<sub>x</sub> emissions of the HFO engines from 565 mg/Nm<sup>3</sup> to 112.5 mg/Nm<sup>3</sup>, which is approximately 12 times higher than the projected emissions of the proposed SG and DF engines operating on natural gas. This allows the removal of the FGD abatement technology for the converted engines. Due to the low sulphur content of the diesel oil that is provided to D3 by Enemalta, the SO<sub>x</sub> emissions of the converted engines when operating on this emergency fuel (gasoil) is also significantly (10-fold) lower than the current HFO emissions.

Furthermore, when operating DF engines on natural gas (with diesel as a continuous pilot fuel), the SO<sub>x</sub> emissions generated are not significantly higher than those emitted from the SG engines (which do not require diesel as a pilot fuel). Since the quantity of diesel used as a pilot fuel is very low, and because the sulphur content in diesel is also very low, the difference between SO<sub>x</sub> emissions of DF and SG engines is negligible to the CEMS (Continuous Emissions Monitoring System) that is fitted at the chimney stack.

The same trends can be observed for the non-abated particulate matter (dust) and NO<sub>x</sub> emissions, although the difference in magnitude between the HFO and NG exhaust emissions is relatively lower than that reported for the SO<sub>x</sub> emissions. SG engines generate a relatively low concentration of NO<sub>x</sub>, because NG does not contain a high content of N-containing compounds. On the other hand, DF engines operating on NG shall generate a higher concentration of NO<sub>x</sub> due to the use of the pilot fuel. The pilot fuel diesel oil supplied by Enemalta has a high Nitrogen content (4,000 mg/kg), which explains the relative difference in emission values. Such NO<sub>x</sub> emissions will be abated through the SCR using urea solution to reach the ELVs set by the relevant authorities.

Table 3 – Summarised list shown the exhaust emissions of the current and proposed engines at D3

Details	Current HFO engines	Proposed SG engines	Proposed DF Engines	Proposed DF Engines
Fuel mode	Heavy fuel oil	Natural gas	Natural gas &	Diesel & diesel as



			diesel as pilot fuel	pilot fuel
Emissions before abatement	565 mg/Nm <sup>3</sup> SO <sub>2</sub> 75 mg/Nm <sup>3</sup> PM 2,000 mg/Nm <sup>3</sup> NO <sub>2</sub> 150mg/Nm <sup>3</sup> CO	9 mg/Nm <sup>3</sup> SO <sub>2</sub> 10 mg/Nm <sup>3</sup> PM 185 mg/Nm <sup>3</sup> NO <sub>2</sub> 208 mg/Nm <sup>3</sup> CO	9 mg/Nm <sup>3</sup> SO <sub>2</sub> 10 mg/Nm <sup>3</sup> PM 369 mg/Nm <sup>3</sup> NO <sub>2</sub> 186 mg/Nm <sup>3</sup> CO	12 mg/Nm <sup>3</sup> SO <sub>2</sub> 30 mg/Nm <sup>3</sup> PM 2,000 mg/Nm <sup>3</sup> NO <sub>2</sub> 57 mg/Nm <sup>3</sup> CO
Emissions after abatement	112.5 mg/Nm <sup>3</sup> SO <sub>2</sub> 15 mg/Nm <sup>3</sup> PM 150 mg/Nm <sup>3</sup> NO <sub>2</sub> 150 mg/Nm <sup>3</sup> CO	9 mg/Nm <sup>3</sup> SO <sub>2</sub> 10 mg/Nm <sup>3</sup> PM 75 mg/Nm <sup>3</sup> NO <sub>2</sub> 100 mg/Nm <sup>3</sup> CO	9 mg/Nm <sup>3</sup> SO <sub>2</sub> 10 mg/Nm <sup>3</sup> PM 75 mg/Nm <sup>3</sup> NO <sub>2</sub> 100 mg/Nm <sup>3</sup> CO	12 mg/Nm <sup>3</sup> SO <sub>2</sub> 30 mg/Nm <sup>3</sup> PM 150 mg/Nm <sup>3</sup> NO <sub>2</sub> 57 mg/Nm <sup>3</sup> CO

As a result of the lower emissions for the proposed engine conversion, the FGD and bag filter abatement systems will no longer be required. This will lead to either:

- » The bypassing of the flue gas desulfurization plant (FGD), which will not be decommissioned but simply blanked off, or
- » Retain the current exhaust pathway to heat the exhaust boilers, but the abatement contents of the FGD and Bag filter towers will be completely removed.

The amount of urea injected in the SCR tower is expected to decrease to about 70L/h when firing natural gas, whilst if diesel is required, injection of urea is expected to decline to 280L/h. An additional catalyst plate will be added to the SCR abatement system to minimize and control carbon monoxide emissions. The trend observed for carbon monoxide emissions behaves in an inverse manner, with higher values obtained for SG engines than DF engines that operate on diesel in emergency mode. This is due to the chemistry of the natural gas combustion process. The high content of methane within natural gas, produces large quantities of carbon monoxide during the combustion process. This trend also explains why the CO catalyst plate was required for the converted engine system.

It is important to note that bypassing the abatement system is not often encouraged because it reduces the efficiency of operations that are related to the generation of steam from the excess heat released from the exhaust.

The waste produced as a by-product of the FGD abatement process which was temporarily stored in a silo and then emptied into sealed container tanks will no longer be produced as the FGD will no longer be in use. This would result in a considerable decrease in solid hazardous waste for disposal.

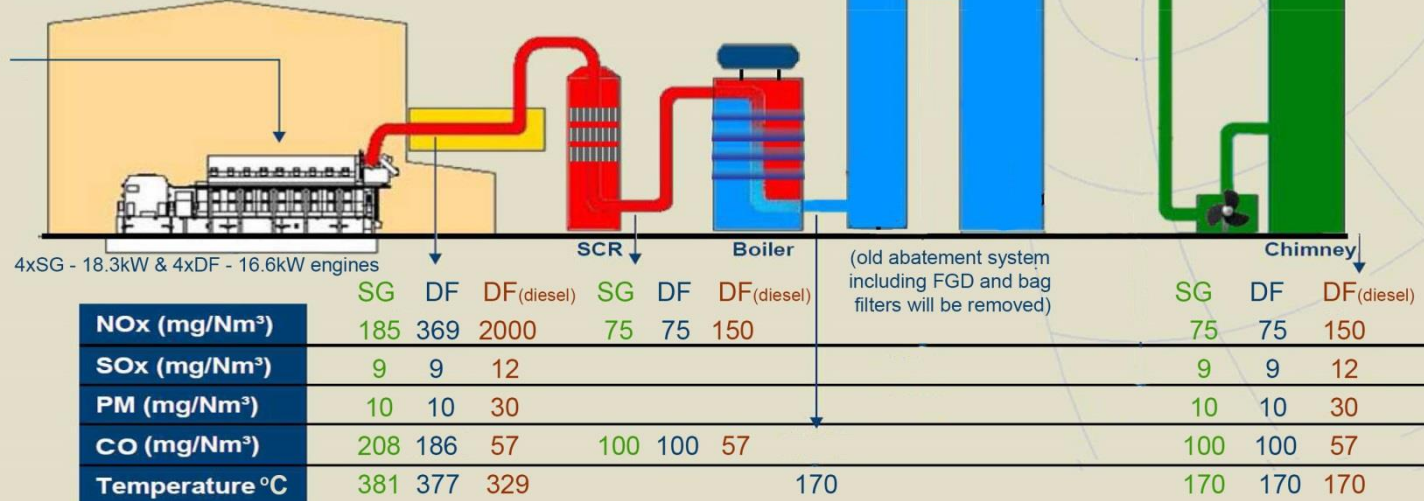
Currently, the exhaust emissions that are generated from the eight HFO engines are passing through four glue gas chimney stacks, whereby each pair of engines is sharing a common chimney stack. In fact, this configuration is commonly referred to as a 'train', and is not expected to change in the proposed conversion.

Typically, gas engines are structured with a vertical chimney system that does not contain any obstructions and/or bends. This is due to the risks of trapping unburnt gas pockets within the chimney when starting and shutting down the engine. Since the current design of the chimney stacks is not completely vertical (which is due to the original demand for restricting the visual and landscape impact of the current HFO powered D3 plant), the risks of forming such unburnt gas pockets during the operation of the proposed converted gas engines is relatively high. It is for this reason, that scientific studies were performed to identify the strategic locations of purge fans and explosion rupture discs that will be fitted along the chimney stack. The fans work by purging the chimney with fresh air to cleanse it from any explosion risks.

## D3 Power Generation Ltd

### NG Emissions Abatement System

Natural Gas at:  
 0-60°C : operating at 10°C  
 6.4 Barg -10 Barg : operating at 7 Barg  
 Min. 70% CH<sub>4</sub>  
 Max. <20% CO<sub>2</sub>  
 Max. 30mg/Nm<sup>3</sup> S  
 Max. 25mg/Nm<sup>3</sup> NH<sub>3</sub>



All concentration values ref. 15% O<sub>2</sub>, dry

Figure 5 – Diagram showing the exhaust emissions released by each engine at different locations within the chimney abatement system

#### 1.1.2.7 Auxiliary infrastructures

A new auxiliary steam boiler (steam: 5t/h, 0.8MPa, 180°C, 3.85MW thermal input) that includes a semi-closed structure and the foundation of the boiler, and a new dump condenser (steam: 2t/h, 0.5 MPA, 150°C) will be installed. Please refer to Figures in Section 1.4.2 and Appendix VII for further details about the boiler's location.

The boiler has an approximate output capacity of 3.5MW thermal, which should be sufficient to generate enough steam to three diesel engines on standby. In fact, this boiler is expected to operate for less than 500 hours *per annum* and only in cases where there is a high demand of high pressure steam. This steam is typically used for sudden engine start operations when the engine has previously been sitting on cold standby. Alternatively, it can also be used to keep engines on warm standby. Such situations are entirely dependent on Enemalta's dispatching order.

It is anticipated that there will be a period of overlap between the operations of D1, D2, D3 and D4, before D1 is decommissioned. It is important to note that the demineralization plant at D1 will continue to service the whole site with boiler water. There is already an auxiliary boiler at D1 that will continue to operate as required. There are also D3's fresh water generators that are used to produce evaporated water for the whole site and for Enemalta to convert some of it to demineralised water (DM) for distribution amongst all the operators at Delimara. D2 will continue to be operated by Enemalta as a standby plant. Exhaust gas boilers at D2 are used to recover heat from the gas turbines' exhaust system. The D2 plant will be on standby and only switched on when required.

As previously stated, water is pumped from a combined seawater inlet at Marsaxlokk bay, which is then used for cooling and for production of demineralized water used in the boiler systems. The site discharges the water effluent to il-Ħofra ż-Żgħira Bay on the opposite side of the Delimara peninsula. This set-up will not change. The temperature of the effluent is controlled to be not greater than 8°C above the inlet seawater temperature in order to protect the sensitive marine biodiversity located within the bay. This preventive mechanism is executed by mixing the effluent water with fresh seawater drawn from the inlet at Marsaxlokk bay. The cooling demand of the converted engines is expected to be different than in the existing scenario, but since seawater cooling pumps have extra cooling capacity and for this reason one may envisage there should be no changes in the final discharge temperature occurring at il-Ħofra ż-Żgħira.

Dosing of sea water will continue to take place by Enemalta. It is the responsibility of Enemalta to supply the operators of D3 with good quality sea water that limits fouling and mechanical damage to the plant.

## 1.2 Non-Technical Summary

The current D3 power electrical generating plant consists of eight Wartsila 18V46 medium speed diesel engines capable of burning HFO and diesel, along with a steam turbine which is operated by steam generated from boilers which recover heat from the exhaust of the diesel engines. Seawater is pumped from an inlet at Marsaxlokk bay, and used for cooling purposes and also the condenser of the aforementioned steam turbines.

Following the conversion process, there will be still eight diesel engines which will comprise of four single fuel engines burning natural gas (Wartstila 18V50SG) and four engines having dual fuel capacities firing natural gas and diesel (Warstila 18V50DF). The latter four engines are expected to be operational prior to the conversion of the four single fuel engines. Natural gas is designated as the main fuel whilst diesel will only be used as a pilot fuel or as the main fuel in emergency situations.

The plan is to have D4 offering the base-load supply whilst using D3 for peaking and times of high demand. Within D3, at least (on average) three of the eight converted engines will be consistently used throughout the year. This value will fluctuate according to demand. The performance guarantee of the proposed engines is according to ISO 3046 standard. These engines are expected to function at 45-50% energy conversion efficiency. It is evident that the proposed system is highly efficient because the proposed engine systems will consume less energy and fuel when operating at 100% load, than when operating at lower loads.

The current four chimney stacks at DPS will remain functional in the proposed changes. The temperature and velocity of the flue gas escaping through these stacks will vary between engine types and fuel that is being used. The highest temperatures (377-381°C) will be reached when burning natural gas on both engine systems. Temperatures will drop significantly (329°C) when burning diesel in DF engines. The gas flow varies between 28.1-32.7kg/s, with the slowest being predicted for natural gas burnt in DF engines, whilst the same engines are also responsible for the fastest exhaust flows from the burning of diesel.

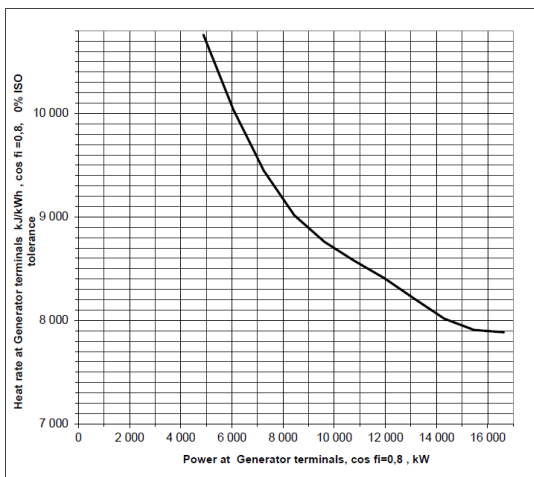
The D3 power plant also includes eight selective catalytic reduction (SCR) units for NO<sub>x</sub> reduction, which will be retained; four reactor units for SO<sub>x</sub> reduction, and filter bag units for the deposition of particulate matter (PM), which will be removed. The abated exhaust gases are released to the atmosphere through four stacks, to which no alternations are planned. Each pair of engines shares a common chimney stack, and is collectively known by the generic term 'train'. The atmospheric emissions from natural gas will be lower than that of HFO diesel and this will lead to the removal of the FGD and the dust deposition bag filters. A new carbon monoxide catalyst will be installed in the SCR units since the current system does not include a CO abatement system.

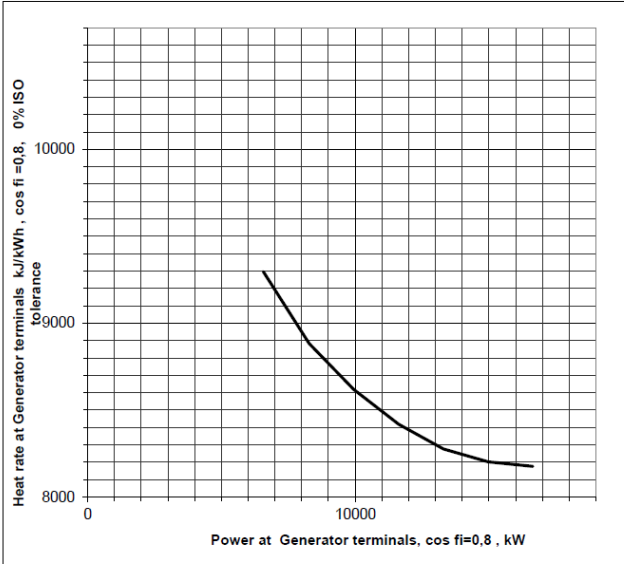
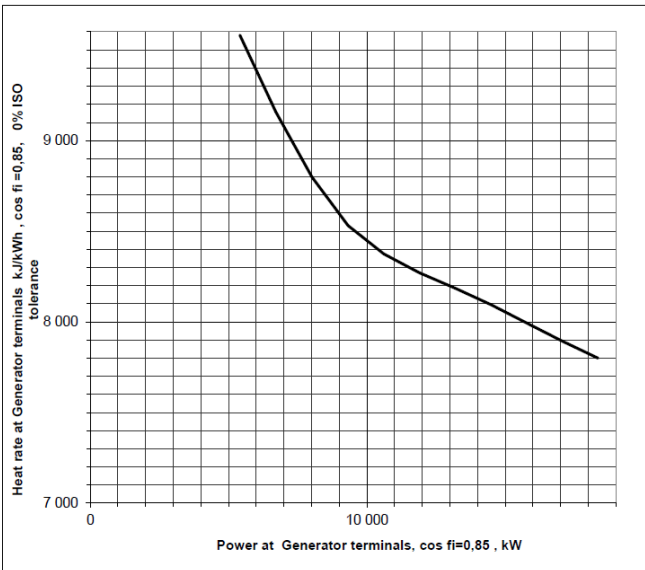
In addition to this, a new auxiliary steam boiler (steam: 5t/h, 0.8MPa, 180°C) that includes a semi-closed structure, the foundation of the boiler, and a new dump condenser (steam: 2t/h, 0.5 MPA, 150°C) will be established. A risk assessment is currently being drafted for the new boiler with a proposed footprint of 70m<sup>2</sup> and a maximum chimney height of 12m. Once the risk assessment is approved, the relevant planning consents and permits will be applied for.

Diesel will be strictly used as a backup fuel in emergency scenarios only including shortage of supply of NG or malfunction of engines amongst others. When operating the dual fuel engines on diesel as a backup fuel, the SO<sub>x</sub> and PM emissions are expected to increase, reaching levels of 12mg/Nm<sup>3</sup> and 30mg/Nm<sup>3</sup> at 100% load, respectively.

### 1.3 Why application is being made

Table 4 – List of proposed changes in operation and the reason why they are being made

Item No.	Change in operation	Variation to IPPC permit																											
1	Conversion to natural gas fuelled engines	<div><ul style="list-style-type: none"><li>Conversion of 8 x HFO engines (Wartsila 18V46) to 4 x SF NG engines (Wartstila 18V50SG) and 4 x DF NG and diesel engines (Warstila 18V50DF).</li><li>The established flues:</li></ul></div> <table><tr><th rowspan="2">Release point</th><th rowspan="2">Source</th><th rowspan="2">Total Thermal Rating MW<sub>th</sub></th><th colspan="2">UTM Co-ordinates</th></tr><tr><th>X</th><th>Y</th></tr><tr><td>Flue D6A</td><td>DPS 6 (Engines 1&amp;2)</td><td>80</td><td>460,137</td><td>3,965,687</td></tr><tr><td>Flue D6B</td><td>DPS 6 (Engines 3&amp;4)</td><td>80</td><td>460,134</td><td>3,965,685</td></tr><tr><td>Flue D6C</td><td>DPS 6 (Engines 5&amp;6)</td><td>73</td><td>460,104</td><td>3,965,663</td></tr><tr><td>Flue D6D</td><td>DPS 6 (Engines 7&amp;8)</td><td>73</td><td>460,101</td><td>3,965,661</td></tr></table> <div>Dual fuel engine system (NG):<ul style="list-style-type: none"><li>At 100% load:<ul style="list-style-type: none"><li>Electrical power = 16,638kW</li><li>Heat rate = 7,924kJ/kWh</li></ul></li><li>At 80% load:<ul style="list-style-type: none"><li>Electrical power = 13,300kW</li><li>Heat rate = 8,220kJ/kWh</li></ul></li></ul></div> <div>Heat rate graph</div> <div>Dual fuel engine system (Gasoil):<ul style="list-style-type: none"><li>At 100% load:<ul style="list-style-type: none"><li>Electrical power = 16,638kW</li><li>Heat rate = 8,197kJ/kWh</li></ul></li></ul></div>	Release point	Source	Total Thermal Rating MW <sub>th</sub>	UTM Co-ordinates		X	Y	Flue D6A	DPS 6 (Engines 1&2)	80	460,137	3,965,687	Flue D6B	DPS 6 (Engines 3&4)	80	460,134	3,965,685	Flue D6C	DPS 6 (Engines 5&6)	73	460,104	3,965,663	Flue D6D	DPS 6 (Engines 7&8)	73	460,101	3,965,661
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Flue D6D	DPS 6 (Engines 7&8)	73	460,101	3,965,661																									

		<ul style="list-style-type: none"> <li>At 80% load: <ul style="list-style-type: none"> <li>Electrical power = 13,300kW</li> <li>Heat rate = 8,297kJ/kWh</li> </ul> </li> </ul> <p>Heat rate graph in back-up fuel mode</p>  <p>Single gas engine system:</p> <ul style="list-style-type: none"> <li>At 100% load: <ul style="list-style-type: none"> <li>Electrical power = 18,321kW</li> <li>Heat rate = 7,838kJ/kWh</li> </ul> </li> <li>At 80% load: <ul style="list-style-type: none"> <li>Electrical power = 14,657kW</li> <li>Heat rate = 8,100kJ/kWh</li> </ul> </li> </ul> <p>Heat rate graph</p> 
2	Emissions and abatement for 4 x SG NG engines	<ul style="list-style-type: none"> <li>SCR (selective catalytic reduction) for NO<sub>x</sub> control using 70L/h urea.</li> <li>New layer of CO catalyst to cater for CO and ammonia slip in the SCR.</li> </ul>

		<ul style="list-style-type: none"> <li>FGD plant (SO<sub>x</sub> control) and dust filtration will no longer be required, therefore injection of SBC (sodium bicarbonate) will discontinue and bag filters will be removed.</li> </ul>
3	Emissions and abatement for 4 x DF NG/gasoil engines	<ul style="list-style-type: none"> <li>Function by burning on diesel only or utilizing 0.0044kg/s (18L/h) of diesel as continuous 'pilot' fuel when burning NG (due to compression ignition in engine).</li> <li>Identical abatement measures as in the SG NG engines</li> <li>When operating on diesel, the urea injection for NO<sub>x</sub> control is expected to increase to 280L/h.</li> <li>The technical, logistical, temporal and financial requirements for the reinstatement of the SBC and bag filter systems in emergency cases are being considered.</li> </ul>
4	Associated activity of fuel handling and storage	<ul style="list-style-type: none"> <li>NG supply will be fed from a Gas Reduction Station (GRS) to the converted engines. GRS will be operated by D4 (not part of this IPPC permit) to reduce the pressure of the natural gas from 40 bar to 8 bar.</li> <li>A single 140m<sup>3</sup> diesel tank with head of pressure to engines at 6 bars should be maintained for the new plant.</li> <li>Workers will have the required operating licences for dealing with SF<sub>6</sub> gases. They will also be trained to work with LNG and adopt the necessary safety procedures in cases of potential accidents.</li> </ul>
5	Associated activity of utilities	<ul style="list-style-type: none"> <li>An auxiliary diesel boiler will be constructed to bring the plant on during cold start in cases where the supply of steam has diminished. Around 90minutes are required to bring the boiler to temperature and raise sufficient steam to bring one engine onto the grid. Diesel supply will be from one of two options: <ul style="list-style-type: none"> <li>Utilize existing diesel supply line from diesel day tank supplying the engines and take a branch to the auxiliary boiler</li> <li>Utilize existing diesel day storage tank and install a dedicated supply line to the boiler</li> </ul> </li> <li>Standby engines will be maintained at 70°C in order to bring them back into operation as soon as possible. This will be achieved by steam originating from operational engines or D2 where necessary.</li> <li>DPS station overall: decrease of seawater for cooling by 5,000m<sup>3</sup>/h is expected due to a more efficient engine system</li> <li>D3 has two seawater pumps, one is used for cooling whilst the other is used to dilute the temperature to the effluent discharge conditions.</li> <li>Post conversion of the eight D3 engines, there is the potential that D1 will utilize cooling water for a short period of time until decommissioned.</li> <li>A new type of lubrication oil will be required for the</li> </ul>



		<p>converted engines, with preference being given to the existing lubrication tank for its storage.</p> <ul style="list-style-type: none"> <li>The current system of storage day tanks is not expected to be modified, except for stopping the operations of HFO storage tanks and reducing the quantities of urea and sludge produced.</li> </ul>
6	Associated activity of storage, treatment and disposal/recycling of waste materials	<ul style="list-style-type: none"> <li>Sludge will be produced at a significantly reduced rate once D3 is converted to natural gas. However, the current sludge tanks will continue to function.</li> <li>By-products of desulphurization that are currently produced from the FGD plant are expected to reach negligible quantities (<math>9\text{mg}/\text{Nm}^3 \text{SO}_2</math> and <math>10\text{mg}/\text{Nm}^3 \text{PM}</math>) once the NG system will be employed. For this reason the FGD plant and the filter bags will be removed.</li> <li>The urea system currently employed is going to be maintained however the quantities of reagent used are expected to decrease from 390L/h to 70L/h (when burning NG) and 280L/h (when burning diesel in df engines).</li> <li>Boiler blow-down will not be modified from existing operations. Boiler wash-down will continue to be discharged into il-Hofra iż-Żghira.</li> <li>Three waste storage areas are allocated: <ul style="list-style-type: none"> <li>6a – Fuel oil treatment area</li> <li>6b – Urea storage yard</li> </ul> </li> </ul>
7	Associated activity of maintenance	<ul style="list-style-type: none"> <li>A preliminary maintenance programme is attached in Appendix II. A refined version will be available after the commissioning phase. This plan will be updated at the beginning of each year to reflect the forecasted running hours of the plant.</li> <li>D3PG will not own a workshop or tools to perform maintenance. It will be subcontracted.</li> <li>The current water dosing system will remain as is submitted in Enemalta's IPPC Submission Section C2.3. Enemalta will be the responsible entity for water dosing at D3. D3 operators will not own or store chemicals for sea water dosing.</li> </ul>
8	Emissions to Air – Release of particulate matter	<ul style="list-style-type: none"> <li>The LCP BREF of 2006 states that the emission level for PM is <math>5 \text{ mg}/\text{Nm}^3</math> at 15% <math>\text{O}_2</math>.</li> <li>The PM emissions from DF engines following abatement are expected to be <math>10\text{mg}/\text{Nm}^3</math> when operating on NG.</li> <li>The PM emissions from SG engines following abatement are expected to be <math>10\text{mg}/\text{Nm}^3</math>.</li> </ul>
8	Emissions to Air – Release of Sulphur dioxides	<ul style="list-style-type: none"> <li>The LCP BREF of 2006 states that the emission level for <math>\text{SO}_x</math> is <math>10 \text{ mg}/\text{Nm}^3</math> at 15% <math>\text{O}_2</math>.</li> <li>The <math>\text{SO}_x</math> emissions from DF engines following abatement are expected to be <math>9\text{mg}/\text{Nm}^3</math> when operating on NG.</li> <li>The <math>\text{SO}_x</math> emissions from SG engines following</li> </ul>

		abatement are expected to be 9mg/Nm <sup>3</sup> .
8	Emissions to Air – Release of Nitrogen oxides	<ul style="list-style-type: none"> <li>The LCP BREF of 2006 states that the emission level for NO<sub>x</sub> is 75 mg/Nm<sup>3</sup> at 15% O<sub>2</sub>.</li> <li>The NO<sub>x</sub> emissions from DF engines following abatement are expected to be 75mg/Nm<sup>3</sup> when operating on NG.</li> <li>The NO<sub>x</sub> emissions from SG engines following abatement are expected to be 75mg/Nm<sup>3</sup>.</li> </ul>
8	Emissions to Air – Release of Carbon Monoxide/ THC and VOCs	<ul style="list-style-type: none"> <li>The LCP BREF of 2006 states that the emission level for CO is 100mg/Nm<sup>3</sup>.</li> <li>The CO emissions from the DF engines following abatement are expected to be 100mg/Nm<sup>3</sup> when operating on NG.</li> <li>The CO emissions from the SG engines following abatement are expected to be 100mg/Nm<sup>3</sup> when operating on NG.</li> </ul>
8	Emissions to Air – Release of NG from pressure relief valves	<ul style="list-style-type: none"> <li>In order to control the flow of NG supply from the GPRS to D3 engines, a total of nine pressure relief valves are situated along the pipe rack.</li> <li>When such valves are opened, they release the components of NG into the air, chiefly methane and carbon dioxide. These are considered to be minimal.</li> </ul>
9	Emissions to Marine Water	<ul style="list-style-type: none"> <li>The maximum amount of cooling water discharged by D3 at Hofra ž-Žghira is projected to be equal to 14,700m<sup>3</sup>/hr, when all pumps are being operated. In doing so, the maximum water temperature of 8°C above ambient water temperature will be retained.</li> <li>At D3's outfall pit, a temperature monitoring probe is present to monitor the aforementioned temperature criterion. No other readings are taken at this outfall pit.</li> <li>The combined maximum discharged by all the three entities operating at DPS at any one time is expected to reduce to 39,200m<sup>3</sup>/h from 44,200m<sup>3</sup>/h, simultaneously retaining the temperature emission limits.</li> </ul>



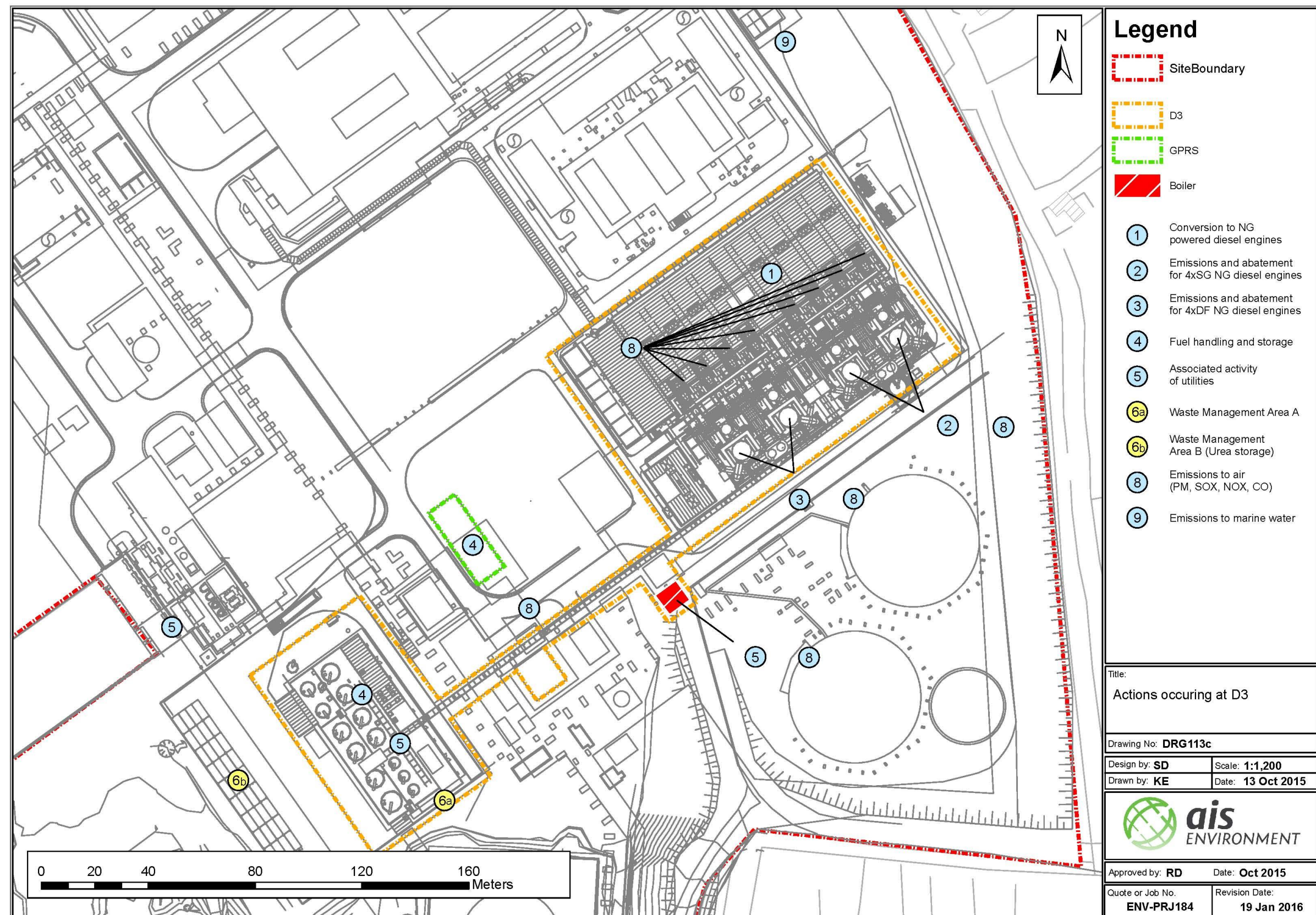


Figure 6 – Map showing the location of the activities proposed in Section 1.3

## 1.4 Site Maps and Reports

### 1.4.1 Site report

#### » Site history

The proposed development is sited within the boundary of the Delimara Power Station (DPS). The DPS is situated in close proximity to agricultural land at Marsaxlokk Harbour in the south eastern corner of Malta (Figure 7). The area is approximately 6175m<sup>2</sup> and includes sections of reclaimed land from the sea when the construction of the DPS was conducted. It began its operations in 1991, where the chimney stack rising up to a height of 150m became the tallest structure in Malta at the time. Enemalta plc and its strategic partners Shangai Electric Power today, operate the facility which consists of the following units:

Table 5 – List of commissioned units throughout the years since the inception of DPS in 1991

Units	Commissioned
Commissioning of Phase 1 operations	1991
2x 60MW Conventional steam Blr/Tur units	1992
2x 35MW Open Cycle Gas turbines	1994
1x 110MW Combined-Cycle plant consisting of 2x 37MW GTs, 2x HRSG, 1x 36MW steam t/a (0.2% sulphur gas oil)	1999
8x Wartsila 18V46, 4 stroke medium speed diesel engines, operating in combined cycle mode, with eight heat recovery boilers and one steam turbine – 149MW	2012

Currently the total power generation capacity at DPS reaches 444MW, with the steam units and diesel engines burning 0.7% sulphur fuel oil, whilst distillate fuel oil (HFO) is burnt in the gas turbines and the combined cycle.

The scheme will not require any land reclamation and will not alter the land use of the site itself since the proposed development is restricted to the conversion of the eight existing HFO engines within the D3 station, to four SG and four DF NG engines and the addition of some ancillary equipment within the same area such as an auxiliary boiler.

#### » Land and groundwater contamination

For the current IPPC application (IP0002/07/E), Enemalta had entrusted RVA group and Environ UK Ltd. to conduct a site condition report for D3. This type of report has now been replaced by a 'baseline' report to address the obligations under regulations 9(3) and 16(2) of the Industrial Emissions (IPPC) Regulations and "*communication from Commission - European Commission Guidance concerning baseline reports under Article 22(2) of Directive 2010/75/EU on industrial emissions (2014/C 136/03)*". The site condition report also used to include a decommissioning report and a monitoring report.



In the land monitoring report that is included in the site condition report, it is stated that a land and groundwater risk assessment had already been carried out in the past (AIS, 2009) as part of the EIS of the proposed D3 power generating plant. For further information please refer to the NTS (Volume III) attached in Appendix V.

This had revealed a number of pollutants which included heavy metals, solvents and hydrocarbons, which were directly associated with potential mineral oil spillages and emissions that may have resulted from the power station activities in the past twenty years, contaminating the soil, and ground water in the process. Nonetheless, the measured parameters were all within acceptable limits. A number of provisions and mitigation measures were subsequently adopted in the D3 plant in order to limit the potential contamination by such substances to land and water.

Subsequently, as part of the site condition report, a conceptual site model was prepared to determine the sources and potential emission points of polluting materials located within D3's installation. The authors also proposed that a number of monitoring reports should be submitted annually as part of the Annual Environmental Review for the IPPC installation.

The first monitoring report for assessing the contamination of land and groundwater was performed in 2011, in conjunction with the Outline Decommissioning Plan (ODP) report. Low concentrations of metals were identified throughout the entire site, whilst PAHs, VOCs, SVOCs and EPH were identified in localised areas. EPHs were observed to surpass the detection limits in two samples located in close proximity to a sump. In these samples, the presence of water was also encountered, which indicated a local seepage from Boiler no. 2.

Enemalta is obliged to publish a revised version of the ODP for the entire installation in 2015. In view of the change of ownership of D3 from Enemalta's responsibility to D3PG, D3PG should carry out a baseline survey for land and groundwater contamination (within 6 months of commissioning). It is being suggested that the current monitoring strategy for land and groundwater assessment is continued, and the results obtained from the next monitoring session are used as the 'baseline report' to ensure that the obligations and standards requested in the IED (Industrial Emissions Directive) will be satisfied. The same monitoring strategy will be proposed for the operational period of the converted D3 plant.

### 1.4.2 Site location

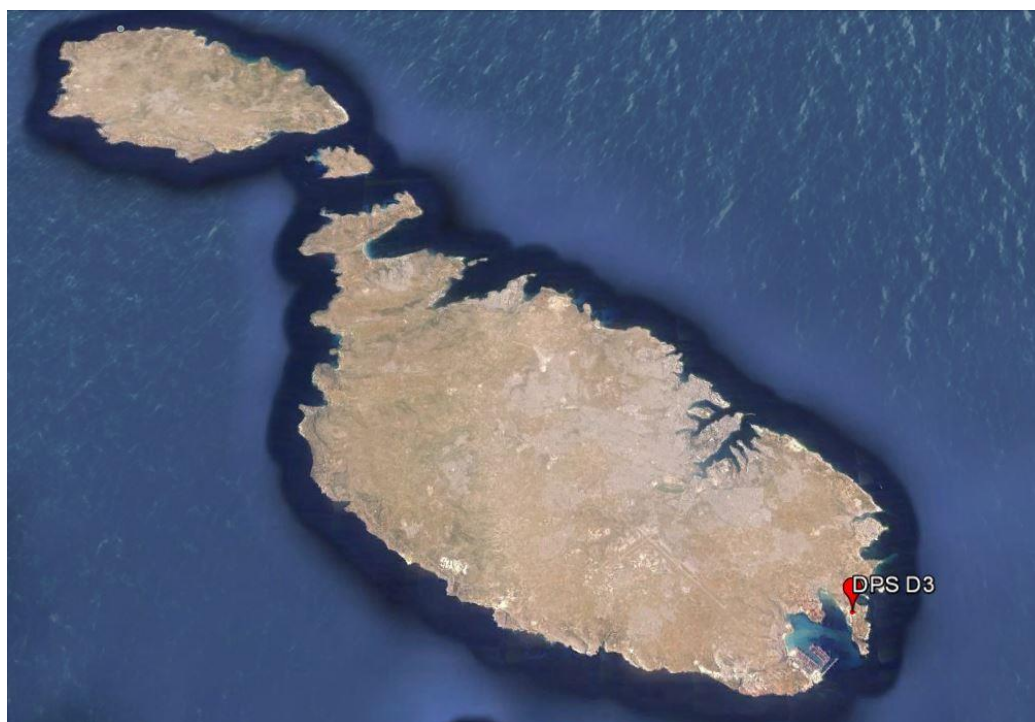


Figure 7 – Map of the Maltese islands showing the south-eastern location of the Delimara Power Station (DPS).

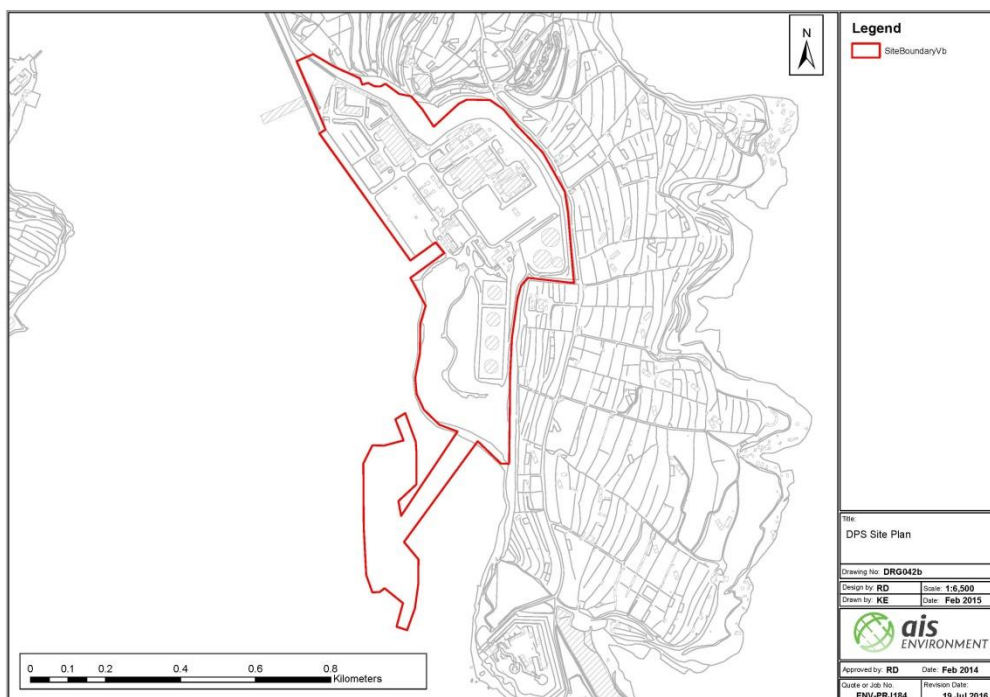


Figure 8 – Diagram showing the site boundary of the DPS.



*Figure 9 – Map showing the current location of D3 engines within the DPS facility*



### 1.4.3 Location of various activities

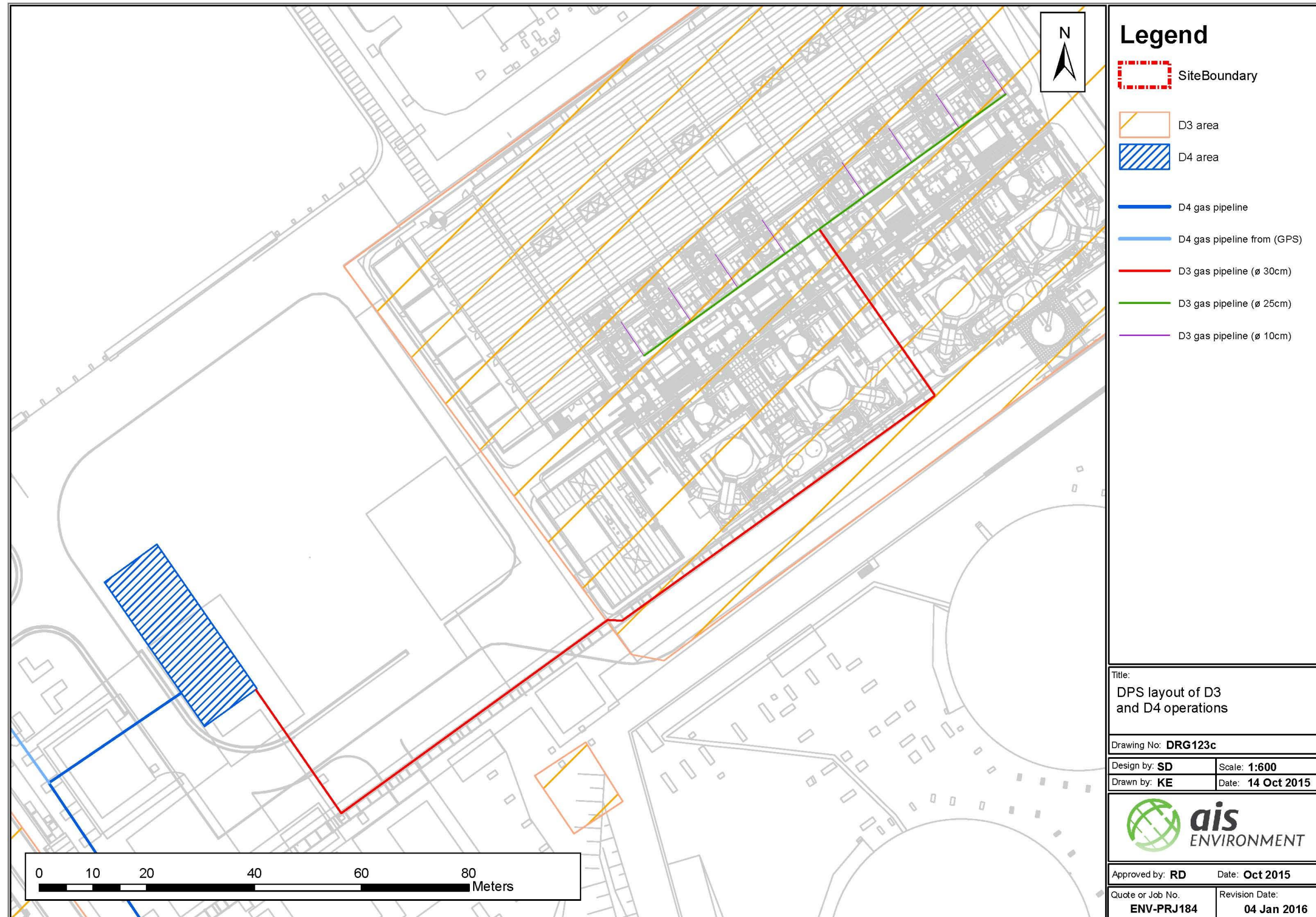


Figure 10 - Scale drawing of the gas supply route from D4 infrastructures to D3



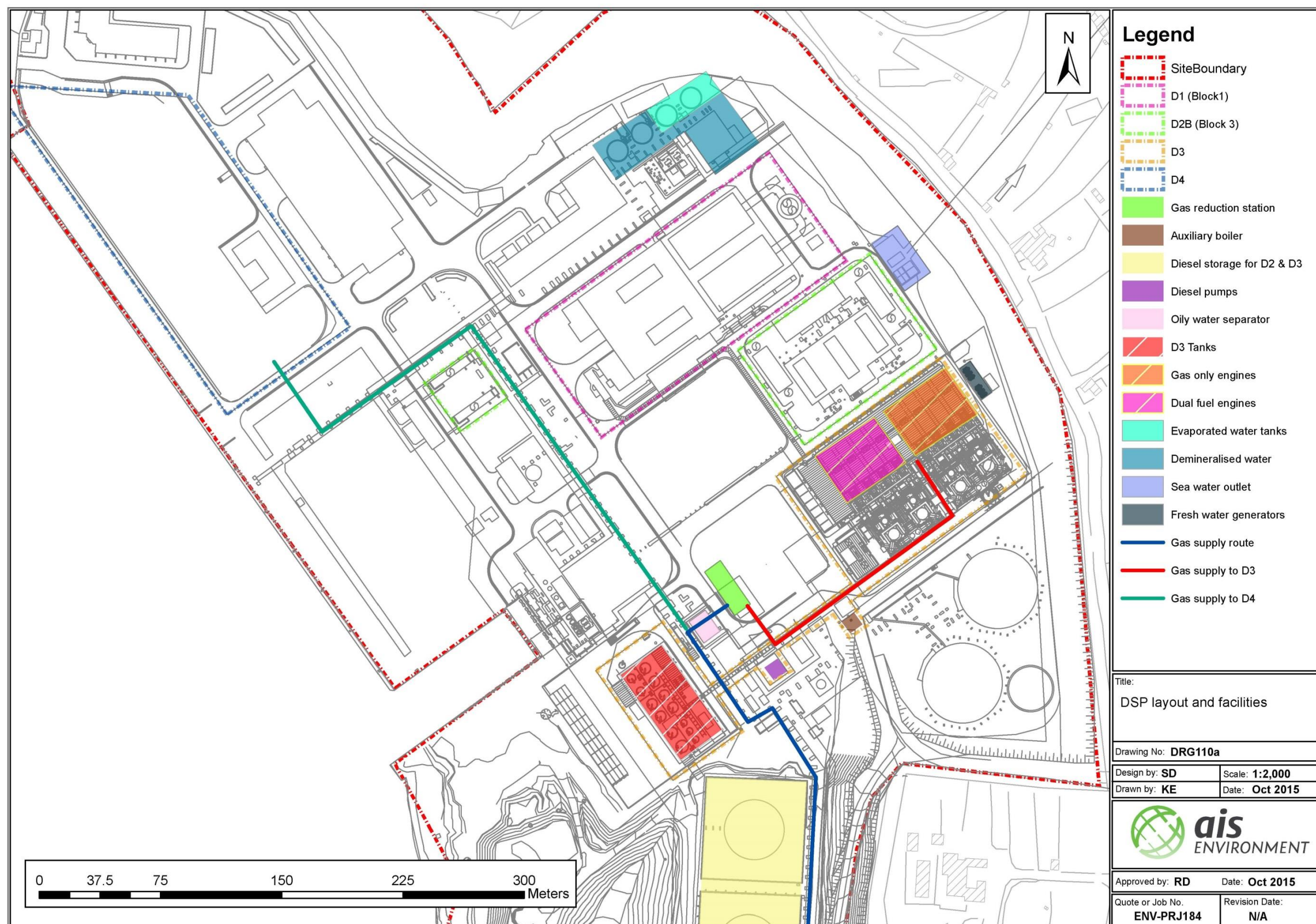


Figure 11 – Map of proposed DPS delineation of D1, D2, D3 and D4 and infrastructures associated with D3



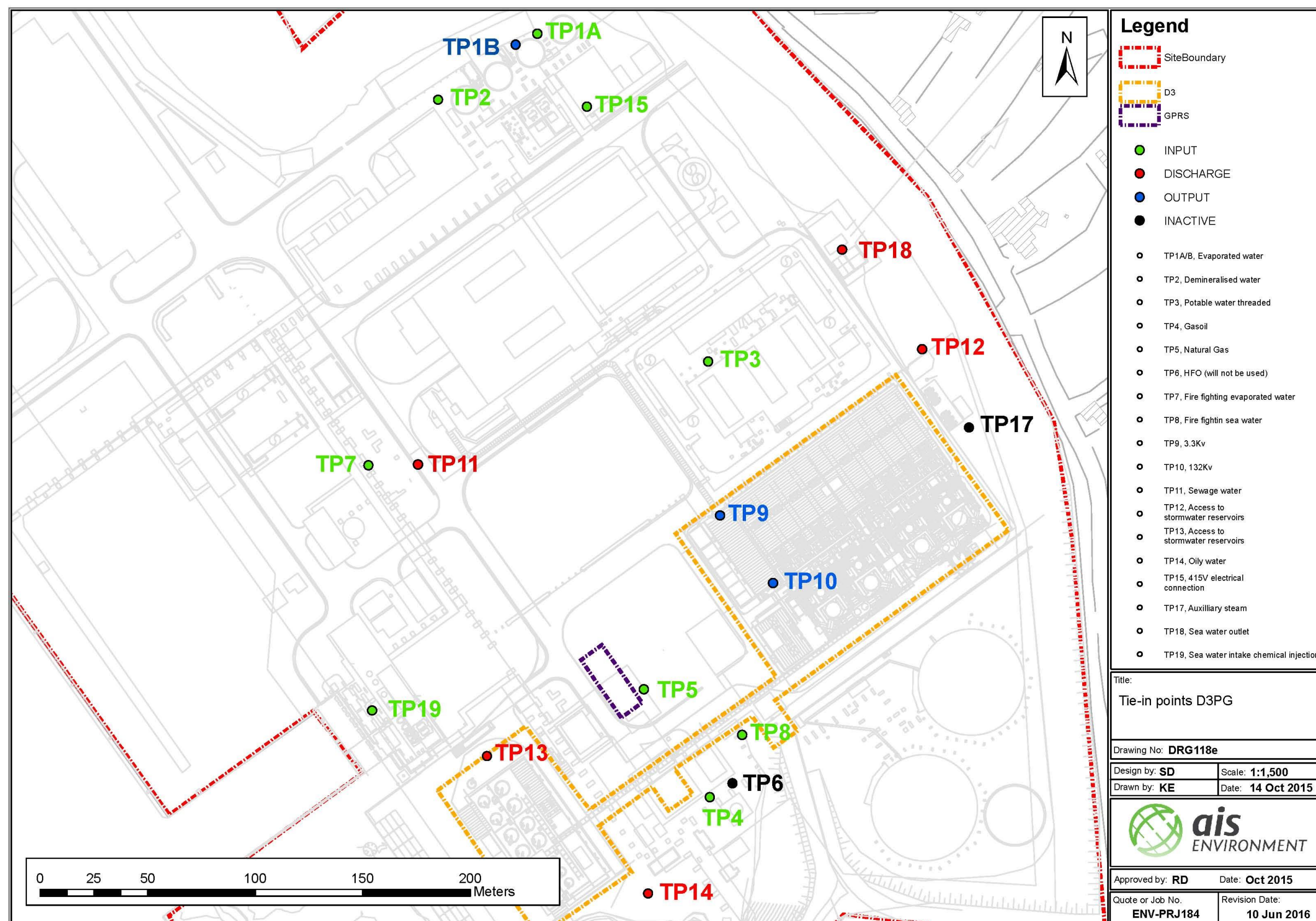


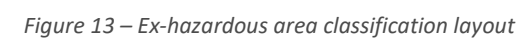
Figure 12 – D3PG's tie-in points with Enemalta and Electrogas Malta

Table 6 – Detailed list of the tie-in points between D3PG and other site operators

Tie-in point	Description	Operator	Destination
TP1A – Evaporated water	Evaporated from Enemalta's evaporated water tanks is supplied to D3 whenever the demand is needed.	Enemalta	Input
TP1B – Evaporated water	Evaporated water produced from D3PG's freshwater generators is supplied to Enemalta's evaporated water tanks. The process of freshwater generation involves the use of seawater that is thermally heated by the internal engine cooling system, to produce evaporated water.	Enemalta	Output
TP2 – Demineralised water	Some of the evaporated water stored in Enemalta's tank is converted to demineralised water thanks to the process occurring in the DM plant. The process involves ion exchange treatments.	Enemalta	Input
TP3 – Potable water threaded	This is the connection to the main for potable water.	Enemalta	Input
TP4 – Gasoil	This is also known as gasoil or diesel tie-in point. This is the connection between Enemalta's large DO tanks and the storage day tanks which are operated by D3PG.	Enemalta	Input
TP5 – Natural gas	This tie-in point shows the supply of natural gas to D3 from the GPRS (gas pressure reduction station).	Electrogas Malta Ltd.	Input
TP6 – HFO	This used to be the tie-in point that linked Enemalta's HFO tanks to D3. This will no longer be operated by D3PG.	Enemalta	Inactive
TP7 – Internal firefighting water (evaporated water)	A freshwater tank of 330m <sup>3</sup> capacity is supplied from the existing evaporated water tanks and is currently being used for the internal firefighting system.	Enemalta	Input
TP8 – External firefighting water (sea water)	Sea water pumps are used for external firefighting water. Electric and diesel pumps are available to supply this water.	Enemalta	Input
TP9 – 3.3kV	This is the electrical connection between D3PG's electric-power generators and Enemalta's 3.3kV electrical station board. The scope of the input from TP9 is to obtain power from D1, allowing the operation of some auxiliary systems when D3 is completely shut down.	Enemalta	Output/Input
TP10 – 132kV	This is the electrical connection between D3PG's GIS and Enemalta's 132kV GIS.	Enemalta	Output
TP11 – Sewage water	One cesspit and two pumped chambers lie within the responsibility of D3PG. The cesspits are connected to Enemalta's large underground pit containing sewage water from all of the operators at DPS (excluding the operators of D4). The contents of the other cesspit are emptied by an authorised waste contractor.	Enemalta	Discharge
TP12 – Access to stormwater reservoirs	The site's drainage run-off system (rainwater) is connected to this reservoir which is operated by Enemalta. D3PG to conduct inspections for any spills which could lead to discharges to il-Hofra ż-Żgħira.	Enemalta	Discharge
TP13 – Access to stormwater reservoirs	Collects rainwater from the containers yard behind the FOT area, but does not include the rainwater collected within the boundary wall of the FOT area. At TP13 there is a safety valve which is almost always open to allow this rainwater to flow to Enemalta's storm water tanks. This tank overflows into the seawater intake channel. Hazardous material will be banded and will not coincide in any way with the safety valve for the collection of rainwater.	Enemalta	Discharge
TP14 – Oily water	The oily water generated by D3PG is a result of rain water falling into fuel bunds that may contain spilled fuel, rain water falling onto areas of the plant where there could be fuel spillages or fuel leaks and transformer oil leaks that get drained to the oily water interceptor. D3's oil interceptors have a PPM equipment which is capable of monitoring the contamination levels of the filtered oily water at a 15ppm threshold. When this level is surpassed, the contaminants are contained and disposed of in the sludge system. Additional monitoring occurs at a pumping pit which ensures that the oily water flowing out of D3. Daily observations form part of the employees' duties and are also included in log sheets and SOPs of the EMS. Inspections occur around two to three times a day. This oily water system is connected to Enemalta's oily water system, to pass through additional polishing interceptors prior to discharge to sea. Enemalta is responsible for monitoring and maintenance of the latter interceptors. The 15ppm threshold has been selected since the previous 5ppm target was causing the system to block and function inefficiently. This was being caused by the dust and silt collected from the surroundings, which in no way are related to the operations of D3. The oily water currently enters the sludge system. After conversion, the quantities of oily water will decrease because HFO will no longer be used. The oil sludge will consist of occasional leaks from engines and lube oil separators. The oil sludge will be exported to an approved facility.	Enemalta	Discharge
TP15 – 415V electrical connection	An electrical connection between Enemalta and D3 for various utilities.	Enemalta	Input
TP17 – Auxiliary steam	Additional steam that is required or supplied from D3 is connected to Enemalta's steam systems.	Enemalta	Inactive
TP18 – Sea water outlet	Excess water collected from cooling and other operations occurring at D3 will be discharged by Enemalta to Hofra ż-Zgħira along with excess water originating from the other site operators at DPS.	Enemalta	Discharge

TP19 –Seawater intake chemical injection	The chemical treatment of the seawater input is performed by Enemalta. This water is subsequently supplied to D3PG for its operations.	Enemalta	Input
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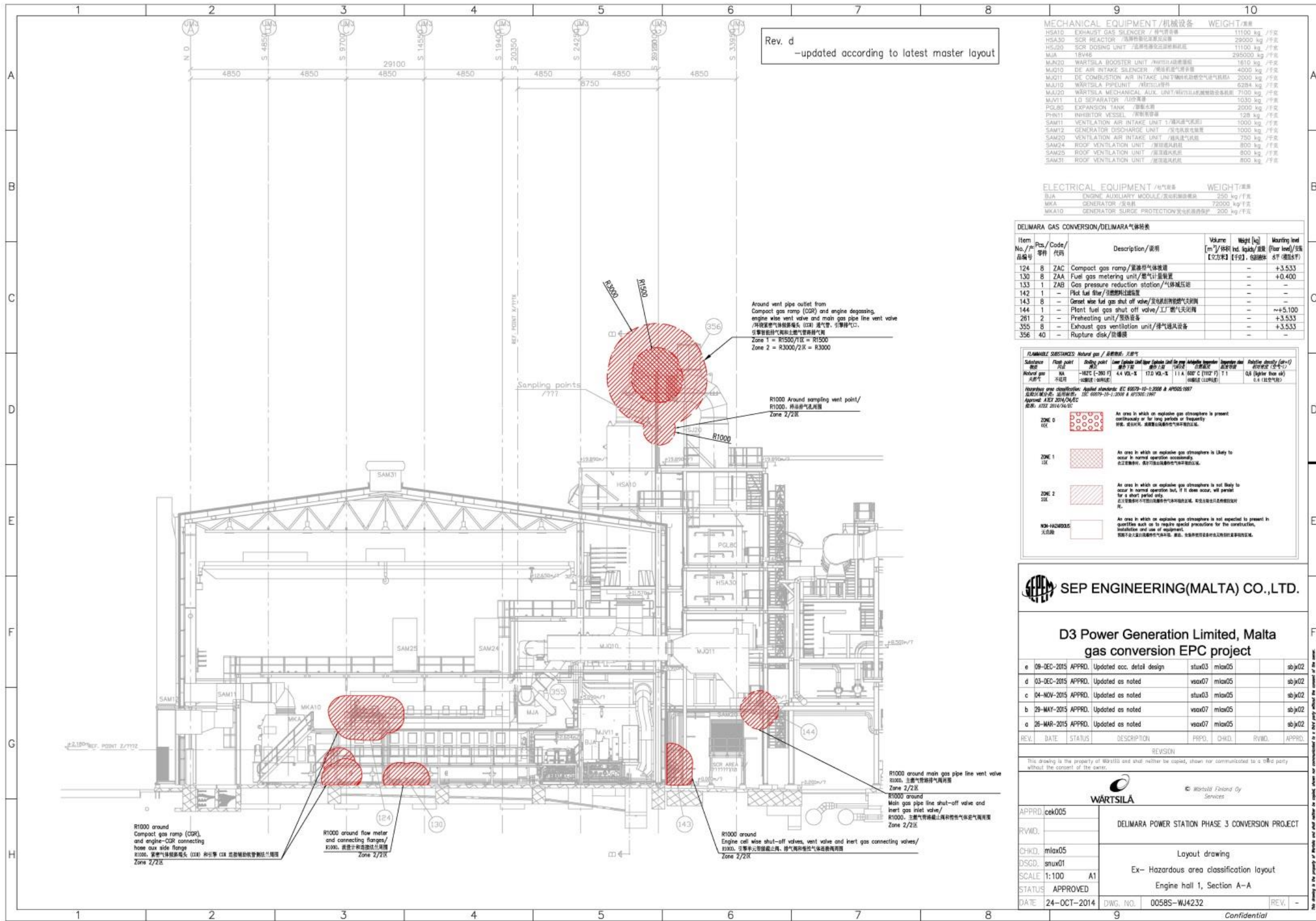


Figure 15 – Ex-hazardous area classification layout engine hall 1, section A-A

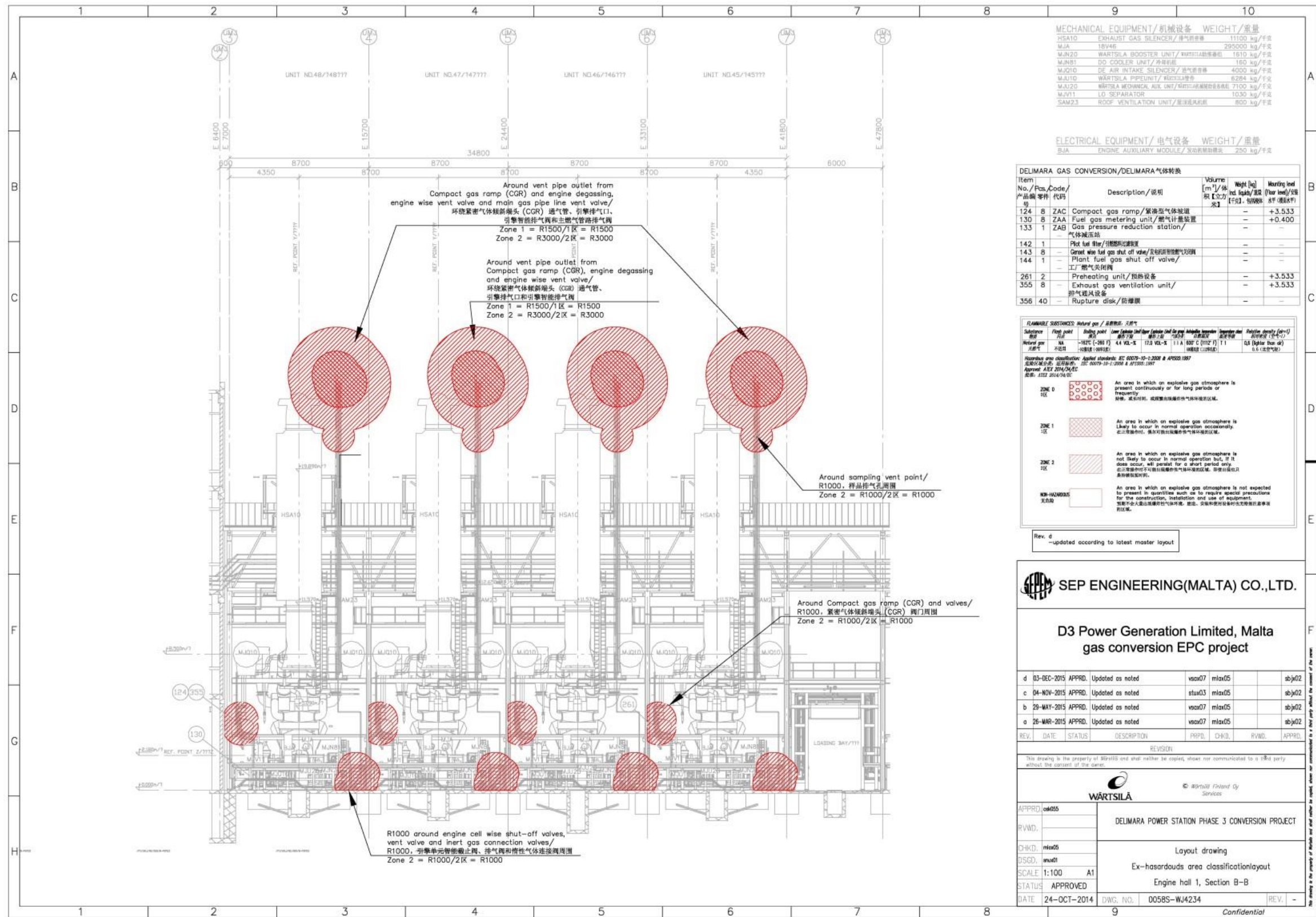


Figure 16 – Ex-hazardous area classification layout engine hall 1, section B-B



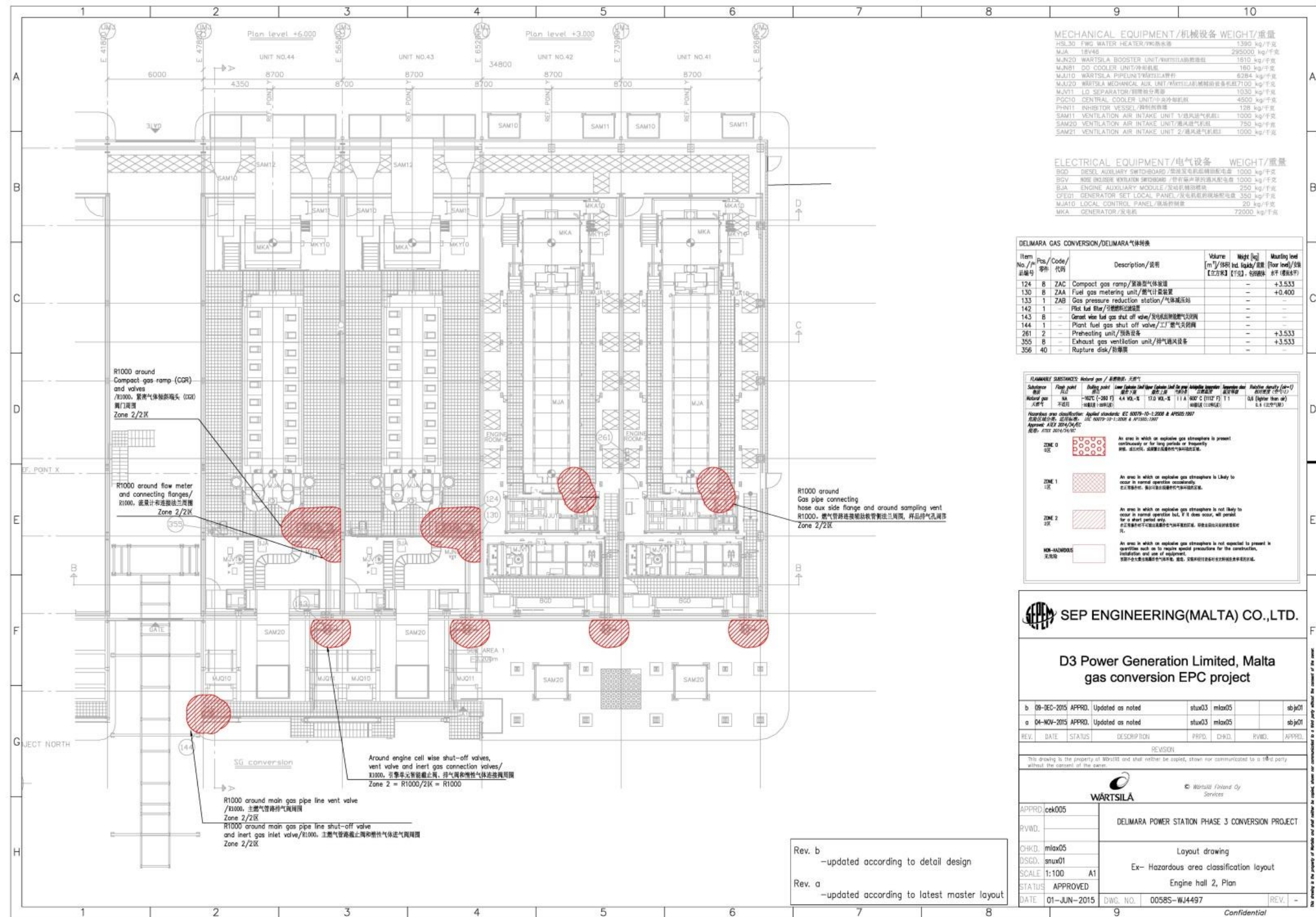


Figure 17 – Ex-hazardous area classification layout engine hall 2





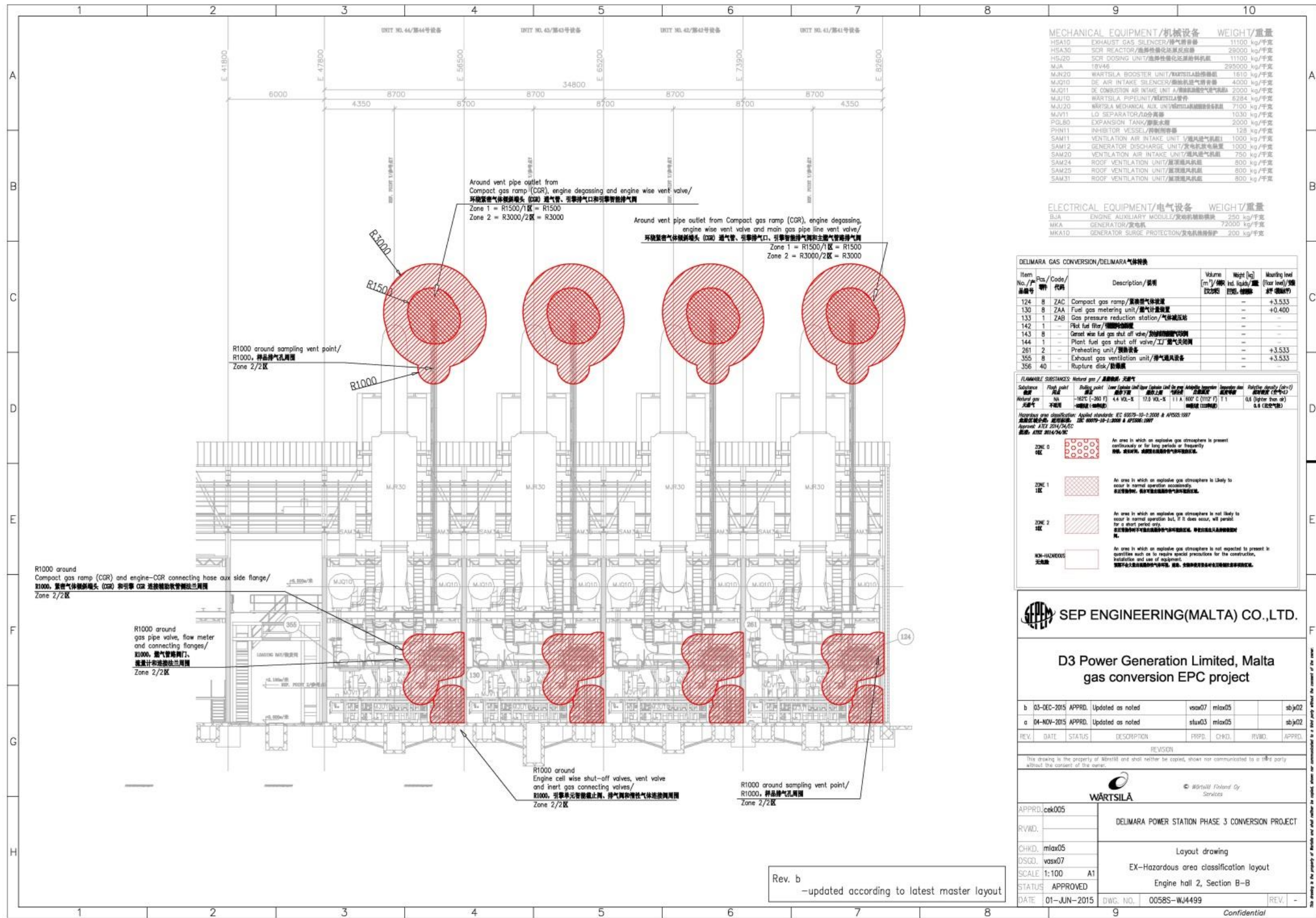


Figure 19 – Ex-hazardous area classification layout engine hall 2, section B-B

## C2 *Proposed techniques*

### 2.1 *Environmental Management system*

The previous operators of D3 (Enemalta) adopted an EMS for the facility that was ISO 14001 certified since 2011. For this reason, it is the desire of the new operators to maintain this standard and improve upon the EMS standards for the operation of the modified D3 plant.

D3PG's responsibility is to be compliant with ISO 14001. It is also responsible to generate and distribute electricity to its customers in a safe and efficient manner whilst ensuring that the surrounding environment (air, land, water and sea) is protected from its own direct and indirect emissions. D3PG acknowledges that some of its operations generate potential negative impacts on the environment; however the company is committed to minimize and prevent such repercussions and continuously strive to improve its performance and environmental efficiency:

- » Abide by IED BREF standards for large combustion plants (LCP) to ensure that the emissions resulting from the company's operations are within the EU standards and to ensure that best-available-technologies (BATs) are used to abate such impacts.
- » Establish clear, measurable environmental targets:
  - Reduce the total energy consumed and reduce distribution losses
  - Reduce consumption of materials in all operations, reuse and promote waste separation and recycling
  - Employ noise and vibration reduction measures
  - Control dust and odour emissions to the surrounding air
  - Promote the adoption of good environmental management practices by the company's contractors and suppliers through a sustainable procurement policy
  - Support groups through Corporate Social Responsibility Charter to help protect the environment and aim to develop a positive and constructive relationship with the local community
  - Perform and publish internal reviews to measure environmental performance and ensure policy goals are met and complied with
  - Minimise the environmental impact caused from the decommissioning of the facility at the end of its projected lifetime
- » Develop emergency response plans to minimise the impacts of accidents
  - Minimise the likelihood of environmental accidents by employing well trained machine operators and regularly performing maintenance cheques on the components of the plant
  - Comply with relevant authorities in cases of accidental spillages or leakages
- » In order to achieve this aim, D3PG shall motivate, train and empower its employees to apply this policy. This policy, driven by the Technically Competent Management, establishes a framework for a management approach designed to promote environmental excellence of work practices and performance. The employees and any sub-contractors shall undertake their responsibilities in compliance with the requirements of all applicable environmental legislation, chiefly L.N. 337 of 2001 (as

repealed by L.N. 184 of 2011 and amended through S.L. 504.37), L.N. 106 of 2007, L.N. 55 of 2010 (as amended by L.N. 245 of 2011).

The following and additional Standard Operating Procedures have to be drafted and included in the EMS. The ones already established by Enemalta will be used as guidelines during the preparation of the new set of SOPs and additional ones will be compiled to include operations and handling of natural gas as a new raw material. This will be done during the commissioning phase and will include amongst others the following SOPs:

- » Monitoring & Reporting Procedures for Greenhouse Gas Emissions
- » Continuous Emissions Monitoring System (CEMS) Installation, Operation & Maintenance;
- » Failure of Diesel Engines Plant Emissions Abatement Equipment;
- » Maintenance of Equipment Containing SF<sub>6</sub> - Management and Leaks Control;
- » Operations SF<sub>6</sub> management and leaks control;
- » Waste Management Procedure;
- » Gas/Fuel Transfer Lines Management and Inspections;
- » Interceptor Cleaning;
- » Interceptor Inspection;
- » Interceptor Maintenance;
- » Tank Area Bund Wall Inspection;
- » Transformer Bund and Reservoir Inspection, Maintenance and Cleaning;
- » Chemical Procurement Storage and Handling;
- » Discharge of Treated Waste Water from Boiler Wash Down Neutralising;
- » Pits Inspection and Maintenance.

Analysis and Reporting Requirements - the following EMS Management Procedures are to be included in the updated EMS:

- » Internal Audit Planning, Conducting and Reporting
- » Suppliers and Contractors Management Procedure
- » Environmental Data Monitoring and Surveillance
- » Non Conformities, Corrective and Preventive Actions Management
- » Environmental Aspects Evaluation
- » Competence, Training and Awareness
- » Legal Requirements
- » Document Control

The following list of EMS documents is to be included in the updated EMS

- » Tender Clauses related to EMS;
- » Contractor's Briefing & Employee Training;
- » GHG Emissions Uncertainty Calculations;
- » Legislation Summary List;
- » Emergency Response Team DPS;
- » Briefing Document for Contractors and Visitors;
- » Communication flow between Fire and RAO;
- » Communication flow between H & S and RAO;
- » EMS Briefing Document for Employees EP 1 - DPS Emergency Plan.

## 2.2 *Proposed Activities*

### 2.2.1 *Proposed changes*

The government initiated a major foreign investment programme in Malta with the purpose of converting the electricity generation on the island from fuel oil to natural gas. The purpose behind such a strategy is to enable the reduction in tariffs for residents and businesses, reduce the emissions and waste products generated to reach Malta's emission and waste targets, and make use of cleaner natural gas fuel having very low quantities of sulphur content.

These statements are backed up by a Strategic Environmental Assessment (SEA) for NEP 2012 (National Environmental Plan) which provides data on the replacement of HFO and gasoil with NG. This would result in a beneficial impact due to:

- » lower CO<sub>2</sub> emissions,
- » very low sulphur content in NG, and
- » lower NO<sub>x</sub> emissions depending on the adapted technology

As a result, an EIA for the proposed gas conversion and the additional infrastructure required was published in 2014.

The main changes proposed at D3 include the transfer of operations from Enemalta to D3PG and the conversion of the diesel engines currently fired on HFO to Natural Gas with Diesel as an emergency fuel. The use of diesel as a pilot fuel for DF engines whilst operating on NG, with a flow of 20L/hr is not considered an emergency situation, and its emissions are abated for.

Engine operation on gasoil is limited to emergency situations as described in Section 1.1.2.5. L.N. 11 of 2013 establishes limited timeframes (<120hours) by which the operators of D3 must abide to when using diesel as a fuel for prolonged periods. In the case of longer periods, the director of the EPD may suspend the requirement to abide by the ELVs for up to 6 months, in cases of overriding energy supply issues on the island.

Such long periods (>120hours) are not envisaged. Should however this be the case, the re-installation and re-commissioning of the full gasoil exhaust abatement system might be required to cater for prolonged gasoil operation. Despite being technically possible, this entails a number of logistical, operational and feasibility considerations which are being discussed.

In addition to the existing steam preheating units, Engines 41 & 45 are also equipped with electrical heating units which allows the engines to be preheated even when steam is not readily available. Prior to entering the engines, the natural gas supply passes through a compact gas ramp (CGR) which controls the gas feed pressure according to the engine load and performs leakage test of the main shut-off valve after every engine stop.

Since the eight diesel engines will not be burning HFO, the quantities and types of waste products generated are expected to change and reduce significantly (Refer to Section 3.1). In fact, the flue gas desulfurization plant (FGD) and filter bag systems will be bypassed, since



SO<sub>x</sub> and PM emissions from burning NG are significantly lower, and this strategy will also help to reduce the residual waste generated from such abatement techniques. These waste by-products used to be temporarily stored in a silo and then emptied into sealed container tanks, which are no longer required. The proposed changes would result in a considerable decrease in solid waste that is considered to be hazardous for disposal. Should the setting up of the current FGD system be required following the commissioning of the converted D3 plant, it is estimated that the process will take approximately six to eight weeks to complete.

The addition of a CO abatement catalyst to the 4<sup>th</sup> layer of the SCR system will be another of the proposed changes. Urea quantities injected in the SCR system are expected to decrease from 390L/h to about 70L/h when firing NG, whilst this amount is expected to decline to 280L/h when using diesel. The use of sodium bicarbonate (SBC) to abate SO<sub>x</sub> emissions will be recommended in emergency situations of prolonged diesel fuel burning. For more information about the atmospheric emissions generated from the proposed engines, please refer to Table 1.

The storage tanks used to store chemicals have a varying capacity of 25-175m<sup>3</sup> depending on the contents of each tank. The following tanks form part of the current D3 operations, some of which will be shut down following the proposed engine conversions. The quantities of urea, lube oil and sludge will reduce drastically in the proposed changes:

- (x2) HFO buffer tanks – 125m<sup>3</sup> – will not be operated any longer
- (x2) HFO service tanks – 125m<sup>3</sup> – will not be operated any longer
- (x1) Lube oil tank – 175m<sup>3</sup>
- (x1) Maintenance lube oil tank – 25m<sup>3</sup>
- (x2) Sludge tanks – 40m<sup>3</sup>
- (x2) Urea dissolving tanks – 65m<sup>3</sup>
- (x2) Urea storage tanks – 125m<sup>3</sup>
- (x1) Diesel day tank – 140m<sup>3</sup>

A new 3.85MW thermal auxiliary steam boiler (steam: 5t/h, 0.8MPa, 180°C) that includes a semi-closed structure and the foundation of the boiler, and a new dump condenser (steam: 2t/h, 0.5 MPA, 150°C) will be installed. This steam boiler system is expected to generate less fouling agents during boiler blow-down, rendering the chemistry of the waste water much more environmentally friendly. The air emissions that are expected from this diesel operated boiler are summarized in the list below:

<b>NO<sub>x</sub> emissions</b>	200mg/Nm <sup>3</sup> (3% O <sub>2</sub> )
<b>SO<sub>x</sub> emissions</b>	170mg/Nm <sup>3</sup> (3% O <sub>2</sub> )
<b>PM emissions</b>	30mg/Nm <sup>3</sup> (3% O <sub>2</sub> )

A risk assessment is currently being drafted for the new boiler with a proposed footprint of 70m<sup>2</sup> and a maximum chimney height of 12-15m. Once the risk assessment is approved, the relevant planning consents and permits will be applied for.

Once DPS1 is decommissioned, the dosing of seawater that is required for cooling D3 and to generate demineralised water for the boiler systems, will still remain the responsibility of Enemalta. The pumping of such water will still occur at the Marsaxlokk bay's seawater inlet. The quantity of cooling water subsequently discharged by D3 at Hofra ż-Żgħira is expected to

be equal to 14,700m<sup>3</sup>/h, whilst retaining a maximum water temperature of 8°C above ambient water temperature.

### 2.2.2 *Start-up and shut-down*

In accordance with the “COMMISSION IMPLEMENTING DECISION concerning the determination of start-up and shut-down periods for the purposes of Directive 2010/75/EU of the European Parliament and of the Council on industrial emissions”, the following criteria have been established:

» Engine start-up period:

- It is important to note that the process described below applies when running on any fuel type used at D3. Switching between NG to gasoil can also occur at full load without requiring any additional shutdown or start up procedures.
- Start-up sequence of a warm-standby engine is initiated in most scenarios, as long as: at least two engines are operated, and sufficient steam is available for the warm-standby of the remaining six engines.
- The engine takes around 10-15minutes to prepare its fuel, oil and auxiliary systems.
- At this point, the engine’s motors begin to spin reaching top speed (500rpm) in a matter of 15-20 seconds. A further 15-20 seconds are required for synchronisation until the switchboard is operated to initiate the supply of electrical energy.
- The increase in load production is a gradual but quick process (15 minutes) at which point the engine is stopped at an 80% load. This 15 minute stall is required to allow the exhaust boilers to generate sufficient steam and to avoid overloading it with engine exhaust.
- Once this period is over, the engine can be safely ramped up to full load. This can be seen as the end of the start-up period.
- With regards to atmospheric emissions, currently an agreement with the local environmental authority is in place to avoid recording the NO<sub>x</sub> emissions during the first 1 hour period of starting-up an engine. This will still be required after the conversion, because in order to supply the urea solution to the exhaust in the SCR system, the temperatures need to reach levels that are higher than 300°C, and it is practically impossible to reach such temperatures during the first hour after start-up.

» Engine shut-down period:

- It is important to note that the process described below applies when running on any fuel type used at D3. Switching between NG to gasoil can also occur at full load without requiring any additional shutdown or start up procedures.
- Shut-down sequence of an operating engine is initiated. This involves a gradual automatic unloading process, which can also be performed manually by lowering load set points of the targeted engine.
- The stepwise process of lowering the load of an engine from 100% to 0% takes approximately 15 minutes. The start of the shut-down period can be taken as the point when a load of <80% is achieved, except in rare circumstances that require lowering the load to about 60% for quick maintenance purposes.
- In exceptional cases, the engines may need the lowering of their load output for quick maintenance purposes (max. 20 minutes before the engine cools, triggers alarms and becomes unstable).

» Measures taken for operating, starting and shutting down engines:



- Scheduled maintenance of diesel engines is required to preserve or fix essential moving and vibrating components of the engine. This typically occurs every 2,000 operating hours for each engine.
- Reducing the start-up and shut-down frequencies is often encouraged so that the excitation and de-excitation of the generator and the associated circuit breaker are not switched on and off very regularly. This would involve additional maintenance hours, and proves to be an economic burden for the operators.
- As a result, the only valid reasons for stopping a running engine should be:
  - Reduction in the local grid supply requirements
  - Scheduled maintenance
  - Reduction in the operational efficiency of the engine
- There is a precautionary and balanced approach in the operational hours assigned to all eight diesel engines, despite the economic efficiency of SG engines. This will ensure that the operating hours of the SG and DF engines is similar to counter for maintenance and downtimes. It is important to point out that when DF engines are used, these will run on NG unless it is an emergency situation.
- During periods of shutdown and start-up the auxiliary boiler will only be used in two instances:
  - i. To heat up and operate cold switched off engines,
  - ii. To keep engines on hot standby whilst the plant is in complete shutdown mode.
- It is important to note that DF engines will be capable of switching on and off on any fuel mode.

<b>Determination of start-up and shut-down for D3</b>		
	<b>One engine</b>	<b>Use of more than 1 engine</b>
End of start-up period	Upstream and downstream temperature of the SCR is >330°C	Upstream and downstream temperatures of the SCR of all operating engines is >330°C
End of shut-down period	Engine load ≤13% of the rated DE Electrical output	All engines ≤13% of the rated DE Electrical output

### 2.2.3 *Flow diagram summarising the proposed installation activities*

Most of the current systems used by D3 are not expected to change. However, below is a more detailed description of the events that are expected to ensue during D3PG's operations:

Each diesel engine contains two internal cooling circuits that are both composed of evaporated water flowing through an enclosed piping network. These circuits are separate and each contains one cooling unit, which acts to dissipate heat from the engines to two additional water piping systems:

- » The second cooling unit (C2) acts as a heat exchanger via direct contact with the seawater cooling system. Cool seawater is passed next to the engine's C2, which cools the engine's internal cooling system, and helps it to dissipate heat by transferring excess heat to the outgoing seawater cooling pipes. These eventually reach D3 outfall pit, but before being released, this hot seawater is cooled by an additional seawater pumping system that specifically targets this hot water and cools it down to the required temperature criterion ( $\leq 8^{\circ}\text{C}$  from input).
- » The first cooling unit (C1) is used for an additional internal cooling system that is also composed of evaporated water. Excess heat is dissipated from C1, reaching the fresh-water generators (FWGs) that require heat for the generation of freshwater from sea water. In doing so, the excess heat in the internal cooling system is absorbed by the FWGs and is additionally cooled by the incoming sea water that enters the FWGs.

An additional seawater pump is used to supply seawater for the following activities:

- » Seawater is pumped to the FWGs for the conversion of seawater into freshwater. In doing so quantities of brine water are produced which end up being discharged in D3's outfall pit. The freshwater generated by these FWGs is connected to Enemalta's evaporated water tanks which eventually supply this evaporated freshwater to the demineralisation plant with the intent of producing DM water. This water ends up in the feed water tank which is used on a regular basis by the operators of D3 to supply the boiler with DM water in cases where steam is lost to the surroundings.
- » Seawater is also pumped to provide cooling to the condenser that is linked to D3's low pressure steam turbine. This seawater cooling system targets the warm water released from the engine's internal cooling system, preventing it from exceeding the established temperature criterion.
- » Every pair of engines (collectively known as a train) share a common chimney stack. Before the exhaust from the engines is emitted through the stack, a series of processes are undertaken, which are confined to each engine and not shared with any other engine. Despite this confinement, such processes are identical for each engine system:
- » Exhaust generated from the diesel engine reaches temperature of around  $380^{\circ}\text{C}$  when operating on natural gas. Urea solution that is prepared in the urea storage tanks is injected in the SCR system, which acts as an abatement measure to reduce the emissions of  $\text{NO}_x$  and CO due to the implementation of a CO catalyst on the 4<sup>th</sup> layer of the SCR.

- » The hot NO<sub>x</sub> and CO abated exhaust reaches the exhaust boiler (EB), and is used to provide sufficient thermal energy for the production of steam from DM water that accumulated in the boiler. As a result of this heat exchange mechanism, the resultant exhaust is significantly cooled and is simply passed through the old abatement system which no longer has any function in the proposed change. This includes: the FGD system (flue gas desulphurisation), the BFT (bag filter tower) and the ID Fan, until ultimately reaching the shared chimney stack. The operators at D3 also have the option of bypassing the EB and old abatement system, allowing the hot NO<sub>x</sub> and CO abated exhaust to be emitted directly to the chimney stack. This is most likely required when steam generation from EB is surplus to requirements or else in cases where the EB is malfunctioning.
- » The steam generated from the EB is used to generate excess energy from the LP steam turbine. Steam produced from exhaust gas boilers that is not used in steam generators passes through where it cools down and then goes back to EGB's feed water system.
- » This DM hot water is passed through a CEP (condensate extraction pump) which continues the heating process of the water in order to improve the efficiency of the thermal cycle, which is required for the deaerator. The latter device is used for the removal of oxygen and other gases from the DM water, ensuring that the collected product in the feed water tank is completely deficient of such impurities. Any steam or hot DM water that is lost throughout this entire cycle is easily replaced by DM water from Enemalta's DM water tank.
- » Once this process is completed, low pressure and high pressure pumps and drums are used to generate sufficient operating pressures at the EB and other auxiliary services at D3.
  - Superheated high pressure steam (12 bar) is used for the electricity generation in the boiler and turbines.
  - Alternatively, high pressure saturated steam (12 bar) is used for the hot purging of the chimney stacks, the heating required for the deaerator system and to keep the engines on warm standby.
  - The low pressure steam (4 bar) is used for lubricating oil separators (by heating up the oil to increase its viscosity and allow for better centrifugal separation. It is also used for the engine's jacket water to keep the temperature above 50°C. Moreover, LP steam is also used for preheating the water that is mixed with the urea granules to create the urea solution that is inputted in the SCR abatement system.

Drawing No. DRG114a Revision Date N/A  
 Date: 19/10/2015 Job No. PRJ-ENV198  
 Designed by: SD  
 Drawn by: KE  
 Approved by: RD



## Processes at D3 Flow diagram

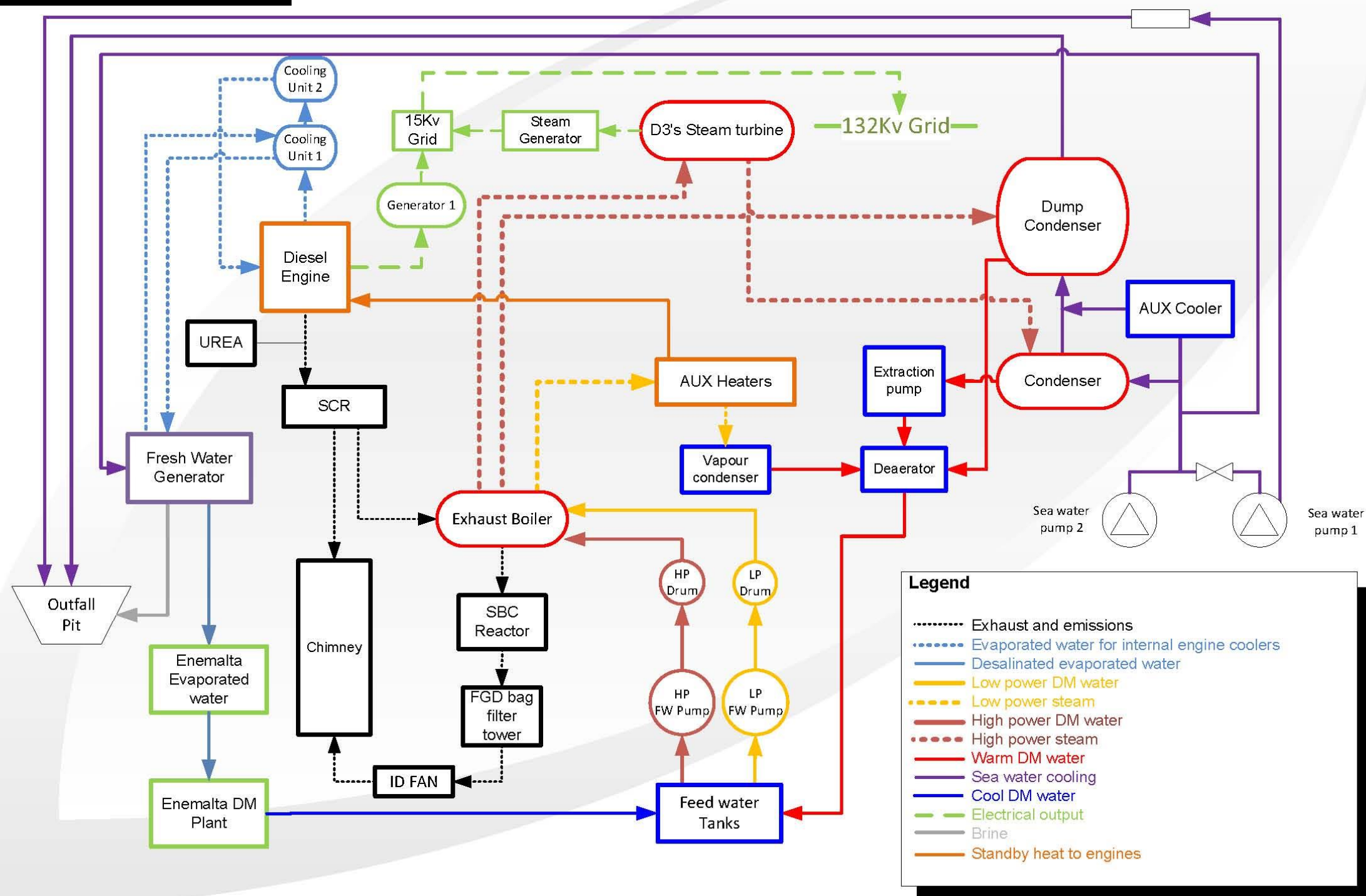


Figure 20- Flowchart showing the proposed activities at D3 by D3PG

## 2.3 Raw materials

The raw materials that will be used by the applicant once D3 is operational are highlighted in the following table and in Appendix I.

Table 7 – List of raw materials used by D3PG

Raw material	R-phases	Consumption at D3 upon conversion	Storage capacity	Purpose and method of storage/location
Natural gas	12	Consumption for DF is expected to be 0.245m <sup>3</sup> /kWh. Consumption for SG is expected to be 0.247m <sup>3</sup> /kWh. NB. Annual consumption dependent on dispatching order.	N/A to D3PG	Engine fuel for SG and DF engines -Supplied from D4
0.1% S Gas oil	40, 65, 66, 51/53	Consumption for pilot ignition of the engines is approximately equal to 18L/h or 15.84kg/h.	140m <sup>3</sup> day tank	Engine fuel for DF engines for pilot ignition and in cases of emergency situations - Tank area, Storage tank in a 110% bunded area. Gas oil is supplied into the day tank by Enemalta.
Urea powder	N/A	Quantity expected to reduce to <2,000,000kgs	68,000kgs	The powder is mixed with hot demineralised water in a urea dissolving tank to produce a urea solution that is used in the SCR abatement system. - Day tanks, Storage tanks in a 110% bunded area
40% Urea solution	N/A	Quantity expected to reduce to <2,000,000kgs	125m <sup>3</sup> day tank	Abatement for NO <sub>x</sub> emissions. The quantity used will depend on the number of times that DF engines will be operated on diesel, since urea consumption increases four-fold when operating on diesel. - Day tanks, Storage tanks in a 110% bunded area
Shell Mysella S5 N40	N/A	N/A	175m <sup>3</sup> day tank	Lubricating oil for normal operations on SG and DF engines. - Tank area, Storage tank in a 110% bunded area
Shell Gadinia 40	N/A	N/A	N/A – this	Lubricating oil for



			lubricating oil is only used in emergency situations which require use or operation of diesel fuel for extended periods. Supply of such oil will arrive on site in the form of a portable tank.	emergency situations when operating DF engines on gasoil for prolonged periods. -Tank area, Storage tank in a 110% bunded area
NALFLEET ENGINE WATER TREATMENT 9 108	22, 25, 34, 35, 50, 60, 61, 8	2,460kgs	250L	Anticorrosion chemical that is dosed in freshwater cooling system of each engine - Bought real-time
SAF-ACID Descaling Compound	N/A	1,350kgs	2,000kgs	Descaling compound that is used to clean freshwater generator when it is fouled -Bought real-time
Activated carbon	N/A	Limited	300kgs	Adsorbant for the VOC emission system that is installed in the gasoil storage tank. - Bought real-time
Sodium metabisulfite	22, 41, 31, 52	1,195kgs	500kgs	Used as an anti-chlorine chemical in freshwater generators -Bought real-time

## 2.4 ODS and F-gases

SF<sub>6</sub> - Sulfur hexafluoride, is the only ozone depleting substance that is currently being generated at D3. As such the generation of this chemical is expected to continue, as part of the general operations occurring at the D3.

866kgs of SF<sub>6</sub> are currently being used as a dielectric and insulating material for two switchgear units. The first one is the Siemens 132kV switchgear containing 855kg of SF<sub>6</sub> in all at 6.1 bar 25°C for insulation purposes. It is important to note that SF<sub>6</sub> containment is partitioned in approximately 7 sections, therefore if there is a fault in one partition, the loss could potentially be of around 115kg of SF<sub>6</sub>.

The other one is the Siemens 15kV neutral earthing switchgear (hermatically sealed) containing 7.5 kg of SF<sub>6</sub> in all at 1.5 bar 25°C for insulation purposes. The aforementioned figure is also contained in different partitions. As long as there are no leakages, no consumption of SF<sub>6</sub> is required on a yearly basis since pressure gauges control the SF<sub>6</sub> pressure range. This pressure is expected to change with temperature conditions. Should a leakage occur, the pressure is expected to go below the established pressure range. This results in the de-energisation of the switchgear to ensure that all the SF<sub>6</sub> is drawn out and collected in adequate portable cylinders. The leaking point is detected by the use of an inert gas like Nitrogen.

No new equipment containing ozone depleting substances is planned to be installed on site. The administration offices are equipped with standard A/C equipment and facilities that will not change from the current IPPC permit.

Energy Service Centre (a subsidiary of Enemalta) will be assigned the task of setting maintenance procedures and ensuring that qualified personnel and fail-proof leak detection systems are employed at D3. The current gas leak detection system should be sufficient, however other types of leakages have to be inspected or tested by using standard manual methods.

## 2.5 Maintenance

Please refer to the preliminary maintenance programme attached in Appendix II. The required maintenance works will be carried out according to the recommendations brought forward by the suppliers/manufacturers, ensuring good engineering practices. This will result in a cost-effective strategy that will ensure that the D3 plant is compliant with the emission limit values established by the IED and that an optimal energy efficiency performance for the whole plant is guaranteed.

Use of maintenance records that integrate maintenance management programmes is a requirement at the facility. Common and fundamental replacement parts should be ordered and stored to ensure a reduced downtime of operations when any engineering system breaks down. In addition to this, the emissions abatement systems should be regularly monitored to ensure that the emissions satisfy EU standards and any other legal obligations. This also applies to waste storage and disposal sites, according to the guidelines written in the Environmental Management System (refer to Section 2.1). Regular service checks and upkeep of the new engines and associated equipment shall be carried out in accordance with good housekeeping practices for such plants.

## 2.6 Energy consumption and efficiency

The annual energy consumption per year in D3 amounts to approximately  $80 \times 10^{12}$  Joules. For the current combined cycle at D3 this amounts to a nominal gross rating of 149MW, 4MW of which are used for auxiliary loads. These include: sea water pumps, induced draft fans, SBC mills, separators, air compressors, fuel pumps and various other pumps and motors that are necessary for operating D3.

The current 8x18V46 diesel engines, each produce 17MW of power, and function at 44.35% efficiency. This implies that each engine requires a rated thermal input of 38.5MW to operate. The new DF engines will each generate 16.6MW of power, whilst operating at about 45.43% efficiency. Whilst operating on diesel, the efficiency to produce the same amount of electrical power is reduced to 43.92%. This equates to a thermal input of 37.8MW in contrast to the 36.62MW required for natural gas. Alternatively, each SG engines will produce 18.3MW of power, at 44.35% efficiency, requiring 38.5MW of thermal input.

Table 8 – Energy consumption, efficiency and generation of four different types of engines

Parameter	Current engines	Single fuel engines	Dual fuel engines	
Engine type	W18V46	W18V50SG	W18V50DF	
Rated thermal input	38,500 kW each	39,888 kW each	36,622 kW (NG)	37,883 kW (Diesel)
Engine power shaft (ISO 3046 standard)	17,075 kW	18,321 kW	16,638 kW (NG)	16,638 kW (Diesel)
Heat rate (at generator terminals, 100% load)	8,000 kJ/kWh	7,838 kJ/kWh	7,924 kJ/kWh (NG)	8,197 kJ/kWh (Diesel)
% Efficiency	44.35%	45.93%	45.43%	43.92%

The performance guarantee of the proposed engines is according to ISO 3046 standard. These engines are expected to function at 45-50% energy conversion efficiency.

It is evident that the proposed system is highly efficient because the proposed DF engine system will consume less energy and fuel when operating at 100% load, than when operating at 50% load:

- » 59% less fuel oil,
- » 11% less natural gas and
- » 12% less thermal energy input

## 2.7 Water

The maximum flow of seawater that could be obtained by D3 is approximately equal to  $22,000\text{m}^3/\text{h}$  with both available pumps being operated at full load. The average forecast is projected for approximately  $15,000\text{m}^3/\text{h}$ .

After converting the D3 engines, the operators are contractually bound to use fresh water generators, to supply the equivalent amount of demineralised and evaporated water that was supplied to it via Enemalta's evaporated water storage tanks. These FWG's function by using the waste heat extracted from the diesel engines' cooling water system. Demineralised water is effectively recycled within the steam cycle itself and is only consumed when it is lost to system leaks, drains and evaporation.

The consumption of demineralised water (DM) and evaporated water at D3 is envisaged to reduce, with the below figures being forecasted:

- » DM consumption:
  - $3\text{m}^3/\text{h}$  for the steam cycle makeup
  - $0.3\text{m}^3/\text{h}$  for urea injection
- » Evaporated water consumption (excluding boiler wash-down and/or turbo washes):
  - $0.6\text{m}^3/\text{h}$  for lube oil separators and engine water top ups

Consumption of potable water from the water mains is mainly for sanitary facilities. In 2014,  $249\text{m}^3$  of potable water was consumed at DPS (only at administration building), averaging  $20.75\text{m}^3/\text{month}$ . The proposed changes at D3 are not expected to contribute to the fluctuation of the aforementioned values.

The quantity of cooling water discharged by D3 at Hofra ż-Żghira is expected to be equal to  $14,700\text{m}^3/\text{h}$ , whilst retaining a maximum water temperature of  $8^\circ\text{C}$  above ambient water temperature.

A freshwater tank of  $330\text{m}^3$  capacity is supplied from the existing evaporated water storage tanks and is currently being used for the internal fire-fighting system. An external system that is seawater based is also available on site. These function by using electric and diesel pumps in case of emergency. The new operators at D3 and D4 will have the provision of fire-fighting water from the current system that will not be amended.



## **2.8 Risk Assessment**

HAZID, HAZOP and ATEX studies have been conducted and have been submitted to OHSA (copies are attached in Appendix III). The aim of these studies is for Enemalta to incorporate the risk studies of all of its plants into one consolidated safety report, which assess the risk of the activities occurring at DPS on human life and on the environment.

For the boiler risk assessment report and the emergency response plan for D3, please refer to Appendix VII.

## 2.9 Training

The training to be provided to the employees working at D3 will cover the following mechanical and electrical operation and maintenance training topics:

- » Plant General Arrangement
- » Plant Operation Routines
- » Design and Function of DF/ SG Engine
- » Function of Built-On Engine Systems DF/ SG
- » Fuel Oil Quality and Treatment
- » Lube Oil Quality Requirements and Analyzes
- » Water Quality Requirements and Analyzes
- » Gas Property, Behaviour and safety
- » Engine Maintenance Schedule DF/ SG Engines
- » Engine Start, Stop and Operation DF/ SG
- » Engine Care
- » Evaluation of Engine Operating Data
- » Engine Condition Check
- » Reading Flow Diagrams
- » Auxiliary Systems Operation Instructions
- » Speed Governing Principles
- » Fuel Injection Equipment, Function and Overhaul
- » Maintenance Operations, Hands-On
- » Installation Documentation System, Power Plants
- » Plant Operating Instructions
- » Familiarizing with the Aux. System
- » Creating a Staff Training Plan
- » Electrification
- » Operation Modes
- » Alternator
- » Excitation System
- » Protection Relay
- » Control and Monitoring System (PLC)
- » Operator Station Programme
- » MV and LV Systems
- » Local Control Panels
- » DC System
- » Governing System
- » Speed measuring System
- » Function of Alarm and Engine protection System

### **2.10 Cessation**

The proposed D3 conversion project has an estimated lifespan of 20 years. Even though the decommissioning report (found in the existing IPPC application as Attachment 14) is still valid, a full decommissioning plan detailing the decommissioning strategy, highlighting the proposed techniques and procedures for reducing the possibility of contamination should be submitted prior to the initiation of any decommissioning works related to D3. This report is planned to be submitted within two years of commissioning the proposed D3 changes.

### 2.11 Multi-operator installations

Apart from the current configuration of D3 which will undergo conversion and transfer of operations from Enemalta to D3PG; DPS also accommodates other generating plant, fuel storage and distribution facilities.

- » DPS1 consists of two steam units each comprising of a boiler, steam turbine and a generator. The plant operates on HFO and is cooled by a sea-water cooling system in order to generate 2x60MW. DPS1 will be decommissioned shortly.
- » DPS2A consists of two open cycle gas turbine generator units operating on gasoil. Each of these air-cooled CCGT units generates 37.5MW. DPS2B is made up of a combined cycle gas turbine block (CCGT) consisting of two gas turbines, two heat recovery steam generators, a steam turbine and generators having a total capacity of 110MW. The fuel used for this plant is gasoil and is typically adopted for mid-range duties. DPS2 operation will continue to be the responsibility of Enemalta.
- » It is expected that once the new DPS4 is commissioned (operated by Electrogas and will include a CCGT power plant, an LNG floating storage unit an onshore regasification unit), DPS1 will not operate unless extreme circumstances dictate otherwise. Once sufficient energy is available, DPS1 will be decommissioned by the end of 2016 and dismantled at the beginning of 2017.
- » Dosing of the cooling water intake by sodium chlorite and hydrochloric acid will continue to be performed by Enemalta, however the operators of the new plants will be responsible for their own pumps. The PPA (Power Purchase Agreement) between D3PG and Enemalta states that Enemalta will be responsible for the dosing of seawater to satisfy the conditions for operating the D3 plant. Such dosage would produce a residual concentration of 0.1ppm after the turbine condensers.
- » D3 will perform discharge temperature monitoring at the D3 outfall pit, ensuring that the outfall remains within an 8°C flux between the inlet and outlet sea water sources. Please refer to Figure 26 in Section 0 for further information.
- » The current sewer system for D3 is not expected to change. Two cesspits collect the foul water from D3 and this water is pumped via two pumping systems into a communal underground pit, in which the foul water contents from D2 are also discharged. Gravitational force is used to transfer this water into another underground pit operated by Enemalta, which pumps the entire contents into the common sewerage system for the locality. Such pits are covered by a concrete layer to prevent ground contamination. For further information please refer to Section 3.3.
- » Site administration/office areas will remain unchanged for D2 and D3.
- » For further information on the established tie-in points please refer to Table 6 and Figure 12.



## C3 Proposed emissions

### 3.1 Waste

#### 3.1.1 Waste characterisation

The table below provides a list of waste streams with the respective EWC code and a comparison between the quantities generated in 2014 and those projected after the conversion.

Table 9- Waste generated at D3 and the projected changes following conversion

Description of waste	EWC Code	Kgs generated in 2014	Kgs projected annually after conversion
Paper and cardboard	15.01.01	2,311kg	2,311kg
Plastic	15.01.02 15.02.03 17.02.03 20.01.39	2,960kg	2,960kg
Wood	15.01.03	6,688kg	6,688kg
Mixed waste	20.03.01	13,255kg	13,255kg
Scrap metal	17.04.07	527kg	527kg
Glass	20.01.02 15.01.07	22kg	22kg
Waste from sea water filtration	10.01.26 20.03.01	1,588kg	1,588kg
Waste oil	13.02.05	80,724kg	57,660kg
Oily water	13.05.07	144,450kg	86,670kg
Oily rags	15.02.02	1,831kg	1,350kg
Boiler cleaning waste	06.07.09	12,576kg	1,260kg
Flyash	10.01.18	3,666,300kg	0kg
Contaminated packaging	15.01.10	1,128kg	1,128kg
Spent tubes	20.01.21 16.02.13	117kg	117kg

#### 3.1.2 Waste management, storage and handling

The location of waste management and storage for D3PG (which is self-bunded) is located in Figure 21. The table below provides information on the maximum storage capacity and the method of containment for each waste stream in the different locations.

Table 10 – Waste management, location and capacity data

Description of waste	Storage location	Max storage capacity	Method of containment
Paper and cardboard	B	5x1100	Skip
Plastic	B	5x1100	Skip
Wood	B	15m <sup>2</sup>	Skip
Mixed waste	B	5x1100	Skip
Scrap metal	B	10m <sup>2</sup>	Skip
Glass	B	1100	Skip
Waste oil	A	30,000L	IBCs and maintenance

			tank
Oily water	B	40,000L	IBCs
Oily rags	B	2x1100	Skip
Boiler cleaning waste	B	15IBCs	IBCs
Contaminated packaging	B	1100	Skip
Spent tubes	B	1100	Skip
Storage location A – Fuel oil treatment area Storage location B – Waste Management site			

### 3.1.3 Waste re-use, recycle and disposal

Waste generated from D3 will be temporarily stored in a shared waste management site at DPS and other assigned areas (refer to Figure 21). Within the shared waste management site, wastes arising from different plants are separated in different sections to ensure better control, sorting and record keeping of the waste generated by the three operators.

Waste contractors arrive on site on a regular basis to dispose of this waste at registered and appropriate waste sites by using suitable and licenced waste carriers. Refer to Figure 22 for further details about how different waste streams are processed by different operators at DPS. Whereas the waste contractors have not as yet been confirmed, they will be sought from the below list since the latter have already worked on site and have been approved by MEPA. The list of waste contracts shall be finalised before the date of the public hearing, allowing enough time for MEPA to review and confirm permits in place.

Table 11 – List of potential waste contractors may change in the future depending on prices tendered

Waste	EW Code	Waste contractor	Permit number	Waste Broker number
Paper and cardboard	15.01.01	Green Skip Services Ltd	WM 0004/07/C	GBR0802
Plastic	15.01.02 15.02.03 17.02.03 20.01.39	Green Skip Services Ltd	WM 0004/07/C	GBR0802
Wood	15.01.03	Green Skip Services Ltd	WM 0004/07/C	GBR0802
Mixed waste	20.03.01	Green Skip Services Ltd	WM 0004/07/C	GBR0802
Scrap metal	17.04.07	DDE Attard Ltd	WM 0009/06/I	GBR0787
Glass	20.01.02 15.01.07	Green Skip Services Ltd	WM 0004/07/C	GBR0802
Waste from sea water filtration	10.01.26 20.03.01	Green Skip Services Ltd	WM 0004/07/C	GBR0802
Waste oil	13.02.05	Waste Oils Co. Ltd	IP 002/08/C	GBR0742
Oily water	13.05.07	Waste Oils Co. Ltd	IP 002/08/C	GBR0742
Oily rags	15.02.02	Green Skip Services Ltd	WM 0004/07/C	GBR0802
Boiler cleaning waste	06.07.09	PTMatic Environmental	N/A	GBR0699

		Services Limited		
Contaminated packaging	15.01.10	Green Skip Services Ltd	<b>WM 0004/07/C</b>	<b>GBR0802</b>
Spent tubes	20.01.21 16.02.13	Green Skip Services Ltd	<b>WM 0004/07/C</b>	<b>GBR0802</b>

The operators at D3 are also responsible for the oils generated by the facility until these pass through Enemalta's oil/water interceptors. The maintenance of these interceptors lies within the remit of Enemalta, which is ultimately responsible to discharge the waste that is collected.

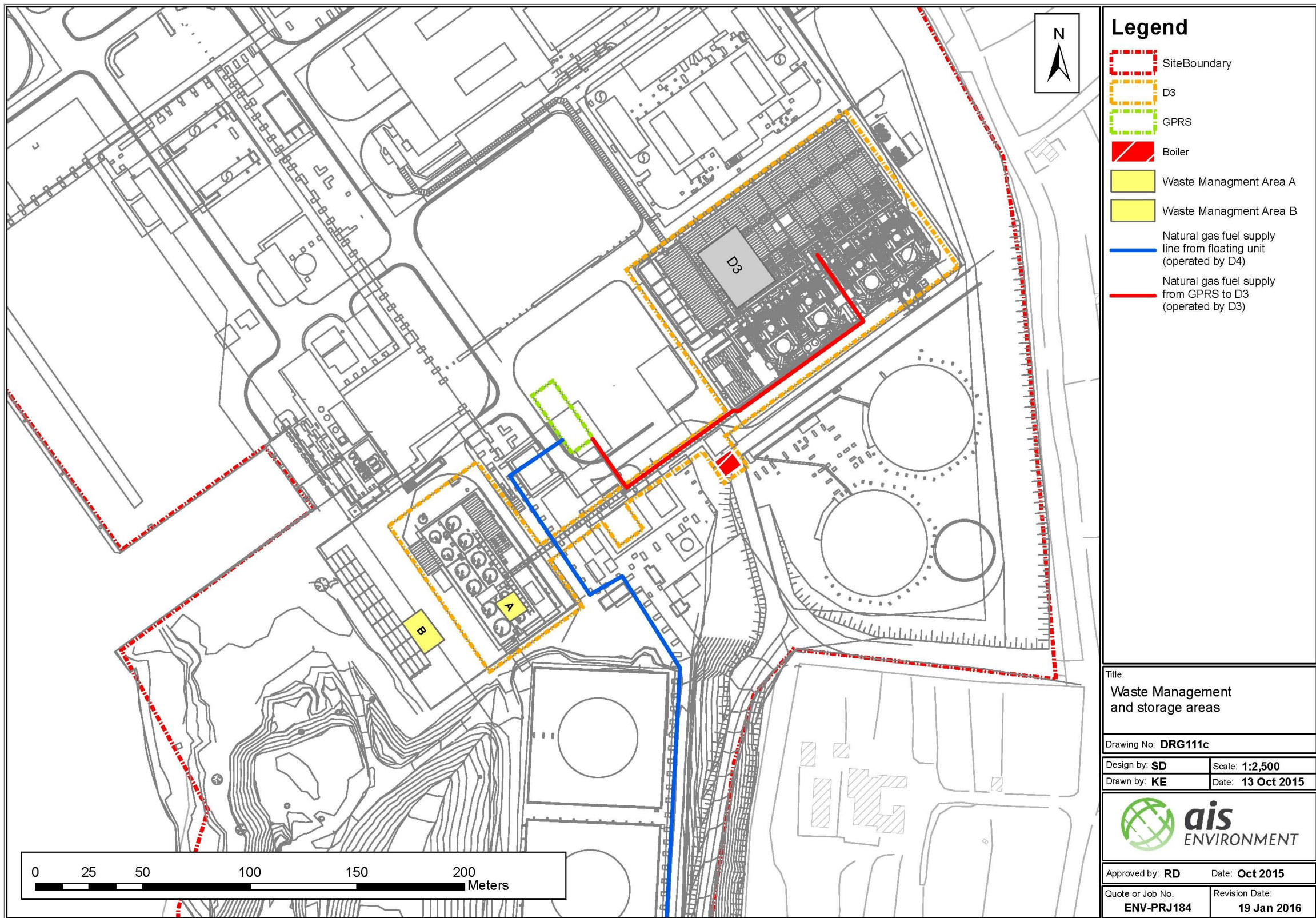


Figure 21 – Map showing the location of D3's waste storage sections



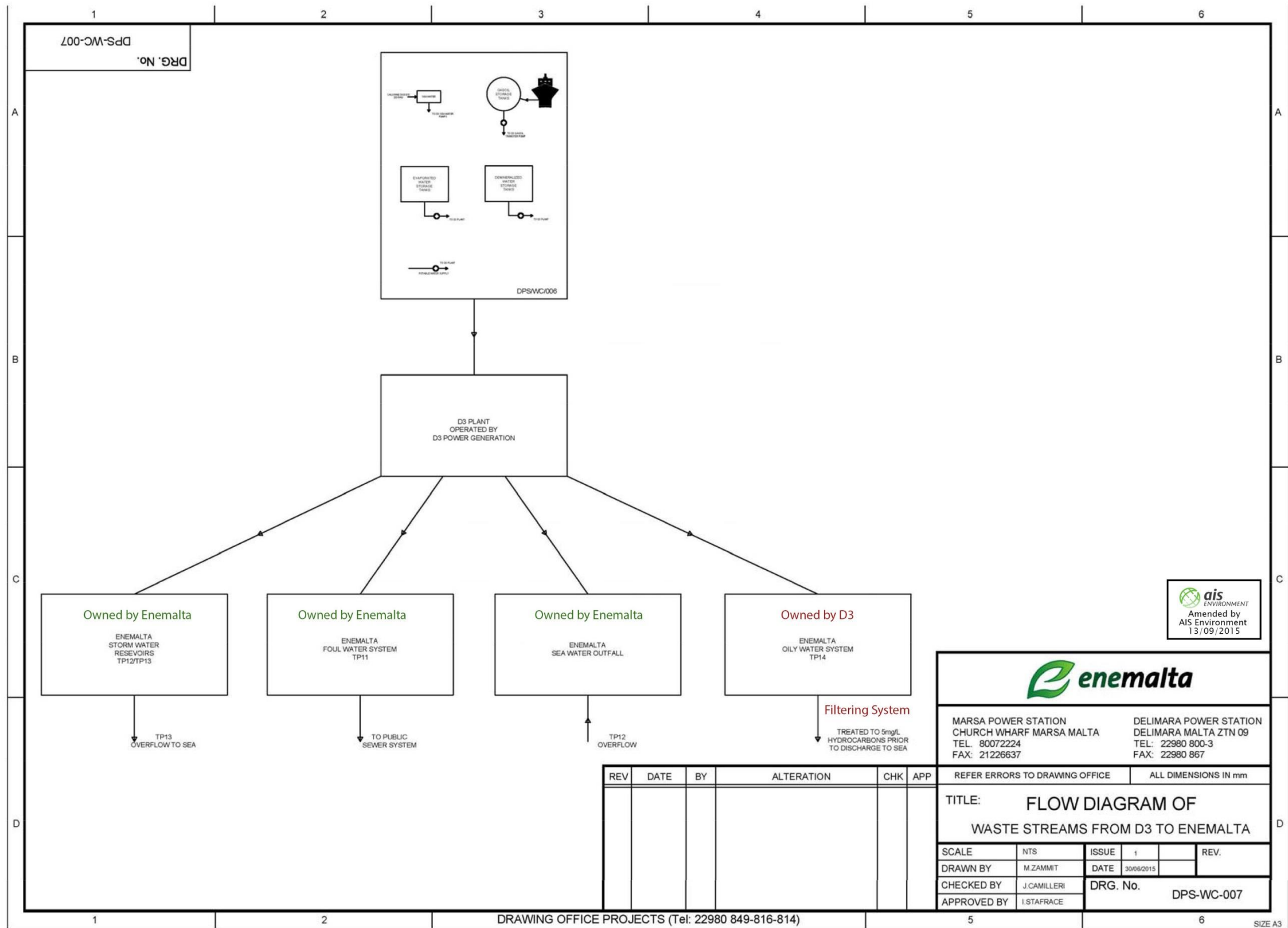


Figure 22- Flow diagram of waste streams generated from D3

### 3.2 Emissions to groundwater

No emissions to groundwater are predicted, except in cases of accidental spillages. To prevent such events from occurring, the following safety measures are being proposed:

- » The effluent treatment plant and oily water treatment plant are designed so that the reception lagoons/tanks can accommodate up to two to three times an average daily flow, with flow being permitted to divert around the coalescer and returned to the reception lagoons/tanks.
- » A discharge shut off is incorporated to retain liquids and prevent discharge in the event of site spillage
- » A planned preventive maintenance programme is in place to ensure proper care and servicing of equipment and facilities (Refer to Appendix II). This takes into account:
  - Effective management and operation of the plant outside normal operating hours
  - Procedures to deal with conditions of high or uncontrolled discharges
- » Daily inspection checks should be conducted and maintenance records should be kept to test for potential leakages.
- » The day tanks are provided with containment including bunding and drainage.
- » Bunds are fully sealed, reinforced concrete of capacity 110% of one tank and 25% of all tanks.
- » Tank levels will be monitored in control room during oil delivery.
- » Tanks will be fitted with sounding high level alarms with interlocks to shutdown delivery when this is required.
- » Maintenance and treatment chemicals such as degreasants and descaling agents will be prevented from entering site drains unless a specific risk assessment has determined that this is acceptable.
- » A new land and ground water risk assessment is being proposed to obtain new baseline values for the new operators.

### **3.3 Emissions to sewer**

The sewer connection that is currently being used by D3 will remain unmodified to serve the requirements of the new operators of the converted D3 plant. The reason for this is because there are no planned changes to the administration areas and offices, therefore the sewer connections and emissions are also expected to remain the same.

The emissions to sewer are strictly limited to sanitary facilities that are linked to the administration building. Any disposal of industrial waste will not be discharged into the sewer system, but will be disposed of accordingly in the established waste management areas.

Two cesspits collect the foul water from D3 and this water is pumped via two pumping systems into a communal underground pit, in which the foul water contents from D2 are also discharged. Gravitational force is used to transfer this water into another underground pit operated by Enemalta, which pumps the entire contents into the common sewerage system of the locality. These underground pits are covered by a concrete layer to prevent ground contamination.

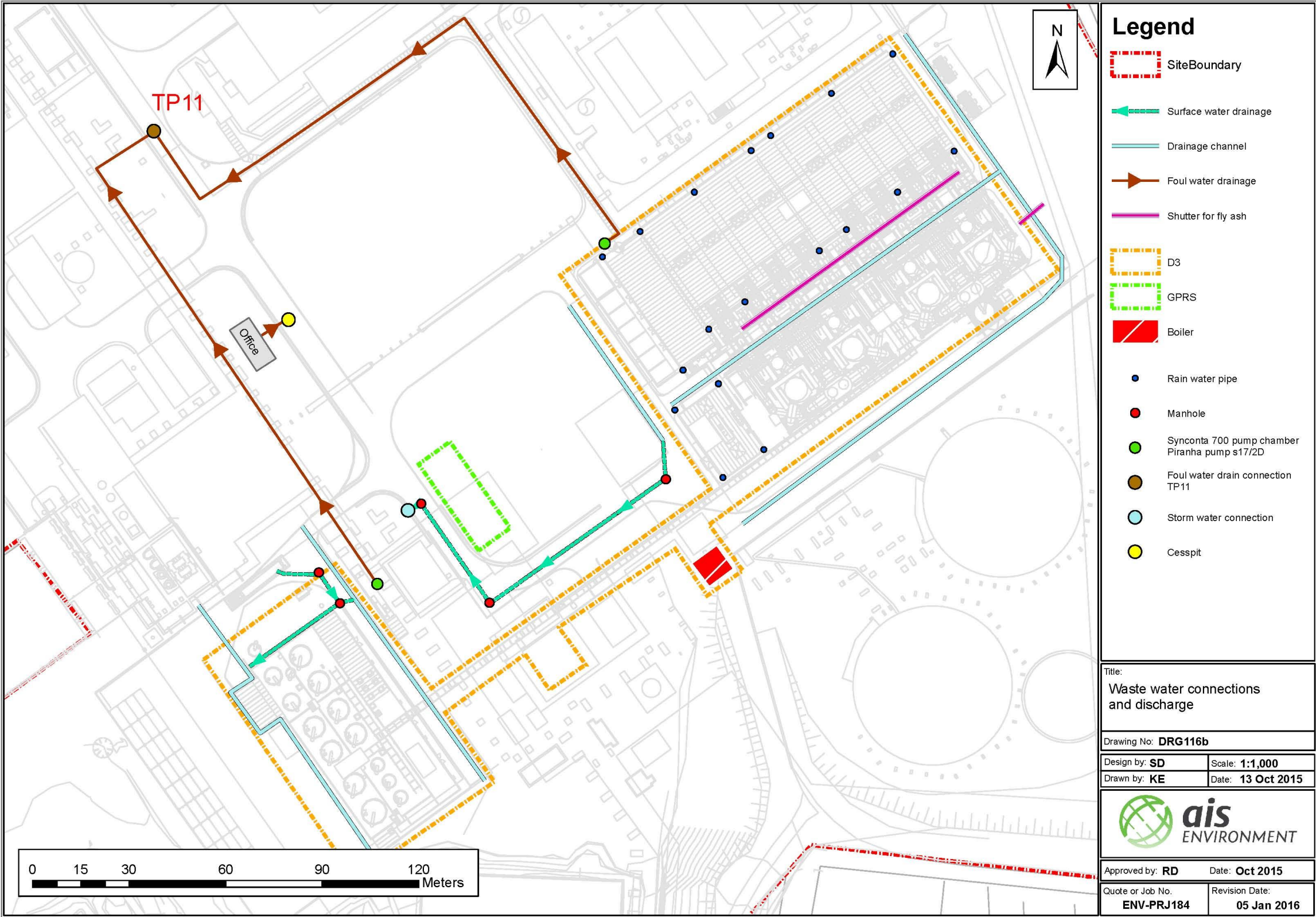


Figure 23 – Map of the waste water connections and discharge points that will be used during D3's operations



### 3.4 Emissions to sea

The effluent that will be released at Hofra ż-Żgħira comprises of emissions generated by all the three plant operators at DPS. This effluent is currently being released at UTM coordinates: X-460,154, Y-3,965,839, and is not expected to change with the proposed amendments to D3 and the construction of D4 (refer to Figure 25). The combined effluent released at any one time from the combined plants is expected to reduce from 44,200m<sup>3</sup>/h to 39,200m<sup>3</sup>/h. This effluent is composed of:

- » Cooling water – D3 will be producing 14,700m<sup>3</sup>/h, whilst retaining a maximum water temperature of 8°C above ambient water temperature (refer to Figure 24).
- » Boiler wash-downs – effluent resulting from boiler washes is collected in a pit, which is neutralised by sodium hydroxide and is subsequently re-circulated. When the pH is between 6 and 10, the neutralised water is left to settle for one day and discharged to the sea following filtration of small particles. These filtered waste products are collected, dried and exported for disposal.
- » Rain water & oily water do not form part of D3's outfall – refer to Section 3.5.

D3PG is only responsible for recording the temperature fluctuation at the D3 outfall pit, and is not responsible for discharging or recording any other physical or chemical parameters. The tie-in points that are connected to Enemalta's emissions to sea include TP 12 and 13 for the stormwater reservoirs, and TP 14 which transfers oily water to Enemalta's oil interceptors. For further information about the location of such tie-in points please refer to Figure 12.

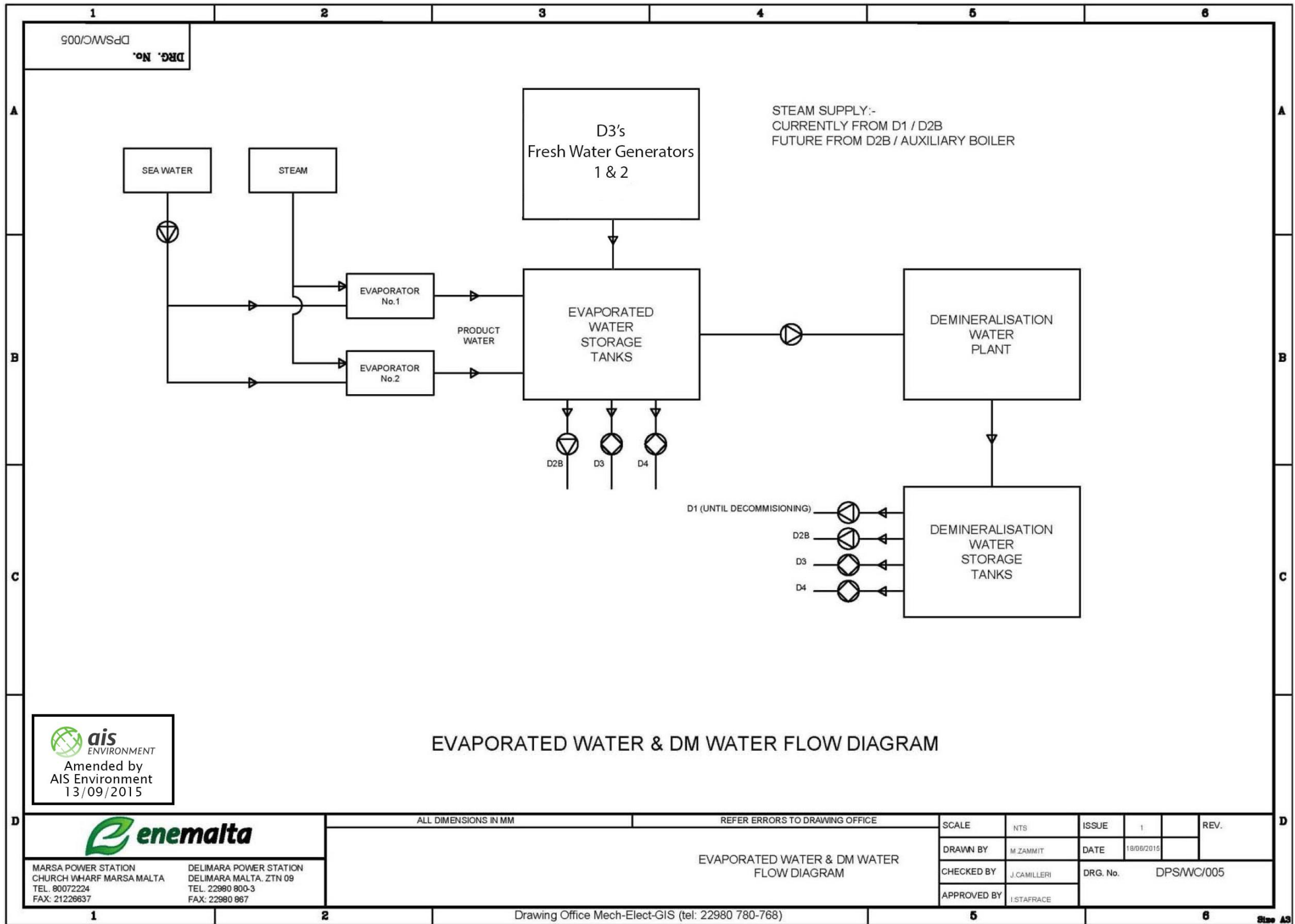


Figure 24 – Flow diagram depicting the process of generating evaporated water and demineralised water

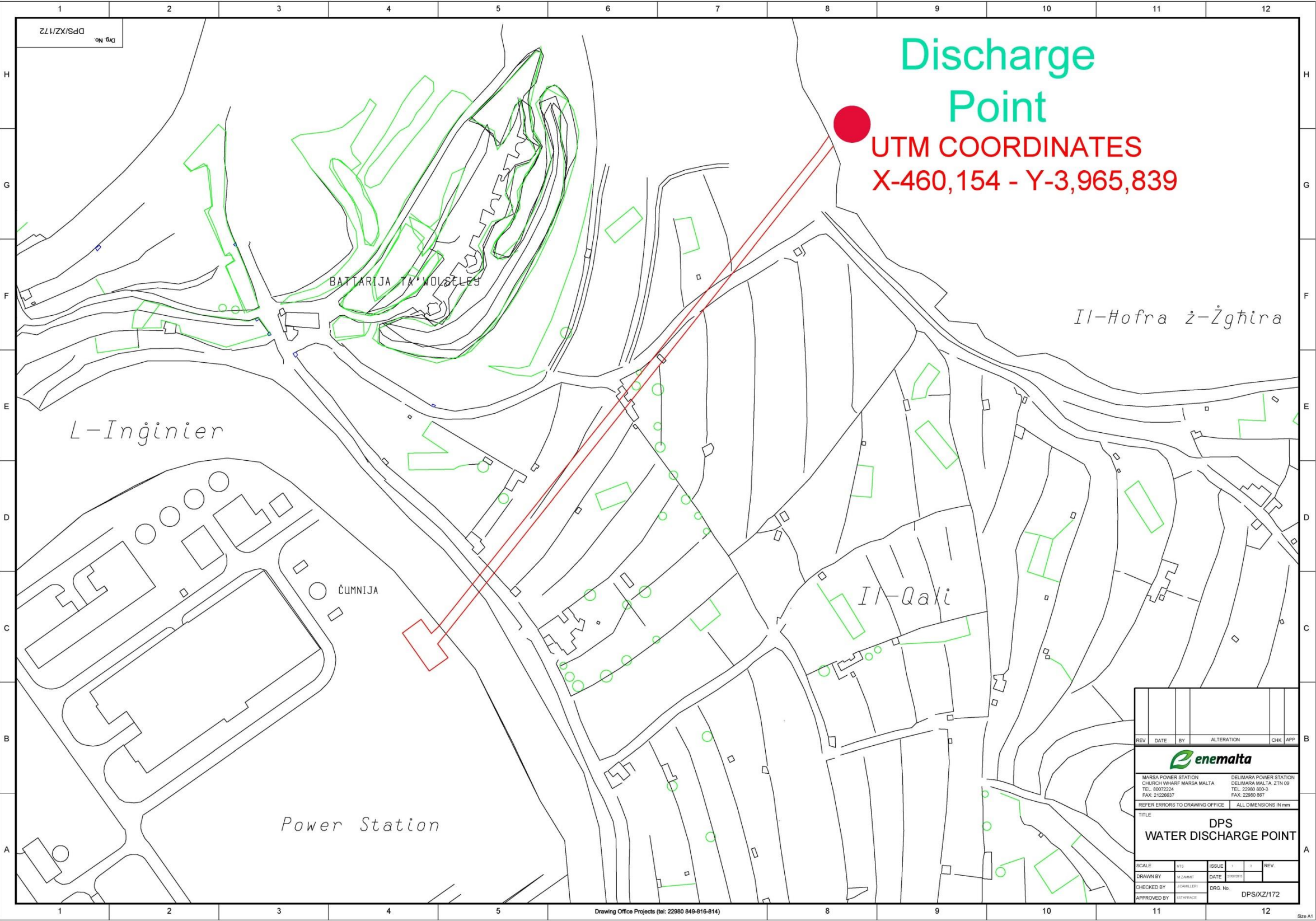


Figure 25 – Map showing the location of DPS water outfall point with accurate UTM coordinates



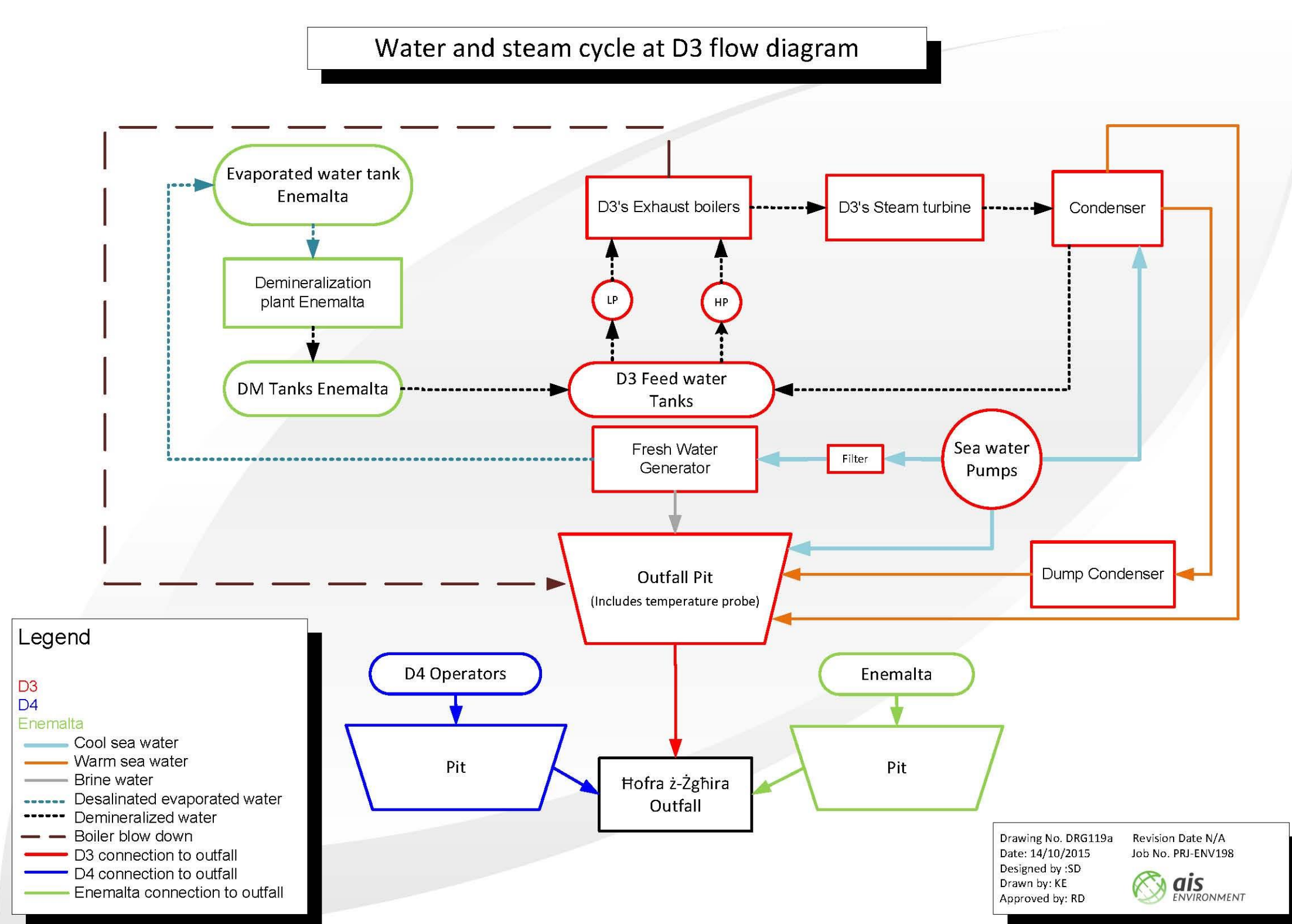


Figure 26 – Diagram of the water and steam cycle for D3



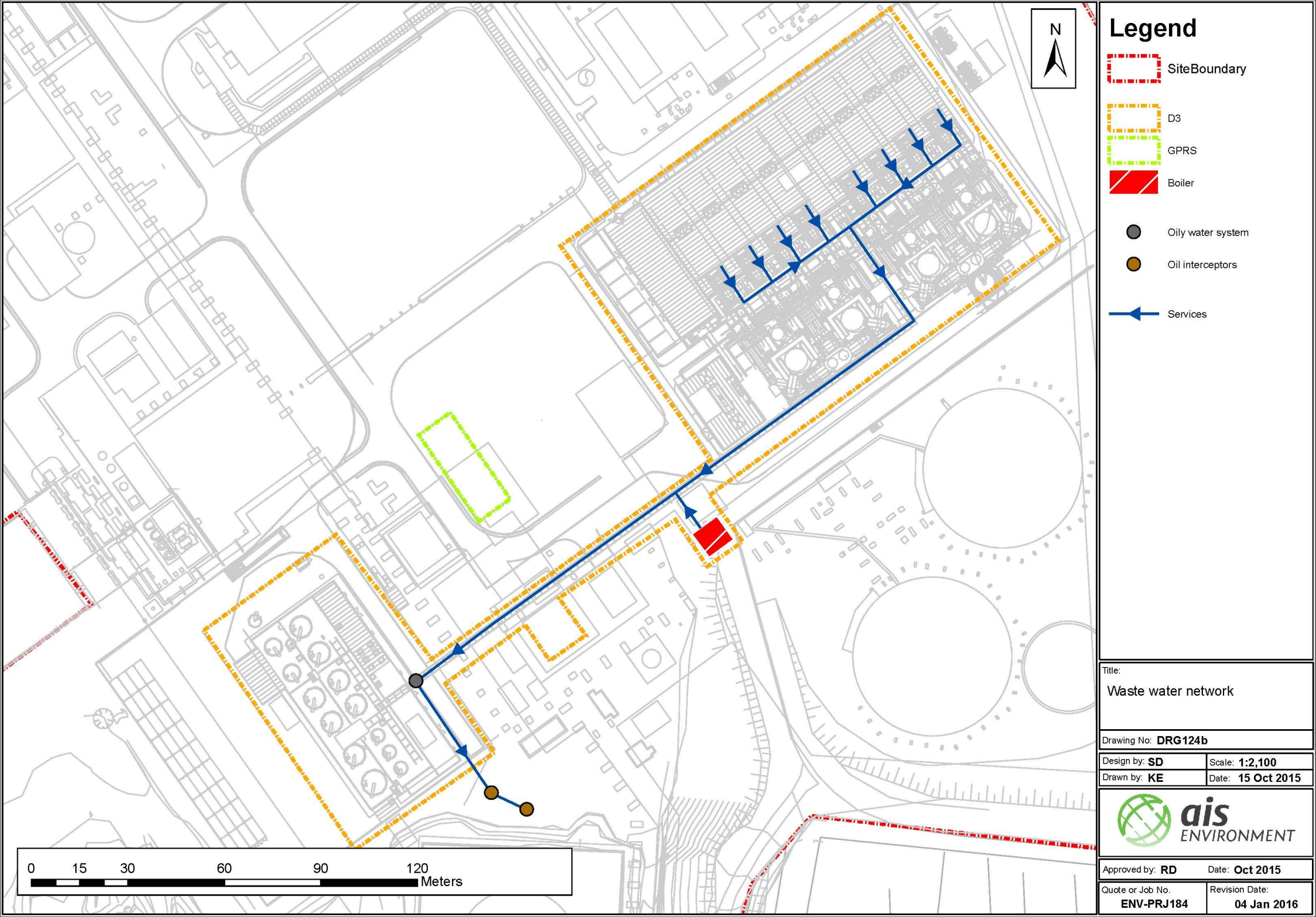


Figure 27 – Map of the source of emissions to sea

### 3.5 Rainwater

Any run-off water that passes through the roads and infrastructures of D3 are collected in a water well, which overflows to a discharge point in the sea having the following co-ordinates: X-459,847, Y-3,965,417. The rainwater drain plan for D3 is attached in Figure 28. Oily water is often generated as a result of:

- » Rain water falling into fuel bunds that may contain spilled fuel
- » Rain water falling onto areas of plant where there could be fuel spillage
- » Fuel leaks and transformer oil leaks that get drained to the oily water interceptor

The drain plan indicates that the surface run-off resulting from rain is divided into two parts for the operators of D3. The northern section, deals with the rainwater that accumulates next to the D3 Engine hall. Access roads leading to D3, are fitted with storm water culverts to gutters that lead to TP12 (Enemalta's stormwater reservoir). The rainwater that makes direct contact with the engine hall building and abatement system (comprising of the chimney stacks) overflows to Hofra ż-Żgħira. The D3 engine hall also contains an oily water catchment area to prevent spillages from entering the stormwater reservoir.

The southern section deals with the rainwater that is collected next to the FOT area. Access roads leading to this area are also fitted with a similar drain and gutter system that lead to TP13 (Enemalta's storm water reservoir). The tanks stored in this area are bunded, and any leakages or spills that are carried by rainwater runoff are transferred to the oily water system (TP14). Excess rainfall overflows to the Marsaxlokk inlet following direct contact with the southern container area and FOT buildings. Ultimately Enemalta's stormwater reservoirs release their contents to the discharge point that is shared between the operators of Delimara Power Station.

The operators at D3 are also responsible for the oils generated by the facility until these pass through Enemalta's oil/water interceptors. The maintenance of these interceptors lies within the remit of Enemalta, which is ultimately responsible to discharge the waste that is collected.



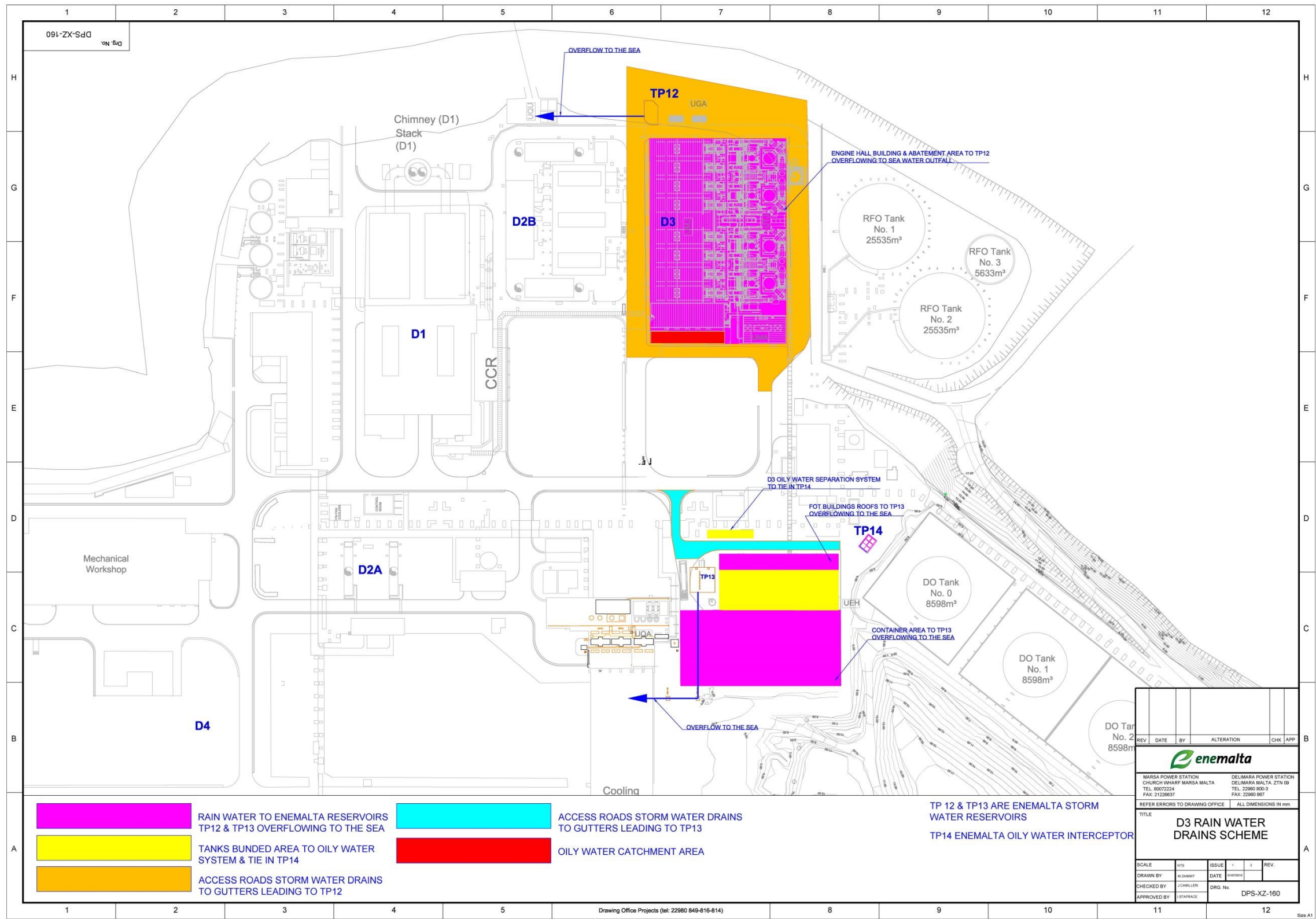


Figure 28 – Rainwater scheme map for D3 plant

### 3.6 Emissions to air

Table 12 – Chimney emission values for D3 plant

Current IPPC chimney nomenclatures	D6A/D6B/D6C/D6D		
Number of flues	4		
Stack location coordinates (UTM, x, y)	460,137; 3,965,687 460,134; 3,965,685 460,104; 3,965,663 460,101; 3,965,661		
Stack height	65m		
Stack diameter	2.1m		
Stack temperature at max. load	381°C		
Average no. of engines operated per annum	3		
Engine type	18V50SG	18V50DF	18V50DF
Fuel type	Natural gas (NG) + pilot gasoil fuel	Natural gas (NG) + pilot gasoil fuel	Gas oil
NO <sub>x</sub> emissions (15% O <sub>2</sub> )	75mg/Nm <sup>3</sup>	75mg/Nm <sup>3</sup>	100mg/Nm <sup>3</sup>
NO <sub>x</sub> ELV(15% O <sub>2</sub> )	75mg/Nm <sup>3</sup>	75mg/Nm <sup>3</sup>	Not applicable
SO <sub>x</sub> emissions (15% O <sub>2</sub> )	9mg/Nm <sup>3</sup>	9mg/Nm <sup>3</sup>	12mg/Nm <sup>3</sup>
SO <sub>x</sub> ELV (15% O <sub>2</sub> )	10mg/Nm <sup>3</sup>	10mg/Nm <sup>3</sup>	Not applicable
CO emissions (15% O <sub>2</sub> )	100mg/Nm <sup>3</sup>	100mg/Nm <sup>3</sup>	57mg/Nm <sup>3</sup>
CO ELV(15% O <sub>2</sub> )	100mg/Nm <sup>3</sup>	100mg/Nm <sup>3</sup>	Not applicable
PM emissions (15% O <sub>2</sub> )	10mg/Nm <sup>3</sup>	10mg/Nm <sup>3</sup>	30mg/Nm <sup>3</sup>
PM ELV (15% O <sub>2</sub> )	5mg/Nm <sup>3</sup>	5mg/Nm <sup>3</sup>	Not applicable
NG consumption	0.247m <sup>3</sup> /kWh	0.245m <sup>3</sup> /kWh	Not applicable
Gasoil consumption	Not applicable	18L/h (pilot fuel)	18L/h (pilot fuel) + gasoil consumption during emergency situations

The ELV (emission limit values) quoted for natural gas and gasoil emissions were extracted from the 2006 BREF describing the BAT for Large Combustion Plants (LCP). In this document, when operating on natural gas, the converted D3 plant is considered as a gas fired combustion plant – new gas engine with heat resistance steam generator (HRSG) in combined heat and power (CHP) mode. The emissions expected to occur from operating on natural gas are within the confinements set by the aforementioned ELVs.

Whilst operating DF engines on gasoil, the ELVs set for the aforementioned atmospheric emission parameters will be no longer be applicable as long as:

- » Gasoil operation qualifies as an emergency situation as described in Section 1.1.2
- » The relevant authority is informed about the scenario within 48 hours of the occurrence and grants the required permission

Emissions by D3PG are also expected to occur from the proposed 3.85MW thermal auxiliary boiler. This is equivalent to burning 0.305 tonnes of diesel per hour. The boiler is being proposed to provide steam in emergency situations for heating purposes, without being dependent on D1 and D2. This is particularly evident when the station is cold preserved, especially in cases where steam is required to heat the jacket water of the diesel engines in order to be able to start and operate. Only two of the proposed converted engines may be maintained on warm-standby when operating the auxiliary boiler.



Table 13 – Air emissions caused by the proposed auxiliary boiler

<b>Number of flues</b>	1
<b>Stack location coordinates (UTM, x &amp; y)</b>	N/A
<b>Stack height</b>	12-15m
<b>Stack diameter</b>	0.1m
<b>Stack temperature at max. load</b>	180°C
<b>Maximum operating hours per annum</b>	500hours
<b>Thermal input</b>	3.85MW
<b>Electrical output</b>	≈2MW
<b>Fuel type</b>	Gas oil (N content of 4,000mg/kg)
<b>Fuel consumption</b>	0.305t/h
<b>Exhaust fume temperature</b>	220°C
<b>NO<sub>x</sub> emissions</b>	200mg/Nm <sup>3</sup> (3% O <sub>2</sub> )
<b>SO<sub>x</sub> emissions</b>	170mg/Nm <sup>3</sup> (3% O <sub>2</sub> )
<b>PM emissions</b>	30mg/Nm <sup>3</sup> (3% O <sub>2</sub> )

### **3.7 Odour emissions**

No significant odour emissions are expected at D3. The proposed conversion to natural gas will result in complete removal of odour generated from the use of HFO. Moreover, the new fuel that will be used (NG) is odourless and is not expected to contribute to any odour emissions when leakages occur. Other chemicals used by D3 (refer to Table 7) may generate small quantities of odour but these will be confined to their storage areas.

### 3.8 Emissions to land

No emissions to land are expected. Refer to Section 3.1 for more details about waste management and characterisation at D3.

For the current IPPC application (IP0002/07/E), Enemalta had entrusted RVA group and Environ UK Ltd. to conduct a site condition report for D3. This type of report has now been replaced by a 'baseline' report to address the obligations under regulations 9(3) and 16(2) of the Industrial Emissions (IPPC) Regulations and "*communication from Commission - European Commission Guidance concerning baseline reports under Article 22(2) of Directive 2010/75/EU on industrial emissions (2014/C 136/03)*". The site condition report also used to include a decommissioning report and a monitoring report.

In the land monitoring report that is included in the site condition report, it is stated that a land and groundwater risk assessment had already been carried out in the past (AIS, 2009) as part of the EIS of the proposed D3 power generating plant. For further information please refer to the NTS (Volume III) attached in Appendix V.

This had revealed a number of pollutants which included heavy metals, solvents and hydrocarbons, which were directly associated with potential mineral oil spillages and emissions that may have resulted from the power station activities in the past twenty years, contaminating the soil, and ground water in the process. Nonetheless, the measured parameters were all within acceptable limits. A number of provisions and mitigation measures were subsequently adopted in the D3 plant in order to limit the potential contamination by such substances to land and water.

Subsequently, as part of the site condition report, a conceptual site model was prepared to determine the sources and potential emission points of polluting materials located within D3's installation. The authors also proposed that a number of monitoring reports should be submitted annually as part of the Annual Environmental Review for the IPPC installation.

The first monitoring report for assessing the contamination of land and groundwater was performed in 2011, in conjunction with the Outline Decommissioning Plan (ODP) report. Low concentrations of metals were identified throughout the entire site, whilst PAHs, VOCs, SVOCs and EPH were identified in localised areas. EPHs were observed to surpass the detection limits in two samples located in close proximity to a sump. In these samples, the presence of water was also encountered, which indicated a local seepage from Boiler no. 2.

Enemalta is obliged to publish a revised version of the ODP for the entire installation in 2015. In view of the change of ownership of D3 from Enemalta's responsibility to D3PG, D3PG should carry out a baseline survey for land and groundwater contamination. It is being suggested that the current monitoring strategy for land and groundwater assessment is continued, and the results obtained from the next monitoring session are used as the 'baseline report' to ensure that the obligations and standards requested in the IED (Industrial Emissions Directive) will be satisfied. The same monitoring strategy will be proposed for the operational period of the converted D3 plant.

A number of geotechnical investigations had been performed to determine whether the proposed development could be constructed or not. The analyses had revealed that the area is highly suitable for traditional, shallow foundations. Alternatively, the area composed of the storage day tanks is less suitable for foundation purposes because this area is built on reclaimed land.

Once this was determined, a number of mitigation measures were proposed by Enemalta in order to ensure that the emissions to land caused by construction practices were reduced to a minimum. In addition to this, the outline decommissioning report that was published in 2012 also listed the following measures to protect land:

- » Submit records as part of the Annual Environmental Review
- » Record complaints concerning effects on the environment
- » Ensure the maintenance of plant and equipment
- » Prevent issues of non-compliance with operating procedures
- » Enforce waste management practices and control measures
- » Record waste oil storage quantities, nature, manner and date of dispatch of the oil
- » Perform frequent lab analysis of emissions to water and discharges to water
- » Publish results of the lab analysis of effluent samples arising from surface drainage, fuel bunds etc.
- » Perform daily visual examinations of the surface water discharge
- » Publish inspection reports and certification by approved auditors for: testing of bunds, pipes, pumps, valves, flanges and oil interceptors.
- » Adopt bunding systems and high level liquid alarms on pump sumps.
- » Notify the relevant authority of accidental contamination of land

Although these measures were proposed by Enemalta, most of them can still be applied by the new operators of D3 wherever there is a proposed transfer of operations.

On the 17<sup>th</sup> September 2012, a significant amount of fly ash dust from the FGD system was accidentally released on the ground during the unloading procedure. This happened because the high level switch did not operate, which resulted in the over filling of the waste container. Immediate actions were taken by Enemalta to clean up the dust that was deposited on the ground. A number of improvement measures were taken by Enemalta and BWSC to prevent such events from occurring again. Please refer to Appendix V for further information.



### 3.9 Noise emissions

The current IPPC permit for D3 stated that D3 is causing no adverse impact on the closest sensitive receptors, based on the findings of the EIA study (PA 03152/05). Additionally, a noise performance test was conducted in 2012 to determine if the predicted noise levels were being actuated. The noise levels at the loading bay, the engine hall's corridor, the engine's noise enclosure, the external noise receptors and the stack contribution were all found to be well below the established target values (Refer to Appendix V for further information).

*Table 14 – Noise levels recorded in 2012 at different locations within D3*

Location	Noise level	Target level
Loading bay	74.9 dB(A)	85 dB(A)
Corridor	78.6 dB(A)	85 dB(A)
Engine noise enclosure	77.1 dB(A)	85 dB(A)
Exterior receptor 1	44.7 dB(A) $\pm$ 2.0	45 dB(A)
Exterior receptor 2	45.0 dB(A) $\pm$ 2.0	45 dB(A)
Stack receptor 1	38.8 dB(A) $\pm$ 1.3	40 dB(A)
Stack receptor 2	40.6 dB(A) $\pm$ 1.3	40 dB(A)

Since the new engines will rotate at the same speed as the current engines, the noise levels that will be generated are not expected to increase. The addition of an auxiliary boiler is also not expected to contribute to an increase in noise emissions, except in cases of equipment malfunctioning or aging. Given that the auxiliary boiler will be used for a limited number of hours only, the noise expected from such a facility is expected to be negligible.

In the case that an equipment, machinery or engine is causing unexpected high levels of noise, the operator is responsible to take the necessary actions to reduce the noise impact by:

- » Shutting down the machinery whenever it is possible
- » Fixing the machinery as soon as possible
- » Providing the necessary noise abatement equipment to employees whilst working in the area

Nonetheless, noise monitoring will be required as part of the IPPC Permit and shall follow: standard ISO8297: 1994 and any revision thereof, and ISO37XX series or specifically ISO 9614-2:1996. The latter is more relevant to multi operator installations. Noise monitoring method statements are currently being drafted by a common consultant appointed by all 3 operators. This exercise is coordinated by Enemalta.

### 3.10 Monitoring

Monitoring data will be made publicly available as per the provisions of the Aarhus Conventions and as per the provisions of the current IPPC permit. In section 3.11, a graphical representation of the emissions generated from different points is provided.

#### » Air emissions

The current CEMS (continuous emission monitoring system) monitors the exhaust gas components arising from 8 diesel power engines at D3. The monitoring strategy that is currently adopted is not being proposed to change, despite the planned amendments to the abatement systems.

The CEMS complies with EN14181 and EN15267-3 and is located at the bottom of the plant stack in a container unit, which will assess the common exhaust gas emitted from 4 engine units. The monitoring involved is continuous, simultaneous and measures the following properties: stack pressure, stack temperature and dust levels, along with the following gaseous components: NO, NO<sub>2</sub>, NO<sub>x</sub> (calculated), SO<sub>2</sub>, CO, CO<sub>2</sub>, NH<sub>3</sub>, H<sub>2</sub>O and O<sub>2</sub>. This system keeps record of hourly emissions of all these gases and dust. All of this data is sent to MEPA.

Gaseous components may be monitored continuously or semi-continuously for each stack by either using individual extractive system analysers for each flue gas pipe in the exhaust gas stacks, or else by adopting an extractive system/common analysers for each flue pipe (2 analysers for 4 stack pipes), as long as the signal from each flue pipe is kept uninterrupted. Alternatively, dust levels, pressure and temperature are monitored for each exhaust gas stack.

The frequency of automatic calibration routines associated with the CEMS equipment have already been discussed with MEPA and should not require further amendments. Calibration of the equipment involves yearly AST tests, along with the QAL2 tests which are performed every five years. These tests should be sufficient and sustained for the proposed conversion. It is being proposed that following the conversion process, the QAL2 tests would need to be conducted, which will be followed by the AST tests whenever they are due.

The current permit also requires the operators to perform the so called non-continuous tests every three months. For these tests an accredited company is brought on site to measure the concentrations of pollutant metals using specialized emission monitoring equipment that is attached to the D3 chimney.

Spare parts of the monitoring instruments will be kept on site to ensure that there is no added delay during equipment malfunction.

#### » Sea emissions

Apart from the CEMS atmospheric emissions monitoring, D3PG is also responsible for the monitoring of seawater outfall temperature and pH at the D3 outfall pit. Temperature probes are installed in this area to monitor the influx of temperature from the inlet source (<8°C is permitted) and to ensure that the relevant seawater cooling systems are functioning properly to cool this effluent water.

The gutter system surrounding D3 collects rainwater that falls in the area of the D3 hall and the surrounding roads. These gutters have two manual shutters which are capable of controlling the flow of rainwater to the settling pit. These shutters are opened only on rainy days to prevent water from overflowing out of the gutters. This implies that the shutters are kept closed during non-rainy days to allow for the collection of contaminated water within the gutter system in cases of accidental spillages. On site engineers are also required to perform gutter checks during their weekly inspections.

When the risk for contaminated water is observed, the collected water is pumped into the sludge water system to prevent it from contaminating the rainwater reservoirs. Otherwise, when the water is clear from contaminants, the shutters are opened to allow the rainwater to collect in the rainwater settling tanks and eventually discharged to the sea by Enemalta.

Emissions from TP14 are controlled by having a stringent monitoring and control regime. Oily water collected from D3's FOT area and engine hall passes through D3's interceptors which monitor the contamination levels of the filtered oily water at a 15ppm threshold. The filtered oily water is transferred to Enemalta's interceptors prior to being discharged to the sea. Physical observation of the oily water occurs just before this material reaches Enemalta's oily water interceptors. This inspection process is listed in specific log sheets and SOPs that are mentioned in the EMS (Environmental Management System). Such inspections are conducted two-three times a day by D3 employees during their work shifts.

» Ground emissions

In addition to this, a land and groundwater contamination report is also being proposed in the improvement programme in order to assess the state of land and compare it to previous baseline reports.

» Noise monitoring

As stated in Section 3.9, noise monitoring according to a number of ISO standards. These noise monitoring standards are more applicable for multi-operator industrial installations.

ISO 8297:1994 offers the possibility of obtaining the acoustic power of the entire installation by performing sound pressure measurements at specific control points located at the perimeter of the plant. This technique is best suited for large industrial installations with multiple outdoor noise sources.

Alternatively, ISO 9614-2:1996 provides means of calculating the sound intensity normal component by using a measurement surface that is specifically chosen so as to enclose the noise source. This technique also involves several surface integrations to cover different extents of the noise source.

Therefore, it is a requirement of all three operators at DPS to agree on employing a single noise monitoring consultant to perform the necessary tests according to the aforementioned standards on the entire installation. This has been agreed between all three operators and the consultant is currently drafting the method statement for approval. Enemalta are coordinating the submission.

### 3.11 Summary

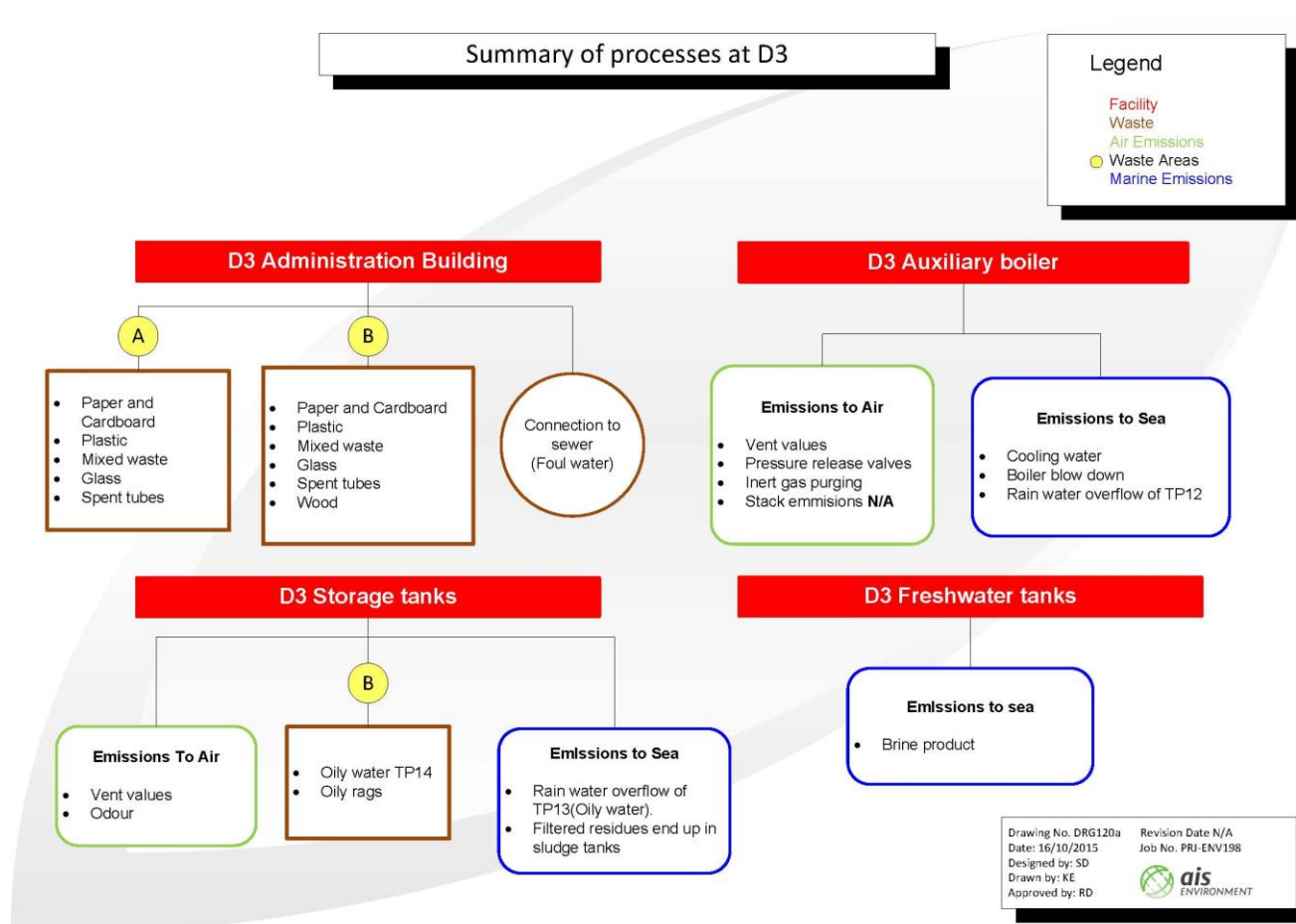


Figure 29 – Summary of the emissions generated by processes and facilities at D3



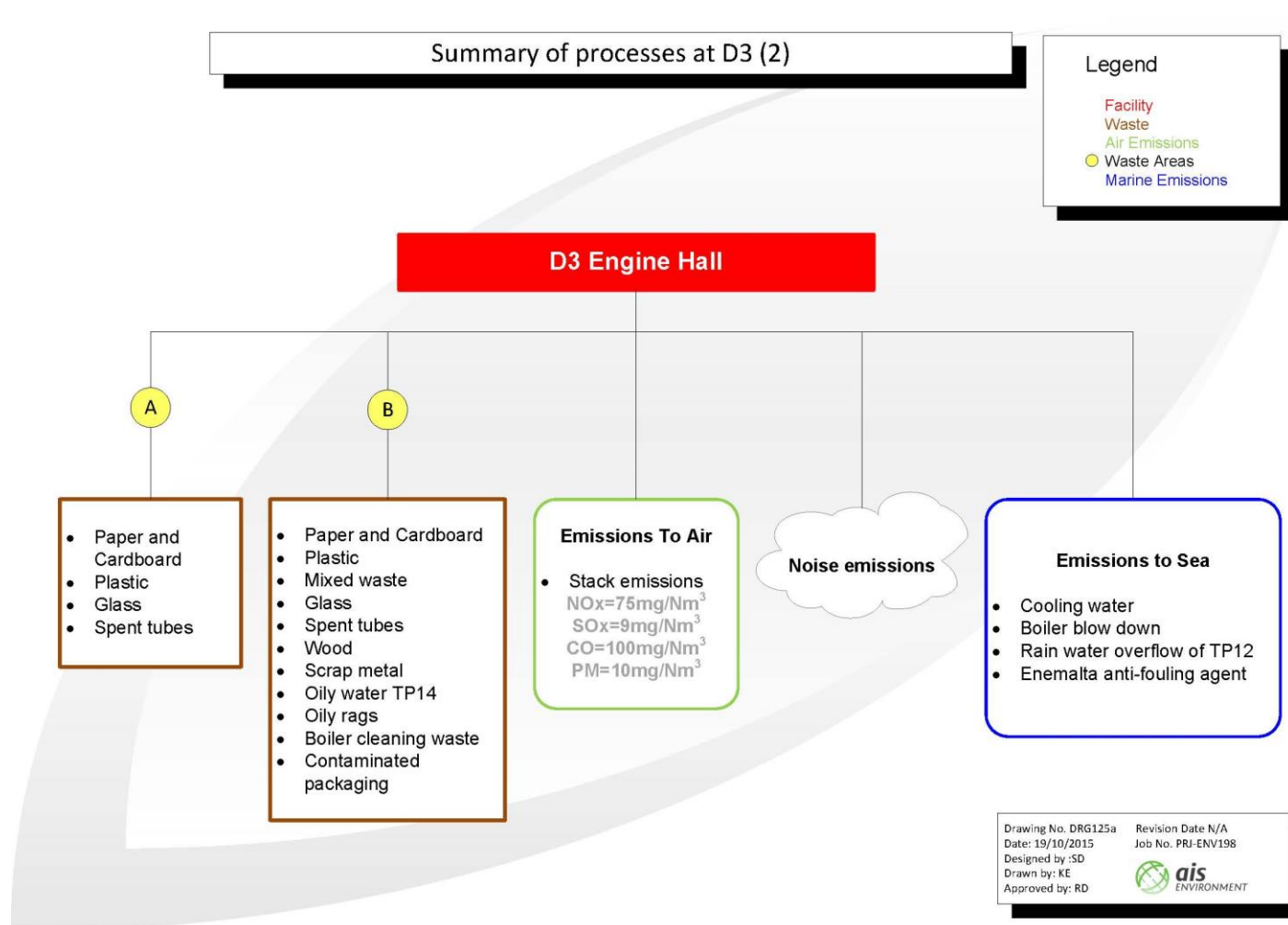


Figure 30 – Summary of emissions generated by the D3 engine hall

## C4 Impact on the environment

### 4.1 Environmental effects

Environmental effect	Description
Land cover and land/sea use	<ul style="list-style-type: none"> <li>Existing land uses are not expected to change with the proposed changes to D3, except for a relatively small parcel of land being assigned to accommodate the auxiliary boiler system. This process will not involve heavy construction practices because the boiler will be situated in a pre-established semi-enclosed structure.</li> <li>No sea use impacts are expected to be generated with the proposed D3 amendments, even though the quantity of water discharged at Hofra ż-Żgħira is expected to decrease and cause a slight beneficial impact when compared to the current situation.</li> </ul>
Landscape character and visual amenity	<ul style="list-style-type: none"> <li>Slight increase in the industrial elements within the predominantly rural context of Delimara peninsula, caused by the placement of the auxiliary boiler structure. This will occupy an approximate 70m<sup>2</sup> footprint and a 12-15m chimney stack which is only 0.15m wide.</li> <li>The proposed conversion of the D3 engines will not cause any significant impact on the landscape and visual amenity of the area.</li> </ul>
Geology, geomorphology, hydrogeology and soils	<ul style="list-style-type: none"> <li>The proposed development will not be having any significant impact on the geo-environment of the area, since no heavy construction and excavation works are required.</li> <li>The project involves the taking up of a 70m<sup>2</sup> area which has been allocated by Enemalta for future expansion.</li> <li>The contamination to the groundwater and land (soil) is expected to also reduce since the likelihood of HFO spillages, leakages and seeping have been completely eradicated with the proposed conversion to natural gas. The use of gasoil will remain at reduced amounts.</li> </ul>
Marine environment	<ul style="list-style-type: none"> <li>Current rate of cooling water discharge is expected to reduce by over 30%.</li> <li>Current dosing of chlorine dioxide as a biocide (0.1ppm), and the outfall temperature criterion (&lt;8°C) will remain unaltered.</li> <li>In the case of spills, methane levels can threaten the water column in the innermost parts of Marsaxlokk Bay, where moderate to low eutrophic conditions can lead to the reduction of sulphur into hydrogen sulphide thanks to methane (EIA, 2014).</li> <li>A positive moderate impact on water quality is expected.</li> </ul>

Terrestrial ecology	<ul style="list-style-type: none"> <li>• Since the emission standards (ELVs) of the proposed conversion have established stricter values, the threat caused to the surrounding vegetation by the production of atmospheric acids are expected to reduce. Moreover, the surrounding vegetation is already accustomed to the current stressful conditions of the site.</li> <li>• Similarly, the vertebrate and invertebrate communities of the area are not expected to be significantly affected by the proposed changes because the area is already disturbed and the proposed increase in area taken up by D3PG's operations are negligible in comparison to the area of the entire site.</li> <li>• The light and noise pollution generated from D3PG's operations are expected to be negligible when compared to the current situation and is therefore not expected to impact the respective vertebrate and invertebrate communities.</li> </ul>
Marine ecology	<ul style="list-style-type: none"> <li>• Since the total discharge to the outfall at Hofra z-Zghira is expected to reduce to 29,600m<sup>3</sup>/h, the temperature of the thermal effluent would remain unaltered and the biocides used would remain the same, the proposed changes are expected to yield a positive impact when compared to current operations.</li> <li>• A three year marine ecology monitoring report was published by AIS Environment in 2015, revealing that deteriorating marine conditions have somewhat affected <i>Cymodocea nodosa</i> mean shoot density values. Contrastingly, the same effect was not as evident on <i>Posidonia oceanica</i>, suggesting that the distance of the assemblages to the outfall might be a contributing factor for these differences. <i>Pinna nobilis</i> individuals were also observed to decrease over this three year period, with the authors suggesting that this could be due to increased predation from <i>Octopus vulgaris</i> in the area.</li> </ul>
Agricultural land	<ul style="list-style-type: none"> <li>• No direct impacts from the proposed development</li> </ul>
Cultural heritage	<ul style="list-style-type: none"> <li>• No direct impacts from the proposed development</li> </ul>
Air quality	<ul style="list-style-type: none"> <li>• Stricter ELV criteria for the proposed converted engines ensure that the exhaust composition that is generated is improved when compared to the current situations.</li> <li>• The emissions from the auxiliary boiler shall be in line with the Medium Combustion Plants (MCP) Directive.</li> </ul>
GHG emissions	<ul style="list-style-type: none"> <li>• CO<sub>2</sub> emissions from the use of natural gas are expected to reduce by 28% of the emissions that are currently released by HFO (EIA, 2014).</li> <li>• Natural gas releases 56.0t CO<sub>2</sub>/TJ, whilst HFO</li> </ul>

	<p>releases 77.4t CO<sub>2</sub>/TJ.</p> <ul style="list-style-type: none"> <li>The CO<sub>2</sub> emissions of the converted D3 plant were calculated to be equal to 0.42t/MWh, with the assumption that all eight engines are functioning.</li> </ul>
Waste	<ul style="list-style-type: none"> <li>Waste associated with the current FGD system is expected to reach negligible quantities with the proposed conversion, due to the complete removal of this abatement system. This reduces the landfill requirements for depositing such waste.</li> <li>Oil sludge that is generated from the operations at D3 will be exported.</li> <li>Oil water is treated to &lt;5ppm and discharged to the sea. The quantities of such waste oil and oily rags are expected to be reduced to the abandonment of HFO as a fuel source.</li> <li>The composition of boiler wash-down water is expected to improve since boilers that heat up on NG exhaust have better exhaust compositions than their HFO counterparts, subsequently generating less pollutants in the resultant water.</li> <li>Enemalta will be responsible for sea water cooling biocide that will be discharged at Hofra ż-Żghira. The concentration of biocide (Chlorine dioxide) is equal to 0.1ppm. This value is not expected to vary from existing operations.</li> </ul>
Noise	<ul style="list-style-type: none"> <li>The noise emitted from the converted D3 engines are not expected to increase since these will be operated at the same speed.</li> <li>The noise emitted from the proposed auxiliary boiler is expected to be very low and should have a very limited impact to the surrounding environment.</li> <li>Regular maintenance and inspection of the boilers and engines is required to avoid the unnecessary generation of noise emissions.</li> </ul>
Health, Safety and Explosion Risks	<ul style="list-style-type: none"> <li>In general, small NG releases to the atmosphere should not cause a large hazard if it is promptly detected by the personnel working at D3.</li> <li>Flammable LNG vapours are easily ignited by machinery, cigarettes and static electricity; therefore strict precautions must be taken by the personnel working at D3.</li> <li>Risks of explosion are higher when dealing with the liquefied state of NG, rather than the gas state, as is the case with D3.</li> <li>Due to the fact that NG is an odourless gas, asphyxiation may result if inhaled in large quantities in close proximity to the emission source.</li> <li>All the safety reports in compliance with the regulations in force have been conducted to ensure that all the safety measures are in place.</li> </ul>



#### **4.2 *Effects on other sites***

D3's operations are not expected to have a direct effect on other sites in Malta, except for a slight beneficial improvement that is caused by the reduction in GHG and pollutant exhaust emissions. Indirect effects on other sites are instigated by the need for the storage, re-gasification and transportation of LNG to D3, which are expected to generate significant visual and social impacts. Such processes lie within the responsibility of D4's operators, given that the supply of NG is mainly contributed for the operation of the new CCGT plant that is proposed by Electrogas Malta Ltd.

In fact one of the main reasons why the conversion of D3 was supported, was to take a more holistic and efficient approach to the use of NG and its associated infrastructures that were being proposed for the new D4 plant. It also acted as a pathway to completely abandon the use of HFO as the main fuel supply.

## C5 Environmental statements

### 5.1 Environmental statement

An EIS was drafted by AIS Environmental Ltd. in 2009 for the construction and operation of the current D3 plant (PA3152/05: Proposed local generating capacity at Delimara Power Station). For the proposed conversion and changes in operation there was no need for an updated EIS.

The current 144MW D3 plant (D3) was commissioned in light of the fact that the Marsa Power Plant was generating 245MW of electricity in a highly inefficient manner, and was expected to be decommissioned by 31 December 2015 (latest), in line with the Large Combustion Plants Directive. D3 was also proposed in light of the heightened environmental standards and to partly address the shortage in generating capacity caused by the decommissioning of the Marsa plant.

- » Since the proposed development is situated at Delimara Power Station, an area that was already serving as part of the power generation of the Maltese islands, the land use of the area was not expected to change. Most of the impact on land use was expected to be generated from activities related to construction, and increase in marine traffic due to waste exportation that is generated at the site during its operational stages.
- » Large quantities of inert construction and excavation material were expected to be generated from the construction stages of D3.
- » Concerns about the hydrogeology through spillage of oil fuels were raised and considered to have a minor impact if proper construction practices and efficient bunding systems were adopted during the operational stage.
- » Significant visual impacts were expected due to the massive size of the D3 engine hall and associated emission stacks.
- » Air quality studies were also conducted and predicted that the combustion emissions would be in line with the air quality standards established for Large Combustion Plants that are operating on liquid fuel engines.
- » Noise studies revealed that the off-site noise levels measured were within the range of values expected, with construction noise levels at all sensitive receptors being lower than the chosen daytime and evening criteria for dwellings. However, it was also revealed that the noise levels are expected to be higher during the night-time criteria.
- » Vibration studies highlighted the fact that the magnitude of vibrations was expected to be below the threshold of cosmetic or structural damage in all classes of buildings, and that these would be barely perceivable to humans in buildings.
- » Thermal effects on the marine benthic communities at the discharge point were expected to generate persistent residual impacts, in view of higher volumes of effluent being discharged. An extensive seagrass specific monitoring programme was subsequently commissioned by Enemalta for the following three year period after D3's start of operations.

- » When the EIS was drafted, the only auxiliary infrastructures and utilities that were envisaged included minor road network upgrades. The reason for this was because the site already benefited from all the required utilities and infrastructures such as potable and cooling water and drainage systems.
- » Various land and groundwater contamination studies during this period identified a number of pollutants (heavy metals, solvents and hydrocarbons) that were measured within acceptable limits. These were thought to originate from mineral oil spillages and emissions from other plants at Delimara Power Station.
- » Most of waste products generated from D3's operation were identified and had their relevant waste management plan.
- » A risk assessment examined the environmental risks of D3 and found that with the mitigation measures that were already in place or being proposed, environmental risks would generally be low to moderate, and therefore acceptable. The most important risks were identified as: catastrophic incidents, and the spillage during quayside oil offloading and transfer.
- » A public health impact assessment had also concluded that D3 was not expected to generate any negative significant impact on public health. Alternatively, it suggests a beneficial impact caused by the decommissioning of the highly polluting and inefficient plant at Marsa.

For the new CCGT NG plant (D4) that will be operated by Electrogas Malta Ltd., an EIS was required and drafted in 2014 (PA 00021/14: Combined cycle gas turbine and liquefied natural gas receiving storage and re-gasification facilities; and PA 00022/14: Construction of jetty and ancillary facilities). The summary of impacts expected from D3 are highlighted below:

- » The conversion of the D3 plant is expected to contribute to the general reduction of emissions from the energy sector, leading to improved air quality.
- » NG is the cleanest of the available fossil fuels, and any excess heat generated from the operation of diesel engines is used to generate steam for additional power supply and for other heating purposes related to the operation of the D3 plant.
- » Compliance with Malta's commitment under Gothenburg protocol can be achieved under the assumption that the electricity demand by 2020 does not exceed current levels and that this can be met by the interconnectors and the two gas fired units at DPS (including D3).
- » The proposed conversion would also lead to overall positive health impacts, with negligible to very low construction noise expected to be generated by D3.
- » Social impacts are also expected to be positive, because the plant will burn cleaner fuel within the same area.
- » Concerns about the large-scale hazards associated with LNG storage and transfer were raised by the residents at Marsaxlokk and Delimara. These include the eruption of 'gas fireballs' from gas leaks once the new gas-operated power plan is completed and operational. These concerns can only be countered by having strict maintenance and inspection protocols by the employees working at D3PG to minimise the occurrences of such events. Additionally, HAZID, HAZOP and ATEX studies that were performed provide sufficient information to address such concerns.

- » Marine water bodies are expected to generate lower quantities of cooling water at the discharge outfall which is deemed as a moderate beneficial impact.
- » Reduction in the amount of hazardous waste streams generated by D3 is also considered to be a low beneficial impact, which further reduces the possibility of spillage and leakage accidents.



## ***C6 Statutory consultees***

### ***6.1 Local council***

Refer to IPPC Form C Application Form.

### ***6.2 Other sites***

Please refer to IPPC Form C Application Form.

### ***6.3 Port Authority***

Please refer to IPPC Form C Application Form.

## C7 Planning status

### 7.1 Planning statuses

The following list includes a history of the planning applications listed for Delimara Power station:

- » IPPC Permit No. IP 0002/07/E (01/04/14)
- » Greenhouse Gas Emission Permit MT-2 - CCP-ETS-F02.02
- » MRA/WHL/PSF/007/09
- » PA/05166/93
- » PA/03052/03
- » PA/03152/05
- » EA00166/05
- » PA/03154/08
- » PA/02933/09
- » PA/04854/09
- » PA/02053/10
- » Case Number 01054/14
- » PA/00021/14
- » PA/02298/14
- » DN/00146/14

No planning consent is required for the auxiliary boiler due to Article 85 (2) (f) of Act VII of 2016: Development Planning Act, 2016.

“70. (1) Subject to the provisions of this article and to the following provisions of this Part of the Act, and subject to articles 55 and 85(2)(n), no development shall be carried out except with development permission.

(2) For the purposes of this article, and, unless the context otherwise requires, for all other purposes in this Act, "development" means the carrying out of building, engineering, quarrying, mining or other operations for the construction, demolition or alterations in, on, over, or under any land or the sea, the placing of advertisements or the making of any material change in use of land or building and sea, other than:

(f) the placing of plant and machinery required for the operation of a use already covered by development permission on land within the perimeter of the site covered by the same permission of the use being operated.”

---

## **C8**   *Technically competent person*

Refer to Appendix VI

## C9 Expenditure plan

### 9.1 Expenditure plan

Environmental monitoring obligations are envisaged during the operational phases of the facility that is issued an IPPC permit. The fees associated with such specific obligations are explained in detail in the table below:

Table 15 – List of permit obligations and their estimated costs

Permit obligation	Estimated cost
<b>1. Monitoring obligations &amp; certifications</b>	Confidential information
CEMS Equipment annual testing (AST)	
Any chimney Discontinuous monitoring + any other ambient and new chimney emission tests that may be imposed	
Non-destructive testing (NDTs) and other certifications and tests for pressure systems, chimney QAL2 tests carried out at different intervals	
Internal and ambient noise monitoring	
<b>2. Management of waste</b>	
Waste management	
Oil spillage costs	
<b>3. Reporting obligations</b>	
Permit, reporting and operating procedure fees	
<b>4. Testing</b>	
Sea water discharge analysis D3 contribution	
Ground water analysis D3 contribution	
<b>5. Certifications</b>	
ISO certifications and related procedures	
Certification of boilers/steam lines safety valves	
<b>6. Abatement</b>	
Urea chemical expenditure	
NOX and CO reduction SCR	
Desulphurisation unit conversion works if required to be installed for DFs (including re-installation of bag filters)	
Estimate of SBC + residual system (fly ash) use if required on the DFs	
<b>7. Other financing to meet permit requirements</b>	
Any other one time emission studies as per new IPPC permit such as dispersion modelling (contingency)	
Decommissioning (including removal of wastes and equipment from site and decontamination of land)	



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## **Appendix I**

### *Material Safety Data Sheets and Chemical Compositions*

# MATERIAL SAFETY DATA SHEET

READ AND UNDERSTAND MATERIAL SAFETY DATA SHEET BEFORE  
HANDLING OR DISPOSING OF PRODUCT

## 29371 GASOIL, DIESEL AND HEATING

### 1. PRODUCT AND COMPANY NAME

#### PRODUCT CODE AND NAME

29371 GASOIL, DIESEL AND HEATING

#### DESCRIPTION

Gas Oils

#### COMPANY

Consols Oils  
Plots 3 – 6 United Road  
St Day  
REDRUTH  
Cornwall  
TR16 5HY  
Tel : 01209 820274  
Fax : 01209 820919  
Emergency Phone Number : 07720455322

### 2. COMPOSITION/INFORMATION ON INGREDIENTS

<u>Name</u>	<u>% Wt</u>	<u>CAS No.</u>	<u>EC No.</u>
Fuels, diesel	95 - 99,99	68334-30-5	269-822-7
Xn R 40 Limited evidence of a carcinogenic effect.			
Xn R 65 Harmful: may cause lung damage if swallowed.			
R 66 Repeated exposure may cause skin dryness or cracking			
N R 51/53 Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.			

Product contains small amounts of additives.

### 3. HAZARDS IDENTIFICATION

Product classification

CARCINOGENIC CATEGORY 3  
HARMFUL  
DANGEROUS FOR THE ENVIRONMENT

Acute effects of exposure to man

Inhalation

Vapours or mist may cause irritation of the nose and throat, headache, nausea, vomiting, dizziness, drowsiness, euphoria, loss of coordination, and disorientation. In poorly ventilated areas or confined spaces, unconsciousness and asphyxiation may result.

Inhalation of vapours or mist may result in the absorption of potentially harmful amounts of material.

Skin contact

Brief contact may cause slight irritation. Prolonged contact, as with clothing wetted with material, may cause more severe irritation and discomfort, seen as local redness and swelling.

Believed not to be a skin sensitiser.

Eye contact

May cause irritation, experienced as mild discomfort and seen as slight excess redness of the eye.

Ingestion

If more than several mouthfuls are swallowed, abdominal discomfort, nausea and diarrhoea may occur.

Aspiration may occur during swallowing or vomiting, resulting in lung damage.

Chronic effects of exposure to man

Medical conditions aggravated by exposure

Because of its irritating properties, repeated skin contact may aggravate an existing dermatitis (skin condition).

Other remarks	Possible risk of irreversible effects.
Effects of exposure to the environment	Some short-term toxicity to aquatic and marine organisms.
<b>4. FIRST AID MEASURES</b>	
Route of exposure	
Inhalation	Remove to fresh air. If not breathing.
Skin contact	Wash skin with plenty of soap and water
Eye contact	Immediately flush eyes with plenty of
Ingestion	Do not induce vomiting. Get medical
Other recommendations	Aspiration of this product during induced intubation. Remove and dry-clean or launder clothing with handling contaminated clothing.

with handling contaminated clothing.

## 5. FIRE-FIGHTING MEASURES

Suitable extinguishing media	Use water fog, dry powder, foam or carbon dioxide. Use water to cool fire-exposed containers. If a leak or spill has not ignited, use water fog to disperse the vapours and to provide protection for personnel attempting to stop the leak.
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Extinguishing media which must not be used for safety reasons	Water jet
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Special exposure hazards arising from the substance or preparation itself,

combustion products, resulting gases	Hydrogen sulphide (H <sub>2</sub> S) may be released when heated.
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In case of fire - Always call the fire brigade. Small fires, such as those capable of being fought with a hand-held extinguisher, can normally be fought by a person who has received instruction on the hazards of flammable liquid fires. Fires that are

beyond that stage should only be tackled by people who have received hands-on training.

Ensure escape path is available.

Special protective equipment for firefighters	<p>The nature of special protective equipment required will depend upon the size of the fire, the degree of confinement of the fire and the natural ventilation available. Fire-resistant clothing and self-contained breathing apparatus is recommended for</p> <p>fires in confined spaces and poorly-ventilated areas. Full fire-proof clothing is recommended for any large fires involving this product.</p>
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## 6. ACCIDENTAL RELEASE MEASURES

Procedures in case of accidental release or leakage	Ventilate area. Avoid breathing vapour. Use self-contained breathing apparatus or supplied air mask for large spills or
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	<p>Wipe up or absorb on suitable material and shovel up. Prevent entry into sewers and</p> <p>waterways. Avoid contact with skin, eyes or clothing.</p>
<b>7. HANDLING AND STORAGE</b>	
Handling	<p>Local exhaust ventilation recommended if generating vapour, dust, or mist. If exhaust ventilation is not available or inadequate, use approved respirator as appropriate.</p> <p>This product may contain volatile hydrocarbons which may accumulate in the container headspace, thereby creating a flammable or explosive atmosphere.</p> <p>Hydrogen sulphide (H<sub>2</sub>S) may be released when heated.</p>
Storage	<p>Transport, handle and store in accordance with applicable local regulations and only in labelled containers designed for this product. Ground and bond shipping container, transfer line, and receiving container. Keep away from sparks, flame and other sources of ignition. Protect containers against static electricity, lightning and physical damage. Hot work (eg cutting or welding) must not be carried out on or near any container used for storage of this product unless it has been made safe by purging or other suitable means.</p> <p>Empty product containers may contain product residue. Do not reuse empty containers without commercial cleaning or reconditioning.</p>
Specific use (s)	On road transportation and Heating
<b>8. EXPOSURE CONTROLS/PERSONAL PROTECTION</b>	
Respiratory protection	<p>Airborne concentrations should be kept to lowest levels possible. If vapour, mist or</p> <p>cleaning large spills or upon entry into tanks, vessels, or other confined spaces.</p>

	<p>cleaning large spills or upon entry into tanks, vessels, or other confined spaces.</p> <p>Oxygen levels should be at least 19.5 % in confined spaces or other work areas.</p>
Hand and skin protection	<p>Protective clothing such as Flame retardant uniforms, coveralls or lab coats should be worn. Launder or dry-clean when soiled. North Red PVC gloves (Ref. 725), Nitrile Rubber or Viton gloves and lace up safety boots with steel toecaps resistant to</p> <p>chemicals and petroleum distillates required.</p>
Eye protection	<p>Safety glasses, chemical type goggles or full face shield recommended to prevent eye contact.</p>
Exposure limit for the product	<p>None established for product.</p> <p>Hydrogen sulphide : ACGIH TLV-TWA 10 ppm STEL 15 ppm. UK : EH40 : OEL : TWA : 10 ppm ; STEL : 15 ppm</p>

## 9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	Clear liquid
Odour	Petroleum odour
Flash point (ASTM D93), °C	56 min
Relative density	0.82 - 0.86 @ 15°C
Viscosity	2 - 5 mm <sup>2</sup> /s @ 40°C
Boiling point/range, °C	160 - 385

## 10. STABILITY AND REACTIVITY

Conditions to avoid	Sources of ignition such as flames, sparks, hot surfaces.
Materials to avoid	Avoid contact with strong oxidising agents.
Hazardous decomposition products	<p>Oxides of carbon, nitrogen and sulphur, aldehydes and ketones.</p> <p>Hydrogen sulphide (H<sub>2</sub>S) may be released on heating and may accumulate in confined spaces.</p>

## 11. TOXICOLOGICAL INFORMATION

### Acute

#### Inhalation

Likely to be irritating to the respiratory tract if high concentrations of mists or vapour are inhaled.

May cause nausea, dizziness, headaches and drowsiness if high concentrations of vapour are inhaled.

May be toxic when hydrogen sulphide is present in the vapour.

#### Skin contact

Repeated exposure may cause skin dryness or cracking

Believed not to be a skin sensitiser.

#### Eye contact

Slightly irritating to the eyes.

#### Ingestion

Unlikely to cause harm if accidentally swallowed in small doses, though larger quantities may cause nausea and diarrhoea. Will injure the lungs if aspiration occurs, eg. during vomiting.

#### Chronic

This product, or a component of this product, has caused skin cancer when repeatedly applied to the skin of laboratory animals without any effort to remove the material between applications.

## 12. ECOLOGICAL INFORMATION

#### Mobility

Spillages may penetrate the soil causing ground water contamination.

#### Persistence and degradability

According to EC criteria : Not readily biodegradable

#### Potential to bioaccumulate

This product is expected to bioaccumulate.

#### Aquatic toxicity

Some short-term toxicity to aquatic and marine organisms.

WGK=2
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### 13. DISPOSAL CONSIDERATIONS

Disposal	Dispose in a safe manner in accordance with local/national regulations.
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Disposal	Dispose in a safe manner in accordance with local/national regulations.
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EWC-No : 13 07 01

## 14. TRANSPORT INFORMATION

Sea transport	
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UN No	1202
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Proper shipping name	GAS OIL
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IMO, IMDG Class/Packing group	3 / III
-------------------------------	---------

Marine pollutant	No
------------------	----

EmS No	3-07
--------	------

Road/rail transport	
---------------------	--

UN No	1202
-------	------

Proper shipping name	GAS OIL
----------------------	---------

ADR/RID Class/Packing group 3 / III

Hazard identification No	30
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CEFIC Tremcard No	30GF1-III
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UK Emergency action code	3Z
--------------------------	----

environment

Inland waterways	
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ADNR Class	3 / III
------------	---------

Air transport	
---------------	--

UN No	1202
-------	------

Proper shipping name	GAS OIL
IATA/ICAO Class/Packing	3 / III

IATA/ICAO Class/Packing group	3 / III
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## 15. REGULATORY INFORMATION

Classification/ Labelling information	Under the criteria of Directive EEC/67/548 (dangerous substances)
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Classification/ Labelling information	Under the criteria of Directive EEC/67/548 (dangerous substances)
---------------------------------------	---

and EEC/1999/45 (dangerous preparations) :

Symbol (letter notation) +  
Indication of danger

Xn HARMFUL

N DANGEROUS FOR THE ENVIRONMENT

Risk phrases

Xn R 40 Limited evidence of a carcinogenic effect.

Xn R 65 Harmful: may cause lung damage if swallowed.

R 66 Repeated exposure may cause skin dryness or cracking

N R 51/53 Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

Safety phrases

S 2 Keep out of the reach of children.

S 24 Avoid contact with skin.

S 36/37 Wear suitable protective clothing and gloves.

S 43 In case of fire, use CO<sub>2</sub>, dry chemical or foam. Never use water.

S 61 Avoid release to the environment. Refer to special instructions/Safety data sheets.

S 62 If swallowed, do not induce vomiting: seek medical advice immediately and show this container or label.

Hazardous ingredients

Fuels, diesel

Additional information

Refer to any national measures that may be relevant.

## 16. OTHER INFORMATION



	<p>Hazardous concentrations of hydrogen sulphide (H<sub>2</sub>S) gas can accumulate in storage and rundown tanks, marine vessel compartments, sump pits or other confined spaces. When opening valves, hatches and dome covers, stand upwind, keep face as far from the</p> <p>opening as possible and avoid breathing any gases or vapours. When exposure concentrations are unknown and respiratory protection is not used, personal H<sub>2</sub>S warning devices should be worn. These devices should not be relied on to warn of life</p> <p>threatening concentrations. H<sub>2</sub>S fatigues the sense of smell rapidly. The rotten egg odour of H<sub>2</sub>S disappears quickly, even though high concentrations are still present. The ACGIH TLV/TWA for H<sub>2</sub>S is 10 ppm, the STEL 15 ppm. UK : EH40 : OEL : TWA : 10</p> <p>ppm ; STEL : 15 ppm</p> <p>The company recommends that all exposures to this product be minimized by strictly adhering to recommended occupational control procedures to avoid any potential adverse health effects.</p>
Full text of risk phrases	<p>Xn R 40 Limited evidence of a carcinogenic effect.</p> <p>Xn R 65 Harmful: may cause lung damage if swallowed.</p> <p>R 66 Repeated exposure may cause skin dryness or cracking</p> <p>N R 51/53 Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.</p>
Changes were made in sections :	3, 5,7, 8,10, 11, 12, 13, 14, 15, 16
MSDS: 29371	
DATE ISSUED 20/5/2003	Supersedes 24/10/2002
<p>All information contained in this Material Safety Data Sheet and, in particular, the health and safety and environmental information is accurate to the best of our knowledge and belief as at the date of issue specified. However, the Company makes no warranty or representation, express or implied, as to the accuracy or completeness of such information.</p> <p>The provision of this Material Safety Data Sheet is not intended, of itself, to</p>	

obviate the need for all users to satisfy themselves that the product described is suitable for their individual purposes and that the safety precautions and environmental advice are adequate for their individual purposes and situation. Further, it is the user's obligation to use this product safely and to comply with all applicable laws and regulations concerning the use of the product.

The company accepts no responsibility for any injury, loss or damage, consequent upon any failure to follow the safety and other recommendations contained in this Material Safety Data Sheet, nor from any hazards inherent in the nature of the material, nor from any abnormal use of the material.

## APPENDIX A

## 0.1%S Gas Oil

Property	Value - Range	Test Method (ASTM)
Relative Density @ 15 °C	0.860 max	D 1298 or ISO 3675 or ISO 12185
Cetane Index	49 min	D 976 or ISO 4264
Sulphur content (%)	0.10 max	D 129 or ISO 8574 or ISO 14596
Flash point (°C)	60 min	D 53
Pour point (°C)	-10 max	D 97 or ISO 3016
Colour	1.5 max	D 1500
Ash Content (% m/m)	0.01 max	D 482 or ISO 6245
Distillation: Initial Boiling Point Recovery at 250 °C Recovery at 350 °C Final Boiling Point	170 °C min 65% Max 85% Min 370 °C max	D 86
Water (% v/v)	0.3 max	D 2709 or ISO 3733
Sediment (% m/m)	0.1 max	ISO 10307-1
Viscosity (cSt) @ 40 °C	2.8 – 4.5 cSt	EN ISO 3104
Carbon Residue (% m/m)	0.15 max	D 524 or ISO 10371
Filterable dirt (mg/100ml)	4 max	D 2276
Sodium (ppm)	0.5 max	D 3605 or ISO 10478
Potassium (ppm)	0.5 max	D3605
Lead (ppm)	0.5 max	D 3605
Calcium (ppm)	2 max	D 3605 or IP 501/470
Vanadium (ppm)	0.5 max	D 5863/A or ISO 14597 or IP501/470
Hydrogen (m/m)	12% min	D 5291
Carbon Content (% m/m)	to be reported	D 5291
Nitrogen content (% m/m)	0.40 max	D 3228
Aluminium + Silicon (mg/kg)	15 max	ISO 10478 or IP501/470
Zinc (mg/kg)	To be reported	IP 501 or 470
Phosphorus (mg/kg)	To be reported	IP 501 or 470
Net Calorific Value (kcal/kg)	10 300min	D 240
Gross Calorific Value (kcal/kg)	To be reported	D240
CFPP (°C)	0 max	IP 309

→ Indicator of  
Combustion speed  
(like cetane in HFO)

**Section 1: Identification of the substance or mixture and of the supplier**

<b>Product Name:</b>	Liquefied Natural Gas
<b>SDS Number:</b>	169200
<b>Synonyms/Other Means of Identification:</b>	LNG Liquid Methane
<b>Intended Use:</b>	Fuel
<b>Manufacturer:</b>	ConocoPhillips Alaska, Inc. A Subsidiary of ConocoPhillips P.O. Box 100360 700 G. Street Anchorage, AK 99510-0360
<b>Emergency Health and Safety Number:</b>	Chemtrec: 800-424-9300 (24 Hours)
<b>Customer Service:</b>	907-659-7812
<b>Technical Information:</b>	907-659-7812
<b>SDS Information:</b>	Phone: 855-244-0762 Email: <a href="mailto:SDS@conocophillips.com">SDS@conocophillips.com</a> URL: <a href="http://www.conocophillips.com">www.conocophillips.com</a>

**Section 2: Hazard(s) Identification**

**Classification**

H220 -- Flammable gases -- Category 1

H281 -- Gases under pressure -- Refrigerated liquefied gas

**Label Elements**



**DANGER**

Extremely flammable gas. (H220)\*

Contains refrigerated gas; may cause cryogenic burns or injury. (H281)\*

Gas may reduce oxygen in confined spaces.

### **Precautionary Statement(s):**

Do not handle until all safety precautions have been read and understood. (P202)\*  
Keep away from heat/sparks/open flames/hot surfaces. - No smoking. (P210)\*  
Take precautionary measures against static discharge. (P243)\*  
Wear cold insulating gloves/face shield/eye protection. (P282)\*  
Get immediate medical advice/attention. (P315)\*  
Thaw frosted parts with lukewarm water. Do not rub affected area. (P336)\*  
Leaking gas fire: Do not extinguish, unless leak can be stopped safely. (P377)\*  
Eliminate all ignition sources if safe to do so. (P381)\*  
Protect from sunlight. Store in a well ventilated place. (P410+P403)\*

*\*(Applicable GHS hazard code.)*

## **Section 3: Composition / Information on Ingredients**

Component	CASRN	Concentration <sup>1</sup>
Natural gas, dried	68410-63-9	100

<sup>1</sup> All concentrations are percent by weight unless ingredient is a gas. Gas concentrations are in percent by volume.

## **Section 4: First Aid Measures**

**Eye Contact:** For contact with the liquefied gas, remove contact lenses if present and easy to do, hold eyelids apart and gently flush the affected eye(s) with lukewarm water. Seek immediate medical attention.

**Skin Contact:** Liquefied gases may cause cryogenic burns or injury. Treat burned or frostbitten skin by flushing or immersing the affected area(s) in lukewarm water. Do not rub affected area. Do not remove clothing that adheres due to freezing. After sensation has returned to the frostbitten skin, keep skin warm, dry, and clean. If blistering occurs, apply a sterile dressing. Seek immediate medical attention.

**Inhalation (Breathing):** If respiratory symptoms develop, move victim away from source of exposure and into fresh air in a position comfortable for breathing. If breathing is difficult, oxygen or artificial respiration should be administered by qualified personnel. If symptoms persist, seek medical attention.

**Ingestion (Swallowing):** This material is a gas under normal atmospheric conditions and ingestion is unlikely.

### **Most important symptoms and effects**

**Acute:** Anesthetic effects at high concentrations.

**Delayed:** None known or anticipated. See Section 11 for information on effects from chronic exposure, if any.

**Notes to Physician:** Epinephrine and other sympathomimetic drugs may initiate cardiac arrhythmias in persons exposed to high concentrations of hydrocarbon solvents (e.g., in enclosed spaces or with deliberate abuse). The use of other drugs with less arrhythmogenic potential should be considered. If sympathomimetic drugs are administered, observe for the development of cardiac arrhythmias.

## **Section 5: Fire-Fighting Measures**



### **NFPA 704 Hazard Class**

**Health:** 3   **Flammability:** 4   **Instability:** 0   (0-Minimal, 1-Slight, 2-Moderate, 3-Serious, 4-Severe)



**Unusual Fire & Explosion Hazards:** Extremely flammable. This material can be ignited by heat, sparks, flames, or other sources of ignition (e.g., static electricity, pilot lights, mechanical/electrical equipment, and electronic devices such as cell phones, computers, calculators, and pagers which have not been certified as intrinsically safe). Vapors may travel considerable distances to a source of ignition where they can ignite, flash back, or explode. May create vapor/air explosion hazard indoors, in confined spaces, outdoors, or in sewers. If container is not properly cooled, it can rupture in the heat of a fire. Drains can be plugged and valves made inoperable by the formation of ice if rapid evaporation of large quantities of the liquefied gas occurs. Do not allow run-off from fire fighting to enter drains or water courses – may cause explosion hazard in drains and may reignite.

**Extinguishing Media:** Dry chemical or carbon dioxide is recommended. Carbon dioxide can displace oxygen. Use caution when applying carbon dioxide in confined spaces.

**Fire Fighting Instructions:** For fires beyond the initial stage, emergency responders in the immediate hazard area should wear protective clothing. When the potential chemical hazard is unknown, in enclosed or confined spaces, a self contained breathing apparatus should be worn. In addition, wear other appropriate protective equipment as conditions warrant (see Section 8).

Isolate immediate hazard area and keep unauthorized personnel out. Stop spill/release if it can be done safely. If this cannot be done, allow fire to burn. Move undamaged containers from immediate hazard area if it can be done safely. Stay away from ends of container. Water spray may be useful in minimizing or dispersing vapors and to protect personnel. Cool equipment exposed to fire with water, if it can be done safely.

**Hazardous Combustion Products:** Combustion may yield smoke, carbon monoxide, and other products of incomplete combustion. Oxides of nitrogen and sulfur may also be formed.

See Section 9 for Flammable Properties including Flash Point and Flammable (Explosive) Limits

## Section 6: Accidental Release Measures

**Personal Precautions:** Extremely flammable. Spillages of liquid product will create a fire hazard and may form an explosive atmosphere. Keep all sources of ignition and hot metal surfaces away from spill/release if safe to do so. The use of explosion-proof electrical equipment is recommended. Beware of accumulation of gas in low areas or contained areas, where explosive concentrations may occur. Prevent from entering drains or any place where accumulation may occur. Ventilate area and allow to evaporate. Stay upwind and away from spill/release. Avoid direct contact with material. For large spillages, notify persons down wind of the spill/release, isolate immediate hazard area and keep unauthorized personnel out. Wear appropriate protective equipment, including respiratory protection, as conditions warrant (see Section 8). See Sections 2 and 7 for additional information on hazards and precautionary measures.

**Environmental Precautions:** Stop spill/release if it can be done safely. Water spray may be useful in minimizing or dispersing vapors. If spill occurs on water notify appropriate authorities and advise shipping of any hazard.

**Methods for Containment and Clean-Up:** Notify relevant authorities in accordance with all applicable regulations.

Recommended measures are based on the most likely spillage scenarios for this material; however local conditions and regulations may influence or limit the choice of appropriate actions to be taken.

## Section 7: Handling and Storage

**Precautions for safe handling:** Keep away from ignition sources such as heat/sparks/open flame – No smoking. Take precautionary measures against static discharge. Use good personal hygiene practices and wear appropriate personal protective equipment (see section 8).

Gas can accumulate in confined spaces and limit oxygen available for breathing. Use only with adequate ventilation. The use of explosion-proof electrical equipment is recommended and may be required (see appropriate fire codes). Refer to NFPA-70 and/or API RP 2003 for specific bonding/grounding requirements. Electrostatic charge may accumulate and create a hazardous condition when handling or processing this material. To avoid fire or explosion, dissipate static electricity during transfer by grounding and bonding containers and equipment before transferring material. Do not enter confined spaces such as tanks or pits without following proper entry procedures such as ASTM D-4276 and 29CFR 1910.146. Cold burns may occur during filling operations. Containers and delivery lines may become cold enough to present cold burn hazard.

The use of hydrocarbon fuel in an area without adequate ventilation may result in hazardous levels of incomplete combustion products (e.g. carbon monoxide, oxides of sulfur and nitrogen, benzene and other hydrocarbons) and/or dangerously low oxygen levels.

**Conditions for safe storage:** Keep container(s) tightly closed and properly labeled. Use and store this material in cool, dry, well-ventilated areas away from heat, direct sunlight, hot metal surfaces, and all sources of ignition. Store only in approved containers. Post area "No Smoking or Open Flame." Keep away from any incompatible material (see Section 10). Protect container(s) against physical damage. Outdoor or detached storage is preferred. Indoor storage should meet OSHA standards and appropriate fire codes.

"Empty" containers retain residue and may be dangerous. Do not pressurize, cut, weld, braze, solder, drill, grind, or expose such containers to heat, flame, sparks, or other sources of ignition. They may explode and cause injury or death. Use and store this material in cool, dry, well-ventilated area away from heat and all sources of ignition. Avoid exposing any part of a compressed-gas cylinder to temperatures above 125F(51.6C). Gas cylinders should be stored outdoors or in well ventilated storerooms at no lower than ground level and should be quickly removable in an emergency.

## Section 8: Exposure Controls / Personal Protection

Component	ACGIH	OSHA	Other
Natural gas, dried	1000 ppm TWA as Aliphatic Hydrocarbons C1-4	---	---

**Note:** State, local or other agencies or advisory groups may have established more stringent limits. Consult an industrial hygienist or similar professional, or your local agencies, for further information.

**Engineering controls:** If current ventilation practices are not adequate to maintain airborne concentrations below the established exposure limits, additional engineering controls may be required.

**Eye/Face Protection:** The use of eye protection (such as splash goggles) that meets or exceeds ANSI Z.87.1 is recommended when there is potential liquid contact to the eye. Depending on conditions of use, a face shield may be necessary.

**Skin/Hand Protection:** Wear thermal insulating gloves and face shield or eye protection when working with materials that present thermal hazards (hot or cold).

**Respiratory Protection:** A NIOSH approved, self-contained breathing apparatus (SCBA) or equivalent operated in a pressure demand or other positive pressure mode should be used in situations of oxygen deficiency (oxygen content less than 19.5 percent), unknown exposure concentrations, or situations that are immediately dangerous to life or health (IDLH).

A respiratory protection program that meets or is equivalent to OSHA 29 CFR 1910.134 and ANSI Z88.2 should be followed whenever workplace conditions warrant a respirator's use.

**Suggestions provided in this section for exposure control and specific types of protective equipment are based on readily available information. Users should consult with the specific manufacturer to confirm the performance of their protective equipment. Specific situations may require consultation with industrial hygiene, safety, or engineering professionals.**

## Section 9: Physical and Chemical Properties

**Note:** Unless otherwise stated, values are determined at 20°C (68°F) and 760 mm Hg (1 atm). Data represent typical values and are not intended to be specifications.

<b>Appearance:</b>	Colorless; Water-white
<b>Physical Form:</b>	Refrigerated Gas
<b>Odor:</b>	No distinct odor
<b>Odor Threshold:</b>	No data
<b>pH:</b>	Not applicable
<b>Vapor Pressure:</b>	>1000 mm Hg @ 77°F / 25°C
<b>Vapor Density (air=1):</b>	0.5
<b>Initial Boiling Point/Range:</b>	-259 °F / -162 °C
<b>Melting/Freezing Point:</b>	No data
<b>Solubility in Water:</b>	Negligible
<b>Partition Coefficient (n-octanol/water) (Kow):</b>	No data
<b>Specific Gravity (water=1):</b>	0.426 @ 60°F (15.6°C)
<b>Percent Volatile:</b>	100%
<b>Evaporation Rate (nBuAc=1):</b>	>1
<b>Flash Point:</b>	< -306 °F / < -188 °C

Lower Explosive Limits (vol % in air): 4.5  
Upper Explosive Limits (vol % in air): 14.0  
Auto-ignition Temperature: 999 °F / 537 °C

## Section 10: Stability and Reactivity

**Stability:** Stable under normal ambient and anticipated conditions of use.

**Conditions to Avoid:** Avoid all possible sources of ignition. Heat will increase pressure in the storage tank.

**Materials to Avoid (Incompatible Materials):** Avoid contact with acids, aluminum chloride, chlorine, chlorine dioxide, halogens and oxidizing agents.

**Hazardous Decomposition Products:** Not anticipated under normal conditions of use.

**Hazardous Polymerization:** Not known to occur.

## Section 11: Toxicological Information

### Information on Toxicological Effects of Substance/Mixture

Acute Toxicity	Hazard	Additional Information	LC50/LD50 Data
Inhalation	Unlikely to be harmful	Asphyxiant. High concentrations in confined spaces may limit oxygen available for breathing. See Signs and Symptoms.	> 20,000 ppm (gas)
Skin Absorption	Skin absorption is not anticipated		Not Applicable
Ingestion (Swallowing)	Ingestion is not anticipated		Not Applicable

**Aspiration Hazard:** Not applicable.

**Skin Corrosion/Irritation:** Not expected to be irritating. Contact with the liquefied or pressurized gas may cause frostbite ("cold" burn).

**Serious Eye Damage/Irritation:** Not expected to be irritating. Contact with the liquefied or pressurized gas may cause momentary freezing followed by swelling and eye damage.

**Signs and Symptoms:** Light hydrocarbon gases are simple asphyxiants and can cause anesthetic effects at high concentrations. Symptoms of overexposure, which are reversible if exposure is stopped, can include shortness of breath, drowsiness, headaches, confusion, decreased coordination, visual disturbances and vomiting. Continued exposure can lead to hypoxia (inadequate oxygen), rapid breathing, cyanosis (bluish discoloration of the skin), numbness of the extremities, unconsciousness and death.

**Skin Sensitization:** Skin contact is not anticipated.

**Respiratory Sensitization:** Not expected to be a respiratory sensitizer.

**Specific Target Organ Toxicity (Single Exposure):** Not expected to cause organ effects from single exposure.

**Specific Target Organ Toxicity (Repeated Exposure):** Not expected to cause organ effects from repeated exposure.

**Carcinogenicity:** Not expected to cause cancer. This substance is not listed as a carcinogen by IARC, NTP or OSHA.

**Germ Cell Mutagenicity:** Not expected to cause heritable genetic effects.

**Reproductive Toxicity:** Not expected to cause reproductive toxicity.

**Other Comments:** High concentrations may reduce the amount of oxygen available for breathing, especially in confined spaces. Hypoxia (inadequate oxygen) during pregnancy may have adverse effects on the developing fetus.

## Section 12: Ecological Information

**Toxicity:** Petroleum gases will readily evaporate from the surface and would not be expected to have significant adverse effects in the aquatic environment. Classification: No classified hazards.

**Persistence and Degradability:** The hydrocarbons in this material are expected to be inherently biodegradable. In practice, hydrocarbon gases are not likely to remain in solution long enough for biodegradation to be a significant loss process.

**Bioaccumulative Potential:** Log Kow values measured for the hydrocarbon gases range from 2.3 for propane to 2.8 for butane and are not regarded as having the potential to bioaccumulate.

**Mobility in Soil:** Due to the extreme volatility of petroleum gases, air is the only environmental compartment in which these hydrocarbons will be found. In air, these hydrocarbons undergo photodegradation by reaction with hydroxyl radicals with half-lives ranging from 3.2 days for n-butane to 7 days for propane.

**Other Adverse Effects:** None anticipated.

## Section 13: Disposal Considerations

This material is a gas and would not typically be managed as a waste.

## Section 14: Transport Information

### U.S. Department of Transportation (DOT)

**Shipping Description:** UN1972, Methane, refrigerated liquid, 2.1  
**Non-Bulk Package Marking:** None [**Not authorized in nonbulk packages.**]  
**Non-Bulk Package Labeling:** None [**Not authorized in nonbulk packages.**]  
**Bulk Package/Placard Marking:** Flammable gas / 1972  
Methane, refrigerated liquid  
**Packaging - References:** None; None; 173.318  
**(Exceptions; Non-bulk; Bulk)**  
**Hazardous Substance:** See Section 15 for RQ's  
**Emergency Response Guide:** 115

**Note:** *Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code: Not applicable*

### International Maritime Dangerous Goods (IMDG)

**Shipping Description:** UN1972, Methane, refrigerated liquid, 2.1  
**Non-Bulk Package Marking:** Methane, refrigerated liquid, UN1972  
**Labels:** Flammable gas  
**Placards/Marking (Bulk):** Flammable / UN1972  
**Packaging - Non-Bulk:** P203  
**EMS:** F-D, S-U

### International Civil Aviation Org. / International Air Transport Assoc. (ICAO/IATA)

**UN/ID #:** *Forbidden*

	LTD. QTY	Passenger Aircraft	Cargo Aircraft Only
<b>Packaging Instruction #:</b>	---	---	---
<b>Max. Net Qty. Per Package:</b>	---	---	---

## Section 15: Regulatory Information

### CERCLA/SARA - Section 302 Extremely Hazardous Substances and TPQs (in pounds):

This material does not contain any chemicals subject to the reporting requirements of SARA 302 and 40 CFR 372.

**CERCLA/SARA - Section 311/312 (Title III Hazard Categories)**

Acute Health:	Yes
Chronic Health:	No
Fire Hazard:	Yes
Pressure Hazard:	Yes
Reactive Hazard:	No

**CERCLA/SARA - Section 313 and 40 CFR 372:**

This material does not contain any chemicals subject to the reporting requirements of SARA 313 and 40 CFR 372.

**EPA (CERCLA) Reportable Quantity (in pounds):**

EPA's Petroleum Exclusion applies to this material - (CERCLA 101(14)).

**California Proposition 65:**

This material does not contain any chemicals which are known to the State of California to cause cancer, birth defects or other reproductive harm at concentrations that trigger the warning requirements of California Proposition 65.

**International Hazard Classification****Canada:**

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the Regulations.

**WHMIS Hazard Class:**

A - Compressed Gas  
B1 - Flammable Gases

**National Chemical Inventories**

All components are either listed on the US TSCA Inventory, or are not regulated under TSCA

All components are either on the DSL, or are exempt from DSL listing requirements.

**U.S. Export Control Classification Number:** EAR99

**Section 16: Other Information**

<b>Date of Issue:</b>	02-Apr-2012
<b>Status:</b>	FINAL
<b>Previous Issue Date:</b>	20-Feb-2012
<b>Revised Sections or Basis for Revision:</b>	Identified Hazards (Section 2) Precautionary Statement(s) (Section 2) First Aid (Section 4) Shipping information (Section 14) Regulatory information (Section 15)
<b>SDS Number:</b>	169200

**Guide to Abbreviations:**

ACGIH = American Conference of Governmental Industrial Hygienists; CASRN = Chemical Abstracts Service Registry Number; CEILING = Ceiling Limit (15 minutes); CERCLA = The Comprehensive Environmental Response, Compensation, and Liability Act; EPA = Environmental Protection Agency; GHS = Globally Harmonized System; IARC = International Agency for Research on Cancer; INSHT = National Institute for Health and Safety at Work; IOPC = International Oil Pollution Compensation; LEL = Lower Explosive Limit; NE = Not Established; NFPA = National Fire Protection Association; NTP = National Toxicology Program; OSHA = Occupational Safety and Health Administration; PEL = Permissible Exposure Limit (OSHA); SARA = Superfund Amendments and Reauthorization Act; STEL = Short Term Exposure Limit (15 minutes); TLV = Threshold Limit Value (ACGIH); TWA = Time Weighted Average (8 hours); UEL = Upper Explosive Limit; WHMIS = Worker Hazardous Materials Information System (Canada)



**Disclaimer of Expressed and implied Warranties:**

The information presented in this Material Safety Data Sheet is based on data believed to be accurate as of the date this Material Safety Data Sheet was prepared. HOWEVER, NO WARRANTY OF MERCHANTABILITY, FITNESS FOR ANY PARTICULAR PURPOSE, OR ANY OTHER WARRANTY IS EXPRESSED OR IS TO BE IMPLIED REGARDING THE ACCURACY OR COMPLETENESS OF THE INFORMATION PROVIDED ABOVE, THE RESULTS TO BE OBTAINED FROM THE USE OF THIS INFORMATION OR THE PRODUCT, THE SAFETY OF THIS PRODUCT, OR THE HAZARDS RELATED TO ITS USE. No responsibility is assumed for any damage or injury resulting from abnormal use or from any failure to adhere to recommended practices. The information provided above, and the product, are furnished on the condition that the person receiving them shall make their own determination as to the suitability of the product for their particular purpose and on the condition that they assume the risk of their use. In addition, no authorization is given nor implied to practice any patented invention without a license.

## Schedule H – LNG and Gas Specifications 1 – LNG Specifications

## 1.1 LNG Specifications

Calorific Value	>0.03038	MMBTU/Nm <sup>3</sup>	LHV	Min (1)
Gas temperature	N/A	°C		Min
Gas temperature	N/A	°C Above dew pt		Min
Gas temperature	N/A	°C		Max
Methane number	-	ISO/TR 22302:2014E using the AVL method		Min (2)
Methane contents CH <sub>4</sub>	70%	vol.		Min
Hydrogen sulphide H <sub>2</sub> S	<0.05	vol.		Max
Total sulphur	30	mg/Nm <sup>3</sup>		Max
Annual Month Average Sulphur	-	mg/kg		Max
Hydrogen, H <sub>2</sub>	<3%	vol.		Max (3)
Carbon dioxide	<20%	vol.		Max
Water		Not allowed		Max (4)
Hydrocarbon condensates		Not allowed		Max (4)
Ammonia	<25	mg/Nm <sup>3</sup>		Max
Chlorine + Fluorine	<50	mg/Nm <sup>3</sup>		Max
Particles or solids, content	<50	mg/Nm <sup>3</sup>		Max
Particles or solids, size	<5	mm		Max

## 2 – Gas Specifications

## 2.1 Gas Specifications (Delimara 3 Gas Specifications, Delimara 4 Gas Specifications)

Calorific Value	0.03038	MMBTU/Nm <sup>3</sup>	LHV	Min (1)
Gas temperature	0	°C		Min
Gas temperature	15	°C Above dew pt		Min
Gas temperature	50	°C		Max
Methane number	75	ISO/TR		Min (2)

		<b>22302:2014E using the AVL method</b>	
Methane contents CH <sub>4</sub>	70%	vol.	Min
Hydrogen sulphide H <sub>2</sub> S	5	mg/kg	Max
Total Sulphur	30	mg/Nm <sup>3</sup>	Max
Hydrogen, H <sub>2</sub>	3.0%	vol.	Max (3)
Carbon dioxide	20%	vol.	Max
Water		Not allowed	Max (4)
Hydrocarbon condensates		Not allowed	Max (4)
Ammonia	25	mg/Nm <sup>3</sup>	Max
Chlorine + Fluorine	50	mg/Nm <sup>3</sup>	Max
Particles or solids, content	50	mg/Nm <sup>3</sup>	Max
Particles or solids, size	5	µm	Max

- 1 Values given in Nm<sup>3</sup> are at 0°C and 101.3 kPa.
- 2 If the total of hydrocarbons CS+ is more than 1% volume, evaluation of acceptability will be required. The methane number is calculated based on the ISO Standard ISO/TR 22302:2014E based on the AVL method.
- 3 For Hydrogen content higher than 3% volume, evaluation of acceptability will be required.
- 4 Dew point of Gas is below the minimum operating temperature and pressure

## 2.2 Pressure (Delimara 3 Gas Specifications)

---

Maximum Pressure	16.0	Barg
Operating Pressure	7.0	Barg
Minimum Pressure	6.4	Barg

## 2.3 Pressure (Delimara 4 Gas Specifications)

---

Maximum Pressure	39	Barg
Operating Pressure	31	Barg
Minimum Pressure	30	Barg

## 2.4 Temperature (Delimara 3 Gas Specifications))

---

Maximum Temperature	60	°C
Operating Temperature	10	°C
Minimum Temperature	0	°C

## 2.5 Temperature (Delimara 4 Gas Specifications)

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Maximum Temperature	50	°C
Operating Temperature	5	°C
Minimum Temperature	2	°C



## **SAF-ACID DESCALING COMPOUND**

### **MSDS Number**

BYFBP

### **National Stock Number**

6850-01-059-9964

### **Product Name**

SAF-ACID DESCALING COMPOUND

### **Manufacturer**

DREW CHEMICAL CORP

### **Product Identification**

Product ID: SAF-ACID DESCALING COMPOUND

MSDS Date: 02/10/1995

FSC: 6850

NIIN: 01-059-9964

MSDS Number: BYFBP

### **Responsible Party**

DREW CHEMICAL CORP

ONE DREW PLAZA

BOONTON , NJ 07005

US

Emergency Phone: 800-274-5263

Info Phone: 201-263-7600

Cage: 52454

### **Contractor**

DREW CHEMICAL CORP, DIV OF ASHLAND CHEMICAL CO

BOONTON, NJ 07005

US

606-324-1133

Cage: 52454

### **Ingredients**

SULFAMIC ACID

CAS: 5329-14-6

RTECS: W05950000

OSHA PELN/K

ACGIH TLV: N/K

INHIBITORS; (INHIBITOR COMPOSITION)

OSHA PELN/K

ACGIH TLV: N/K

MAGNESIUM OXIDE

CAS: 1309-48-4

RTECS: OM3850000





OSHA PEL15 MG/M3 PARTICULATE

ACGIH TLV: 10 MG/M3; FUME

## Hazards

LD50 LC50 Mixture:NONE SPECIFIED BY MANUFACTURER.

Routes of Entry: Inhalation:YES Skin:YES Ingestion:NO

Reports of Carcinogenicity:NTP:NO IARC:NO OSHA:NO

Health Hazards Acute and Chronic:EYES:EXPOS CAUSES IRREVERSIBLE DMG.

SYMPS MAY INCLUDE STINGING, TEARING, REDNESS, SWELLING, CORNEAL DMG

& BLINDNESS. SKIN:EXPOS CAUSES IRREVERSIBLE DMG. SYMPS MAY INCLUDE

REDNESS, SWELLING, BURNS, & S EV DMG. PRE-EXISTING SKIN DISORDERS

MAYBE AGGRAVATED BY EXPOS TO MATL. INHAL:EXPOS TO DUST IS POSS.

(EFTS OF OVEREXP)

Explanation of Carcinogenicity:NOT RELEVANT

Effects of Overexposure:HLTH HAZS:EXPOS MAY BE HARMFUL/FATAL. SYMPS MAY

INCLUDE SEV IRRIT & BURNS TO NOSE, THROAT & RESP TRACT.

PRE-EXISTING LUNG DISORDERS (E.G. ASTHMA-LIKE CNDTNS) MAY BE

AGGRAVATED BY EXPOS TO MATL. INGEST :MAY BE HARMFUL/FATAL. SYMPS

MAY INCLUDE SEV IRRIT & BURNS OF MOUTH, THROAT & DIGESTIVE TRACT.

Medical Cond Aggravated by Exposure:PRE-EXISTING SKIN & LUNG DISORDERS

(E.G. ASHTMA-LIKE CONDITIONS) MAY BE AGGRAVATED BY EXPOSURE TO THIS

MATERIAL.

## First Aid

First Aid:SKIN:IMMED FLUSH W/WATER FOR @ LST 15 MIN WHILE REMOVING

CONTAM CLTHG & SHOES. SEEK IMMED MED ATTN. WASH CLTHG BEFORE REUSE

& DECONTAM/DISCARD CONTAM SHOES. EYES:IMMED FLUSH GENTLY W/WATER

FOR @ LST 1 5 MIN WHILE HOLDING EYELIDS APART. IF SYMPS DEVELOP AS

RSLT OF VAP EXPOS, IMMED MOVE INDIVIDUAL AWAY FROM EXPOS & INTO

FRESH AIR BEFORE FLUSHING AS REC. SEEK IMMED MED ATTN. INGEST:SEEK

IMMED MED ATTN . DO NOT INDUCE VOMIT. VOMIT WILL CAUSE FURTHER DMG

TO MOUTH & THROAT. IF INDIVIDUAL IS CONSCIOUS & ALERT, IMMED RINSE

MOUTH W/WATER & GIVE MILK/WATER TO DRINK. IF POSS, DO NOT LEAVE

INDIVIDUAL UNATTE NDED. INHAL:IMMED REMOVE TO (SUPDAT)

## Fire Fighting

Extinguishing Media:ALCOHOL FOAM/WATER FOG/CARBON DIOXIDE/DRY CHEMICAL.

Fire Fighting Procedures:WEAR NIOSH/MSHA APPRVD SCBA & FULL PROT EQUIP

. REFER TO CTL MEASURES OF MSDS. WATER MAY BE USED TO EXTING FIRE

BY COOLING, & DILUTING LIQ W/WATER.

Unusual Fire/Explosion Hazard:NONE SPECIFIED BY MANUFACTURER.

## Accidental Release

Spill Release Procedures:SM SPILL:COVER CONTAM SURF W/SODIUM

BICARBONATE/SODA ASH/FLAKED LIME MIX (50-50). MIX & ADD WATER IF

NEC TO FORM SLURRY. SCOOP UP SLURRY & WASH SITE W/SODA ASH SOLN.

PROPER MIXING PROC ARE ESSNTL. TRA INED PERS SHOULD CONDUCT PROC.

UNTRAINED PERS SHOULD BE REMOVED FROM SPILL AREA. LG SPILL:SHOVEL

MATL INTO CNTNRS. THORO SWEEP AREA OF SPILL TO CLEAN UP ANY

RESIDUAL MATERIAL.

Neutralizing Agent:SODIUM BICARBONATE/SODA ASH/FLAKED LIME MIXTURE

(50-50).

## Handling

Handling and Storage Precautions:PREVENT SKIN CONTACT.

Other Precautions:CONTAINERS OF THIS MATERIAL MAY BE HAZARDOUS WHEN

EMPTIED. SINCE EMPTIED CONTAINERS RETAIN PRODUCT RESIDUES (VAPOR,

LIQUID AND/OR SOLID), ALL HAZARD PRECAUTIONS GIVEN IN THE DATA

SHEET MUST BE OBSERVE D.

## Exposure Controls

Respiratory Protection:IF WORKPLACE EXPOS LIM(S) OF PROD/ANY COMPONENT

IS EXCEEDED (SEE INGS), NIOSH/MSHA APPRVD AIR SUPPLIED RESP IS

ADVISED IN ABSENCE OF PROPER ENVIRON CTL. OSHA REGS ALSO PERMIT

OTHER NIOSH/MSHA APPRVD R ESPS (NEG PRESS TYPE) UNDER SPECIFIED

CNDTNS (SEE YOUR INDUST HYGIENIST). ENGINEERING/ADMIN CTLS SHOULD



BE IMPLEMENTED TO REDUCE EXPOS.

Ventilation:PROVIDE SUFFICIENT MECHANICAL (GENREAL AND/OR LOCAL EXHAUST) VENTILATION TO MAINTAIN EXPOSURE BELOW TLV(S).

Protective Gloves:WEAR RESISTANT GLOVES SUCH AS: POLYVINYL CHLORIDE.

Eye Protection:ANSI APPROVED CHEMICAL WORKERS GOGGLES AND FULL LENGTH FACESHIELD .

Other Protective Equipment:EMERGENCY EYE WASH & DELUGE SHOWER WHICH MEET ANSI DESIGN CRITERIA . WEAR IMPERVIOUS CLOTHING AND BOOTS.

Work Hygienic Practices:NONE SPECIFIED BY MANUFACTURER.

Supplemental Safety and Health

FIRST AID PROC: FRESH AIR. SEEK IMMED MED ATTN; KEEP PERSON WARM & QUIET. IF PERSON IS NOT BREATHING, BEGIN ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT ADMINISTER OXYGEN.

## Chemical Properties

Appearance and Odor:FREE FLOWING SOLID GREEN POWDER.

Percent Volatiles by Volume:

## Stability

Stability Indicator/Materials to Avoid:YES

STRONG MINERAL ACIDS, STRONG ALKALIES, STRONG OXIDIZING AGENTS, AMINES, WATER, HALOGENATED HYDROCARBONS.

Stability Condition to Avoid:NONE SPECIFIED BY MANUFACTURER.

Hazardous Decomposition Products:MAY FORM:NITROGEN COMPOUNDS, SULFUR COMPOUNDS, NITROGEN OXIDES, MAGNESIUM OXIDE, CARBON MONOXIDE.

## Disposal

Waste Disposal Methods:DISP MUST BE I/A/W FED, STATE & LOC REGS . SM SPILL:FLUSH DOWN DRAIN W/LG AMTS OF WATER IN ACCORD W/APPLIC REGS. LG SPILL:COLLECT & ADD SLOWLY TO LG VOL OF AGITATED SOLN OF SODA ASH & SLAKED LIM E. ADD NEUT SOLN TO EXCESS RUNNING WATER IN ACCORDANCE WITH APPLICABLE REGULATIONS.

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# SODIUM METABISULFITE

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## 1. Product Identification

**Synonyms:** Sodium pyrosulfite; pyrosulfurous acid, disodium salt  
**CAS No.:** 7681-57-4 Sodium Metabisulfite; 7631-90-5 Sodium Bisulfite.  
**Molecular Weight:** 190.11  
**Chemical Formula:** Na<sub>2</sub>S<sub>2</sub>O<sub>5</sub> (sodium metabisulfite) and NaHSO<sub>3</sub> (sodium bisulfite)  
**Product Codes:**  
J.T. Baker: 3550, 3551  
Mallinckrodt: 7776, 7777

---

## 2. Composition/Information on Ingredients

Ingredient	CAS No	Percent
Hazardous		
-----	-----	-----
-----		
Sodium Metabisulfite	7681-57-4	100%
Yes		
Sodium Bisulfite	7631-90-5	< 0.001%
No		

---

## 3. Hazards Identification

### Emergency Overview

-----

**WARNING! HARMFUL IF SWALLOWED OR INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. MAY CAUSE ALLERGIC RESPIRATORY REACTION. REACTS WITH ACIDS AND WATER RELEASING TOXIC SULFUR DIOXIDE GAS.**

**J.T. Baker SAF-T-DATA<sup>(tm)</sup>** Ratings (Provided here for your convenience)

-----

Health Rating: 2 - Moderate  
Flammability Rating: 0 - None  
Reactivity Rating: 2 - Moderate  
Contact Rating: 3 - Severe  
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD;

## PROPER GLOVES

Storage Color Code: Green (General Storage)

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### Potential Health Effects

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#### **Inhalation:**

Causes irritation to the respiratory tract. Symptoms may include coughing, shortness of breath. May cause allergic reaction in sensitive individuals.

#### **Ingestion:**

May cause gastric irritation by the liberation of sulfurous acid. An asthmatic reaction may occur after ingestion. Large doses may result in nausea, vomiting, diarrhea, abdominal pains, circulatory disturbance, and central nervous system depression. Estimated fatal dose is 10 gm.

#### **Skin Contact:**

Causes irritation to skin. Symptoms include redness, itching, and pain.

#### **Eye Contact:**

Causes irritation, redness, and pain. Contact may cause irreversible eye damage. Symptoms may include stinging, tearing, redness, swelling, corneal damage and blindness.

#### **Chronic Exposure:**

No information found.

#### **Aggravation of Pre-existing Conditions:**

Some individuals are said to be dangerously sensitive to minute amounts of sulfites in foods. Symptoms may include broncho constriction, shock, gastrointestinal disturbances, angio edema, flushing, and tingling sensations. Once allergy develops, future exposures can cause asthma attacks with shortness of breath, wheezing, and cough.

---

## 4. First Aid Measures

#### **Inhalation:**

Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

#### **Ingestion:**

Induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. Get medical attention.

#### **Skin Contact:**

Wipe off excess material from skin then immediately flush skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Get medical attention.

Wash clothing before reuse. Thoroughly clean shoes before reuse.

#### **Eye Contact:**

Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

---

## 5. Fire Fighting Measures

**Fire:**

Not considered to be a fire hazard.

**Explosion:**

Not considered to be an explosion hazard.

**Fire Extinguishing Media:**

Use any means suitable for extinguishing surrounding fire. Do not allow water runoff to enter sewers or waterways.

**Special Information:**

In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

---

## 6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Spills: Pick up and place in a suitable container for reclamation or disposal, using a method that does not generate dust. Cautiously spray residue with plenty of water, providing ventilation to clear sulfur dioxide fumes generated from water contact. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

---

## 7. Handling and Storage

Keep in a tightly closed container. Protect from physical damage. Store in a cool, dry, ventilated area away from sources of heat, moisture and incompatibilities. Releases toxic sulfur dioxide gas when in contact with water, ice. Keep away from acids, water, ice, and oxidizing agents. Use only with appropriate protective equipment. Do not use in unventilated areas such as holds of fishing boats, walk in coolers or confined spaces. Containers of this material may be hazardous when empty since they retain product residues (dust, solids); observe all warnings and precautions listed for the product.

---

## 8. Exposure Controls/Personal Protection

**Airborne Exposure Limits:**

-ACGIH Threshold Limit Value (TLV):

5mg/m<sup>3</sup> (TWA) for sodium bisulfite & for sodium metabisulfite, A4 Not classifiable as a



human carcinogen.

**Ventilation System:**

A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

**Personal Respirators (NIOSH Approved):**

If the exposure limit is exceeded, a half-face respirator with an acid gas cartridge may be worn for up to ten times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. A full-face piece respirator with an acid gas cartridge may be worn up to 50 times the exposure limit, or the maximum use concentration specified by the appropriate regulatory agency, or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator. **WARNING:** Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.

**Skin Protection:**

Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact. (neoprene, polyvinyl chloride).

**Eye Protection:**

Use chemical safety goggles and/or full face shield where dusting or splashing of solutions is possible. Maintain eye wash fountain and quick-drench facilities in work area.

---

## 9. Physical and Chemical Properties

**Appearance:**

White to yellow white crystalline granules.

**Odor:**

Slight odor of sulfur dioxide.

**Solubility:**

Very soluble in water, insoluble in alcohol.

**Specific Gravity:**

1.48

**pH:**

Aqueous solution is acidic.

**% Volatiles by volume @ 21C (70F):**

0

**Boiling Point:**

Not applicable.

**Melting Point:**

150C (302F)

**Vapor Density (Air=1):**

No information found.

**Vapor Pressure (mm Hg):**

No information found.

**Evaporation Rate (BuAc=1):**

No information found.

---

## 10. Stability and Reactivity

**Stability:**

Strength diminishes somewhat with age. Gradually decomposes in air to sulfate, generating sulfurous acid gas. Contact with moisture (water, wet ice, etc.), will release toxic sulfur dioxide gas.

**Hazardous Decomposition Products:**

Oxides of sulfur and sodium may form when heated to decomposition.

**Hazardous Polymerization:**

Will not occur.

**Incompatibilities:**

Water, acids, alkalis, sodium nitrite, oxidizers, aluminum powder.

**Conditions to Avoid:**

Moisture, heat, flames, ignition sources and incompatibles.

---

## 11. Toxicological Information

Sodium Metabisulfite [7681-57-4]: No LD50/LC50 information found relating to normal routes of occupational exposure. Investigated as a tumorigen, mutagen and reproductive effector. Sodium Bisulfite [7631-90-5]: Oral rat LD50: 2000 mg/kg. Investigated as a tumorigen and mutagen.

-----\Cancer Lists\-----				
-----				
Ingredient Category	---NTP Carcinogen---		IARC	
	Known	Anticipated		
-----				
-----				
Sodium Metabisulfite (7681-57-4)	No	No	3	
Sodium Bisulfite (7631-90-5)	No	No	3	

## 12. Ecological Information

**Environmental Fate:**

No information found.

### Environmental Toxicity:

No information found.

## 13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste disposal facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

## 14. Transport Information

Not regulated.

## 15. Regulatory Information

-----\Chemical Inventory Status - Part 1\-----				
-----				
Ingredient	TSCA	EC	Japan	
Australia				
-----				
Sodium Metabisulfite (7681-57-4)	Yes	Yes	Yes	
Yes				
Sodium Bisulfite (7631-90-5)	Yes	Yes	Yes	
Yes				
-----\Chemical Inventory Status - Part 2\-----				
-----				
Ingredient	Korea	--Canada--		
Phil.		DSL	NDSL	
-----				
Sodium Metabisulfite (7681-57-4)	Yes	Yes	No	
Yes				
Sodium Bisulfite (7631-90-5)	Yes	Yes	No	
Yes				
-----\Federal, State & International Regulations - Part 1\-----				
-----				
	-SARA 302-		-----SARA	
313-----				
Ingredient	RQ	TPQ	List	
Chemical Catg.				

Sodium Metabisulfite (7681-57-4)	No	No	No	No
Sodium Bisulfite (7631-90-5)	No	No	No	No

-----\Federal, State & International Regulations - Part 2\-----

Ingredient	CERCLA	-RCRA-	-TSCA-
		261.33	8 (d)
Sodium Metabisulfite (7681-57-4)	No	No	Yes
Sodium Bisulfite (7631-90-5)	5000	No	Yes

Chemical Weapons Convention: No      TSCA 12(b): No      CDTA: No  
SARA 311/312: Acute: Yes      Chronic: No      Fire: No      Pressure: No  
Reactivity: Yes      (Mixture / Solid)

**Australian Hazchem Code:** None allocated.

**Poison Schedule:** None allocated.

**WHMIS:**

This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

## 16. Other Information

**NFPA Ratings:** Health: **3** Flammability: **0** Reactivity: **1**

**Label Hazard Warning:**

WARNING! HARMFUL IF SWALLOWED OR INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. MAY CAUSE ALLERGIC RESPIRATORY REACTION. REACTS WITH ACIDS AND WATER RELEASING TOXIC SULFUR DIOXIDE GAS.

**Label Precautions:**

Avoid contact with eyes, skin and clothing.

Avoid breathing dust.

Keep container closed.

Use only with adequate ventilation.

Wash thoroughly after handling.

For Reagent and Technical Grades: Not For Food Use. For TAC Grades: Do not use in meats or in foods recognized as a source of Vitamin B-1, nor in fruits or vegetables to be served or sold raw to consumers or to be presented to consumers as fresh.

**Label First Aid:**

If swallowed, induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, wipe off excess material from skin then immediately flush eyes or skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Wash

clothing before reuse. In all cases, get medical attention.

**Product Use:**

Laboratory Reagent.

**Revision Information:**

No Changes.

**Disclaimer:**

\*\*\*\*\*  
\*\*\*\*\*

**Mallinckrodt Baker, Inc. provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person using this product. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose. MALLINCKRODT BAKER, INC. MAKES NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR THE PRODUCT TO WHICH THE INFORMATION REFERS. ACCORDINGLY, MALLINCKRODT BAKER, INC. WILL NOT BE RESPONSIBLE FOR DAMAGES RESULTING FROM USE OF OR RELIANCE UPON THIS INFORMATION.**

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**Prepared by:** Environmental Health & Safety

Phone Number: (314) 654-1600 (U.S.A.)



**DATASHEET**No. 3345  
Jul 2010**NORIT® ROZ 3****EXTRUDED ACTIVATED CARBON**

**NORIT ROZ 3** is an impregnated steam activated extruded carbon with a diameter of 3 mm. It is especially designed for the removal of hydrogen sulphide and mercaptans from gases including sewage gas. Its best performance is reached the gas contains oxygen and water vapor.

**Product Specifications**

KL content, mass %	2 min.
Moisture (as packed), mass %	5 max.

**Typical Properties**

Apparent density, vibrating feed, g/mL	0.47
lb/ft <sup>3</sup>	29
Ball-pan hardness	99
Pressure drop in air at gas velocity of 25 cm/s, kPa/m	2.0

**NOTES**

- 1) All analyses based on Norit Standard Test Methods (NSTM).
- 2) Typical properties for general information only, not to be used as purchase specifications.

**Packaging/Transportation**

Standard package is 25 kg bags, 40 bags per pallet for a net pallet weight of 1000 kg. Alternate packages include 450 kg bulk bags.

Activated carbon (NOT REGULATED)

Exempt from DOT, IATA, and IMDG regulations

Import/Export classification: 3802.10.0000 (HS Tariff Classification)

Domestic Freight Classification: NMFC 040560

CAS # 7440-44-0

**Material Handling**

Wet activated carbon depletes oxygen from air and, therefore, dangerously low levels of oxygen may be encountered. Whenever workers enter a vessel containing activated carbon, the vessel's oxygen content should be determined and work procedures for potentially low oxygen areas should be followed. Appropriate protective equipment should be worn. Avoid inhalation of excessive carbon dust. No problems are known to be associated in handling this material. This product may contain silica. Please see the product Material Safety Data Sheet for details. Long-term inhalation of high dust concentrations can lead to respiratory impairment. Use forced ventilation or a dust mask when necessary for protection against airborne dust exposure (see Code of Federal Regulations - Title 29, Subpart Z, par. 1910.1000, Table Z-3).

(continued on reverse side)

# DATASHEET

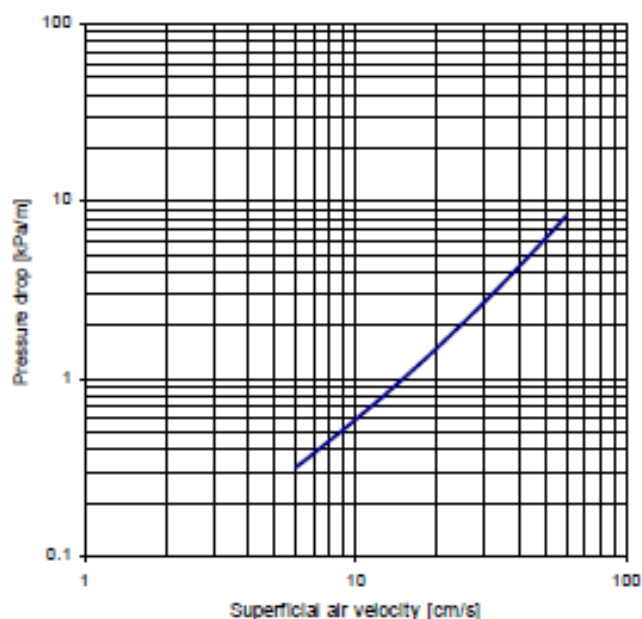
No. 3345  
Jul 2010

## NORIT® ROZ 3

(continued)

### Engineering Data

Typical Pressure Drop Curve for 3 mm Extruded Pellets



Note: Any specification given was valid at time of Issuance of the publication. However, we maintain a policy of continuous development and reserve the right to amend any specification without notice.

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<b>Document number</b> 98500056-ENG-03	<b>First issued</b> 2001-08-22	<b>Revised date</b> 2007-12-17	<b>Revision</b> 2	<b>Issued by</b> Jeanette Hasseson	<b>Page</b> 1 of 5
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## Alpacon Altreat 400

### 1. Product and Company identification

<b>Trade Name:</b>	<b>Supplier:</b>
Alpacon Altreat 400	Alfa Laval Copenhagen A/S
	Maskinvej 5
<b>Product Type:</b>	DK-2860 Soeborg
Antiscalant in desalination plants	Denmark
	Tel: +45 39 53 6000
	Fax: +45 39 53 6578
<b>e-mail:</b>	<a href="mailto:sds.question@alfalaval.com">sds.question@alfalaval.com</a>
<b>Emergency number:</b> +46 8 33 70 43	

### 2. Hazard Identification

Advice on critical hazards to man and the environment:	The product is not hazardous according to EU instructions regarding classification and labeling of chemical products.
--	---

### 3. Composition and Information on the Components

Ingredients	Weight-%	CAS No	EC No	Classification	Risk Phrases
Polymaleic acid	30-45	127121-37-3	-	Not applicable	Not applicable

## Alpacon Altreat 400

### 4. First Aid Measurements

First aid – General advice	Remove contaminated clothing.
First aid – Skin contact	Wash thoroughly with soap and water.
First aid – Eye contact	Wash affected eyes for at least 10 minutes with tepid. Hold eyelids apart.
First aid – Inhalation	If difficulties occur after vapor/aerosol has been inhaled, remove to fresh air and seek medical attention.
First aid – Ingestion	Rinse mouth and then drink plenty of water. <b>Do not induce vomiting.</b> Get medical attention.
Note to physician	Treat according to symptoms (decontamination, vital functions), no known specific antidote.

### 5. Fire Fighting Measures

Extinguishing media	Water spray, carbon dioxide (CO <sub>2</sub> ), foam or dry extinguishing media
Specific hazards	Harmful vapors, evolution of fumes/fog. The substances/groups of substances mentioned can be released in case of fire.
Further information	Contaminated extinguishing water must be disposed of in accordance with local regulations.

### 6. Accidental Release Measures

Personal precautions	Use personal protective clothing
Environmental precautions	Contain contaminated water/firefighting water. Do not discharge into drains/surface waters/groundwater.
Methods for cleaning up or taking up	For large amounts: Pump off product. For residues: Pick up with suitable absorbent material. Dispose of absorbed material in accordance with regulations.

### 7. Handling and Storage

Storage	Keep container tightly closed and in a cool place.
Handling	No special measures necessary provided product is used correctly
Protection against fire and explosion	No special measures necessary

## Alpacon Altreat 400

### 8. Exposure Control / Personal Protection

Respiratory protection	Respiratory protection in case of vapor/aerosol release.
Hand protection	Chemical resistant protective gloves (EN 374) e.g. nitrile rubber (0.4 mm), chloroprene rubber (0.5 mm), polyvinyl chloride (0.7 mm) and other. Manufacturer's directions for use should be observed because of great diversity of types.
Eye protection	Safety glasses with side-shields (frame goggles) (EN 166)
General safety and hygiene measures	Handle in accordance with good industrial hygiene and safety practice. Wearing of closed work clothing is recommended.

### 9. Physical and Chemical Properties

Appearance	Light brown liquid
Odour	Product specific
Solidification temperature	Approx -20 °C (-4 °F)
Flash point	>100 °C (>212 °F) (DIN 51758)
Ignition temperature	>200 °C (>392 °F) (DIN 51794)
pH (20°C, 68 °F)	Approx. 8
Density (g/cm <sup>3</sup> )	Approx 1.3 (23 °C, 73.4 °F)
Miscibility with water	Miscible in all proportions
Partitioning coefficient n-octanol/water (log Pow)	< -2
Viscosity, kinematic (mm <sup>2</sup> /s)	Approx 600 (23 °C, 73.4 °F)

### 10. Stability and Reactivity

Hazardous reactions	No hazardous reactions when stored and handled according to instructions.
Hazardous decomposition products	No hazardous decomposition products if stored and handled as prescribed/indicated.

### 11. Toxicological Information

LD50, oral (rat)	> 2.000 mg/kg
Primary skin irritation (rabbit)	Non-irritant
Primary irritations of the mucous membrane (rabbit)	Non-irritant



## Alpacon Altreat 400

### 12. Ecological Information

#### Ecotoxicity

Toxicity to fish, *Brachydanio rerio*,  
LC50 (96 h): >100 mg/l

Microorganisms /  
Effect on activated sludge Inhibition of degradation activity in activated sludge is not to be anticipated during correct introduction of low concentrations.

#### Persistence and degradability, Elimination information

Test method OECD 302B; ISO 9888; 88/302/EEC, part C,

Method of analysis DOC reduction

Degree of elimination < 10 % (28 d)

Evaluation Poorly biodegradable

### 13. Disposal considerations

Disposal of product Must be dumped or incinerated in accordance with local regulations.

Disposal of containers Uncontaminated containers can be re-used. Containers that cannot be cleaned should be disposed of in the same manner as the product.

### 14. Transport Information

Not classified as hazardous under transport regulations (ADR, RID, IMDG, DGR)

### 15. Regulatory Information

Not subject to labeling according to Regulations of the European union (Labeling)

### 16. Other Information

This Safety Data Sheet does not constitute a workplace risk assessment.

All information is given in good faith but users must satisfy themselves that there are no circumstances requiring additional information or precautions or the verification of details given herein.

Changes have been made in section: 2, 4 and 14.

### DISCLAIM OF RESPONSIBILITY

Alfa Laval provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. This document is only a guide to the potential hazards of the product. All individuals working with or around the product should be properly trained. Persons coming into contact with the product must be capable of exercising their own independent judgment concerning the conditions or methods of handling, storage and usage of the product. Alfa Laval will not be responsible for claims, losses, or damages of any kind resulting from the information provided in this Material Safety Data Sheet or the use, handling, storage or disposal of the product. **Alfa Laval makes no representations or warranties, either express or implied, including without limitation any**

Contact details for all countries are continually updated on our website.  
Please visit [www.alfalaval.com](http://www.alfalaval.com) to access the information.  
The latest version of Alfa Laval's SDS is available on our website.

Article Number  
25 l plastic can: 98500056-82  
200 l barrel: 98500056-81

## Alpacon Altreat 400

warranties of merchantability or fitness for a particular purpose with respect to the information set out herein or the product to which the information refers.

**Safety Data Sheet**

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**SECTION 1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING****1.1 Product Identifier****Material Name** : Shell Gadinia 40**Product Code** : 001A0218**1.2 Relevant identified uses of the substance or mixture and uses advised against****Product Use** : Engine oil.**Uses Advised Against** : This product must not be used in applications other than those recommended in Section 1, without first seeking the advice of the supplier.**1.3 Details of the Supplier of the safety data sheet****Manufacturer/Supplier** : Attard Services Ltd.  
53, Tanks Street  
BBG 02 Birzebbugia  
Malta**Telephone** : +356 (21) 652 222**1.4 Emergency Telephone Number**

: +356 (99) 406 601

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**SECTION 2. HAZARDS IDENTIFICATION****2.1 Classification of the substance or mixture**

1999/45/EC	
Hazard Characteristics	R-phrases(s)
Not classified as dangerous under EC criteria.;	

**2.2 Label Elements****Labeling according to Directive 1999/45/EC****EC Symbols** : No Hazard Symbol required

**Safety Data Sheet**

EC Classification : Not classified as dangerous under EC criteria.  
EC Risk Phrases : Not classified.  
EC Safety Phrases : Not classified.

**2.3 Other Hazards**

**Health Hazards** : Not expected to be a health hazard when used under normal conditions. Prolonged or repeated skin contact without proper cleaning can clog the pores of the skin resulting in disorders such as oil acne/folliculitis. Used oil may contain harmful impurities.

**Safety Hazards** : Not classified as flammable but will burn.

**Environmental Hazards** : Not classified as dangerous for the environment.

---

**SECTION 3. COMPOSITION/INFORMATION ON INGREDIENTS****3.1 Substance**

**Material Name** : Not applicable.

**3.2 Mixtures**

**Mixture Description** : Highly refined mineral oils and additives.

**Hazardous Components****Classification of components according to Regulation (EC) No 1272/2008**

Chemical Name	CAS No.	EC Number	REACH Registration No.	Conc.
Interchangeable low viscosity base oil (<20,5 cSt @40°C) *	*	*	*	0.00 - 90.00%

Chemical Name	Hazard Class & Category	Hazard Statement
Interchangeable low viscosity base oil (<20,5 cSt @40°C) *	Asp. Tox., 1;	H304;

## Safety Data Sheet

**Additional Information** : The highly refined mineral oil contains <3% (w/w) DMSO-extract, according to IP346.

Refer to Ch 16 for full text of H phrases.

\* contains one or more of the following CAS-numbers (REACH registration numbers): 64742-53-6 (01-2119480375-34), 64742-54-7 (01-2119484627-25), 64742-55-8 (01-2119487077-29), 64742-56-9 (01-2119480132-48), 64742-65-0 (01-2119471299-27), 68037-01-4 (01-2119486452-34), 72623-86-0 (01-2119474878-16), 72623-87-1 (01-2119474889-13), 8042-47-5 (01-2119487078-27), 848301-69-9 (01-0000020164-80).

This mixture does not contain any REACH registered substances that are assessed to be a PBT or a vPvB.

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### SECTION 4. FIRST AID MEASURES

#### 4.1 Description of First Aid Measures

- General Information** : Not expected to be a health hazard when used under normal conditions.
- Inhalation** : No treatment necessary under normal conditions of use. If symptoms persist, obtain medical advice.
- Skin Contact** : Remove contaminated clothing. Flush exposed area with water and follow by washing with soap if available. If persistent irritation occurs, obtain medical attention.
- Eye Contact** : Flush eye with copious quantities of water. If persistent irritation occurs, obtain medical attention.
- Ingestion** : In general no treatment is necessary unless large quantities are swallowed, however, get medical advice.
- Self-protection of the first aider** : When administering first aid, ensure that you are wearing the appropriate personal protective equipment according to the incident, injury and surroundings.
- 4.2 Most important symptoms and effects, both acute and delayed** : Oil acne/folliculitis signs and symptoms may include formation of black pustules and spots on the skin of exposed areas. Ingestion may result in nausea, vomiting and/or diarrhoea.
- 4.3 Indication of any immediate medical attention and special treatment needed** : Notes to doctor/physician:  
Treat symptomatically.

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### SECTION 5. FIRE FIGHTING MEASURES



## Safety Data Sheet

Clear fire area of all non-emergency personnel.

- 5.1 Extinguishing Media** : Foam, water spray or fog. Dry chemical powder, carbon dioxide, sand or earth may be used for small fires only.
- Unsuitable Extinguishing Media** : Do not use water in a jet.
- 5.2 Special hazards arising from the substance or mixture** : Hazardous combustion products may include: A complex mixture of airborne solid and liquid particulates and gases (smoke). Carbon monoxide. Unidentified organic and inorganic compounds.
- 5.3 Advice for firefighters** : Proper protective equipment including chemical resistant gloves are to be worn; chemical resistant suit is indicated if large contact with spilled product is expected. Self-Contained Breathing Apparatus must be worn when approaching a fire in a confined space. Select fire fighter's clothing approved to relevant Standards (e.g. Europe: EN469).

---

## SECTION 6. ACCIDENTAL RELEASE MEASURES

Avoid contact with spilled or released material. For guidance on selection of personal protective equipment see Chapter 8 of this Material Safety Data Sheet. Observe the relevant local and international regulations.

- 6.1 Personal Precautions, Protective Equipment and Emergency Procedures** : 6.1.1 For non emergency personnel: Avoid contact with skin and eyes.  
6.1.2 For emergency responders: Avoid contact with skin and eyes.
- 6.2 Environmental Precautions** : Use appropriate containment to avoid environmental contamination. Prevent from spreading or entering drains, ditches or rivers by using sand, earth, or other appropriate barriers.
- 6.3 Methods and Material for Containment and Cleaning Up** : Slippery when spilt. Avoid accidents, clean up immediately. Prevent from spreading by making a barrier with sand, earth or other containment material. Reclaim liquid directly or in an absorbent. Soak up residue with an absorbent such as clay, sand or other suitable material and dispose of properly.
- Additional Advice** : Local authorities should be advised if significant spillages cannot be contained.
- 6.4 Reference to other sections** : For guidance on selection of personal protective equipment see Chapter 8 of this Material Safety Data Sheet. For guidance on disposal of spilled material see Chapter 13 of this Material Safety Data Sheet.

## Safety Data Sheet

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SECTION 7. HANDLING AND STORAGE

- General Precautions** : Use local exhaust ventilation if there is risk of inhalation of vapours, mists or aerosols. Use the information in this data sheet as input to a risk assessment of local circumstances to help determine appropriate controls for safe handling, storage and disposal of this material.
- 7.1 Precautions for Safe Handling** : Avoid prolonged or repeated contact with skin. Avoid inhaling vapour and/or mists. When handling product in drums, safety footwear should be worn and proper handling equipment should be used. Properly dispose of any contaminated rags or cleaning materials in order to prevent fires. Keep container tightly closed and in a cool, well-ventilated place. Use properly labelled and closeable containers.
- Product Transfer** : This material has the potential to be a static accumulator. Proper grounding and bonding procedures should be used during all bulk transfer operations.
- 7.2 Conditions for safe storage, including any incompatibilities** : Store at ambient temperature.
- Recommended Materials** : Refer to section 15 for any additional specific legislation covering the packaging and storage of this product.  
: For containers or container linings, use mild steel or high density polyethylene.
- Unsuitable Materials** : PVC.
- 7.3 Specific end use(s)** : Not applicable
- Additional Information** : Polyethylene containers should not be exposed to high temperatures because of possible risk of distortion.

---

SECTION 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

If the American Conference of Governmental Industrial Hygienists (ACGIH) value is provided on this document, it is provided for information only.

## 8.1 Control Parameters

## Occupational Exposure Limits

Material	Source	Type	ppm	mg/m3	Notation
Oil mist, mineral	ACGIH	TWA(Inhalable fraction.)		5 mg/m3	

## Safety Data Sheet

### Biological Exposure Index (BEI)

No biological limit allocated.

**PNEC related information** : Data not available

**Monitoring Methods** : Monitoring of the concentration of substances in the breathing zone of workers or in the general workplace may be required to confirm compliance with an OEL and adequacy of exposure controls. For some substances biological monitoring may also be appropriate. Validated exposure measurement methods should be applied by a competent person and samples analysed by an accredited laboratory. Examples of sources of recommended exposure measurement methods are given below or contact the supplier. Further national methods may be available.

National Institute of Occupational Safety and Health (NIOSH),  
USA: Manual of Analytical Methods <http://www.cdc.gov/niosh/>

Occupational Safety and Health Administration (OSHA), USA:  
Sampling and Analytical Methods <http://www.osha.gov/>

Health and Safety Executive (HSE), UK: Methods for the  
Determination of Hazardous Substances  
<http://www.hse.gov.uk/>

Institut für Arbeitsschutz Deutschen Gesetzlichen  
Unfallversicherung (IFA), Germany.  
<http://www.dguv.de/inhalt/index.jsp>

L'Institut National de Recherche et de Sécurité, (INRS), France  
<http://www.inrs.fr/accueil>

### 8.2 Exposure Controls General Information

: The level of protection and types of controls necessary will vary depending upon potential exposure conditions. Select controls based on a risk assessment of local circumstances.  
Appropriate measures include: Adequate ventilation to control airborne concentrations. Where material is heated, sprayed or

**Safety Data Sheet**

mist formed, there is greater potential for airborne concentrations to be generated.

Define procedures for safe handling and maintenance of controls. Educate and train workers in the hazards and control measures relevant to normal activities associated with this product. Ensure appropriate selection, testing and maintenance of equipment used to control exposure, e.g. personal protective equipment, local exhaust ventilation. Drain down system prior to equipment break-in or maintenance. Retain drain downs in sealed storage pending disposal or for subsequent recycle. Always observe good personal hygiene measures, such as washing hands after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants. Discard contaminated clothing and footwear that cannot be cleaned. Practice good housekeeping.

**Occupational Exposure Controls**

- Personal Protective Equipment** : The provided information is made in consideration of the PPE directive (Council Directive 89/686/EEC) and the CEN European Committee for Standardisation (CEN) standards. Personal protective equipment (PPE) should meet recommended national standards. Check with PPE suppliers.
- Eye Protection** : Wear safety glasses or full face shield if splashes are likely to occur. Approved to EU Standard EN166.
- Hand Protection** : Where hand contact with the product may occur the use of gloves approved to relevant standards (e.g. Europe: EN374, US: F739) made from the following materials may provide suitable chemical protection: PVC, neoprene or nitrile rubber gloves. Suitability and durability of a glove is dependent on usage, e.g. frequency and duration of contact, chemical resistance of glove material, dexterity. Always seek advice from glove suppliers. Contaminated gloves should be replaced. Personal hygiene is a key element of effective hand care. Gloves must only be worn on clean hands. After using gloves, hands should be washed and dried thoroughly. Application of a non-perfumed moisturizer is recommended. For continuous contact we recommend gloves with breakthrough time of more than 240 minutes with preference for > 480 minutes where suitable gloves can be identified. For short-term/splash protection we recommend the same, but recognise that suitable gloves offering this level of protection

**Safety Data Sheet**

- may not be available and in this case a lower breakthrough time may be acceptable so long as appropriate maintenance and replacement regimes are followed. Glove thickness is not a good predictor of glove resistance to a chemical as it is dependent on the exact composition of the glove material.
- Body protection** : Skin protection not ordinarily required beyond standard issue work clothes.
- Respiratory Protection** : No respiratory protection is ordinarily required under normal conditions of use. In accordance with good industrial hygiene practices, precautions should be taken to avoid breathing of material. If engineering controls do not maintain airborne concentrations to a level which is adequate to protect worker health, select respiratory protection equipment suitable for the specific conditions of use and meeting relevant legislation. Check with respiratory protective equipment suppliers. Where air-filtering respirators are suitable, select an appropriate combination of mask and filter. Select a filter suitable for combined particulate/organic gases and vapours [boiling point >65 °C (149 °F)] meeting EN14387.
- Thermal Hazards** : Not applicable.

**Environmental Exposure Controls**

- Environmental exposure control measures** : Minimise release to the environment. An environmental assessment must be made to ensure compliance with local environmental legislation. Information on accidental release measures are to be found in section 6.

---

**SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES****9.1 Information on basic physical and chemical properties**

- Appearance : Amber. Liquid.
- Odour : Slight hydrocarbon.
- Odour threshold : Data not available
- pH : Not applicable.
- Initial Boiling Point and Boiling Range : > 280 °C / 536 °F estimated value(s)
- Pour point : Typical -18 °C / 0 °F
- Flash point : > 225 °C / 437 °F (PMCC / ASTM D93)
- Upper / lower Flammability or Explosion limits : Typical 1 - 10 %(V) (based on mineral oil)
- Auto-ignition temperature : > 320 °C / 608 °F
- Vapour pressure : < 0.5 Pa at 20 °C / 68 °F (estimated value(s))
- Relative Density : Typical 0.9 at 15 °C / 59 °F

## Safety Data Sheet

Density	: Typical 900 kg/m <sup>3</sup> at 15 °C / 59 °F
Water solubility	: Negligible.
Solubility in other solvents	: Data not available
n-octanol/water partition coefficient (log Pow)	: > 6 (based on information on similar products)
Dynamic viscosity	: Data not available
Kinematic viscosity	: Typical 139 mm <sup>2</sup> /s at 40 °C / 104 °F
Vapour density (air=1)	: > 1 (estimated value(s))
Evaporation rate (nBuAc=1)	: Data not available
Decomposition Temperature	: Data not available
Flammability	: Data not available
Oxidizing Properties	: Data not available
Explosive Properties	: Not classified

### 9.2 Other Information

Electrical conductivity	: This material is not expected to be a static accumulator.
Other Information	: not a VOC
Volatile organic compound	: 0 %

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## SECTION 10. STABILITY AND REACTIVITY

10.1 Reactivity	: The product does not pose any further reactivity hazards in addition to those listed in the following sub-paragraph.
10.2 Chemical stability	: No hazardous reaction is expected when handled and stored according to provisions.
10.3 Possibility of Hazardous Reactions	: Reacts with strong oxidising agents.
10.4 Conditions to Avoid	: Extremes of temperature and direct sunlight.
10.5 Incompatible Materials	: Strong oxidising agents.
10.6 Hazardous Decomposition Products	: Hazardous decomposition products are not expected to form during normal storage.

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## SECTION 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on Toxicological effects

Basis for Assessment	: Information given is based on data on the components and the
----------------------	--



## Safety Data Sheet

toxicology of similar products.

Unless indicated otherwise, the data presented is representative of the product as a whole, rather than for individual component(s).

<b>Likely Routes of Exposure</b>	: Skin and eye contact are the primary routes of exposure although exposure may occur following accidental ingestion.
<b>Acute Oral Toxicity</b>	: Expected to be of low toxicity: LD50 > 5000 mg/kg , Rat
<b>Acute Dermal Toxicity</b>	: Expected to be of low toxicity: LD50 > 5000 mg/kg , Rabbit
<b>Acute Inhalation Toxicity</b>	: Not considered to be an inhalation hazard under normal conditions of use.
<b>Skin corrosion/irritation</b>	: Expected to be slightly irritating. Prolonged or repeated skin contact without proper cleaning can clog the pores of the skin resulting in disorders such as oil acne/folliculitis.
<b>Serious eye damage/irritation</b>	: Expected to be slightly irritating.
<b>Respiratory Irritation</b>	: Inhalation of vapours or mists may cause irritation.
<b>Respiratory or skin sensitisation</b>	: For respiratory and skin sensitisation: Not expected to be a sensitiser.
<b>Aspiration Hazard</b>	: Not considered an aspiration hazard.
<b>Germ cell mutagenicity</b>	: Not considered a mutagenic hazard.
<b>Carcinogenicity</b>	: Not expected to be carcinogenic. Product contains mineral oils of types shown to be non-carcinogenic in animal skin-painting studies. Highly refined mineral oils are not classified as carcinogenic by the International Agency for Research on Cancer (IARC).

<b>Material</b>	<b>Carcinogenicity Classification</b>
Highly refined mineral oil (IP346 <3%)	: ACGIH Group A4: Not classifiable as a human carcinogen.
Highly refined mineral oil (IP346 <3%)	: IARC 3: Not classifiable as to carcinogenicity to humans.
Highly refined mineral oil (IP346 <3%)	: GHS / CLP: No carcinogenicity classification

<b>Reproductive and Developmental Toxicity</b>	: Not expected to be a hazard.
--	--------------------------------

#### Summary on evaluation of the CMR properties

<b>Carcinogenicity</b>	: This product does not meet the criteria for classification in categories 1A/1B.,
<b>Mutagenicity</b>	: This product does not meet the criteria for classification in categories 1A/1B.
<b>Reproductive Toxicity</b>	: This product does not meet the criteria for classification in

## Safety Data Sheet

(fertility)	categories 1A/1B.
Specific target organ toxicity - single exposure	: Not expected to be a hazard.
Specific target organ toxicity - repeated exposure	: Not expected to be a hazard.
Additional Information	: Used oils may contain harmful impurities that have accumulated during use. The concentration of such impurities will depend on use and they may present risks to health and the environment on disposal. ALL used oil should be handled with caution and skin contact avoided as far as possible. Continuous contact with used engine oils has caused skin cancer in animal tests. Classifications by other authorities under varying regulatory frameworks may exist.

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SECTION 12. ECOLOGICAL INFORMATION

Basis for Assessment	: Ecotoxicological data have not been determined specifically for this product. Information given is based on a knowledge of the components and the ecotoxicology of similar products. Unless indicated otherwise, the data presented is representative of the product as a whole, rather than for individual component(s).
12.1 Toxicity Acute Toxicity	: Poorly soluble mixture. May cause physical fouling of aquatic organisms. Expected to be practically non toxic: LL/EL/IL50 > 100 mg/l (to aquatic organisms) LL/EL50 expressed as the nominal amount of product required to prepare aqueous test extract. Mineral oil is not expected to cause any chronic effects to aquatic organisms at concentrations less than 1 mg/l.
12.2 Persistence and degradability	: Expected to be not readily biodegradable. Major constituents are expected to be inherently biodegradable, but the product contains components that may persist in the environment.
12.3 Bioaccumulative Potential	: Contains components with the potential to bioaccumulate.
12.4 Mobility in Soil	: Liquid under most environmental conditions. If it enters soil, it will adsorb to soil particles and will not be mobile. Floats on water.
12.5 Result of PBT and	: This mixture does not contain any REACH registered

## Safety Data Sheet

**vPvB assesment** substances that are assessed to be a PBT or a vPvB.

**12.6 Other Adverse Effects** : Product is a mixture of non-volatile components, which are not expected to be released to air in any significant quantities. Not expected to have ozone depletion potential, photochemical ozone creation potential or global warming potential.

---

### SECTION 13. DISPOSAL CONSIDERATIONS

#### 13.1 Waste Treatment Methods

**Material Disposal** : Recover or recycle if possible. It is the responsibility of the waste generator to determine the toxicity and physical properties of the material generated to determine the proper waste classification and disposal methods in compliance with applicable regulations. Do not dispose into the environment, in drains or in water courses.

**Container Disposal** : Dispose in accordance with prevailing regulations, preferably to a recognised collector or contractor. The competence of the collector or contractor should be established beforehand.

**Local Legislation** : Disposal should be in accordance with applicable regional, national, and local laws and regulations.  
EU Waste Disposal Code (EWC): 13 02 05 mineral-based non-chlorinated engine, gear and lubricating oils. Classification of waste is always the responsibility of the end user.

---

### SECTION 14. TRANSPORT INFORMATION

#### Land transport (ADR/RID):

##### ADR

This product is not classified as dangerous for this mode of transport. Therefore 14.1 UN Number, 14.2 UN Proper Shipping name, 14.3 Transport hazard class(es), 14.4 Packing group, 14.5 Environmental hazards, 14.6 Special precautions for user do not apply.

##### RID

This product is not classified as dangerous for this mode of transport. Therefore 14.1 UN Number, 14.2 UN Proper Shipping name, 14.3 Transport hazard class(es), 14.4 Packing group, 14.5 Environmental hazards, 14.6 Special precautions for user do not apply.

#### Inland waterways transport (ADN):

This product is not classified as dangerous for this mode of transport. Therefore 14.1 UN Number, 14.2 UN Proper Shipping name, 14.3 Transport hazard class(es), 14.4 Packing group,

## Safety Data Sheet

14.5 Environmental hazards, 14.6 Special precautions for user do not apply.

### Sea transport (IMDG Code):

This product is not classified as dangerous for this mode of transport. Therefore 14.1 UN Number, 14.2 UN Proper Shipping name, 14.3 Transport hazard class(es), 14.4 Packing group, 14.5 Environmental hazards, 14.6 Special precautions for user do not apply.

### Air transport (IATA):

This product is not classified as dangerous for this mode of transport. Therefore 14.1 UN Number, 14.2 UN Proper Shipping name, 14.3 Transport hazard class(es), 14.4 Packing group, 14.5 Environmental hazards, 14.6 Special precautions for user do not apply.

### 14.7 Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code

Pollution Category	: Not applicable.
Ship Type	: Not applicable.
Product Name	: Not applicable.
Special Precaution	: Not applicable.

**Additional Information** : MARPOL Annex 1 rules apply for bulk shipments by sea.

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## SECTION 15. REGULATORY INFORMATION

The regulatory information is not intended to be comprehensive. Other regulations may apply to this material.

### 15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

#### Other regulatory Information

**Authorisations and/or restrictions on use** : Product is not subject to Authorisation under REACh.

**Recommended Restrictions on Use (Advice Against)** : This product must not be used in applications other than those recommended in Section 1, without first seeking the advice of the supplier.

#### Chemical Inventory Status

EINECS	: All components listed or polymer exempt.
TSCA	: All components listed.

## Safety Data Sheet

**15.2 Chemical Safety Assessment** : No Chemical Safety Assessment has been carried out for this substance/mixture by the supplier.

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### SECTION 16. OTHER INFORMATION

Not classified.

#### CLP Hazard Statements

H304 May be fatal if swallowed and enters airways.

**Additional Information** : No Exposure Scenario annex is attached to this safety data sheet. It is a non-classified mixture containing hazardous substances as detailed in Section 3; relevant information from Exposure Scenarios for the hazardous substances contained have been integrated into the core sections 1-16 of this SDS.

#### Other Information

#### Abbreviations and Acronyms

: Acute Tox. = Acute toxicity  
 Asp. Tox. = Aspiration hazard  
 Aquatic Acute = Acute hazards to the aquatic environment  
 Aquatic Chronic = Hazardous to the aquatic environment - Long-term Hazard  
 Eye Dam. = Serious eye damage/eye irritation  
 Flam. Liq. = Flammable liquids  
 Skin Corr. = Skin corrosion/irritation  
 Skin Sens. = Skin sensitizer  
 STOT SE = Specific target organ toxicity - single exposure  
 STOT RE = Specific target organ toxicity - repeated exposure

The standard abbreviations and acronyms used in this document can be looked up in reference literature (e.g. scientific dictionaries) and/or websites.

ACGIH = American Conference of Governmental Industrial Hygienists  
 ADR = European Agreement concerning the International Carriage of Dangerous Goods by Road  
 AICS = Australian Inventory of Chemical Substances  
 ASTM = American Society for Testing and Materials  
 BEL = Biological exposure limits  
 BTEX = Benzene, Toluene, Ethylbenzene, Xylenes  
 CAS = Chemical Abstracts Service

## Safety Data Sheet

CEFIC = European Chemical Industry Council  
 CLP = Classification Packaging and Labelling  
 COC = Cleveland Open-Cup  
 DIN = Deutsches Institut für Normung  
 DMEL = Derived Minimal Effect Level  
 DNEL = Derived No Effect Level  
 DSL = Canada Domestic Substance List  
 EC = European Commission  
 EC50 = Effective Concentration fifty  
 ECETOC = European Center on Ecotoxicology and Toxicology  
 Of Chemicals  
 ECHA = European Chemicals Agency  
 EINECS = The European Inventory of Existing Commercial  
 Chemical Substances  
 EL50 = Effective Loading fifty  
 ENCS = Japanese Existing and New Chemical Substances  
 Inventory  
 EWC = European Waste Code  
 GHS = Globally Harmonised System of Classification and  
 Labelling of Chemicals  
 IARC = International Agency for Research on Cancer  
 IATA = International Air Transport Association  
 IC50 = Inhibitory Concentration fifty  
 IL50 = Inhibitory Level fifty  
 IMDG = International Maritime Dangerous Goods  
 INV = Chinese Chemicals Inventory  
 IP346 = Institute of Petroleum test method N° 346 for the  
 determination of polycyclic aromatics DMSO-extractables  
 KECI = Korea Existing Chemicals Inventory  
 LC50 = Lethal Concentration fifty  
 LD50 = Lethal Dose fifty per cent.  
 LL/EL/IL = Lethal Loading/Effective Loading/Inhibitory loading  
 LL50 = Lethal Loading fifty  
 MARPOL = International Convention for the Prevention of  
 Pollution From Ships  
 NOEC/NOEL = No Observed Effect Concentration / No  
 Observed Effect Level  
 OE\_HP V = Occupational Exposure - High Production Volume  
 PBT = Persistent, Bioaccumulative and Toxic  
 PICCS = Philippine Inventory of Chemicals and Chemical  
 Substances  
 PNEC = Predicted No Effect Concentration  
 REACH = Registration Evaluation And Authorisation Of  
 Chemicals



**Safety Data Sheet**

RID = Regulations Relating to International Carriage of  
Dangerous Goods by Rail

SKIN\_DES = Skin Designation

STEL = Short term exposure limit

TRA = Targeted Risk Assessment

TSCA = US Toxic Substances Control Act

TWA = Time-Weighted Average

vPvB = very Persistent and very Bioaccumulative

- SDS Distribution** : The information in this document should be made available to all who may handle the product.
- SDS Version Number** : 1.1
- SDS Effective Date** : 08.02.2013
- SDS Revisions** : A vertical bar (|) in the left margin indicates an amendment from the previous version.
- SDS Regulation** : Regulation 1907/2006/EC as amended by Regulation (EU) 453/2010
- Disclaimer** : This information is based on our current knowledge and is intended to describe the product for the purposes of health, safety and environmental requirements only. It should not therefore be construed as guaranteeing any specific property of the product.

Services, Wärtsilä Finland Oy

Engine section	Engine type	Ref.	Date	Issue	Document No.	Page
02 Lubricating oil	<b>32DF, 34DF, 50DF</b>	WFI-S	21-Oct-2009	02	WS02N001	1(2)+13

## Lubricating oils for WÄRTSILÄ® 32DF, 34DF and 50DF engines

<b>General</b>	The enclosed specification contains oil requirements and quality for WÄRTSILÄ® 32DF, 34DF and 50DF engines.
<b>Letter distribution</b>	Wärtsilä Services Network and operators/owners of engines concerned.
<b>Letter validity</b>	Until further notice. This document replaces document WS02N001, issue 01, dated 14.12.2005.
<b>Enclosure</b>	Requirements and oil quality 4V92A1051, rev. I, 13 pages.




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**Unless otherwise expressly set forth, no recommendation contained in this document is to be construed as provided due to a defect in the engine, but merely as an improvement of the engine and/or the maintenance procedures relating thereto. Any actions by the owner/operator as a result of the recommendations are not covered under any warranty provided by Wärtsilä and such actions will thus be at the owners/operators own cost and expense.**

**NO LIABILITY WHETHER DIRECT, INDIRECT, SPECIAL, INCIDENTAL OR CONSEQUENTIAL, IS ASSUMED WITH RESPECT TO THE INFORMATION CONTAINED HEREIN. THIS PUBLICATION IS CONFIDENTIAL AND INTENDED FOR INFORMATION PURPOSES ONLY.**

 <b>WÄRTSILÄ</b>	© Wärtsilä Corporation Finland Technology	<b>INSTALLATION MANUAL</b>					
This doc. is the property of Wärtsilä Corp. and shall neither be copied, shown or communicated to a third party without the consent of the owner.							
Subtitle	Product	Made	06.03.2000		Page	Document No	Rev
-	Wärtsilä® 32DF Wärtsilä® 34DF Wärtsilä® 50DF	Appd.	12.10.2000		1 (13)	4V92A1051	I
Revised date: 19.05.2009	Changed by:		Approved by:		D-message No.: 181182		

## REQUIREMENTS AND OIL QUALITY

### LUBRICATING OIL REQUIREMENTS AND QUALITY FOR WÄRTSILÄ® 32DF, WÄRTSILÄ® 34DF AND WÄRTSILÄ® 50DF ENGINES

#### 1. CONTINUOUS NATURAL GAS OPERATION

##### 1.1 FRESH LUBRICATING OIL REQUIREMENTS

###### **Viscosity**

Viscosity class SAE 40

###### **Viscosity Index (VI)**

Min. 95

###### **Alkalinity (BN)**

Lubricating oils with BN of 4-7 mg KOH/g shall be used, if possible. However, in practise, especially on marine installations it can be difficult to guarantee whether natural gas as a main fuel is possible to use continuously. In such cases also lubricating oils with 10 – 20 mg KOH/g designed for distillate fuel operation can be used.

###### **Sulphated ash level**

The content of sulphated ash in gas engine lubricating oils is a very important property. Too high ash content can cause preignition and knocking, while too low ash content can lead to increased valve wear. Low ash lubricating oils have sulphated ash level of max. 0.6 % m/m and shall be used, if possible, see Alkalinity here above. BN 10 – 20 lubricating oils have typically sulphated ash content of 1,2 – 2,5 % m/m.

###### **Additives**

The oils should contain additives that give good oxidation stability, corrosion protection, load carrying capacity, neutralisation of acid combustion and oxidation residues and should prevent deposit formation on internal engine parts.

###### **Foaming characteristics**

Fresh lubricating oil should meet the following limits for foaming tendency and stability, according to the ASTM D 892-92 test method:

Sequence I: 100/0 ml

Sequence II: 100/0 ml

Sequence III: 100/0 ml

### Base oils

Use of virgin base stocks is only allowed, i.e. recycled or re-refined base oils are not allowed.

## 1.2 CONDEMNING LIMITS FOR USED LUBRICATING OIL

When estimating the condition of used lubricating oil, the following properties along with the corresponding limit values must be noted. If the limits are exceeded, measures must be taken. Compare also with guidance values for fresh lubricating of the brand used.

Property	Unit	Limit	Test method
Viscosity	cSt at 40 °C	max. 25% decrease max. 50% increase	ASTM D 445
Viscosity	cSt at 100 °C	max. 20% decrease max. 25% increase	ASTM D 445
Water	% V/V	max. 0.30	ASTM D 95 or D 6304C
Base Number	mg KOH/g	max. 50% depletion	ASTM D 2896
Total Acid Number	mg KOH/g	max. 2.5 mg KOH/g increase	ASTM D 664
Insolubles	% m/m in n-Pentane	max. 1.0	ASTM D 893b
Flash point, PMCC	°C	min. 170	ASTM D 93
Flash point, COC	°C	min. 190	ASTM D 92
Oxidation	Abs/cm	max. 25	IR
Nitration	Abs/cm	max. 20	IR

## 1.3 APPROVED LUBRICATING OIL QUALITIES FOR W 32DF, W 34DF AND W 50DF ENGINES

In addition to continuous natural gas operation, the below mentioned lubricating oils can also be used during short operating periods on periodical natural gas / LFO operation. See the details in the chapter 2.4.

SUPPLIER	BRAND NAME	VISCOSITY	BN	SULPHATED ASH (% m/m)
BP	Energas NGL	SAE 40	4.5	0.45
Castrol	Duratec L	SAE 40	4.5	0.45
Chevron (Texaco)	Geotex LA	SAE 40	5.2	0.45
	HDAX Low Ash Gas Engine Oil SAE 40	SAE 40	4.2	0.50
ExxonMobil	Pegasus 705	SAE 40	5.3	0.49
	Pegasus 805	SAE 40	6.2	0.50
	Pegasus 905	SAE 40	6.2	0.49
	Pegasus 1005	SAE 40	5.0	0.50
	Pegasus 1	SAE 40	6.5	0.49
Idemitsu Kosan Co. Ltd.	Apolloil GHP 40L	SAE 40	4.7	0.45

SUPPLIER	BRAND NAME	VISCOSITY	BN	SULPHATED ASH (% m/m)
Petro-Canada	Sentron 445	SAE 40	4.7	0.40
Shell	Mysella LA 40	SAE 40	5.2	0.45
	Mysella XL 40	SAE 40	4.5	0.50
Total	Nateria X 405	SAE 40	5.2	0.45

The table here below includes BN 10 – 20 lubricating oils, which have to be used on DF engines, if continuous operation on natural gas can not be guaranteed and the running hours on LFO are exceeding the allowed limits for the use of low ash gas engine oils included in chapter 2.4, but on the other hand these products can be used as well, even if the a.m. limits will not be exceeded.

SUPPLIER	BRAND NAME	VISCOSITY	BN
BP	Energol HPDX 40	SAE 40	12
	Energol IC-HFX 204	SAE 40	20
Castrol	HLX 40	SAE 40	12
	MHP 154	SAE 40	15
	Seamax Extra 40	SAE 40	15
	TLX Plus 204	SAE 40	20
Chevron (Texaco + Caltex + FAMM)	Delo 1000 Marine 40	SAE 40	12
	Delo 2000 Marine 40	SAE 40	20
	Taro 12 XD 40	SAE 40	12
	Taro 20 DP 40	SAE 40	20
ExxonMobil	Delvac 1640	SAE 40	12
	Mobilgard ADL 40	SAE 40	15
	Mobilgard 412	SAE 40	15
	Mobilgard 1 SHC	SAE 40	15
Indian Oil Corporation	Servo Marine 1040	SAE 40	10
	Servo Marine 2040	SAE 40	20
Petrobras	Marbrax CCD-410-AP	SAE 40	12
	Marbrax CCD-415	SAE 40	15
	Marbrax CCD-420	SAE 40	20
Shell	Gadinia Oil 40	SAE 40	12
Statoil	MarWay 1040	SAE 40	10.6
Total / Lubmarine	Disola M 4015	SAE 40	14
	Disola M 4020	SAE 40	20

## **2. CONTINUOUS LIGHT FUEL OIL OPERATION OR PERIODIC OPERATION WITH NATURAL GAS AND LIGHT FUEL OIL**

### **2.1 FRESH LUBRICATING OIL REQUIREMENTS**

#### **Viscosity**

Viscosity class SAE 40

#### **Viscosity Index (VI)**

Min. 95



### Alkalinity (BN)

Liquid fuel always contains some sulphur and because of that higher BN in lubricating oil compared to natural gas operation is required. The required lubricating oil alkalinity in LFO operation is tied to the fuel specified for the engine, which is shown in the table below.

FUEL STANDARDS AND LUBRICATING OIL REQUIREMENTS			
Category	Fuel standard		Lube oil BN
A	ASTM D 975-01, BS MA 100: 1996 CIMAC 2003 ISO 8217: 2005(E)	GRADE NO. 1-D, 2-D DMX, DMA DX, DA ISO-F-DMX, DMA	10 - 20
B	BS MA 100: 1996 CIMAC 2003 ISO 8217: 2005(E)	DMB DB ISO-F-DMB	15 - 20

If the installation is equipped with either a SCR or oxidation catalyst, lubricating oil with lower BN decreases the risk of fouling and may result in longer maintenance intervals of the catalyst.

### Additives

The oils should contain additives that give good oxidation stability, corrosion protection, load carrying capacity, neutralisation of acid combustion and oxidation residues and should prevent deposit formation on internal engine parts (piston cooling gallery, piston ring zone and bearing surfaces in particular).

### Foaming characteristics

Fresh lubricating oil should meet the following limits for foaming tendency and stability, according to the ASTM D 892-92 test method:

Sequence I: 100/0 ml  
Sequence II: 100/0 ml  
Sequence III: 100/0 ml

### Base oils

Use of virgin base stocks is only allowed, i.e. recycled or re-refined base oils are not allowed.

## 2.2 CONDEMNING LIMITS FOR USED LUBRICATING OIL

When estimating the condition of used lubricating oil, the following properties along with the corresponding limit values must be noted. If the limits are exceeded, measures must be taken. Compare also with guidance values for fresh lubricating of the brand used.

Property	Unit	Limit	Test method
Viscosity	cSt at 40 °C	max. 25% decrease max. 45% increase	ASTM D 445
Viscosity	cSt at 100 °C	max. 20% decrease max. 25% increase	ASTM D 445
Water	% V/V	max. 0.30	ASTM D 95 or D 6304C
Base Number	mg KOH/g	max. 50% depletion	ASTM D 2896
Insolubles	% m/m in n-Pentane	max. 2.0	ASTM D 893b
Flash Point, PMCC	°C	min. 170	ASTM D 93
Flash Point, COC	°C	min. 190	ASTM D 92

### 2.3 APPROVED LUBRICATING OIL QUALITIES FOR W 32DF, W 34DF AND W 50DF ENGINES

If in addition to natural gas also light fuel oil (LFO, MGO, MDO) is used either continuously or periodically as fuel, lubricating oils with a BN of 10-20 have to be used. If only short periods at a time on LFO are operated, low ash gas engine oils listed in the chapter 1.3 can also be used. Allowed running periods are mentioned in the chapter 2.4.

SUPPLIER	BRAND NAME	VISCOSITY	BN	FUEL CATEG.
BP	Energol HPDX 40	SAE 40	12	NG,A
	Energol IC-HFX 204	SAE 40	20	NG,A,B
Castrol	HLX 40	SAE 40	12	NG,A
	MHP 154	SAE 40	15	NG,A,B
	Seamax Extra 40	SAE 40	15	NG,A,B
	TLX Plus 204	SAE 40	20	NG,A,B
Chevron (Texaco + Caltex + FAMM)	Delo 1000 Marine 40	SAE 40	12	NG,A
	Delo 2000 Marine 40	SAE 40	20	NG,A,B
	Taro 12 XD 40	SAE 40	12	NG,A
	Taro 20 DP 40	SAE 40	20	NG,A,B
ExxonMobil	Delvac 1640	SAE 40	12	NG,A
	Mobilgard ADL 40	SAE 40	15	NG,A,B
	Mobilgard 412	SAE 40	15	NG,A,B
	Mobilgard 1 SHC	SAE 40	15	NG,A,B
Indian Oil Corporation	Servo Marine 1040	SAE 40	10	NG,A
	Servo Marine 2040	SAE 40	20	NG,A,B
Petrobras	Marbrax CCD-410-AP	SAE 40	12	NG,A
	Marbrax CCD-415	SAE 40	15	NG,A,B
	Marbrax CCD-420	SAE 40	20	NG,A,B
Shell	Gadinia Oil 40	SAE 40	12	NG,A
Statoil	MarWay 1040	SAE 40	10.6	NG,A
Total / Lubmarine	Disola M 4015	SAE 40	14	NG,A
	Disola M 4020	SAE 40	20	NG,A,B

\*) NG = Natural gas

## **2.4 ALLOWED RUNNING HOURS FOR ENGINES LUBRICATED WITH LOW ASH GAS ENGINE OILS AND USING LFO PERIODICALLY AS A MAIN FUEL**

It is allowed to operate the W 32DF, W 34DF and W 50DF engines in some extent on LFO when still using low ash gas engine oils.

The allowed running periods are depending on total yearly accumulated running hours as well as on the sulphur content of LFO quality. If longer periods, than specified below, are operated on LFO, lubricating oil qualities according to the chapter 2.3 have to be used.

LFO qualities fulfilling ISO-F-DMX or DMA standard and having sulphur content of max. 0.2 % m/m:

Engines accumulating > 4000 hours yearly	Engines accumulating < 4000 hours yearly
Max. running hours per week: 50	Max. running hours per week: 25
Max. running hours per month: 100	Max. running hours per month: 50
Max. running hours per year 400	Max. running hours per year: 200

LFO qualities fulfilling ISO-F-DMB standard and / or having sulphur content of max. 0.2 - 0.5 % m/m:

Engines accumulating > 4000 hours yearly	Engines accumulating < 4000 hours yearly
Max. running hours per week: 25	Max. running hours per week: 15
Max. running hours per month: 50	Max. running hours per month: 25
Max. running hours per year 200	Max. running hours per year: 100

## **3. CONTINUOUS HEAVY FUEL OIL OPERATION OR PERIODIC OPERATION WITH HEAVY FUEL OIL, LIGHT FUEL OIL AND NATURAL GAS**

In the W 32DF engine HFO as a main fuel can be used, if the engine is modified according to the document 4V92A1109.

In the W 50DF engine it depends on the engine design, whether the engine in question needs modifications in order to be able to run on HFO or if the use of HFO is allowed without modifications. The modifications are described in the document 4V92A1168.

When operating the W 50DF engines periodically on two or three fuel qualities including heavy fuel, only one lubricating oil quality is needed and that has to be chosen based on heavy fuel operation requirements. Approved products are listed hereafter in the table included in chapter 3.3.

### 3.1 FRESH LUBRICATING OIL REQUIREMENTS

#### Viscosity

Viscosity class SAE 40

#### Viscosity Index (VI)

Min. 95

#### Alkalinity (BN)

The required lubricating oil alkalinity on HFO operation is tied to the fuel specified for the engine, which is shown in the table hereafter.

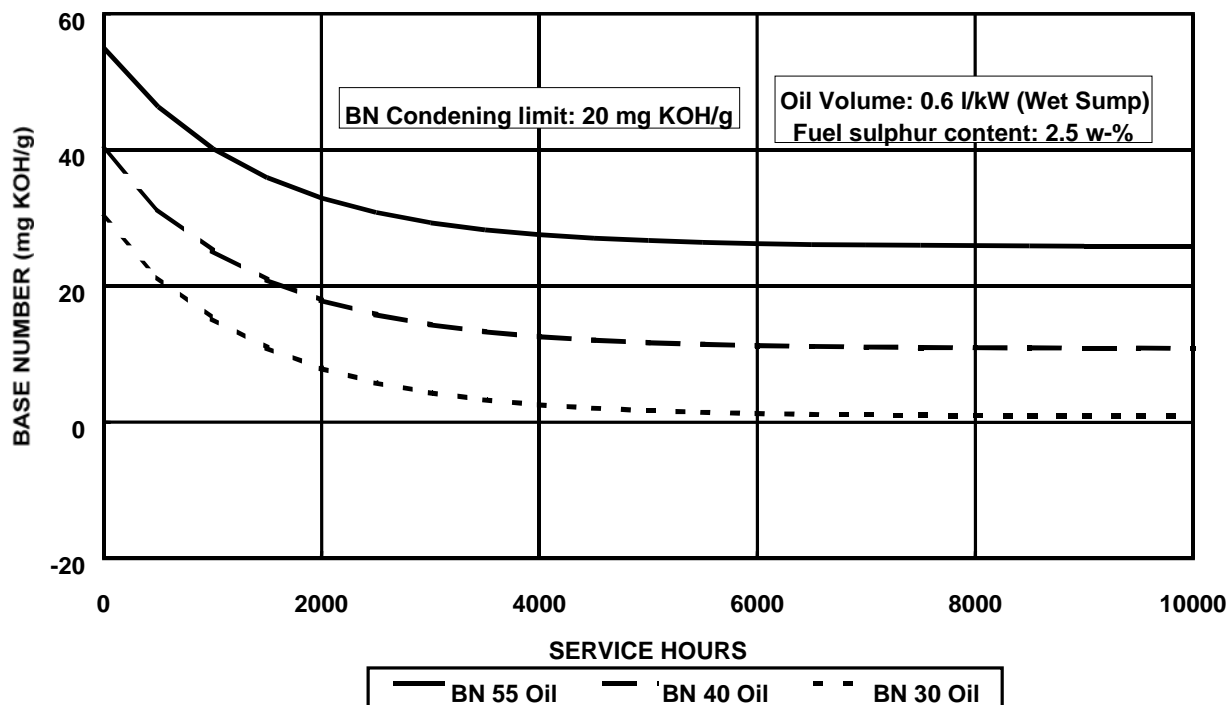
FUEL STANDARDS AND LUBRICATING OIL REQUIREMENTS			
Category	Fuel standard		Lube oil BN
C	ASTM D 975-01 ASTM D 396-04, BS MA 100: 1996 CIMAC 2003 ISO 8217: 2005(E)	GRADE NO. 4-D GRADE NO. 5-6 DMC, RMA 10 - RMK 55 DC, A30 - K700 ISO-F-DMC, RMA 30-RMK 700	30 - 55

For installations running periodically with two fuel qualities, i.e. natural gas and heavy fuel or three qualities including additionally distillate fuel, lubricating oil quality must be chosen based on heavy fuel operating requirements, i.e. BN 30 – 40 must be used. It's the responsibility of the operator to follow the used lubricating oil condition, especially alkali reserve (BN) and to ensure that a chosen lubricating oil brand suits from BN point of view to the operating conditions resulting from the fuel qualities being used. This is very important, since there are several factors, like operating periods on each fuel quality, sulphur content of each fuel quality and lubricating oil consumption all influencing on BN depletion rate.

It is recommended to use in the first place min. BN 50 lubricants when operating continuously on heavy fuel. By continuous heavy fuel operation it is meant that natural gas operation can not be anticipated, that only heavy fuel is available or that the engine is specified so that only the use of heavy fuel is possible, see page 5, chapter 3. This recommendation is valid especially for engines having wet lubricating oil sump and using heavy fuel with sulphur content above 2.0 % m/m. BN 30 and 40 lubricants can be used as well if experience shows that the lubricating oil BN equilibrium remains at an acceptable level and if operation on different fuels including natural gas, light fuel oil and heavy fuel is taking place periodically. The optimum BN level of fresh lubricating oil depends on sulphur content of each fuel being used, operating periods on each fuel as well as on lubricating oil consumption of the engine in question.

Further, on heavy fuelled installations BN 30 lubricants have eventually a positive influence on cleanliness of the SCR catalyst. With BN 30 oils lubricating oil change intervals may be rather short, but lower total operating costs may be achieved because of better plant availability provided that the maintenance intervals of the SCR catalyst can be increased.

An example of BN depletion curve with different BN lubricating oils is shown hereafter.



### Additives

The oils should contain additives that give good oxidation stability, corrosion protection, load carrying capacity, neutralisation of acid combustion and oxidation residues and should prevent deposit formation on internal engine parts (piston cooling gallery, piston ring zone and bearing surfaces in particular).

### Foaming characteristics

Fresh lubricating oil should meet the following limits for foaming tendency and stability, according to the ASTM D 892-92 test method:

Sequence I: 100/0 ml  
 Sequence II: 100/0 ml  
 Sequence III: 100/0 ml

### Base oils

Use of virgin base stocks is only allowed, i.e. recycled or re-refined base oils are not allowed.

## 3.2 CONDEMNING LIMITS FOR USED LUBRICATING OIL

When estimating the condition of used lubricating oil, the following properties along with the corresponding limit values must be noted. If the limits are exceeded, measures must be taken. Compare also with guidance values for fresh lubricating of the brand used.

Property	Unit	Limit	Test method
Viscosity	cSt at 40 °C	max. 25% decrease max. 45% increase	ASTM D 445
Viscosity	cSt at 100 °C	max. 20% decrease max. 25% increase	ASTM D 445
Water	% V/V	max. 0.30	ASTM D 95 or D 6304C
Base Number	mg KOH/g	min. 20	ASTM D 2896
Insolubles	% m/m in n-Pentane	max. 2.0	ASTM D 893b
Flash Point, PMCC	°C	min. 170	ASTM D 93
Flash Point, COC	°C	min. 190	ASTM D 92

### 3.3 APPROVED LUBRICATING OIL QUALITIES FOR W 32DF, W 34DF AND W 50DF ENGINES

In case of heavy fuel oil (HFO) as a main fuel is used periodically in addition to natural gas (NG) and light fuel oil (LFO), BN 30 and 40 lubricating oils listed in the table hereafter have to be used. BN 50 and 55 lubricating oils listed here are recommended only to the engines running continuously on HFO.

SUPPLIER	BRAND NAME	VISCOSITY	BN	FUEL CATEG.
BP	Energol IC-HFX 304	SAE 40	30	NG,A,B,C
	Energol IC-HFX 404	SAE 40	40	NG,A,B,C
	Energol IC-HFX 504	SAE 40	50	C
Castrol	TLX Plus 304	SAE 40	30	NG,A,B,C
	TLX Plus 404	SAE 40	40	NG,A,B,C
	TLX Plus 504	SAE 40	50	C
	TLX Plus 554	SAE 40	55	C
Cepsa	Troncoil 3040 PLUS	SAE 40	30	NG,A,B,C
	Troncoil 4040 PLUS	SAE 40	40	NG,A,B,C
	Troncoil 5040 PLUS	SAE 40	50	C
	Ertoil Koral 3040 SHF	SAE 40	30	NG,A,B,C
	Ertoil Koral 4040 SHF	SAE 40	40	NG,A,B,C
	Ertoil Koral 5040 SHF	SAE 40	50	C
Chevron (Texaco + Caltex + FAMM)	Taro 30 DP 40	SAE 40	30	NG,A,B,C
	Taro 40 XL 40	SAE 40	40	NG,A,B,C
	Taro 50 XL 40	SAE 40	50	C
	Delo 3000 Marine 40	SAE 40	30	NG,A,B,C
	Delo 3400 Marine 40	SAE 40	40	NG,A,B,C
	Delo 3550 Marine 40	SAE 40	55	C
Chinese Petroleum Corporation	Marilube Oil W 304	SAE 40	30	NG,A,B,C
	Marilube Oil W 404	SAE 40	40	NG,A,B,C
	Marilube Oil W 504	SAE 40	50	C
ENI S.p.A.	Cladium 300 S SAE 40	SAE 40	30	NG,A,B,C
	Cladium 400 S SAE 40	SAE 40	40	NG,A,B,C
	Cladium 500 S SAE 40	SAE 40	50	C
	Cladium 550 S SAE 40	SAE 40	55	C



SUPPLIER	BRAND NAME	VISCOSITY	BN	FUEL CATEG.
ExxonMobil	Mobilgard M 430	SAE 40	30	NG,A,B,C
	Mobilgard M 440	SAE 40	40	NG,A,B,C
	Mobilgard M50	SAE 40	50	C
	Exxmar 30 TP 40	SAE 40	30	NG,A,B,C
	Exxmar 40 TP 40	SAE 40	40	NG,A,B,C
	Exxmar 50 TP 40	SAE 40	50	C
Fuchs	Titan PSW 30 SAE 40	SAE 40	30	NG,A,B,C
	Titan PSW 40 SAE 40	SAE 40	40	NG,A,B,C
	Titan PSW 55 SAE 40	SAE 40	55	C
Indian Oil Corporation	Servo Marine K-3040	SAE 40	30	NG,A,B,C
	Servo Marine K-4040	SAE 40	40	NG,A,B,C
	Servo Marine K-5040	SAE 40	50	C
	Servo Marine K-5540	SAE 40	55	C
Morris Lubricants	Aquamor 130MD	SAE 40	30	NG,A,B,C
	Aquamor 140MD	SAE 40	40	NG,A,B,C
	Aquamor 150MD	SAE 40	50	C
Nippon Oil Corporation	Marine T 304	SAE 40	30	NG,A,B,C
	Marine T 404	SAE 40	40	NG,A,B,C
	Marine T 504	SAE 40	50	C
Pertamina	Martron 430	SAE 40	30	NG,A,B,C
	Martron 440	SAE 40	40	NG,A,B,C
	Martron 450	SAE 40	50	C
	Medripal 430	SAE 40	30	NG,A,B,C
	Medripal 440	SAE 40	40	NG,A,B,C
	Medripal 450	SAE 40	50	C
	Salyx 430	SAE 40	30	NG,A,B,C
	Salyx 440	SAE 40	40	NG,A,B,C
	Salyx 450	SAE 40	50	C
Petrobras	Marbrax CCD-430	SAE 40	30	NG,A,B,C
	Marbrax CCD-440	SAE 40	40	NG,A,B,C
	Marbrax CCD-450	SAE 40	50	C
Petron	Petromar XC 3040	SAE 40	30	NG,A,B,C
	Petromar XC 4040	SAE 40	40	NG,A,B,C
	Petromar XC 5540	SAE 40	55	C
Petronas Lubricants International	Disrol 300 SAE 40	SAE 40	30	NG,A,B,C
	Disrol 400 SAE 40	SAE 40	40	NG,A,B,C
	Disrol 500 SAE 40	SAE 40	50	C
	MAEO 4040	SAE 40	40	NG,A,B,C
	MAEO 4050	SAE 40	50	C
Repsol YPF	Neptuno W NT 4000 SAE 40	SAE 40	40	NG,A,B,C
	Neptuno W NT 5500 SAE 40	SAE 40	55	C

SUPPLIER	BRAND NAME	VISCOSITY	BN	FUEL CATEG.
Saudi Arabian Lubricating Oil Company (Petrolube)	Petromin Petropower 2-40	SAE 40	30	NG,A,B,C
	Petromin Petropower 3-40	SAE 40	40	NG,A,B,C
	Petromin Petropower 4-40	SAE 40	55	C
Shell	Argina T 40	SAE 40	30	NG,A,B,C
	Argina X 40	SAE 40	40	NG,A,B,C
	Argina XL 40	SAE 40	50	C
Total / Lubmarine	Aurelia XL 4030	SAE 40	30	NG,A,B,C
	Aurelia XL 4040	SAE 40	40	NG,A,B,C
	Aurelia XL 4055	SAE 40	55	C
	Aurelia TI 4030	SAE 40	30	NG,A,B,C
	Aurelia TI 4040	SAE 40	40	NG,A,B,C
	Aurelia TI 4055	SAE 40	55	C

\*) NG = Natural gas

#### **4. ADDITIONAL REQUIREMENTS AND RECOMMENDATIONS**

##### **LUBRICATING OIL LEVEL:**

The intervals between lubricating oil changes may be extended by adding oil daily to keep the oil level constantly close to the maximum level.

##### **CHANGE OF LUBRICATING OIL BRAND:**

Top-up with another lubricating oil brand than being filled to the system is not allowed, except if the both two lubricating oils originate from the same manufacturer. E.g. if Company A's BN 30 oil is filled into the oil system and top-up with same Company A's BN 40 oil is desired, that can be done provided that both products are based on same base oils and additive technology. Otherwise the lubricating oil system has to be drained and then filled with another brand by following the procedure described here below.

If the main fuel type is changed from natural gas to light fuel oil or heavy fuel oil, or vice versa, change the lubricating oil to a suitable product as shown in the chapters 1.3, 2.3 and 3.3 of this document.

In order to minimize the risk of lubricating oil foaming, deposit formation, blocking of lubricating oil filters, damage of engine components, etc., the following procedure should be followed when lubricating oil brand is changed from one to another:

- If possible, change the lubricating oil brand in connection with an engine (piston) overhaul
- Drain old lubricating oil from the lubricating oil system
- Clean the lubricating oil system in case of an excessive amount of deposits on the surfaces of engine components, like crankcase, camshaft compartment, etc.
- Fill the lubricating oil system with fresh lubricating oil

If the procedure described above is not followed, responsibility of possible damage and malfunctions caused by lubricating oil change should always be agreed between the oil company and customer.

#### USE OF NON-APPROVED LUBRICATING OILS:

Before using a lubricating oil not listed in the tables above, the engine manufacturer must be contacted. Lubricating oils that are not approved have to be tested according to engine manufacturer's procedure.

Should unapproved lubricating oils be used during the engine warranty period, and there exist no agreement with the engine manufacturer about testing, the engine guarantee does not hold.

### **5. APPROVED LUBRICATING OILS FOR ENGINE TURNING DEVICE**

It is recommended to use EP-gear oils, viscosity 400-500 cSt at 40 °C = ISO VG 460 as lubricating oils for turning device.

<b>LUBRICATING OILS FOR ENGINE TURNING DEVICE</b>				
<b>SUPPLIER</b>	<b>BRAND NAME</b>	<b>VISCOSITY cSt at 40 °C</b>	<b>VISCOSITY cSt at 100 °C</b>	<b>VISCOSITY INDEX (VI)</b>
<b>BP</b>	<b>Energol GR-XP 460</b>	<b>460</b>	<b>30.5</b>	<b>95</b>
<b>Castrol</b>	<b>Alpha SP 460</b>	<b>460</b>	<b>30.5</b>	<b>95</b>
<b>Chevron (Texaco + Caltex + FMM)</b>	<b>Meropa 460</b>	<b>460</b>	<b>31.6</b>	<b>100</b>
<b>ENI S.p.A.</b>	<b>Blasia 320</b>	<b>300</b>	<b>23.0</b>	<b>95</b>
<b>ExxonMobil</b>	<b>Mobilgear 600 XP 460</b>	<b>460</b>	<b>30.6</b>	<b>96</b>
	<b>Mobilgear 634</b>	<b>437</b>	<b>27.8</b>	<b>96</b>
<b>Shell</b>	<b>Omala Oil 460</b>	<b>460</b>	<b>30.8</b>	<b>97</b>
<b>Total / Lubmarine</b>	<b>Epona Z 460</b>	<b>470</b>	<b>30.3</b>	<b>93</b>

### **6. LUBRICATING OILS FOR GOVERNOR / ACTUATOR**

An oil of viscosity class SAE 30 or SAE 40 is suitable and usually the same oil can be used as in the engine. Turbocharger oil can also be used in the governor. In low ambient conditions it may be necessary to use a multigrade oil (e.g. SAE 5W-40) to get a good control during start-up. Oil change interval: 2000 service hours.

## **7. LUBRICATING OILS FOR COUPLING OF PILOT FUEL PUMP**

**ONLY FOR W 32DF and W 34DF:**

It is recommended to use lithium soap based EP-greases having a penetration of 300 - 350 when measured according to the ASTM D 217 standard and being classed as NLGI Grade 1 at 30 - 70 °C operating temperature.

<b>LUBRICATING OILS FOR COUPLING OF PILOT FUEL PUMP</b>	
<b>SUPPLIER</b>	<b>BRAND NAME</b>
<b>BP</b>	<b>Energrease 1 Energrease SY 4601</b>
<b>Castrol</b>	<b>Spheerol EPL 1</b>
<b>Chevron (Texaco + Caltex + FAMM)</b>	<b>Dura-Lith Grease EP 1</b>
<b>ENI S.p.A.</b>	<b>GR-MU EP 1</b>
<b>ExxonMobil</b>	<b>Beacon EP 1 Mobiltemp 78 Mobilux EP 111 Mobilith SHC 460</b>
<b>IP</b>	<b>Athesia EP 1</b>
<b>Shell</b>	<b>Alvania EP 1</b>

**Product Name: Urea, Industrial Prills**

Page 1 of 5

**1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION**

Product Name: Urea, Industrial Prills  
Generic Name: Carbamide  
Chemical Family: Organic salt

Responsible Party: Cervantes~Delgado, Inc.  
P.O. Box 9083  
Brea, California 92822

For further information contact MSDS Coordinator  
8 am -4 pm Pacific Time, Mon- Fri: 714-990-3940

**EMERGENCY OVERVIEW**

**24 Hour Emergency Telephone Numbers:**

For Chemical Emergencies:

Spill, Leak, Fire or Accident  
Call CHEMTREC  
North America: (800) 424-9300  
Others: (703) 527-3887 (collect)

For Health Emergencies:

California Poison  
Control System  
Cont. US: (800) 356-3129  
Outside US: (415) 821-5338

**Health Hazards:** Avoid contact with eyes, skin and clothing. Wash thoroughly after handling.

**Physical Hazards:** None Anticipated

Physical Form: Solid  
Appearance: White prills  
Odor: None

NFPA HAZARD CLASS: Health: 0 (Least)  
Flammability: 0 (Least)  
Reactivity: 0 (Least)

## 2. COMPOSITION/INFORMATION ON INGREDIENTS

HAZARDOUS COMPONENTS	% Weight	EXPOSURE LIMITS		
		Limits	Agency	Type
Nuisance Dust, If Generated		10 mg/m <sup>3</sup>	ACGIH	TWA-Tot.
		3 mg/m <sup>3</sup>	ACGIH	TWA-Resp.
		15 mg/m <sup>3</sup>	OSHA	TWA-Tot.
		5 mg/m <sup>3</sup>	OSHA	TWA-Resp.
		10 mg/m <sup>3</sup>	MSHA	TWA
		10 mg/m <sup>3</sup>	Cal. OSHA	TWA-Tot.
		5 mg/m <sup>3</sup>	Cal. OSHA	TWA-Resp.
OTHER COMPONENTS	% Weight	EXPOSURE GUIDELINE		
		Limits	Agency	Type
Urea CAS# 57-13-6	97-99	(See Nuisance Dust, If Generated)		
Methylenediurea* CAS# 13547-17-6	1.5-2.5	Not Established		
Biuret CAS# 108-19-0	0.75-1.3	Not Established		

\*Methylenediurea is in the class of materials known as Urea, reaction products (CAS# 68611-64-3).

Note: State, local or other agencies or advisory groups may have established more stringent limits. Consult an industrial hygienist or similar professional, or your local agencies, for further information.

## 3. HAZARDS IDENTIFICATION

### **POTENTIAL HEALTH EFFECTS:**

**Eye:** Contact may cause mild eye irritation including stinging, watering, and redness.

**Skin:** Contact may cause mild skin irritation including redness and burning. No harmful effects from skin absorption have been reported.

**Inhalation (Breathing):** No information available. Studies by other exposure routes suggest a low degree of toxicity by inhalation.

**Ingestion (Swallowing):** No harmful effects reported from ingestion.

**Signs and Symptoms:** Effects of overexposure may include irritation of the nose, throat and digestive tract, headaches, coughing, nausea, vomiting, and transient disorientation.

**Cancer:** Inadequate data available to evaluate the cancer hazard of this material.

**Target Organs:** No data available.

**Developmental:** Inadequate data available for this material.

**Pre-Existing Medical Conditions:** None known.



#### **4. FIRST AID MEASURES**

**Eye:** If irritation or redness develops, move victim away from exposure and into fresh air. Flush eyes with clean water. If symptoms persist, seek medical attention.

**Skin:** Remove contaminated shoes and clothing and cleanse affected area(s) thoroughly by washing with mild soap and water. If irritation or redness develops and persists, seek medical attention.

**Inhalation (Breathing):** If respiratory symptoms develop, move victim away from source of exposure and into fresh air. If symptoms persist, seek medical attention. If victim is not breathing, clear airway and immediately begin artificial respiration. If breathing difficulties develop, oxygen should be administered by qualified personnel. Seek immediate medical attention.

**Ingestion (Swallowing):** First aid is not normally required; however, if swallowed and symptoms develop, seek medical attention.

#### **5. FIRE FIGHTING MEASURES**

**Flammable Properties:**

Flash Point:	No data
OSHA Flammability Class:	Not applicable
LEL/UEL:	No data
Autoignition Temperature:	No data
Burn Rate (solids):	No data

**Unusual Fire & Explosion Hazards:** No unusual fire or explosion hazards are expected.

**Fire Fighting Instructions:** For fires beyond the incipient stage, emergency responders in the immediate hazard area should wear bunker gear. When the potential chemical hazard is unknown, in enclosed or confined spaces, or when explicitly required by DOT, a self-contained breathing apparatus should be worn. In addition, wear other appropriate protective equipment as conditions warrant (see Section 8). Isolate immediate hazard area and keep unauthorized personnel out. Contain spill if it can be done with minimal risk. Move undamaged containers from immediate hazard area if it can be done with minimal risk. Cool equipment exposed to fire with water, if it can be done with minimal risk.

#### **6. ACCIDENTAL RELEASE MEASURES**

Stay upwind and away from spill. Isolate immediate hazard area and keep unauthorized personnel out. Contain spill if it can be done with minimal risk. Wear appropriate protective equipment including respiratory protection as conditions warrant (see Section 8). Prevent spilled material from entering sewers, storm drains, other unauthorized treatment drainage systems, and natural waterways. Notify appropriate federal, state, and local agencies. Minimize dust generation. Sweep up and package appropriately for disposal.

## **7. HANDLING AND STORAGE**

**Handling:** Do not enter confined spaces such as tanks or pits without following proper entry procedures such as ASTM D-4276 and 29CFR 1910.146. The use of appropriate respiratory protection is advised when concentrations exceed any established exposure limits (see Sections 2 and 8). Wash thoroughly after handling. Do not wear contaminated clothing or shoes. Use good personal hygiene practice.

**Storage:** Keep container(s) tightly closed. Use and store this material in cool, dry, well-ventilated areas. Store only in approved containers. Keep away from any incompatible material (see Section 10). Protect container(s) against physical damage.

## **8. EXPOSURE CONTROLS/PERSONAL PROTECTION**

**Engineering controls:** If current ventilation practices are not adequate to minimize exposure, additional ventilation or exhaust systems may be required.

### **Personal Protective Equipment (PPE):**

**Respiratory:** A NIOSH certified air-purifying respirator with a N95 filter may be used under conditions where airborne concentrations are expected to exceed exposure limits (see Section 2). Protection provided by air purifying respirators is limited (see manufacturer's respirator selection guide). Use a positive pressure air supplied respirator if there is potential for uncontrolled release, exposure levels are not known, or any other circumstances where air-purifying respirators may not provide adequate protection. A respiratory protection program that meets OSHA's 29CFR 1910.134 and ANSI 288.2 requirements must be followed whenever workplace conditions warrant a respirator's use.

**Skin:** The use of gloves impermeable to the specific material handled is advised to prevent skin contact, possible irritation, and absorption (see glove manufacturer literature for information on permeability).

**Eye/Face:** Approved eye protection to safeguard against potential eye contact, irritation, or injury is recommended. Depending on conditions of use, a face shield may be necessary.

**Other Protective Equipment:** A source of clean water should be available in the work area for flushing eyes and skin. Impervious clothing should be worn as needed.

## **9. PHYSICAL AND CHEMICAL PROPERTIES**

Note: Unless otherwise stated, values are determined at 20°C (68°F) and 760 mm Hg (1 atm).

<b>Flash Point:</b>	Not applicable
<b>Flammable/Explosive Limits (%):</b>	Not applicable
<b>Autoignition Temperature:</b>	Not applicable
<b>Burn Rate (solids only):</b>	No data
<b>Appearance:</b>	White prills
<b>Physical State:</b>	Solid
<b>Odor:</b>	None to slight ammonia
<b>Vapor Pressure (mm Hg):</b>	Not applicable
<b>Vapor Density (air=1):</b>	Not applicable
<b>Boiling Point:</b>	Not applicable
<b>Freezing/Melting Point:</b>	271°F
<b>Solubility in Water:</b>	100%
<b>Specific Gravity:</b>	>1
<b>Bulk Density:</b>	49.5 lbs/ft <sup>3</sup>

## **10. STABILITY AND REACTIVITY**

**Chemical Stability:** Stable under normal conditions of storage and handling.

**Conditions To Avoid:** None known

**Incompatible Materials:** Avoid contact with strong oxidizing agents such as chlorine (bleach), peroxides, chromates, nitric acid, perchlorates, concentrated oxygen or permanganates. Contact can generate heat, fires, explosions and release toxic fumes.

**Hazardous Decomposition Products:** If involved in a fire, oxides of carbon and nitrogen may be generated. Exposure to heat may generate ammonia and ammonium cyanate fumes.

**Hazardous Polymerization:** will not occur.

## **11. TOXICOLOGICAL INFORMATION**

No definitive information available on carcinogenicity, mutagenicity, target organs or developmental toxicity.

## **12. DISPOSAL CONSIDERATIONS**

This material, if discarded as produced, is not a RCRA "listed" or "characteristic" hazardous waste. Use resulting in chemical or physical change or contamination may subject it to regulation as a hazardous waste. Along with properly characterizing all waste materials consult state and local regulations regarding the proper disposal of this material.

**13. TRANSPORT INFORMATION**

Hazard Class or Division: Not classified as hazardous

**14. REGULATORY INFORMATION**

This material contains the following chemicals subject to the reporting requirements of **SARA 313** and 40 CFR 372.

--None--

**Warning:** This material contains the following chemicals which are known to the State of California to cause cancer, birth defects or other reproductive harm, and are subject to the requirements of **California Proposition 65** (CA Health & Safety Code Section 25249.5)

--None Known--

This material has not been identified as a carcinogen by NTP, IARC, or OSHA.

**EPA (CERCLA) Reportable Quantity:** --None--

**15. DOCUMENTARY INFORMATION**

Issue Date: 12/15/05

Previous Issue Date: 11/01/01

**16. DISCLAIMER OF EXPRESSED AND IMPLIED WARRANTIES**

The information in this document is believed to be correct as of the date issued. **HOWEVER, NO WARRANTY OF MERCHANTABILITY, FITNESS FOR ANY PARTICULAR PURPOSE, OR ANY OTHER WARRANTY IS EXPRESSED OR IS TO BE IMPLIED REGARDING THE ACCURACY OR COMPLETENESS OF THIS INFORMATION, THE RESULTS TO BE OBTAINED FROM THE USE OF THIS INFORMATION OR THE PRODUCT, THE SAFETY OF THIS PRODUCT, OR THE HAZARDS RELATED TO ITS USE.** This information and product are furnished on the condition that the person receiving them shall make his own determination as to the suitability of the product for his particular purpose and on the condition that he assumes the risk of his use thereof.

Table 4 - Urea Quality Schedule

Parameters	Unit of Measure	Value
Total Nitrogen	% weight	46.4
Aldehydes **	mg/kg	5.0 typical
Biuret	% weight	0.8 typical
Insoluble matter	mg/kg	5.0
Iron	mg/kg	0.75
Calcium	mg/kg	0.75
Magnesium	mg/kg	0.10
Phosphates	mg/kg	0.12
Potassium	mg/kg	0.30
Sulphates	mg/kg	0.01 typical
Alkalinity expressed as free Ammonia (free NH <sub>3</sub> )	mg/kg	0.01
Chlorides	mg/kg	0.01
Colour	° APHA	20.0 typical
Fraction > 5mm	% weight	0.5 typical
Fraction 2-5mm	% weight	99.0 typical
Fraction <2mm	% weight	0.5 typical
Angle of rest *	Degrees	34.0 typical
Crushing strength *	kg	5.0 typical
Bulk density loose *	kg/m <sup>3</sup>	785 typical
Bulk density tapped *	kg/m <sup>3</sup>	825 typical

Formaldehyde should <b>NOT</b> be present in the raw state.	Present / Not Present	Not present
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\* Typical Values, not specific to any particular batch.

\*\* A higher aldehyde concentration is allowed as long as **both** of the conditions below are observed:

- a. there are no other undefined and unspecified additives
- b. The concentration of any of the following elements in the urea - Sodium, Copper, Zinc, Nickel, Chromium, Alumina and Magnesia -, if present, should be lower than 2mg/kg.

## Safety Data Sheet

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### SECTION 1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

#### 1.1 Product Identifier

**Material Name** : Shell Mysella S5 N 40

**Product Code** : 001E7185

#### 1.2 Relevant identified uses of the substance or mixture and uses advised against

**Product Use** : Engine oil.

**Uses Advised Against** : This product must not be used in applications other than the above without first seeking the advice of the supplier.

#### 1.3 Details of the Supplier of the safety data sheet

**Manufacturer/Supplier** : Attard Services Ltd.

53, Tanks Street

BBG 02 Birzebbugia

Malta

**Telephone** : +356 (21) 652 222

#### 1.4 Emergency Telephone Number

: +356 (99) 406 601

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### SECTION 2. HAZARDS IDENTIFICATION

#### 2.1 Classification of the substance or mixture

1999/45/EC	
<b>Hazard Characteristics</b>	<b>R-phrases(s)</b>
Not classified as dangerous under EC criteria.;	

**Sensitiser not sufficient to classify** : Contains calcium sulphonate. May produce an allergic reaction.

#### 2.2 Label Elements



## Safety Data Sheet

### Labeling according to Directive 1999/45/EC

EC Symbols : No Hazard Symbol required

EC Classification : Not classified as dangerous under EC criteria.

EC Risk Phrases : Not classified.

EC Safety Phrases : Not classified.

### 2.3 Other Hazards

**Health Hazards** : Not expected to be a health hazard when used under normal conditions. Prolonged or repeated skin contact without proper cleaning can clog the pores of the skin resulting in disorders such as oil acne/folliculitis. Used oil may contain harmful impurities.

**Safety Hazards** : Not classified as flammable but will burn.

**Environmental Hazards** : Not classified as dangerous for the environment.

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## SECTION 3. COMPOSITION/INFORMATION ON INGREDIENTS

### 3.1 Substance

**Material Name** : Not applicable.

### 3.2 Mixtures

**Mixture Description** : Highly refined mineral oils and additives.

### Hazardous Components

#### Classification of components according to Regulation (EC) No 1272/2008

Chemical Name	CAS No.	EC Number	REACH Registration No.	Conc.
Polyolefin polyamine succinimide	Not available	Not available	Not available / Not applicable.	1.00 - 3.00%
Calcium alkaryl sulphonate	90480-91-4	291-829-9	Not available / Not applicable.	1.00 - 3.00%
Hindered phenol ester	Not available	Not available	Not available / Not applicable.	1.00 - 3.00%

## Safety Data Sheet

Calcium alkaryl sulphonate	722503-68-6	Not available	Not available / Not applicable.	0.10 - 0.50%
Interchangeable low viscosity base oil (<20,5 cSt @40°C) *	*	*	*	0.00 - 90.00%

Chemical Name	Hazard Class & Category	Hazard Statement
Polyolefin polyamine succinimide	Aquatic Chronic, 4;	H413;
Calcium alkaryl sulphonate	Aquatic Chronic, 4;	H413;
Hindered phenol ester	Aquatic Chronic, 4;	H413;
Calcium alkaryl sulphonate	Skin Sens., 1; Aquatic Chronic, 4;	H317; H413;
Interchangeable low viscosity base oil (<20,5 cSt @40°C) *	Asp. Tox., 1;	H304;

## Classification of components according to 67/548/EEC

Chemical Name	CAS No.	EC Number	REACH Registration No.	Symbol(s)	R-phrase(s)	Conc.
Polyolefin polyamine succinimide	Not available	Not available	Not available / Not applicable.		R53	1.00 - 3.00%
Calcium alkaryl sulphonate	90480-91-4	291-829-9	Not available / Not applicable.		R53	1.00 - 3.00%
Hindered phenol ester	Not available	Not available	Not available / Not applicable.		R53	1.00 - 3.00%
Calcium alkaryl sulphonate	722503-68-6	Not available	Not available / Not applicable.	Xi	R43; R53	0.10 - 0.50%

**Additional Information** : The highly refined mineral oil contains <3% (w/w) DMSO-extract, according to IP346.

Refer to Ch 16 for full text of R- and H- phrases.

\* contains one or more of the following CAS-numbers (REACH registration numbers): 64742-53-6 (01-2119480375-34), 64742-54-7 (01-2119484627-25), 64742-55-8 (01-2119487077-29),

## Safety Data Sheet

64742-56-9 (01-2119480132-48), 64742-65-0 (01-2119471299-27), 68037-01-4 (01-2119486452-34), 72623-86-0 (01-2119474878-16), 72623-87-1 (01-2119474889-13), 8042-47-5 (01-2119487078-27), 848301-69-9 (01-0000020164-80).

This mixture does not contain any REACH registered substances that are assessed to be a PBT or a vPvB.

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### SECTION 4. FIRST AID MEASURES

#### 4.1 Description of First Aid Measures

<b>General Information</b>	: Not expected to be a health hazard when used under normal conditions.
<b>Inhalation</b>	: No treatment necessary under normal conditions of use. If symptoms persist, obtain medical advice.
<b>Skin Contact</b>	: Remove contaminated clothing. Flush exposed area with water and follow by washing with soap if available. If persistent irritation occurs, obtain medical attention.
<b>Eye Contact</b>	: Flush eye with copious quantities of water. If persistent irritation occurs, obtain medical attention.
<b>Ingestion</b>	: In general no treatment is necessary unless large quantities are swallowed, however, get medical advice.
<b>Self-protection of the first aider</b>	: When administering first aid, ensure that you are wearing the appropriate personal protective equipment according to the incident, injury and surroundings.
<b>4.2 Most important symptoms and effects, both acute and delayed</b>	: Oil acne/folliculitis signs and symptoms may include formation of black pustules and spots on the skin of exposed areas. Ingestion may result in nausea, vomiting and/or diarrhoea.
<b>4.3 Indication of any immediate medical attention and special treatment needed</b>	: Notes to doctor/physician: Treat symptomatically.

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### SECTION 5. FIRE FIGHTING MEASURES

Clear fire area of all non-emergency personnel.

<b>5.1 Extinguishing Media</b>	: Foam, water spray or fog. Dry chemical powder, carbon dioxide, sand or earth may be used for small fires only.
<b>Unsuitable Extinguishing Media</b>	: Do not use water in a jet.
<b>5.2 Special hazards arising from the</b>	: Hazardous combustion products may include: A complex mixture of airborne solid and liquid particulates and gases

## Safety Data Sheet

- substance or mixture** (smoke). Carbon monoxide. Unidentified organic and inorganic compounds.
- 5.3 Advice for firefighters** : Proper protective equipment including chemical resistant gloves are to be worn; chemical resistant suit is indicated if large contact with spilled product is expected. Self-Contained Breathing Apparatus must be worn when approaching a fire in a confined space. Select fire fighter's clothing approved to relevant Standards (e.g. Europe: EN469).

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### SECTION 6. ACCIDENTAL RELEASE MEASURES

Avoid contact with spilled or released material. For guidance on selection of personal protective equipment see Chapter 8 of this Material Safety Data Sheet. Observe the relevant local and international regulations.

- 6.1 Personal Precautions, Protective Equipment and Emergency Procedures** : 6.1.1 For non emergency personnel: Avoid contact with skin and eyes.  
6.1.2 For emergency responders: Avoid contact with skin and eyes.
- 6.2 Environmental Precautions** : Use appropriate containment to avoid environmental contamination. Prevent from spreading or entering drains, ditches or rivers by using sand, earth, or other appropriate barriers.
- 6.3 Methods and Material for Containment and Cleaning Up** : Slippery when spilt. Avoid accidents, clean up immediately. Prevent from spreading by making a barrier with sand, earth or other containment material. Reclaim liquid directly or in an absorbent. Soak up residue with an absorbent such as clay, sand or other suitable material and dispose of properly.
- Additional Advice** : Local authorities should be advised if significant spillages cannot be contained.
- 6.4 Reference to other sections** : For guidance on selection of personal protective equipment see Chapter 8 of this Material Safety Data Sheet. For guidance on disposal of spilled material see Chapter 13 of this Material Safety Data Sheet.

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### SECTION 7. HANDLING AND STORAGE

- General Precautions** : Use local exhaust ventilation if there is risk of inhalation of vapours, mists or aerosols. Use the information in this data sheet as input to a risk assessment of local circumstances to help determine appropriate controls for safe handling, storage and disposal of this material.
- 7.1 Precautions for Safe** : Avoid prolonged or repeated contact with skin. Avoid inhaling

**Safety Data Sheet**

<b>Handling</b>	vapour and/or mists. When handling product in drums, safety footwear should be worn and proper handling equipment should be used. Properly dispose of any contaminated rags or cleaning materials in order to prevent fires. Keep container tightly closed and in a cool, well-ventilated place. Use properly labelled and closeable containers.
<b>Product Transfer</b>	: This material has the potential to be a static accumulator. Proper grounding and bonding procedures should be used during all bulk transfer operations.
<b>7.2 Conditions for safe storage, including any incompatibilities</b>	: Store at ambient temperature.
<b>Recommended Materials</b>	Refer to section 15 for any additional specific legislation covering the packaging and storage of this product. : For containers or container linings, use mild steel or high density polyethylene.
<b>Unsuitable Materials</b>	: PVC.
<b>7.3 Specific end use(s)</b>	: Not applicable
<b>Additional Information</b>	: Polyethylene containers should not be exposed to high temperatures because of possible risk of distortion.

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**SECTION 8. EXPOSURE CONTROLS/PERSONAL PROTECTION**

If the American Conference of Governmental Industrial Hygienists (ACGIH) value is provided on this document, it is provided for information only.

**8.1 Control Parameters****Occupational Exposure Limits**

Material	Source	Type	ppm	mg/m3	Notation
Oil mist, mineral	ACGIH	TWA(Inhalable fraction.)		5 mg/m3	

**Biological Exposure Index (BEI)**

No biological limit allocated.

**PNEC related information** : Data not available

**Monitoring Methods** : Monitoring of the concentration of substances in the breathing

## Safety Data Sheet

zone of workers or in the general workplace may be required to confirm compliance with an OEL and adequacy of exposure controls. For some substances biological monitoring may also be appropriate. Validated exposure measurement methods should be applied by a competent person and samples analysed by an accredited laboratory. Examples of sources of recommended exposure measurement methods are given below or contact the supplier. Further national methods may be available.

National Institute of Occupational Safety and Health (NIOSH), USA: Manual of Analytical Methods <http://www.cdc.gov/niosh/>

Occupational Safety and Health Administration (OSHA), USA: Sampling and Analytical Methods <http://www.osha.gov/>

Health and Safety Executive (HSE), UK: Methods for the Determination of Hazardous Substances <http://www.hse.gov.uk/>

Institut für Arbeitsschutz Deutschen Gesetzlichen Unfallversicherung (IFA), Germany. <http://www.dguv.de/inhalt/index.jsp>

L'Institut National de Recherche et de Sécurité, (INRS), France <http://www.inrs.fr/accueil>

### 8.2 Exposure Controls General Information

: The level of protection and types of controls necessary will vary depending upon potential exposure conditions. Select controls based on a risk assessment of local circumstances. Appropriate measures include: Adequate ventilation to control airborne concentrations. Where material is heated, sprayed or mist formed, there is greater potential for airborne concentrations to be generated.

Define procedures for safe handling and maintenance of controls. Educate and train workers in the hazards and control measures relevant to normal activities associated with this product. Ensure appropriate selection, testing and maintenance of equipment used to control exposure, e.g. personal protective equipment, local exhaust ventilation. Drain



**Safety Data Sheet**

down system prior to equipment break-in or maintenance. Retain drain downs in sealed storage pending disposal or for subsequent recycle. Always observe good personal hygiene measures, such as washing hands after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants. Discard contaminated clothing and footwear that cannot be cleaned. Practice good housekeeping.

**Occupational Exposure Controls**

- Personal Protective Equipment** : The provided information is made in consideration of the PPE directive (Council Directive 89/686/EEC) and the CEN European Committee for Standardisation (CEN) standards. Personal protective equipment (PPE) should meet recommended national standards. Check with PPE suppliers.
- Eye Protection** : Wear safety glasses or full face shield if splashes are likely to occur. Approved to EU Standard EN166.
- Hand Protection** : Where hand contact with the product may occur the use of gloves approved to relevant standards (e.g. Europe: EN374, US: F739) made from the following materials may provide suitable chemical protection: PVC, neoprene or nitrile rubber gloves. Suitability and durability of a glove is dependent on usage, e.g. frequency and duration of contact, chemical resistance of glove material, dexterity. Always seek advice from glove suppliers. Contaminated gloves should be replaced. Personal hygiene is a key element of effective hand care. Gloves must only be worn on clean hands. After using gloves, hands should be washed and dried thoroughly. Application of a non-perfumed moisturizer is recommended. For continuous contact we recommend gloves with breakthrough time of more than 240 minutes with preference for > 480 minutes where suitable gloves can be identified. For short-term/splash protection we recommend the same, but recognise that suitable gloves offering this level of protection may not be available and in this case a lower breakthrough time may be acceptable so long as appropriate maintenance and replacement regimes are followed. Glove thickness is not a good predictor of glove resistance to a chemical as it is dependent on the exact composition of the glove material.
- Body protection** : Skin protection not ordinarily required beyond standard issue work clothes.
- Respiratory Protection** : No respiratory protection is ordinarily required under normal conditions of use. In accordance with good industrial hygiene

**Safety Data Sheet**

practices, precautions should be taken to avoid breathing of material. If engineering controls do not maintain airborne concentrations to a level which is adequate to protect worker health, select respiratory protection equipment suitable for the specific conditions of use and meeting relevant legislation. Check with respiratory protective equipment suppliers. Where air-filtering respirators are suitable, select an appropriate combination of mask and filter. Select a filter suitable for combined particulate/organic gases and vapours [boiling point >65 °C (149 °F)] meeting EN14387.

**Thermal Hazards** : Not applicable.

**Environmental Exposure Controls**

**Environmental exposure control measures** : Minimise release to the environment. An environmental assessment must be made to ensure compliance with local environmental legislation. Information on accidental release measures are to be found in section 6.

**SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES****9.1 Information on basic physical and chemical properties**

Appearance	: Amber. Liquid at room temperature.
Odour	: Slight hydrocarbon.
Odour threshold	: Data not available
pH	: Not applicable.
Initial Boiling Point and Boiling Range	: > 280 °C / 536 °F estimated value(s)
Pour point	: Typical -18 °C / 0 °F
Flash point	: Typical 230 °C / 446 °F (COC)
Upper / lower Flammability or Explosion limits	: Typical 1 - 10 %(V) (based on mineral oil)
Auto-ignition temperature	: > 320 °C / 608 °F
Vapour pressure	: < 0.5 Pa at 20 °C / 68 °F (estimated value(s))
Relative Density	: Typical 0.89 at 15 °C / 59 °F
Density	: Typical 890 kg/m <sup>3</sup> at 15 °C / 59 °F
Water solubility	: Negligible.
Solubility in other solvents	: Data not available
n-octanol/water partition coefficient (log Pow)	: > 6 (based on information on similar products)
Dynamic viscosity	: Data not available
Kinematic viscosity	: Typical 135 mm <sup>2</sup> /s at 40 °C / 104 °F
Vapour density (air=1)	: > 1 (estimated value(s))

## Safety Data Sheet

Evaporation rate (nBuAc=1) : Data not available  
 Decomposition : Data not available  
 Temperature  
 Flammability : Data not available  
 Oxidizing Properties : Data not available  
 Explosive Properties : Not classified

### 9.2 Other Information

Other Information : not a VOC  
 Volatile organic carbon content : 0 %

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## SECTION 10. STABILITY AND REACTIVITY

**10.1 Reactivity** : The product does not pose any further reactivity hazards in addition to those listed in the following sub-paragraph.  
**10.2 Chemical stability** : No hazardous reaction is expected when handled and stored according to provisions.  
**10.3 Possibility of Hazardous Reactions** : Reacts with strong oxidising agents.  
**10.4 Conditions to Avoid** : Extremes of temperature and direct sunlight.  
**10.5 Incompatible Materials** : Strong oxidising agents.  
**10.6 Hazardous Decomposition Products** : Hazardous decomposition products are not expected to form during normal storage.

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## SECTION 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on Toxicological effects

**Basis for Assessment** : Information given is based on data on the components and the toxicology of similar products.  
 Unless indicated otherwise, the data presented is representative of the product as a whole, rather than for individual component(s).  
**Likely Routes of Exposure** : Skin and eye contact are the primary routes of exposure although exposure may occur following accidental ingestion.  
**Acute Oral Toxicity** : Expected to be of low toxicity: LD50 > 5000 mg/kg , Rat  
**Acute Dermal Toxicity** : Expected to be of low toxicity: LD50 > 5000 mg/kg , Rabbit  
**Acute Inhalation Toxicity** : Not considered to be an inhalation hazard under normal

## Safety Data Sheet

	conditions of use.
<b>Skin corrosion/irritation</b>	: Expected to be slightly irritating. Prolonged or repeated skin contact without proper cleaning can clog the pores of the skin resulting in disorders such as oil acne/folliculitis.
<b>Serious eye damage/irritation</b>	: Expected to be slightly irritating.
<b>Respiratory Irritation</b>	: Inhalation of vapours or mists may cause irritation.
<b>Respiratory or skin sensitisation</b>	: For respiratory and skin sensitisation: Not expected to be a sensitiser.
<b>Aspiration Hazard</b>	: Not considered an aspiration hazard.
<b>Germ cell mutagenicity</b>	: Not considered a mutagenic hazard.
<b>Carcinogenicity</b>	: Not expected to be carcinogenic. Product contains mineral oils of types shown to be non-carcinogenic in animal skin-painting studies. Highly refined mineral oils are not classified as carcinogenic by the International Agency for Research on Cancer (IARC).

Material		Carcinogenicity Classification
Highly refined mineral oil (IP346 <3%)	:	ACGIH Group A4: Not classifiable as a human carcinogen.
Highly refined mineral oil (IP346 <3%)	:	IARC 3: Not classifiable as to carcinogenicity to humans.
Highly refined mineral oil (IP346 <3%)	:	GHS / CLP: No carcinogenicity classification

<b>Reproductive and Developmental Toxicity</b>	: Not expected to be a hazard.
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## Summary on evaluation of the CMR properties

<b>Carcinogenicity</b>	: This product does not meet the criteria for classification in categories 1A/1B.,
<b>Mutagenicity</b>	: This product does not meet the criteria for classification in categories 1A/1B.
<b>Reproductive Toxicity (fertility)</b>	: This product does not meet the criteria for classification in categories 1A/1B.
<b>Specific target organ toxicity - single exposure</b>	: Not expected to be a hazard.
<b>Specific target organ toxicity - repeated exposure</b>	: Not expected to be a hazard.
<b>Additional Information</b>	: Used oils may contain harmful impurities that have accumulated during use. The concentration of such impurities

**Safety Data Sheet**

will depend on use and they may present risks to health and the environment on disposal. ALL used oil should be handled with caution and skin contact avoided as far as possible. Classifications by other authorities under varying regulatory frameworks may exist.

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**SECTION 12. ECOLOGICAL INFORMATION**

- Basis for Assessment** : Ecotoxicological data have not been determined specifically for this product. Information given is based on a knowledge of the components and the ecotoxicology of similar products. Unless indicated otherwise, the data presented is representative of the product as a whole, rather than for individual component(s).
- 12.1 Toxicity**  
**Acute Toxicity** : Poorly soluble mixture. May cause physical fouling of aquatic organisms. Expected to be practically non toxic: LL/EL/IL50 > 100 mg/l (to aquatic organisms) LL/EL50 expressed as the nominal amount of product required to prepare aqueous test extract. Mineral oil is not expected to cause any chronic effects to aquatic organisms at concentrations less than 1 mg/l.
- 12.2 Persistence and degradability** : Expected to be not readily biodegradable. Major constituents are expected to be inherently biodegradable, but the product contains components that may persist in the environment.
- 12.3 Bioaccumulative Potential** : Contains components with the potential to bioaccumulate.
- 12.4 Mobility in Soil** : Liquid under most environmental conditions. If it enters soil, it will adsorb to soil particles and will not be mobile. Floats on water.
- 12.5 Result of PBT and vPvB assesment** : This mixture does not contain any REACH registered substances that are assessed to be a PBT or a vPvB.
- 12.6 Other Adverse Effects** : Product is a mixture of non-volatile components, which are not expected to be released to air in any significant quantities. Not expected to have ozone depletion potential, photochemical ozone creation potential or global warming potential.

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**SECTION 13. DISPOSAL CONSIDERATIONS****13.1 Waste Treatment Methods**

## Safety Data Sheet

- Material Disposal** : Recover or recycle if possible. It is the responsibility of the waste generator to determine the toxicity and physical properties of the material generated to determine the proper waste classification and disposal methods in compliance with applicable regulations. Do not dispose into the environment, in drains or in water courses.
- Container Disposal** : Dispose in accordance with prevailing regulations, preferably to a recognised collector or contractor. The competence of the collector or contractor should be established beforehand.
- Local Legislation** : Disposal should be in accordance with applicable regional, national, and local laws and regulations.  
EU Waste Disposal Code (EWC): 13 02 05 mineral-based non-chlorinated engine, gear and lubricating oils. Classification of waste is always the responsibility of the end user.

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### SECTION 14. TRANSPORT INFORMATION

#### Land transport (ADR/RID):

##### ADR

This product is not classified as dangerous for this mode of transport. Therefore 14.1 UN Number, 14.2 UN Proper Shipping name, 14.3 Transport hazard class(es), 14.4 Packing group, 14.5 Environmental hazards, 14.6 Special precautions for user do not apply.

##### RID

This product is not classified as dangerous for this mode of transport. Therefore 14.1 UN Number, 14.2 UN Proper Shipping name, 14.3 Transport hazard class(es), 14.4 Packing group, 14.5 Environmental hazards, 14.6 Special precautions for user do not apply.

#### Inland waterways transport (ADN):

This product is not classified as dangerous for this mode of transport. Therefore 14.1 UN Number, 14.2 UN Proper Shipping name, 14.3 Transport hazard class(es), 14.4 Packing group, 14.5 Environmental hazards, 14.6 Special precautions for user do not apply.

#### Sea transport (IMDG Code):

This product is not classified as dangerous for this mode of transport. Therefore 14.1 UN Number, 14.2 UN Proper Shipping name, 14.3 Transport hazard class(es), 14.4 Packing group, 14.5 Environmental hazards, 14.6 Special precautions for user do not apply.

#### Air transport (IATA):

This product is not classified as dangerous for this mode of transport. Therefore 14.1 UN Number, 14.2 UN Proper Shipping name, 14.3 Transport hazard class(es), 14.4 Packing group, 14.5 Environmental hazards, 14.6 Special precautions for user do not apply.

## Safety Data Sheet

### 14.7 Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code

Pollution Category : Not applicable.  
Ship Type : Not applicable.  
Product Name : Not applicable.  
Special Precaution : Not applicable.

**Additional Information** : MARPOL Annex 1 rules apply for bulk shipments by sea.

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## SECTION 15. REGULATORY INFORMATION

The regulatory information is not intended to be comprehensive. Other regulations may apply to this material.

### 15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

#### Other regulatory Information

**Authorisations and/or restrictions on use** : Product is not subject to Authorisation under REACh.

**Recommended Restrictions on Use (Advice Against)** : This product must not be used in applications other than the above without first seeking the advice of the supplier.

#### Chemical Inventory Status

EINECS : All components listed or polymer exempt.  
TSCA : All components listed.

**15.2 Chemical Safety Assessment** : No Chemical Safety Assessment has been carried out for this substance/mixture by the supplier.

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## SECTION 16. OTHER INFORMATION

### R-phrases(s)

Not classified.  
R43 May cause sensitisation by skin contact.  
R53 May cause long-term adverse effects in the aquatic environment.



## Safety Data Sheet

### CLP Hazard Statements

- H304 May be fatal if swallowed and enters airways.
- H317 May cause an allergic skin reaction.
- H413 May cause long lasting harmful effects to aquatic life.

**Additional Information** : No Exposure Scenario annex is attached to this safety data sheet. It is a non-classified mixture containing hazardous substances as detailed in Section 3; relevant information from Exposure Scenarios for the hazardous substances contained have been integrated into the core sections 1-16 of this SDS.

### Other Information

#### Abbreviations and Acronyms

- : Acute Tox. = Acute toxicity  
 Asp. Tox. = Aspiration hazard  
 Aquatic Acute = Acute hazards to the aquatic environment  
 Aquatic Chronic = Hazardous to the aquatic environment - Long-term Hazard  
 Eye Dam. = Serious eye damage/eye irritation  
 Flam. Liq. = Flammable liquids  
 Skin Corr. = Skin corrosion/irritation  
 Skin Sens. = Skin sensitizer  
 STOT SE = Specific target organ toxicity - single exposure  
 STOT RE = Specific target organ toxicity - repeated exposure

The standard abbreviations and acronyms used in this document can be looked up in reference literature (e.g. scientific dictionaries) and/or websites.

ACGIH = American Conference of Governmental Industrial Hygienists  
 ADR = European Agreement concerning the International Carriage of Dangerous Goods by Road  
 AICS = Australian Inventory of Chemical Substances  
 ASTM = American Society for Testing and Materials  
 BEL = Biological exposure limits  
 BTEX = Benzene, Toluene, Ethylbenzene, Xylenes  
 CAS = Chemical Abstracts Service  
 CEFIC = European Chemical Industry Council  
 CLP = Classification Packaging and Labelling

## Safety Data Sheet

COC = Cleveland Open-Cup  
DIN = Deutsches Institut für Normung  
DMEL = Derived Minimal Effect Level  
DNEL = Derived No Effect Level  
DSL = Canada Domestic Substance List  
EC = European Commission  
EC50 = Effective Concentration fifty  
ECETOC = European Center on Ecotoxicology and Toxicology  
Of Chemicals  
ECHA = European Chemicals Agency  
EINECS = The European Inventory of Existing Commercial  
Chemical Substances  
EL50 = Effective Loading fifty  
ENCS = Japanese Existing and New Chemical Substances  
Inventory  
EWC = European Waste Code  
GHS = Globally Harmonised System of Classification and  
Labelling of Chemicals  
IARC = International Agency for Research on Cancer  
IATA = International Air Transport Association  
IC50 = Inhibitory Concentration fifty  
IL50 = Inhibitory Level fifty  
IMDG = International Maritime Dangerous Goods  
INV = Chinese Chemicals Inventory  
IP346 = Institute of Petroleum test method N° 346 for the  
determination of polycyclic aromatics DMSO-extractables  
KECI = Korea Existing Chemicals Inventory  
LC50 = Lethal Concentration fifty  
LD50 = Lethal Dose fifty per cent.  
LL/EL/IL = Lethal Loading/Effective Loading/Inhibitory loading  
LL50 = Lethal Loading fifty  
MARPOL = International Convention for the Prevention of  
Pollution From Ships  
NOEC/NOEL = No Observed Effect Concentration / No  
Observed Effect Level  
OE\_HP V = Occupational Exposure - High Production Volume  
PBT = Persistent, Bioaccumulative and Toxic  
PICCS = Philippine Inventory of Chemicals and Chemical  
Substances  
PNEC = Predicted No Effect Concentration  
REACH = Registration Evaluation And Authorisation Of  
Chemicals  
RID = Regulations Relating to International Carriage of  
Dangerous Goods by Rail

**Safety Data Sheet**

SKIN\_DES = Skin Designation  
STEL = Short term exposure limit  
TRA = Targeted Risk Assessment  
TSCA = US Toxic Substances Control Act  
TWA = Time-Weighted Average  
vPvB = very Persistent and very Bioaccumulative

- SDS Distribution** : The information in this document should be made available to all who may handle the product.
- SDS Version Number** : 1.0
- SDS Effective Date** : 06.11.2012
- SDS Revisions** : A vertical bar (|) in the left margin indicates an amendment from the previous version.
- SDS Regulation** : Regulation 1907/2006/EC as amended by Regulation (EU) 453/2010
- Disclaimer** : This information is based on our current knowledge and is intended to describe the product for the purposes of health, safety and environmental requirements only. It should not therefore be construed as guaranteeing any specific property of the product.

## SAFETY DATA SHEET

### 1 Identification of the substance or preparation and of the company/undertaking

#### 1.1 Product identifier

Product Name: ENGINE WATER TREATMENT 9-108  
 Datasheet Number: 777703 6. 0. 0  
 Product Part Number: 777703 (25Ltr)  
 Head Office:: Wilhelmsen Ships Service AS  
 Address: Strandveien 20, N1324 Lysaker, Norway, Tel: (+47) 67 58 45 50

#### 1.2 Relevant identified uses of the substance or mixture and uses advised against

##### Water treatment

#### 1.3 Details of the supplier of the safety data sheet

Name of Supplier: Wilhelmsen Ships Service AS  
 Address of Supplier: Willem Barentszstraat 50  
 3165AB Rotterdam  
 +31 4877 888  
 The Netherlands  
 Telephone: +31 4877 777  
 Fax:  
 Responsible Person: Patrick.Rijsdijk, Product HSE Manager, Tel.: +31 6 349 440 35  
 Email: Patrick.Rijsdijk@wilhelmsen.com

#### 1.4 Emergency telephone number

-ONLY TO BE USED IN CASE OF AN INCIDENT-  
 NCEC: +44 1865 407333, CHEMTREC (800) 424 9300  
 American Chemistry Council +1 703 527 3887,  
 Greece +30 210 7793777  
 Australia: +61 3 9630 0998  
 Giftinformasjonssentralen in Norway Tel.: +47 22591300

### 2 Hazards identification

#### 2.1 Classification of the substance or mixture

- Council Directive 1999/45/EEC Classification, packing and labelling of dangerous preparations.
- Refer to current The Dangerous Substances Directive (67/548/EEC)
- Regulations 1272/2008/EEC. Classification, labeling and packing of dangerous substances and preparations

#### 2.2 Label elements



Toxic



Dangerous for the Environment

- Contains:
- sodium nitrite
- sodium hydroxide

## 2 Hazards identification (....)

- Sodiumtetraborate
- Sodium tolytriazole

### Risk Phrases

- Toxic if swallowed (R25)
- Causes burns (R34)
- Very toxic to aquatic organisms (R50)

### Safety Phrases

- Avoid contact with skin and eyes (S24/25)
- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice (S26)
- This material and its container must be disposed of in a safe way (S35)
- Wear suitable protective clothing, eye/face protection and gloves (S36/37/39)
- In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible) (S45)

### 2.3 Other hazards

- Odour: Odourless
- Appearance: Liquid, light, yellow
- Inhalation: Inhalation may cause severe irritation and, dependent on dose, chemical burns.

## 3 Composition/information on ingredients

### 3.1 Mixtures

Chemical Name	Concentration	CAS Number	EC Number	R/H Phrases*	Symbols
sodium nitrite	30-60%	7632-00-0	231-555-9	R8, 25, 50	O, T, N
GHS CLASSIFICATION: Acute Tox. 3, Eye Irrit. 2 Aquatic Acute 1, Ox. Sol.2				H301, H400 H319, H272	GHS09, GHS06 GHS03
sodium hydroxide	1-5%	1310-73-2	215-185-5	R35	C
GHS CLASSIFICATION: Eye Dam. 1, Skin Corr.1B Met.Corr. 1				H318, H314 H290	GHS05
Sodiumtetraborate	1-2%	1330-43-4	215-540-4	R60, 61	T
GHS CLASSIFICATION: Repr. 1B, Eye Irrit. 2				H360, H319	GHS07
Sodium tolytriazole	1-5%	64665-57-2	265-004-9	R22, 34	C
GHS CLASSIFICATION: Skin Corr. 1B, Acute Tox. 4				H314, H302	GHS05, GHS07

\*See Section 16

## 4 First aid measures

### 4.1 Description of first aid measures

- IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower.
- When in doubt or symptoms persist, seek medical attention

## **4 First aid measures (....)**

- 
- IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
- Irrigate eyes thoroughly whilst lifting eyelids
- Obtain immediate medical attention
- 
- IF SWALLOWED: rinse mouth. Do NOT induce vomiting.
- Seek immediate medical attention
- 
- IF INHALED: If breathing is difficult, remove to fresh air and keep at rest in a position comfortable for breathing.
- Seek medical attention if irritation persists

### **4.2 Most important symptoms and effects, both acute and delayed**

- Prolonged skin or eye contact may cause chemical burns
- The ingestion of significant quantities may cause damage to lungs

### **4.3 Indication of immediate medical attention and special treatment needed**

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## **5 Fire-fighting measures**

### **5.1 Extinguishing media**

- Not flammable. In case of fire use extinguishing media appropriate to surrounding conditions

### **5.2 Special hazards arising from the substance or mixture**

- Smoke from fires is toxic. Take precautions to protect personnel from exposure

### **5.3 Advice for firefighters**

- Wear chemical protection suit and positive-pressure breathing apparatus
- 

## **6 Accidental release measures**

### **6.1 Personal precautions, protective equipment and emergency procedures**

- Wear protective clothing as per section 8
- Wash thoroughly after dealing with spillage

### **6.2 Environmental Precautions**

- Do not allow to enter public sewers and watercourses
- Do not flush spilt material into any public water system

### **6.3 Methods and material for containment and cleaning up**

- Ventilate the area and wash spill site after material pick-up is complete
- Absorb spillage in earth or sand

### **6.4 Reference to other sections**

- None
- 

## **7 Handling and storage**

### **7.1 Precautions for safe handling**

- Avoid breathing dust/fume/gas/mist/vapours/spray.
-

## 7 Handling and storage (....)

- Do not get in eyes, on skin, or on clothing.
- Eyewash bottles should be available

### 7.2 Conditions for safe storage, including any incompatibilities

- Keep container tightly closed, in a cool, well ventilated place (S3/7/9)
- Avoid contact with acid

### 7.3 Specific end use(s)

---

## 8 Exposure controls/personal protection

### 8.1 Control parameters

- sodium hydroxide  
WEL (short term) 2 mg/m<sup>3</sup>
- Sodiumtetraborate  
TLV (TWA) 1 mg/m<sup>3</sup> ( )

### 8.2 Exposure controls

- Engineering controls should be provided which maintain airborne concentrations as low as practicable

#### Occupational exposure controls

- In case of high airborne concentrations, wear suitable positive pressure respiratory protection equipment
- Wear rubber or PVC gloves
- Wear plastic or rubber gloves, boots and apron
- Wear goggles giving complete eye protection



Gloves



Suit



Respirator

Boots

---

## 9 Physical and chemical properties

### 9.1 Information on basic physical and chemical properties

- Odour: Amine odour
- Appearance: Liquid, light, yellow
- pH 13.2 - 14 at 100 % concentration
- Boiling point 100 °C at 760 mm /Hg
- Completely soluble in water
- Density 1.31 g/cm<sup>3</sup> at 20 deg C
- Auto-ignition point - not known

### 9.2 Other information

- None
- 

## 10 Stability and reactivity

### 10.1 Reactivity

- This article is considered stable under normal conditions
-



## 10 Stability and reactivity (....)

### 10.2 Chemical stability

- Considered stable under normal conditions

### 10.3 Possibility of hazardous reactions

- No hazardous reactions known if used for its intended purpose

### 10.4 Conditions to avoid

- Keep away from heat and sources of ignition

### 10.5 Incompatible materials

- Contact with reducing agents liberates toxic gas
- Contact with reducing agents may form explosive gases
- Contact with amines liberates toxic gas

### 10.6 Hazardous Decomposition Products

- Decomposition products may include nitrogen oxides
- 

## 11 Toxicological information

### 11.1 Information on toxicological effects

- LD50 (oral,rat) (Sodium nitrite) 85 mg/kg

#### Inhalation

- Can cause damage to the lungs

#### Contact with skin

- Prolonged skin or eye contact may cause chemical burns

#### Contact with eyes

- Prolonged skin or eye contact may cause chemical burns
- Can cause damage to the eyes

#### Ingestion

- Not regarded as a potential route of exposure.
  - The ingestion of significant quantities may cause damage to mucous membranes
  - Toxic if swallowed.
- 

## 12 Ecological information

### 12.1 Toxicity

- LC50 (fish) (Sodium nitrite) 0.56 - 1.78 mg/l (96 hr)
- LC50 (fish) (Sodium tetraborate) 650 mg/l (96 hr)
- LC50 (rainbow trout) (Sodium tolytriazole) 23.7 mg/l (96 hr)
- EC50 (daphnia) (Sodium nitrite) 12.5-100 mg/l (48 hr)
- EC50 (daphnia) (Sodium tetraborate) 100 mg/l (48 hr)

### 12.2 Persistence and degradability

- No information available

### 12.3 Bioaccumulation Potential

- Bioaccumulation of the components in this product is insignificant.
-

## 12 Ecological information (....)

### 12.4 Mobility in soil

- Completely soluble in water

### 12.5 Results of PBT and vPvB assessment

- Not a PBT according to REACH Annex XIII

### 12.6 Other Adverse Effects

---

## 13 Disposal considerations

### 13.1 Waste treatment methods

- Disposal should be in accordance with local, state or national legislation
- Do not discharge into drains or the environment, dispose to an authorised waste collection point

#### Classification

- EU Waste class: 16-03-03
- 

## 14 Transport information



Corrosive



Toxic

### 14.1 UN Number

- UN2922

### 14.2 UN Proper Shipping Name

- CORROSIVE LIQUID, TOXIC, N.O.S. (Sodium Hydroxide, Sodium Nitrite mixture)

### 14.3 Transport hazard class(es)

- 8+6.1

### 14.4 Packing group

- III

### 14.5 Environmental hazards

- This product contains components which are classified in the EU as dangerous for the environment.

### 14.6 Special precautions for user

- No special precautions are required for this product

### 14.7 Transport in bulk according to Annex II of MARPOL 73/78 and the IBC code

- Not applicable

#### Other information

---

**14 Transport information (....)**

## Road/Rail (ADR/RID)

Proper Shipping Name:	CORROSIVE LIQUID, TOXIC, N.O.S. (Sodium Hydroxide, Sodium Nitrite mixture)		
ADR UN No.:	UN2922	ADR Hazard Class:	8
ADR Packing Group:	III	ADR subrisk:	6.1
ADR Flashpoint:	n/a		

## Sea (IMDG)

Proper Shipping Name:	CORROSIVE LIQUID, TOXIC, N.O.S. (Sodium Hydroxide, Sodium Nitrite mixture)		
IMDG UN No.:	UN2922	IMDG Hazard Class.:	8
IMDG Pack Group.:	III	IMDG EmS:	F-A, S-B
IMDG subrisk:	6.1	IMDG Flashpoint:	n/a

## Air (ICAO/IATA)

Proper Shipping Name:	CORROSIVE LIQUID, TOXIC, N.O.S. (Sodium Hydroxide, Sodium Nitrite mixture)		
ICAO Un No.:	UN2922	ICAO Hazard Class.:	8
ICAO Packing Group.:	III	ICAO subrisk:	6.1
ICAO Flashpoint:	n/a		

## DOT / CFR (US Department of Transportation)

DOT Proper Shipping Name:	CORROSIVE LIQUID, TOXIC, N.O.S. (Sodium Hydroxide, Sodium Nitrite mixture)		
Hazardous Material:	Sodium Hydroxide, Sodium Nitrite		
Hazard Class:	8	Identification Number:	UN2922
Product RQ (lbs):	n/a	DOT subrisk:	6.1
DOT Flashpoint:	n/a		

**15 Regulatory information**

## 15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

- This Safety Data Sheet has been prepared in accordance with article 31 and annex II in REACH and Directive 453/2010/EU.
- 
- SUBSTANCES OF VERY HIGH CONCERN (SVHC) ACCORDING TO REACH, ARTICLE 57:  
CAS: 1330-43-4 - Sodiumtetraborate

## 15.2 Chemical Safety Assessment

None

**16 Other information**

---

**16 Other information (....)**

Text of R and S phrase codes used in this safety data sheet:- H272: May intensify fire; oxidizer.; H290: May be corrosive to metals.; H301: Toxic if swallowed.; H302: Harmful if swallowed.; H314: Causes severe skin burns and eye damage.; H318: Causes serious eye damage.; H319: Causes serious eye irritation.; H360: May damage fertility or the unborn child.; H400: Very toxic to aquatic life.; R22: Harmful if swallowed; R25: Toxic if swallowed; R34: Causes burns; R35: Causes severe burns; R50: Very toxic to aquatic organisms; R60: May impair fertility; R61: May cause harm to the unborn child; R8: Contact with combustible material may cause fire.

The data given here is based on current knowledge and experience. This Safety Data Sheet describes the product in terms of safety requirements and does not signify any warranty with regard to the product's properties

The data given here only applies when product used for proper application(s). The product is not sold as suitable for other applications - usage in such may cause risks not mentioned in this sheet. Do not use for other application(s) without seeking advice from manufacturer

The information provided about the product on this Safety Data Sheet has been compiled from knowledge of the individual constituents

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---

## **Appendix II**

### *Preliminary Maintenance Programme*

# **Summary of the Operations and Maintenance Manual**

## **General characteristics**

### **Risk Reduction**

- All personnel using the engine and related equipment must be trained and have read in detail the operational and maintenance manual.
- Proper personal safety equipment is required in all circumstances.
- All necessary measures to minimize or eliminate the risk of electronic equipment being damaged by electrostatic discharge are taken.
- Risks were categorised accordingly:
  - General hazards
    - Crankcase safety explosion valves opening due to crankcase explosion
    - Fire or explosion due to leakage in fuel/gas line or lube oil system
    - Explosion or fire if flammable gas/vapour is leaking into the insulation box
  - Hazards due to moving parts
    - Unexpected movement of components
  - Hazards due to incorrect operating conditions
    - Overspeed or explosion due to air-gas mixture in the charge air
    - Low lube-oil flow
  - Hazards due to leakage, breakdown or improper component assembly
    - Leakage of fuel at joints on the low and/or high pressure side, lubricating oil, high pressure on direct water injection engines, HT water, charge air, exhaust gas and pressurised air.
    - Fire or explosion due to leakage from a fuel or gas line
    - Failure of pneumatic stop
  - Electrical hazards
    - Fire or sparks due to damage or short circuit in electrical equipment
    - Contact with electricity during maintenance work if power is not disconnected
    - Overload of a control system component due to incorrect electrical connections, damage control circuitry or incorrect voltage.
  - Other hazards
    - Improper treatment of water additives and treatment products
    - Exposure to high noise levels

### **Hazardous substances**

- Fuel oils, lubricating oils and cooling water additives are environmentally hazardous substances.
- **Fuel oils**
  - Non-volatile burning liquids that also contain volatile fractions and present a risk of fire and explosion.

- They also may be a cause of long-term harm and damage in the water environments and contaminate the soil and ground water.
- Prolonged contact may cause irritation and increase the risk of skin cancer.
- Fumes of hydrogen sulphide or light hydrocarbons may be released during loading or bunkering and these are irritating for the eyes and respiratory organs.
- Note the risk of methane gas formation in storage tanks due to bacterial activities during long-term storage. This may be a cause of explosion, especially during unloading and operating storage tanks.
- **Natural gas**
  - non-toxic and will not harm anyone breathing in low concentrations.
  - Heavy concentrations, however, can cause drowsiness and eventual suffocation. Particularly serious are fires and explosions, caused by gas leakage into the engine room, and explosions caused by unburnt gas in the exhaust system.
  - Damage from explosion is caused by the shockwave and the burning effect of the expanding and partly burning gases.
  - This can be avoided by preventing pressure build up in the equipment and extracting the released gas to an open area.
- **Lubricating oils**
  - Fresh lubricating oils are normally not particularly toxic but they should be handled with care.
  - Used lubricating oils may contain significant amounts of harmful metal and PAH (polyaromatic hydrocarbon) compounds.
  - There is a risk of long term contamination of the soil and the ground water.
  - Safety precautions and recommended protection equipment are explained in the manual to deal with this chemical.
- Cooling water additives are toxic if swallowed and may cause pain, headache and irritations.
- Lead in bearings – Wartsila uses bearings containing lead and are therefore toxic. Scrapped bearings should be disposed of carefully.
- Fluoride rubber products

## **Single gas system**

### **Start, Stop and Operation**

- An engine logbook is kept for every engine, whereby the starting and stopping times, loads, pressures and temperatures of each engine are listed.
- A prerequisite checklist is given to ensure proper conditions before operating the engine. These include: lubricating oil temperatures, cooling water temperatures, space for turning device.
- Only trained personnel are allowed to use the turning device and the control unit.
- Engines operate on standby mode. The engine is ready to accept load within 3 to 4 minutes according to the engine loading guidelines (circulation of lubricating oil and water at predetermined temperatures) and several other precautions must be taken.
- Indications about maximum permissible load steps are given for varying conditions.



- The engines and their control panels are fixed with an alarm to indicate abnormal conditions. If these conditions are considered to be extreme, the engine will automatically shut down.
- Idling of the engine is only used for a few minutes during maintenance checks i.e. running the engine while it is declutched or generator breaker open.
- As part of the supervision procedure of the engine operation, the following data should be recorded during operation:
  - Temperatures
  - Pressures
  - Load
  - Engine speed
  - Turbocharger speed
- Further checklists applying to the engine which has been stopped:
  - for less than eight hours
  - for a prolonged period of time
  - due to an overhaul
- Guidelines are also given on how to adjust to varying ambient conditions of temperature and humidity, because these may lead to varying condensation conditions in the charge air coolers.
- Supervision of strong blow-by past the pistons and the monitoring of the oil mist detector is also mentioned.
- Guidelines on how to start and operate the engine after an engine overhaul are clearly stated in the guidelines.
- The engines should not be run on low loads, because there is a risk of misfiring which may lead to unburnt gas entering the exhaust system and causing an explosion. Running on low load will be done in a controlled manner and only for overhaul purposes.
- The engine can also be started/stopped remotely by using a master console. It can also be stopped by using the emergency stop button, especially in cases of emergency, whereby guidelines are also given to deal with common emergency situations.
- Recommendations and guidelines are given to prepare the engines for prolonged halt periods.
- Running in procedures are explained to deal with cases of piston overhaul, changing piston rings, pistons or cylinder liners and honing cylinder liners.

### **Maintenance schedule**

- Detailed maintenance guidelines are given to prevent personal injury, engine damage and environmental threats.
- Daily inspections of:
  - Gas system – gas leakages
  - Oil mist detector – observe normal operation
  - Pneumatic system - drain condensate water
- Every second day:
  - Automatic prelubrication
  - Crankshaft

- Once a week:
  - Test start process when engine is on standby
  - Lubricating oil pressure pulsation damper
  - Charge air cooler's condensation drain
  - Oil mist detector (cleaning)
- Every second week:
  - Cooling water system (check water quality and content additives)
- Every 50 operating hours:
  - Air cooler (cleaning and leakages)
  - Automation (check and record all operating values)
  - Cooling water system (Water level, pressure, ventilation)
  - Gas and lubricating oil filters
  - Turbocharger (cleaning)
  - Valve mechanism
- Every 500 operating hours:
  - Centrifugal filter
  - Charge air cooler
  - Lubricating oil
  - Oil mist detector
  - Wastegate valve
  - Bypass valve
- Every 1000 operating hours:
  - Air-filter
  - Electrical lubricating oil pump
  - Engine fastening bolts
  - Gas filter engine mounted
  - Gas filter on gas regulating unit
- Every 2000 operating hours:
  - Control and monitoring system
  - Gas system
  - Ignition system
  - Lubricating oil filter
  - Oil mist detector
  - Valves
  - Valve rotators
- New maintenance criteria pursue for: 4000hrs, 6000hrs, 8000hrs, 9000hrs, 12000hrs, 18000hrs, 24000hrs, 32000hrs, 36000hrs, 48000hrs and 72000hrs. As the number of hours increase, the maintenance programme will fluctuate from simple every day inspections to time-consuming replacement of engine components to ensure an efficient and safe process.

## **Dual Fuel System**

- The DF engine fuel can be changed while the engine is running, within certain limits, without interrupting the operation or power generation. When the gas supply fails, the engine automatically transfers to diesel mode operation.
- When operating on natural gas, it is injected into the engine at a low pressure, and is ignited by injecting a small amount of pilot diesel fuel.
- When operating on diesel, the engine operates only on liquid fuel oil (HFO)

### **Start, stop, operation**

- Engine can be operated in three different modes:
  - Gas mode with diesel pilot injection
  - Diesel mode with pilot injection
  - Diesel mode without pilot injection (backup mode)
- The engine can be started, stopped and operated on all types of fuel under all operating conditions. Depending on the fuel quality and combustion, idling and operating at low loads may form more soot, deposits, and sludge compared to operating at high loads. These deposits contaminate the engine internally.
- This causes the lubricating oil filters and separators to be loaded more heavily, and piston rings and valve stems to stick. The deposits that are not sufficiently neutralised by the lubricating oil may cause corrosion, along with potential hard deposits stuck in the sealing surfaces between exhaust valve.
- Loading the engine is important also prior to engine stop or transfer to gas mode.
- Refer to previous SG section for the remaining details.

### **Maintenance**

- Maintenance schedule distinguishes between the following fuel types:
  - Heavy fuel oil normal quality
  - Heavy fuel oil quality below normal standard
  - Diesel oil or light fuel oil
  - Natural gas
- The maintenance schedule is practically identical to the single fuel system when considering frequent or day to day inspections. However, some significant alterations are mentioned as the number of operating hours increase, in order to cater for the different components of the dual fuel system. This also varies with the fuel type and quality that is used.

---

## **Appendix III**

*Safety reports*

# *Delimara Power Station – D3 Hazard Studies 1 and 2*

**Technical Report**

DOCUMENT REF. NO: ENV332381/A/14

**24 April 2015**



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D3 POWER GENERATION MALTA

# HAZOP Report

Shanghai Electric Power Engineering (Malta) Co.,Ltd.

**Report No.:** , Rev.

**Document No.:** 1S95ODH-2

**Date:** 2015-06-15



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VLT1236, Malta  
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# *ATEX and Ventilation Analysis*

*For study of 4th and 5th June 2015 at Delimara  
D3 Power Station*

## **Technical Report**

DOCUMENT REF. NO: ENV332453/B/15  
THIRD DRAFT

09 July 2015




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Normal shut down

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vent system during in the event of a jet fire.

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## **Appendix IV**

*BAT documents for Large Combustion Plants,  
Emissions from Storage and Industrial cooling systems BREFs*

## Annex I: Comparison of the processes at the Installation with the BREF for Emissions from storage (published July 2006).

### Part 1: Storage of liquids and liquefied gases

#### 1.1 Tanks

Aspect of BAT	BAT	Status at Installation
<b>General principles to prevent and reduce emissions</b> <b>Tank design</b>	<p>BAT for a proper design is to take into account at least the following:</p> <ul style="list-style-type: none"> <li>• the physico-chemical properties of the substance being stored</li> <li>• how the storage is operated, what level of instrumentation is needed, how many operators are required, and what their workload will be</li> <li>• how the operators are informed of deviations from normal process conditions (alarms)</li> <li>• how the storage is protected against deviations from normal process conditions (safety instructions, interlock systems, pressure relief devices, leak detection and containment, etc.)</li> <li>• what equipment has to be installed, largely taking account of past experiences of the product (construction materials, valve quality, etc.)</li> <li>• which maintenance and inspection plan needs to be implemented and how to ease the maintenance and inspection work (access, layout, etc.)</li> <li>• how to deal with emergency situations (distances to other tanks, facilities and to the boundary, fire protection, access for emergency services such as the fire brigade, etc.).</li> </ul>	<p>The day tanks that are currently present on site have a varying capacity of 25-175m<sup>3</sup> depending on the contents of each tank. The following tanks form part of the current D3 operations, some of which will be shut down following the proposed engine conversions:</p> <ul style="list-style-type: none"> <li>• (x2) HFO buffer tanks – 125m<sup>3</sup> – will not be operated any longer</li> <li>• (x2) HFO service tanks – 125m<sup>3</sup> – will not be operated any longer</li> <li>• (x1) Lube oil tank – 175m<sup>3</sup></li> <li>• (x1) Maintenance lube oil tank – 25m<sup>3</sup></li> <li>• (x2) Sludge tanks – 40m<sup>3</sup></li> <li>• (x2) Urea dissolving tanks – 65m<sup>3</sup></li> <li>• (x2) Urea storage tanks – 125m<sup>3</sup></li> <li>• (x1) Diesel day tank – 140m<sup>3</sup></li> </ul> <p>Tanks and associated pipe work are designed and installed according to established standards. No new tanks or piping systems are being proposed.</p> <p>Preventive maintenance programmes (daily checks) and a bund drainage system are already being employed at D3, and are expected to ensue. Day tanks are also provided with containment including fully-sealed bunds with reinforced</p>

Aspect of BAT	BAT	Status at Installation
	See Annex 8.19 for a typical checklist.	<p>concrete of 110% capacity of one tank and 25% capacity of all tanks.</p> <p>Moreover, a software programme is used at the control room to monitor the day tank levels and rapidly identify potential leakages that may be occurring at real-time basis (24/7).</p> <p>Both local and remote level indications are in place. These include sounding high level alarms with interlocks to shut down in cases of emergency.</p>
<b>General principles to prevent and reduce emissions</b> <b>Inspection and maintenance</b>	<p>BAT is to apply a tool to determine proactive maintenance plans and to develop risk-based inspection plans such as the risk and reliability based maintenance approach; see Section 4.1.2.2.1.</p> <p>Inspection work can be divided into routine inspections, in-service external inspections and out-of-service internal inspections and are described in detail in Section 4.1.2.2.2.</p>	Noted. Daily inspection checks will be conducted to prevent and reduce potential leakages. In addition to this, the tanks are continuously supervised by trained operators.
<b>General principles to prevent and reduce emissions</b> <b>Location and lay-out</b>	<p>For building new tanks it is important to select the location and the layout with care, e.g. water protection areas and water catchment areas should be avoided whenever possible. See Section 4.1.2.3.</p> <p>BAT is to locate a tank operating at, or close to, atmospheric pressure aboveground. However, for storing flammable liquids on a site with restricted space, underground tanks can also be considered. For liquefied gases, underground, mounded storage or spheres can be</p>	Not applicable, since new tanks will not be proposed.

Aspect of BAT	BAT	Status at Installation
	considered, depending on the storage volume.	
<b>General principles to prevent and reduce emissions</b> <b>Tank colour</b>	BAT is to apply either a tank colour with a reflectivity of thermal or light radiation of at least 70 %, or a solar shield on aboveground tanks which contain volatile substances, see Section 4.1.3.6 and 4.1.3.7 respectively.	The tanks' colours have a high reflectivity in accordance with the BAT.
<b>General principles to prevent and reduce emissions</b> <b>Emissions minimization principle in tank storage</b>	BAT is to abate emissions from tank storage, transfer and handling that have a significant negative environmental effect, as described in Section 4.1.3.1. This is applicable to large storage facilities allowing a certain time frame for implementation.	Emission vapours arise when topping up the gasoil day tanks. During refilling, displaced air is extracted from tank vents and is passed through an activated carbon filter before releasing the air into the atmosphere. The carbon filter provides a high surface area to volume ratio for the adsorption of impurities released from the tank.  The tanks are also fully-sealed and bunded according to EU standards as explained above. The bunding system contains a network of drains and pits which are connected to a diaphragm pump that transfers the collected leaks or spillages to the oily water system (sludge) or to the general drains of the DPS.
<b>General principles to prevent and reduce emissions</b> <b>Monitoring of VOC</b>	On sites where significant VOC emissions are to be expected, BAT includes calculating the VOC emissions regularly. The calculation model may occasionally need to be validated by applying a measurement method. See Section 4.1.2.2.3. <sup>1</sup>	VOC emissions are expected to occur mostly from gasoil storage. Air vents are present in the gasoil tank. These are fitted with a CO sensor and a carbon filter before allowing vapours to be released into the atmosphere. The purpose of the CO sensor is to monitor the CO levels contained in each tank's extracted air vent. An alarm is sounded when a 3% CO level is reached. This alarm acts as an indicator for maintenance personnel to remove the fully-saturated activated carbon and replace it with a new layer of non-saturated activated carbon.

Aspect of BAT	BAT	Status at Installation
		VOC monitoring for lube oil tanks, urea and sludge tanks is not applied because the emissions generated are not significant.
<b>General principles to prevent and reduce emissions</b> <b>Dedicating systems</b>	<p>BAT is to apply dedicated systems; see Section 4.1.4.4.</p> <p>Dedicated systems are generally not applicable on sites where tanks are used for short to medium-term storage of different products.</p>	The storage tanks used by D3PG are all dedicated systems. This reduces the need for cleaning operations and significantly reduces the emissions to air and the wastes generated.
<b>Tank specific considerations</b> <b>Open top tanks</b>	<p>Open top tanks are used for the storage of, e.g. manure slurry in agricultural premises and water and other non-flammable or non-volatile liquids in industrial facilities, see Section 3.1.1.</p> <p>If emissions to air occur, BAT is to cover the tank by applying:</p> <ul style="list-style-type: none"> <li>• a floating cover, see Section 4.1.3.2</li> <li>• a flexible or tent cover, see Section 4.1.3.3, or</li> <li>• a rigid cover, see Section 4.1.3.4.</li> </ul> <p>Additionally, with an open top tank covered with a flexible, tent or a rigid cover, a vapour treatment installation can be applied to achieve an additional emission reduction, see Section 4.1.3.15. The type of cover and the necessity for applying the vapour treatment system depend on the substances stored and must be decided on a case-by-case basis.</p> <p>To prevent deposition that would call for an additional</p>	Not applicable, since no open top tanks are present.

Aspect of BAT	BAT	Status at Installation
	cleaning step, BAT is to mix the stored substance (e.g. slurry), see Section 4.1.5.1.	
<b>Tank specific considerations</b> <b>External floating roof tank</b>	<p>External floating roof tanks are used for the storage of, e.g. crude oil; see Section 3.1.2.</p> <p>The BAT associated emission reduction level for a large tank is at least 97 % (compared to a fixed roof tank without measures), which can be achieved when over at least 95 % of the circumference the gap between the roof and the wall is less than 3.2 mm and the seals are liquid mounted, mechanical shoe seals. By installing liquid mounted primary seals and rim mounted secondary seals, a reduction in air emissions of up to 99.5 % (compared to a fixed roof tank without measures) can be achieved. However, the choice of seal is related to reliability, e.g. shoe seals are preferred for longevity and, therefore, for high turnovers. See Section 4.1.3.9.</p> <p>BAT is to apply direct contact floating roofs (double-deck), however, existing non-contact floating roofs (pontoon) are also BAT. See Section 3.1.2.</p> <p>Additional measures to reduce emissions are (see Section 4.1.3.9.2):</p> <ul style="list-style-type: none"> <li>• applying a float in the slotted guide pole</li> <li>• applying a sleeve over the slotted guide pole, and/or</li> <li>• applying ‘socks’ over the roof legs.</li> </ul> <p>A dome can be BAT for adverse weather conditions, such as high winds, rain or snowfall. See Section 4.1.3.5.</p>	Not applicable, since external floating roof tanks are not used at D3.



Aspect of BAT	BAT	Status at Installation
	For liquids containing a high level of particles (e.g. crude oil), BAT is to mix the stored substance to prevent deposition that would call for an additional cleaning step, see Section 4.1.5.1.	
<b>Tank specific considerations</b> <b>Fixed roof tanks</b>	<p>Fixed roof tanks are used for the storage of flammable and other liquids, such as oil products and chemicals with all levels of toxicity, see Section 3.1.3.</p> <p>For the storage of volatile substances which are toxic (T), very toxic (T+), or carcinogenic, mutagenic and reproductive toxic (CMR) categories 1 and 2 in a fixed roof tank, BAT is to apply a vapour treatment installation.<sup>2</sup></p> <p>For other substances, BAT is to apply a vapour treatment installation, or to install an internal floating roof (see Sections 4.1.3.15 and 4.1.3.10 respectively). Direct contact floating roofs and non-contact floating roofs are BAT. In the Netherlands, the condition for when to apply these BAT is when the substance has a vapour pressure (at 20 °C) of 1 kPa and the tank has a volume of <math>\geq 50 \text{ m}^3</math>. In Germany, the condition for when to apply these BAT is when the substance has a vapour pressure (at 20 °C) of 1.3 kPa and the tank has a volume of <math>\geq 300 \text{ m}^3</math>.</p> <p>For tanks <math>&lt; 50 \text{ m}^3</math>, BAT is to apply a pressure relief valve set at the highest possible value consistent with the tank design criteria.</p>	<p>Fixed roof tanks are used for all of the storage tanks used by D3PG. Non-pressurised fixed roof tanks are suitable for storage at atmospheric pressure and therefore have open vents (although designed to withstand internal pressures up to 7.5 mbar and a vacuum of 2.5 mbar).</p> <p>The tank containing gasoil, also contains an activated carbon filter, so that the displaced air within the tank is filtered from impurities that escape to the atmosphere via the open vents. Such a system is not present for the lube oil tanks, urea and sludge tanks because it is not necessary.</p> <p>In the case of tanks that are smaller than <math>50 \text{ m}^3</math>, a pressure relief valve is present. This is particularly evident for the compressed air systems:</p> <ul style="list-style-type: none"> <li>• Control/service air – 6 bar <ul style="list-style-type: none"> <li>○ 3 tanks in all supplied by six rotary type high flow compressors and kept at 6 bar</li> <li>○ Serve as a buffer for the control compressed air headers and piping around the station</li> </ul> </li> <li>• Starting air – 28 bar <ul style="list-style-type: none"> <li>○ Kept at 28 bar by three reciprocating type compressors.</li> <li>○ Serve to supply air to crank an engine to start</li> </ul> </li> </ul>

Aspect of BAT	BAT	Status at Installation
	<p>The selection of the vapour treatment technology is based on criteria such as cost, toxicity of the product, abatement efficiency, quantities of rest-emissions and possibilities for product or energy recovery, and has to be decided case-by-case. The BAT associated emission reduction is at least 98 % (compared to a fixed roof tank without measures). See Section 4.1.3.15.</p> <p>The achievable emission reduction for a large tank using an internal floating roof is at least 97 % (compared to a fixed roof tank without measures), which can be achieved when over at least 95 % of the circumference of the gap between the roof and wall is less than 3.2 mm and the seals are liquid mounted, mechanical shoe seals. By applying liquid mounted primary seals and rim mounted secondary seals, even higher emission reductions can be achieved. However, the smaller the tank and the smaller the number of turnovers the less effective the floating roof is, see Annex 8.22 and Annex 8.23 respectively.</p> <p>Also the case studies in Annex 8.13 show that achievable emission reductions depend on several issues such as the substance that is actually stored, meteorological circumstances, number of turnovers and diameter of the tank. The calculations show that with an internal floating roof an emission reduction in the range 62.9 – 97.6 % can be achieved (compared to a fixed roof tank without measures); where 62.9 % refers to a tank of 100 m<sup>3</sup> equipped with only primary seals and 97.6 % refers to a tank of 10263 m<sup>3</sup> equipped with primary and secondary</p>	

Aspect of BAT	BAT	Status at Installation
	<p>seals.</p> <p>For liquids containing a high level of particles (e.g. crude oil) BAT is to mix the stored substance to prevent deposition that would call for an additional cleaning step, see Section 4.1.5.1.</p>	
<b>Tank specific considerations</b> <b>Atmospheric horizontal tanks</b>	<p>Atmospheric horizontal tanks are used for the storage of flammable and other liquids, such as oil products and chemicals in all levels of flammability and toxicity, see Section 3.1.4.</p> <p>Horizontal tanks are different to vertical tanks, e.g. since they can inherently operate under higher pressures.</p> <p>For the storage of volatile substances which are toxic (T), very toxic (T+), or CMR categories 1 and 2 in an atmospheric horizontal tank, BAT is to apply a vapour treatment installation.<sup>3</sup></p> <p>For other substances, BAT is to do all, or a combination, of the following techniques, depending on the substances stored:</p> <ul style="list-style-type: none"> <li>• apply pressure vacuum relief valves; see Section 4.1.3.11</li> <li>• up rate to 56 mbar; see Section 4.1.3.11</li> <li>• apply vapour balancing; see Section 4.1.3.13</li> <li>• apply a vapour holding tank, see Section 4.1.3.14, or</li> <li>• apply vapour treatment; see Section 4.1.3.15.</li> </ul> <p>The selection of the vapour treatment technology has to be decided on a case-by-case basis.</p>	<p>Not applicable, since the day tanks operated by D3PG are all vertical storage tanks.</p>

Aspect of BAT	BAT	Status at Installation
<b>Tank specific considerations</b> <b>Pressurised storage</b>	<p>Pressurised storage is used for storing all categories of liquefied gases, from non-flammable up to flammable and highly toxic. The only significant emissions to air from normal operation are from draining.</p> <p>BAT for draining depends on the tank type, but may be the application of a closed drain system connected to a vapour treatment installation, see Section 4.1.4.</p> <p>The selection of the vapour treatment technology has to be decided on a case-by-case basis.</p>	<p>The supply and storage of natural gas will be provided by D4's Gas reduction station. The only pressurised storage that lies within D3PG's operational responsibilities is the storage of compressed air systems.</p> <ul style="list-style-type: none"> <li>• Control/service air – 6 bar <ul style="list-style-type: none"> <li>○ 3 tanks in all supplied by six rotary type high flow compressors and kept at 6 bar</li> <li>○ Serve as a buffer for the control compressed air headers and piping around the station</li> </ul> </li> <li>• Starting air – 28 bar <ul style="list-style-type: none"> <li>○ Kept at 28 bar by three reciprocating type compressors.</li> <li>○ Serve to supply air to crank an engine to start</li> </ul> </li> </ul>
<b>Tank specific considerations</b> <b>Lifter roof tanks</b>	<p>For emissions to air, BAT is to (see Sections 3.1.9 and 4.1.3.14):</p> <ul style="list-style-type: none"> <li>• apply a flexible diaphragm tank equipped with pressure/vacuum relief valves, or</li> <li>• apply a lifter roof tank equipped with pressure/vacuum relief valves and connected to a vapour treatment installation.</li> </ul> <p>The selection of the vapour treatment technology has to be decided on a case-by-case basis.</p>	Not applicable, since no lifter roof tanks are used at D3.
<b>Tank specific considerations</b> <b>Refrigerated tanks</b>	There are no significant emissions from normal operation, see Section 3.1.10.	Not applicable, since no refrigerated tanks are used at D3.
<b>Tank specific</b>	Underground and mounded tanks are used especially for	Not applicable, since underground and mounted tanks are

Aspect of BAT	BAT	Status at Installation
<b>considerations</b> <b>Underground and mounded tanks</b>	<p>flammable products, see Sections 3.1.11 and 3.1.8 respectively.</p> <p>For the storage of volatile substances which are toxic (T), very toxic (T+), or CMR categories 1 and 2 in an underground or mounded tank, BAT is to apply a vapour treatment installation.<sup>4</sup></p> <p>For other substances, BAT is to do all, or a combination, of the following techniques, depending on the substances stored:</p> <ul style="list-style-type: none"> <li>• apply pressure vacuum relief valves; see Section 4.1.3.11</li> <li>• apply vapour balancing; see Section 4.1.3.13</li> <li>• apply a vapour holding tank, see Section 4.1.3.14, or</li> <li>• apply vapour treatment; see Section 4.1.3.15.</li> </ul> <p>The selection of the vapour treatment technology has to be decided on a case-by-case basis.</p>	not operated by D3PG.
<b>Preventing incidents and (major) accidents</b> <b>Safety and risk management</b>	<p>The Seveso II Directive (Council Directive 96/82/EC of 9 December 1996 on the control of major accident hazards involving dangerous substances) requires companies to take all measures necessary to prevent and limit the consequences of major accidents. They must, in any case, have a major accident prevention policy (MAPP) and a safety management system to implement the MAPP. Companies holding large quantities of dangerous substances, the so-called upper tiered establishments, must also draw up a safety report and an on-site emergency plan and maintain an up-to-date list of substances. However, plants that do not fall under the scope of the Seveso II</p>	<p>D3 is not considered a COMAH site as the storage of fuel is not within the remit of D3 PG. Nonetheless, HAZID, HAZOP and ATEX safety reports for D3 have been compiled and submitted. Enemalta is in the process of submitting a consolidated safety report comprising of different safety and risk assessment studies conducted for the different facilities at Delimara Power Station.</p>

Aspect of BAT	BAT	Status at Installation
	<p>Directive can also cause emissions from incidents and accidents. Applying a similar, maybe less detailed, safety management system is the first step in preventing and limiting these.</p> <p>BAT in preventing incidents and accidents is to apply a safety management system as described in Section 4.1.6.1.</p>	
<b>Preventing incidents and (major) accidents Operational procedures and training</b>	BAT is to implement and follow adequate organisational measures and to enable training and instruction of employees for safe and responsible operation of the installation as described in Section 4.1.6.1.1.	<p>Since no additional storage tanks are being proposed for D3, the current operational procedures and training for inspecting and servicing the current tanks will be maintained.</p> <p>In addition to this, employees will be trained and instructed on how to deal with the mechanical and electrical components of the converted engines. They will also be trained on how to deal with SF<sub>6</sub> and natural gas leakages. A preliminary maintenance programme has been attached in Appendix II of the report.</p>
<b>Preventing incidents and (major) accidents Leakage due to corrosion and/or erosion</b>	<p>Corrosion is one of the main causes of equipment failure and can occur both internally and externally on any metal surface, see Section 4.1.6.1.4. BAT is to prevent corrosion by:</p> <ul style="list-style-type: none"> <li>• selecting construction material that is resistant to the product stored</li> <li>• applying proper construction methods</li> <li>• preventing rainwater or groundwater entering the tank and if necessary, removing water that has accumulated in the tank</li> <li>• applying rainwater management to bund drainage</li> <li>• applying preventive maintenance, and</li> </ul>	<p>The day tanks and respective piping systems are covered by an anti-corrosion material. Preventive maintenance programmes (daily checks) and a proper rainwater management to bund drainage are already being employed at D3. Moreover, a software programme is used at the control room to monitor the day tank levels and rapidly identify potential leakages that may be occurring at real-time basis.</p> <p>The tanks are fully-sealed and banded according to EU standards as explained above. The bunding system contains a network of drains and pits which are connected to a</p>

Aspect of BAT	BAT	Status at Installation
	<ul style="list-style-type: none"> <li>• where applicable, adding corrosion inhibitors, or applying cathodic protection on the inside of the tank.</li> </ul> <p>Additionally for an underground tank, BAT is to apply to the outside of the tank:</p> <ul style="list-style-type: none"> <li>• a corrosion-resistant coating</li> <li>• plating, and/or</li> <li>• a cathodic protection system.</li> </ul> <p>Stress corrosion cracking (SCC) is a specific problem for spheres, semi-refrigerated tanks and some fully refrigerated tanks containing ammonia. BAT is to prevent SCC by:</p> <ul style="list-style-type: none"> <li>• stress relieving by post-weld heat treatment, see Section 4.1.6.1.4, and</li> <li>• applying a risk based inspection as described in Section 4.1.2.2.1.</li> </ul>	<p>diaphragm pump that transfers the collected leaks or spillages to the oily water system (sludge) or to the general drains of the DPS.</p>
<b>Preventing incidents and (major) accidents</b> <b>Operational procedures and instrumentation to prevent overfill</b>	<p>BAT is to implement and maintain operational procedures – e.g. by means of a management system – as described in Section 4.1.6.1.5, to ensure that:</p> <ul style="list-style-type: none"> <li>• high level or high pressure instrumentation with alarm settings and/or auto closing of valves is installed</li> <li>• proper operating instructions are applied to prevent overfill during a tank filling operation, and</li> <li>• sufficient ullage is available to receive a batch filling.</li> </ul> <p>A standalone alarm requires manual intervention and appropriate procedures, and automatic valves need to be integrated into the upstream process design to ensure no consequential effects of closure. The type of alarm to be</p>	<p>High sounding alarms are already fitted onto these day tanks to notify in cases of malfunction. These alarms, along with the fitted dipsticks within each tank are regularly inspected during maintenance checks by authorised employees.</p> <p>All the tanks are also fitted with an overfill prevention system. This functions by having a sludge piping system that is situated at the top-end of the tank. When the tank overfills, the excess liquid passes through the relevant piping system and is dumped into a common pit. A pumping system is subsequently used to pump this excess liquid into the pipes that lead to the sludge storage tanks.</p>

Aspect of BAT	BAT	Status at Installation
	applied has to be decided for every single tank. See Section 4.1.6.1.6.	Regular inspections are made by the operator to ensure that such a system is functioning properly and that there are no causes of leakage.
<b>Preventing incidents and (major) accidents</b> <b>Instrumentation and automation to detect leakage</b>	<p>The four different basic techniques that can be used to detect leaks are:</p> <ul style="list-style-type: none"> <li>• release prevention barrier system</li> <li>• inventory checks</li> <li>• acoustic emission method</li> <li>• soil vapour monitoring.</li> </ul> <p>BAT is to apply leak detection on storage tanks containing liquids that can potentially cause soil pollution. The applicability of the different techniques depends on the tank type and is discussed in detail in Section 4.1.6.1.7.</p>	<p>Leaks that may result are easily collected thanks to EU standard sized concrete bunding systems that are fitted with pits and diaphragm pumps that transfer the leakages to appropriate sewage tanks. Frequent inspections for leakages are also made.</p> <p>In addition to this, the day tanks' capacity levels are continuously monitored on a software program. Such a technology is capable of highlighting abnormal reductions in the liquid levels that are being consumed within the tank, alerting the maintenance personnel of potential leakages.</p>
<b>Preventing incidents and (major) accidents</b> <b>Risk-based approach to emissions to soil below tanks</b>	<p>The risk-based approach to emissions to soil from an aboveground flat-bottom and vertical, storage tank containing liquids with a potency to pollute soil, is that soil protection measures are applied at such a level that there is a 'negligible risk' for soil pollution because of leakage from the tank bottom or from the seal where the bottom and the wall are connected. See Section 4.1.6.1.8 where the approach and the risk levels are explained.</p> <p>BAT is to achieve a 'negligible risk level' of soil pollution from bottom and bottom-wall connections of aboveground storage tanks. However, on a case-by-case basis, situations might be identified where an 'acceptable risk level' is sufficient.</p>	All points have been noted. Risk assessment had determined that there are no potential emissions to land when all the precautionary measures are taken.



Aspect of BAT	BAT	Status at Installation
<b>Preventing incidents and (major) accidents</b> <b>Soil protection around tanks - containment</b>	<p>BAT for aboveground tanks containing flammable liquids or liquids that pose a risk for significant soil pollution or a significant pollution of adjacent watercourses is to provide secondary containment, such as:</p> <ul style="list-style-type: none"> <li>• tank bunds around single wall tanks; see Section 4.1.6.1.11</li> <li>• double wall tanks; see Section 4.1.6.1.13</li> <li>• cup-tanks; see Section 4.1.6.1.14</li> <li>• double wall tanks with monitored bottom discharge; see Section 4.1.6.1.15.</li> </ul> <p>For building new single walled tanks containing liquids that pose a risk for significant soil pollution or a significant pollution of adjacent watercourses, BAT is to apply a full, impervious, barrier in the bund, see Section 4.1.6.1.10.</p> <p>For existing tanks within a bund, BAT is to apply a risk-based approach, considering the significance of risk from product spillage to the soil, to determine if and which barrier is best applicable. This risk-based approach can also be applied to determine if a partial impervious barrier in a tank bund is sufficient or if the whole bund needs to be equipped with an impervious barrier. See Section 4.1.6.1.11.</p> <p>Impervious barriers include:</p> <ul style="list-style-type: none"> <li>• a flexible membrane, such as HDPE</li> <li>• a clay mat</li> <li>• an asphalt surface</li> <li>• a concrete surface.</li> </ul>	<p>Implemented, see above notes.</p>

Aspect of BAT	BAT	Status at Installation
	<p>For chlorinated hydrocarbon solvents (CHC) in single walled tanks, BAT is to apply CHC-proof laminates to concrete barriers (and containments), based on phenolic or furan resins. One form of epoxy resin is also CHC-proof. See Section 4.1.6.1.12.</p> <p>BAT for underground and mounded tanks containing products that can potentially cause soil pollution is to:</p> <ul style="list-style-type: none"> <li>• apply a double walled tank with leak detection, see Section 4.1.6.1.16, or</li> <li>• to apply a single walled tank with secondary containment and leak detection, see Section 4.1.6.1.17.</li> </ul>	
<b>Preventing incidents and (major) accidents</b> <b>Flammable areas and ignition sources</b>	See Section 4.1.6.2.1 together with ATEX Directive 1999/92/EC.	An ATEX report has been submitted with the IPPC permit Form C for D3.
<b>Preventing incidents and (major) accidents</b> <b>Fire protection</b>	<p>The necessity for implementing fire protection measures has to be decided on a case-by-case basis. Fire protection measures can be provided by applying, e.g. (see Section 4.1.6.2.2):</p> <ul style="list-style-type: none"> <li>• fire resistant claddings or coatings</li> <li>• firewalls (only for smaller tanks), and/or</li> <li>• water cooling systems</li> </ul>	Storage tanks are protected from fire by means of sea water and foam. This requires manual opening of water valves that are dedicated to each tank which is mixed with foam that is also generated on site.
<b>Preventing incidents and (major) accidents</b> <b>Fire-fighting equipment</b>	The necessity for implementing fire-fighting equipment and the decision on which equipment to apply has to be taken on a case-by-case basis in agreement with the local fire brigade. Some examples are given in Section 4.1.6.2.3.	A freshwater tank of 330m <sup>3</sup> capacity is supplied from the existing evaporated water storage tanks and is currently being used for the internal fire-fighting system. An external system that is seawater based is also available on site. These

Aspect of BAT	BAT	Status at Installation
		function by using electric and diesel pumps in case of emergency. The new operators at D3 will have the provision of fire-fighting water from the current system that will be amended.
<b>Preventing incidents and (major) accidents</b> <b>Containment of contaminated extinguishant</b>	<p>The capacity for containing contaminated extinguishant depends on the local circumstances, such as which substances are stored and whether the storage is close to watercourses and/or situated in a water catchment area. The applied containment therefore has to be decided on a case-by-case basis, see Section 4.1.6.2.4.</p> <p>For toxic, carcinogenic or other hazardous substances, BAT is to apply full containment.</p>	Any extinguishant would be contained within the bunded areas and transferred to the sludge tanks via a diaphragm pump.

## 1.2 Storage of packaged dangerous substances

Aspect of BAT	BAT	Status at Installation
<b>Safety and risk management</b>	Operational losses do not occur in storing packaged dangerous materials. The only possible emissions are from incidents and (major) accidents. Companies that fall under the scope of the Seveso II Directive are required to take all measures necessary to prevent and limit the consequences of major accidents. They must, in any, case have a major accident prevention policy (MAPP) and a safety management system to implement the MAPP. Companies in the high risk category (Annex I of the Directive) must also draw up a safety report and an on-site emergency plan	<p>Although Delimara Power station is currently considered to be a COMAH site, the proposed demerger of operations at DPS excluded D3 from being considered as a COMAH site. This is attributed to the fact that no large areas for storage of fuel are present at D3. The storage of such fuel lies within the responsibility of another operator at DPS.</p> <p>Having said this, all precautionary actions are taken to prevent major accidents from happening at D3. Accident prevention policies and a safety management system will be</p>

Aspect of BAT	BAT	Status at Installation
	<p>and maintain an up-to-date list of substances. However, companies storing dangerous substances not falling under the scope of the Seveso II Directive can also cause emissions from incidents and accidents. Applying a similar, maybe less detailed, safety management system is the first step in preventing and limiting these.</p> <p>BAT in preventing incidents and accidents is to apply a safety management system as described in Sections 4.1.6.1.</p> <p>The degree of detail of the system is clearly dependent on various factors such as: the quantities of substances stored, specific hazards of the substances and the location of the storage. However, the minimum level of BAT is to assess the risks of accidents and incidents on the site using the five steps described in Section 4.1.6.1</p>	<p>implemented.</p>
<b>Training and responsibility</b>	<p>BAT is to appoint a person or persons who is or are responsible for the operation of the store.</p> <p>BAT is to provide the responsible person(s) with specific training and retraining in emergency procedures as described in Section 4.1.7.1 and to inform other staff on the site of the risks of storing packaged dangerous substances and the precautions necessary to safely store substances that have different hazards.</p>	<p>Small quantities of chemicals will be stored in Enemalta's current store. These chemicals are stored in appropriate tanks and jerrycans. Enemalta will no longer be responsible for the store, and will assign it to the new operators according to their requirements. D3 will subsequently assign a store administrator to be responsible for record keeping, making orders and performing inspections.</p>
<b>Storage area</b>	<p>BAT is to apply a storage building and/or an outdoor storage area covered with a roof, as described in Section 4.1.7.2. For storing quantities of less than 2500 litres or kilograms dangerous substances, applying a storage cell as described in Section 4.1.7.2 is also BAT.</p>	<p>One of the storage areas containing chemicals will be situated in Enemalta's current store building.</p>

Aspect of BAT	BAT	Status at Installation
<b>Separation and segregation</b>	<p>BAT is to separate the storage area or building of packaged dangerous substances from other storage, from ignition sources and from other buildings on- and off-site by applying a sufficient distance, sometimes in combination with fire-resistant walls. Member States apply different distances between the (outdoor) storage of packaged dangerous substances and other objects on- and off-site; see Section 4.1.7.3 for some examples.</p> <p>BAT is to separate and/or segregate incompatible substances. For the compatible and incompatible combinations see Annex 8.3 of the BREF. Member States apply different distances and/or physical partitioning between the storage of incompatible substances; see Section 4.1.7.4 for some examples.</p>	Implemented.
<b>Containment of leakage and contaminated extinguishant</b>	<p>BAT is to install a liquid-tight reservoir according to Section 4.1.7.5, that can contain all or a part of the dangerous liquids stored above such a reservoir. The choice whether all or only a part of the leakage needs to be contained depends on the substances stored and on the location of the storage (e.g. in a water catchment area) and can only be decided on a case-by-case basis.</p> <p>BAT is to install a liquid-tight extinguishant collecting provision in storage buildings and storage areas according to Section 4.1.7.5. The collecting capacity depends on the substances stored, the amount of substances stored, the type of package used and the applied fire-fighting system and can only be decided on a case-by-case basis.</p>	110% bunds and trays are implemented in storage areas to contain dangerous liquids that may leak.

Aspect of BAT	BAT	Status at Installation
<b>Fire-fighting equipment</b>	BAT is to apply a suitable protection level of fire prevention and fire-fighting measures as described in Section 4.1.7.6. The appropriate protection level has to be decided on a case-by-case basis in agreement with the local fire brigade.	A freshwater tank of 330m <sup>3</sup> capacity is supplied from the existing evaporated water storage tanks and is currently being used for the internal fire-fighting system. An external system that is seawater based is also available on site.
<b>Preventing ignition</b>	BAT is to prevent ignition at source as described in Section 4.1.7.6.1.	<p>In order to reduce the chances of ignition:</p> <ul style="list-style-type: none"> <li>• Different goods are stored in separate areas by</li> <li>• Smoking is prohibited in the storage area</li> <li>• Suitable fire-fighting equipment is present in the storage area</li> <li>• Ignitable materials are not stored in close proximity to electrical equipment</li> </ul>

### 1.3 Basins and lagoons

Aspect of BAT	BAT	Status at Installation
<b>Basins and lagoons</b>	<p>Basins and lagoons are used for the storage of, e.g. manure slurry in agricultural premises and water and other non-flammable or volatile liquids in industrial facilities.</p> <p>Where emissions to air from normal operation are significant, e.g. with the storage of pig slurry, BAT is to cover basins and lagoons using one of the following options:</p> <ul style="list-style-type: none"> <li>• a plastic cover; see Section 4.1.8.2</li> <li>• a floating cover; see Section 4.1.8.1, or</li> <li>• only small basins, a rigid cover; see Section 4.1.8.2.</li> </ul> <p>Additionally, where a rigid cover is used, a vapour treatment installation can be applied to achieve an extra</p>	Lagoons and tanks can accommodate up to three times an average daily flow. The flow is permitted to be diverted around the coalescer.

Aspect of BAT	BAT	Status at Installation
	<p>emission reduction, see Section 4.1.3.15. The need for and type of vapour treatment must be decided on a case-by-case basis.</p> <p>To prevent overfilling due to rainfall in situations where the basin or lagoon is not covered, BAT is to apply a sufficient freeboard, see Section 4.1.11.1.</p> <p>Where substances are stored in a basin or lagoon with a risk of soil contamination, BAT is to apply an impervious barrier. This can be a flexible membrane, a sufficient clay layer or concrete, see Section 4.1.9.1.</p>	

#### 1.4 Atmospheric mined caverns

Aspect of BAT	BAT	Status at Installation
<b>Emissions to air from normal operation</b>	Where a number of caverns with a fixed waterbed storing liquid hydrocarbons are present, BAT is to apply vapour balancing, see Section 4.1.12.1.	Not applicable.
<b>Emissions from incidents and (major) accidents</b>	<p>By their intrinsic nature, caverns are by far the safest way of storing large quantities of hydrocarbon products. BAT for storing large quantities of hydrocarbons is, therefore, to apply caverns wherever the site geology is suitable, see Sections 3.1.15 and 4.1.13.3.</p> <p>BAT, in preventing incidents and accidents, is to apply a safety management system as described in Section 4.1.6.1.</p>	Not applicable.

Aspect of BAT	BAT	Status at Installation
	<p>BAT is to apply, and then regularly evaluate, a monitoring programme which at least includes the following (see Section 4.1.13.2):</p> <ul style="list-style-type: none"> <li>• monitoring of the hydraulic flow pattern around the caverns by means of groundwater measurements, piezometers and/or pressure cells, seepage water flowrate metering</li> <li>• assessment of cavern stability by seismic monitoring</li> <li>• water quality follow-up procedures by regular sampling and analysis</li> <li>• corrosion monitoring, including periodic casing evaluation.</li> </ul> <p>For preventing the stored product from escaping out of the cavern, BAT is to design the cavern in such a way that at the depth at which it is situated, the hydrostatic pressure of the groundwater surrounding the cavern is always greater than that of the stored product, see Section 4.1.13.5.</p> <p>For preventing seepage water entering the cavern, BAT is, apart from a proper design, to additionally apply cement injection, see Section 4.1.13.6.</p> <p>If seepage water that enters the cavern is pumped out, BAT is to apply waste water treatment before discharge, see Section 4.1.13.3.</p> <p>BAT is to apply automated overfill protection, see Section 4.1.13.8.</p>	



## 1.5 Pressurised mined caverns

Aspect of BAT	BAT	Status at Installation
<b>Emissions from incidents and (major) accidents</b>	<p>By their intrinsic nature, caverns are by far the safest way of storing large quantities of hydrocarbon products. BAT for storing large quantities of hydrocarbons is, therefore, to apply caverns wherever the site geology is suitable, see Sections 3.1.16 and 4.1.14.3.</p> <p>BAT, in preventing incidents and accidents, is to apply a safety management system as described in Section 4.1.6.1.</p> <p>BAT is to apply, and then regularly evaluate a monitoring programme which at least includes the following (see Section 4.1.14.2):</p> <ul style="list-style-type: none"> <li>• monitoring of the hydraulic flow pattern around the caverns by means of groundwater measurements, piezometers and/or pressure cells, seepage water flowrate metering</li> <li>• assessment of cavern stability by seismic monitoring</li> <li>• water quality follow-up procedures by regular sampling and analysis</li> <li>• corrosion monitoring, including periodic casing evaluation.</li> </ul> <p>For preventing the stored product from escaping out of the cavern, BAT is to design the cavern in such a way that at the depth at which it is situated, the hydrostatic pressure of the groundwater surrounding the cavern is always greater than that of the stored product, see Section 4.1.14.5.</p> <p>For preventing seepage water entering the cavern, BAT is,</p>	Not applicable.

Aspect of BAT	BAT	Status at Installation
	<p>apart from a proper design, to additionally apply cement injection, see Section 4.1.14.6</p> <p>If seepage water that enters the cavern is pumped out, BAT is to apply waste water treatment before discharge, see Section 4.1.14.3.</p> <p>BAT is to apply automated overfill protection, see Section 4.1.14.8.</p> <p>BAT is to apply fail-safe valves in the event of a surface emergency event, see Section 4.1.14.4.</p>	

## 1.6 Salt leached caverns

Aspect of BAT	BAT	Status at Installation
<b>Salt leached caverns</b>	<p>By their intrinsic nature, caverns are by far the safest way of storing large quantities of hydrocarbon products. BAT for storing large quantities of hydrocarbons is, therefore, to apply caverns wherever the site geology is suitable. For more detail see Sections 3.1.17 and 4.1.15.3.</p> <p>BAT, in preventing incidents and accidents, is to apply a safety management system as described in Section 4.1.6.1.</p> <p>BAT is to apply, and then regularly evaluate a monitoring programme which at least includes the following (see Section 4.1.15.2):</p>	Not applicable

Aspect of BAT	BAT	Status at Installation
	<ul style="list-style-type: none"> <li>• assessment of cavern stability by seismic monitoring</li> <li>• corrosion monitoring, including periodic casing evaluation</li> <li>• carrying out of regular sonar evaluations to monitor eventual shape variations, particularly if undersaturated brine is used.</li> </ul> <p>Small traces of hydrocarbons may be present at the brine/hydrocarbon interface due to filling and emptying the caverns. If this is the case, BAT is to separate these hydrocarbon products in a brine treatment unit and to collect and dispose of them safely.</p>	

## 1.7 Floating storage

Aspect of BAT	BAT	Status at Installation
<b>Floating storage</b>	Floating storage is not BAT, see Section 3.1.18.	Not applicable

## Part 2: Transfer and handling of liquids and liquefied gases

### 2.1 General principles to prevent and reduce emissions

Aspect of BAT	BAT	Status at Installation
<b>Inspection and maintenance</b>	BAT is to apply a tool to determine proactive maintenance plans and to develop risk-based inspection plans such as, the risk and reliability based maintenance approach; see Section 4.1.2.2.1.	Maintenance employees will conduct regular inspections and maintenance of the day tanks and associated piping systems. This is also applicable to gas supply lines.
<b>Leak detection and repair</b>	For large storage facilities, according to the properties of the products stored, BAT is to apply a leak detection and repair	Operations personnel supervise the installations on a constant basis. In addition there is the facility for the remote

<b>Aspect of BAT</b>	<b>BAT</b>	<b>Status at Installation</b>
<b>programme</b>	programme. Focus needs to be on those situations most likely to cause emissions (such as gas/light liquid, under high pressure and/or temperature duties). See Section 4.2.1.3.	supervision of the tank levels from the central control room. Handheld gas detectors will also be used during routine checks as a preventive measure against gas leakage.
<b>Emissions minimisation principle in tank storage</b>	<p>BAT is to abate emissions from tank storage, transfer and handling that have a significant negative environmental effect, as described in Section 4.1.3.1.</p> <p>This is applicable to large storage facilities, allowing a certain time frame for implementation.</p>	The most significant emissions are expected to occur from the storage and transfer of gasoil (diesel). For this reason, VOC emissions from gasoil tanks are monitored by a CO sensors that detect over-saturation of the activated carbon filters that adsorb the VOC emissions.
<b>Safety and risk management</b>	BAT in preventing incidents and accidents is to apply a safety management system as described in Section 4.1.6.1.	A safety management system is being compiled by Enemalta for all the operators at Delimara Power Station.
<b>Operational procedures and training</b>	BAT is to implement and follow adequate organisational measures and to enable the training and instruction of employees for safe and responsible operation of the installation as described in Section 4.1.6.1.1.	Adequate training and maintenance programmes will be provided to the employees for safe and responsible operation of the installation.

## 2.2 Considerations on transfer and handling techniques

<b>Aspect of BAT</b>	<b>BAT</b>	<b>Status at Installation</b>
<b>Piping</b>	<p>BAT is to apply aboveground closed piping in new situations, see Section 4.2.4.1. For existing underground piping it is BAT to apply a risk and reliability based maintenance approach as described in Section 4.1.2.2.1.</p> <p>Bolted flanges and gasket-sealed joints are an important source of fugitive emissions. BAT is to minimise the</p>	<p>The current aboveground system is not expected to change.</p> <p>The numbers of bolted flanges are kept to a minimum with the pipes being entirely welded. This ensures that fugitive emissions are kept to a bare minimum. Flanges were evaluated also during the ATEX study to assess risks associated with such emissions.</p>

Aspect of BAT	BAT	Status at Installation
	<p>number of flanges by replacing them with welded connections, within the limitation of operational requirements for equipment maintenance or transfer system flexibility, see Section 4.2.2.1.</p> <p>BAT for bolted flange connections (see Section 4.2.2.2.) include:</p> <ul style="list-style-type: none"> <li>• fitting blind flanges to infrequently used fittings to prevent accidental opening</li> <li>• using end caps or plugs on open-ended lines and not valves</li> <li>• ensuring gaskets are selected appropriate to the process application</li> <li>• ensuring the gasket is installed correctly</li> <li>• ensuring the flange joint is assembled and loaded correctly</li> <li>• where toxic, carcinogenic or other hazardous substances are transferred, fitting high integrity gaskets, such as spiral wound, kammprofile or ring joints.</li> </ul> <p>Internal corrosion may be caused by the corrosive nature of the product being transferred, see Section 4.2.3.1. BAT is to prevent corrosion by:</p> <ul style="list-style-type: none"> <li>• selecting construction material that is resistant to the product</li> <li>• applying proper construction methods</li> <li>• applying preventive maintenance, and</li> <li>• where applicable, applying an internal coating or adding corrosion inhibitors.</li> </ul> <p>To prevent the piping from external corrosion, BAT is to apply a one, two, or three layer coating system depending</p>	<p>Proper coating is also applied to prevent corrosion of such piping systems and eventual release of emissions.</p> <p>The piping between the gas reducing station and engine will ensure a constant pressure of about 7 bar. A number of shut-off valves are also present to prevent the pipes from reaching pressures that are very high and dangerous.</p>

Aspect of BAT	BAT	Status at Installation
	on the site-specific conditions (e.g. close to sea). Coating is normally not applied to plastic or stainless steel pipelines. See Section 4.2.3.2.	
<b>Vapour treatment</b>	<p>BAT is to apply vapour balancing or treatment on significant emissions from the loading and unloading of volatile substances to (or from) trucks, barges and ships. The significance of the emission depends on the substance and the volume that is emitted, and has to be decided on a case-by-case basis. For more detail see Section 4.2.8.</p> <p>For example, according to Dutch regulations, the emission of methanol is significant when over 500 kg/yr is emitted.</p>	<p>Currently the biggest source of vapours occurs from the loading, storing and unloading of HFO. This will no longer fall under the operations of the new operators of D3, unlike gasoil fixed roof storage tanks which will remain to be used.</p> <p>The loading and unloading procedure of volatile gasoil to the storage tanks incorporates a vapour balancing system is in place. This implies that during loading, the vapours displaced from the transport vehicle are transferred through a piping system (loading arms). These vapours are eventually transferred back to the storage tank through the vapour balancing pipework. During unloading, the vapour move in the opposite direction.</p> <p>In order to treat the vapours generated a VOC abatement system is currently in place for the diesel storage tank.</p>
<b>Valves</b>	<p>BAT for valves include:</p> <ul style="list-style-type: none"> <li>• correct selection of the packing material and construction for the process application</li> <li>• with monitoring, focus on those valves most at risk (such as rising stem control valves in continual operation)</li> <li>• applying rotating control valves or variable speed pumps instead of rising stem control valves</li> <li>• where toxic, carcinogenic or other hazardous substances are involved, fit diaphragm, bellows, or double walled valves</li> </ul>	<p>The system that is currently in use will not be modified. Valves include manual isolating valves (gate type) and automatic air operated valves (butterfly type). The latter are equipped with 24 DC coil solenoids that direct compressed air either to open or close the valves. These valves are used to prevent leaks from sources that are most at risk. Other kinds of valves are employed for different storage and piping systems.</p> <p>A number of shut off (pressure release) valves are present</p>

Aspect of BAT	BAT	Status at Installation
	<ul style="list-style-type: none"> <li>• route relief valves back into the transfer or storage system or to a vapour treatment system.</li> </ul> <p>See Sections 3.2.2.6 and 4.2.9.</p>	<p>on the piping system that leads to the day tanks from the gas reduction system. This implies that any buildup of pressure in the pipes is vented into the air, without flaming.</p>
<p><b>Pumps and compressors</b> Installation and maintenance of pumps and compressors</p>	<p>The design, installation and operation of the pump or compressor heavily influence the life potential and reliability of the sealing system. The following are some of the main factors which constitute BAT:</p> <ul style="list-style-type: none"> <li>• proper fixing of the pump or compressor unit to its base-plate or frame</li> <li>• having connecting pipe forces within producers' recommendations</li> <li>• proper design of suction pipework to minimise hydraulic imbalance</li> <li>• alignment of shaft and casing within producers' recommendations</li> <li>• alignment of driver/pump or compressor coupling within producers' recommendations when fitted</li> <li>• correct level of balance of rotating parts</li> <li>• effective priming of pumps and compressors prior to start-up</li> <li>• operation of the pump and compressor within producers' recommended performance range (The optimum performance is achieved at its best efficiency point.)</li> <li>• the level of net positive suction head available should always be in excess of the pump or compressor</li> <li>• regular monitoring and maintenance of both rotating equipment and seal systems, combined with a repair or replacement programme.</li> </ul>	<p>Noted and implemented; the system that is currently in use already is covered by the previous IPPC permit and will not be modified.</p>

Aspect of BAT	BAT	Status at Installation
<b>Pumps and compressors</b> <b>Sealing system in pumps</b>	BAT is to use the correct selection of pump and seal types for the process application, preferably pumps that are technologically designed to be tight such as canned motor pumps, magnetically coupled pumps, pumps with multiple mechanical seals and a quench or buffer system, pumps with multiple mechanical seals and seals dry to the atmosphere, diaphragm pumps or bellows pumps. For more details see Sections 3.2.2.2, 3.2.4.1 and 4.2.9.	Proper sealing and pumping system is in place according to the established standards.
<b>Pumps and compressors</b> <b>Sealing systems in compressors</b>	<p>BAT for compressors transferring non-toxic gases is to apply gas lubricated mechanical seals.</p> <p>BAT for compressors, transferring toxic gases is to apply double seals with a liquid or gas barrier and to purge the process side of the containment seal with an inert buffer gas.</p> <p>In very high pressure services, BAT is to apply a triple tandem seal system.</p> <p>For more detail see Sections 3.2.3 and 4.2.9.13.</p>	The majority of storage tanks used by D3PG contain liquid chemicals. Five small compressed air tanks are the only exception. These are properly fitted with gas lubricated mechanical seals.
<b>Sampling connections</b>	BAT, for sample points for volatile products, is to apply a ram type sampling valve or a needle valve and a block valve. Where sampling lines require purging, BAT is to apply closed-loop sampling lines. See Section 4.2.9.14.	Will be implemented as soon as sampling locations will be determined.



### Part 3: Storage of solids

Aspect of BAT	BAT	Status at Installation
<b>Open storage</b>	<p>BAT is to apply enclosed storage by using, for example, silos, bunkers, hoppers and containers, to eliminate the influence of wind and to prevent the formation of dust by wind as far as possible by primary measures. See Table 4.12 for these primary measures with cross-references to the relevant sections.</p> <p>However, although large volume silos and sheds are available, for (very) large quantities of not or only moderately drift sensitive and wettable material, open storage might be the only option. Examples are the long-term strategic storage of coal and the storage of ores and gypsum.</p> <p>BAT for open storage is to carry out regular or continuous visual inspections to see if dust emissions occur and to check if preventive measures are in good working order. Following the weather forecast by, e.g, using meteorological instruments on site, will help to identify when the moistening of heaps is necessary and will prevent unnecessary use of resources for moistening the open storage. See Section 4.3.3.1.</p> <p>BAT for long-term open storage are one, or a proper combination, of the following techniques:</p> <ul style="list-style-type: none"> <li>• moistening the surface using durable dust-binding substances, see Section 4.3.6.1</li> <li>• covering the surface, e.g. with tarpaulins, see Section</li> </ul>	<p>Sodium bicarbonate and urea are stored in an open unroofed yard in close proximity to the day tanks. These powders are obtained from the relevant contractors and stored in pressurised containers within the yard. Risks of emissions are negligible because of the physical state of the materials and due to the fact that they are enclosed in pressurised containers.</p> <p>These lie within the responsibility of the operator, which will be present whenever transfer of such materials is required, and ensure that the employees are aware of the hazards and safety measures required for transferring such products.</p>

Aspect of BAT	BAT	Status at Installation
	<p>4.3.4.4</p> <ul style="list-style-type: none"> <li>• solidification of the surface, see Table 4.13</li> <li>• grassing-over of the surface, see Table 4.13.</li> </ul> <p>BAT for short-term open storage are one, or a proper combination, of the following techniques:</p> <ul style="list-style-type: none"> <li>• moistening the surface using durable dust-binding substances, see Section 4.3.6.1</li> <li>• moistening the surface with water, see Sections 4.3.6.1</li> <li>• covering the surface, e.g. with tarpaulins, see Section 4.3.4.4.</li> </ul> <p>Additional measures to reduce dust emissions from both long and short-term open storage are:</p> <ul style="list-style-type: none"> <li>• placing longitudinal axis of the heap parallel with the prevailing wind</li> <li>• applying protective plantings, windbreak fences or upwind mounds to lower the wind velocity</li> <li>• applying only one heap instead of several heaps as far as possible; with two heaps storing the same amount as one, the free surface increases with 26 %</li> <li>• applying storage with retaining walls reduces the free surface, leading to a reduction of diffuse dust emissions; this reduction is maximised if the wall is placed upwind of the heap</li> <li>• placing retaining walls close together.</li> </ul> <p>See Table 4.13 for more details.</p>	
<b>Enclosed storage</b>	BAT is to apply enclosed storage by using, for example,	Currently, the only solid material that is stored in an

<b>Aspect of BAT</b>	<b>BAT</b>	<b>Status at Installation</b>
	<p>silos, bunkers, hoppers and containers. Where silos are not applicable, storage in sheds can be an alternative. This is, e.g. the case if apart from storage, the mixing of batches is needed.</p> <p>BAT for silos is to apply a proper design to provide stability and prevent the silo from collapsing. See Sections 4.3.4.1 and 4.3.4.5.</p> <p>BAT for sheds is to apply proper designed ventilation and filtering systems and to keep the doors closed. See Section 4.3.4.2.</p> <p>BAT is to apply dust abatement and a BAT associated emission level of 1 – 10 mg/m<sup>3</sup>, depending on the nature/type of substance stored. The type of abatement technique has to be decided on a case-by-case basis. See Section 4.3.7.</p> <p>For a silo containing organic solids, BAT is to apply an explosion resistant silo (see Section 4.3.8.3), equipped with a relief valve that closes rapidly after the explosion to prevent oxygen entering the silo, as described in Section 4.3.8.4.</p>	<p>enclosed storage area and lies within the responsibility of D3PG is:</p> <ul style="list-style-type: none"> <li>• Sodium metabisulphite – in 25kg bags on pellets (dosing of sea water)</li> </ul>
<b>Storage of packaged dangerous solids</b>	For details regarding BAT for the storage of packaged dangerous solids, see Section 5.1.2.	No dangerous solids are stored by D3PG.
<b>Preventing incidents and</b>	The Seveso II Directive (Council Directive 96/82/EC of 9 December 1996 on the control of major accident hazards	D3 is not considered a COMAH site as the storage of fuel is not within the remit of D3 PG. Nonetheless, HAZID,

Aspect of BAT	BAT	Status at Installation
<b>(major) accidents</b> <b>Safety and risk management</b>	<p>involving dangerous substances) requires companies to take all measures necessary to prevent and limit the consequences of major accidents. They must in any case have a major accident prevention policy (MAPP) and a safety management system to implement the MAPP. Companies holding large quantities of dangerous substances, so-called upper tiered establishments, must also draw up a safety report and an on-site emergency plan and maintain an up-to-date list of substances. However, plants that do not fall under the scope of the Seveso II Directive can also cause emissions from incidents and accidents. Applying a similar, maybe less detailed, safety management system is the first step in preventing and limiting these.</p> <p>BAT in preventing incidents and accidents is applying a safety management system as described in Section 4.1.7.1.</p>	HAZOP and ATEX safety reports for D3 have been compiled and submitted. Enemalta is in the process of submitting a consolidated safety report comprising of different safety and risk assessment studies conducted for the different facilities at Delimara Power Station.

## Part 4: Transfer and handling of solids

Aspect of BAT	BAT	Status at Installation
<b>General approaches to minimise dust from transfer and handling</b>	<p>BAT is to prevent dust dispersion due to loading and unloading activities in the open air, by scheduling the transfer as much as possible when the wind speed is low. However, and taking into account the local situation, this type of measure cannot be generalised to the whole EU and to any situation irrespective of the possible high costs. See Section 4.4.3.1.</p> <p>Discontinuous transport (e.g. shovel or truck) generally generates more dust emissions than continuous transport such as conveyors. BAT is to make transport distances as short as possible and to apply, wherever possible, continuous transport modes. For existing plants, this might be a very expensive measure. See Section 4.4.3.5.1.</p> <p>When applying a mechanical shovel, BAT is to reduce the drop height and to choose the best position during discharging into a truck; see Section 4.4.3.4.</p> <p>While driving, vehicles might swirl up dust from solids spread on the ground. BAT then is to adjust the speed of vehicles on-site to avoid or minimise dust being swirled up; see Section 4.4.3.5.2.</p> <p>BAT for roads that are used by trucks and cars only, is applying hard surfaces to the roads of, for example, concrete or asphalt, because these can be cleaned easily to avoid dust being swirled up by vehicles, see Section 4.4.3.5.3.</p>	<p>The solid materials that are transferred and handled by D3PG are stored in pressurised containers; therefore the only emissions that may arise occur during the transfer and handling of such powders.</p> <p>Any solid material that settles on the ground will be removed and treated to prevent its dispersion to the rainwater system.</p> <p>Transport distances are kept as close as possible. In fact the storage yard containing powdered urea is in very close proximity to the urea mixing tanks.</p>

Aspect of BAT	BAT	Status at Installation
	<p>However, applying hard surfaces to the roads is not justified when the roads are used just for big shovel vehicles or when a road is temporary.</p> <p>BAT is to clean roads that are fitted with hard surfaces according to Section 4.4.6.12.</p> <p>Cleaning of vehicle tyres is BAT. The frequency of cleaning and type of cleaning facility applied (see Section 4.4.6.13) has to be decided on a case-by-case basis.</p> <p>Where it neither compromises product quality, plant safety, nor water resources, BAT for loading/unloading drift sensitive, wettable products is to moisten the product as described in Sections 4.4.6.8, 4.4.6.9 and 4.3.6.1. Risk of freezing of the product, risk of slippery situations because of ice forming or wet product on the road and shortage of water are examples when this BAT might not be applicable.</p> <p>For loading/unloading activities, BAT is to minimise the speed of descent and the free fall height of the product; see Sections 4.4.5.6 and 4.4.5.7 respectively. Minimising the speed of descent can be achieved by the following techniques that are BAT:</p> <ul style="list-style-type: none"> <li>• installing baffles inside fill pipes</li> <li>• applying a loading head at the end of the pipe or tube to regulate the output speed</li> <li>• applying a cascade (e.g. cascade tube or hopper)</li> <li>• applying a minimum slope angle with, e.g. chutes.</li> </ul>	<p>Loading occurs via height adjustable fill pipes that are connected between the small pressurised container stored in the yard and the large day tanks. The powder contents of the tank are removed thanks to an interior air compressor system that generates sufficient kinetic energy for the material to transfer along the pipe route and into the storage tanks.</p>

Aspect of BAT	BAT	Status at Installation
	<p>To minimise the free fall height of the product, the outlet of the discharger should reach down onto the bottom of the cargo space or onto the material already piled up. Loading techniques that can achieve this, and that are BAT, are:</p> <ul style="list-style-type: none"> <li>• height adjustable fill pipes</li> <li>• height adjustable fill tubes, and</li> <li>• height adjustable cascade tubes.</li> </ul> <p>These techniques are BAT, except when loading/unloading non drift sensitive products, for which the free fall height is not that critical.</p> <p>Optimised discharged hoppers are available and described in Section 4.4.6.7</p>	
<b>Considerations on transfer techniques</b> <b>Grabs</b>	<p>For applying a grab, BAT is to follow the decision diagram as shown in Section 4.4.3.2 and to leave the grab in the hopper for a sufficient time after the material discharge.</p> <p>BAT for new grabs, is to apply grabs with the following properties (see Section 4.4.5.1):</p> <ul style="list-style-type: none"> <li>• geometric shape and optimal load capacity</li> <li>• the grab volume is always higher than the volume that is given by the grab curve</li> <li>• the surface is smooth to avoid material adhering, and</li> <li>• a good closure capacity during permanent operation.</li> </ul>	No grabs are used by DP3G.
<b>Considerations on transfer techniques</b>	For all types of substances, BAT is to design conveyor to conveyor transfer chutes in such a way that spillage is reduced to a minimum. A modelling process is available to	Neither conveyors nor transfer chutes are adopted. The system that is used is dependent on compressed air and has been explained in the previous note.

Aspect of BAT	BAT	Status at Installation
Conveyors and transfer chutes	<p>generate detail designs for new and existing transfer points. For more details see Section 4.4.5.5.</p> <p>For non or very slightly drift sensitive products (S5) and moderately drift sensitive, wettable products (S4), BAT is to apply an open belt conveyor and additionally, depending on the local circumstances, one or a proper combination of the following techniques:</p> <ul style="list-style-type: none"> <li>• lateral wind protection, see Section 4.4.6.1</li> <li>• spraying water and jet spraying at the transfer points, see Sections 4.4.6.8 and 4.4.6.9, and/or</li> <li>• belt cleaning, see Section 4.4.6.10.</li> </ul> <p>For highly drift sensitive products (S1 and S2) and moderately drift sensitive, not wettable products (S3) BAT for new situations, is to:</p> <ul style="list-style-type: none"> <li>○ apply closed conveyors, or types where the belt itself or a second belt locks the material (see Section 4.4.5.2), such as: <ul style="list-style-type: none"> <li>• pneumatic conveyors</li> <li>• trough chain conveyors</li> <li>• screw conveyors</li> <li>• tube belt conveyor</li> <li>• loop belt conveyor</li> <li>• double belt conveyor <ul style="list-style-type: none"> <li>○ or to apply enclosed conveyor belts without support pulleys (see Section 4.4.5.3), such as:</li> </ul> </li> <li>• aerobelt conveyor</li> <li>• low friction conveyor</li> <li>• conveyor with diabolos.</li> </ul> </li> </ul>	



Aspect of BAT	BAT	Status at Installation
	<p>The type of conveyor depends on the substance to be transported and on the location and has to be decided on a case-by-case basis.</p> <p>For existing conventional conveyors, transporting highly drift sensitive products (S1 and S2) and moderately drift sensitive, not wettable products (S3), BAT is to apply housing; see Section 4.4.6.2. When applying an extraction system, BAT is to filter the outgoing air stream; see Section 4.4.6.4.</p> <p>To reduce energy consumption for conveyor belts (see Section 4.4.5.2), BAT is to apply:</p> <ul style="list-style-type: none"> <li>• a good conveyor design, including idlers and idler spacing</li> <li>• an accurate installation tolerance, and</li> <li>• a belt with low rolling resistance.</li> </ul> <p>See Annex 8.4 for the disperseveness classes (S1 – S4) of solid bulk materials.</p>	

<sup>1</sup> There is a split view from three Member States, because in their view, on sites where significant VOC emissions are to be expected (e.g. refineries, petrochemical plants and oil terminals), BAT is to calculate the VOC emissions regularly with validated calculation methods, and because of uncertainties in the calculation methods, emissions from the plants should be monitored occasionally in order to quantify the emissions and to give basic data for refining calculation methods. This can be carried out by using DIAL techniques. The necessity and frequency of emission monitoring needs to be decided on a case-by-case basis.

<sup>2</sup> There is a split view from industry, that this technique is not BAT because in their view:

a) there is no definition of ‘volatile’ in this BREF

- 
- b) there is no test of environmental significance
  - c) products which may be dangerous to the environment, but not classed as toxic, are not captured
  - d) it can be demonstrated that other emission control measures may provide a higher level of environmental protection taking into account the costs and advantages of the various techniques
  - e) there are no commonly understood performance criteria for a vapour treatment installation
  - f) this does not take into account the cost, or advantages of other techniques
  - g) this does not provide the flexibility to take into account the technical characteristics of the installation concerned, its geographical location and the local environmental conditions
  - h) there is no proportionality in this conclusion.

<sup>3</sup> There is a split view from industry, that this technique is not BAT because in their view:

- a) there is no definition of 'volatile' in this BREF
- b) there is no test of environmental significance
- c) products which may be dangerous to the environment, but not classed as toxic, are not captured
- d) it can be demonstrated that other emission control measures may provide a higher level of environmental protection taking into account the costs and advantages of the various techniques
- e) there are no commonly understood performance criteria for a vapour treatment installation
- f) this does not take into account the costs or advantages of other techniques
- g) this does not provide the flexibility to take into account the technical characteristics of the installation concerned, its geographical location and the local environmental conditions
- h) there is no proportionality in this conclusion.

<sup>4</sup> There is a split view from industry, that this technique is not BAT because in their view:

- a) there is no definition of 'volatile' in this BREF
- b) there is no test of environmental significance
- c) products which may be dangerous to the environment, but not classed as toxic, are not captured
- d) it can be demonstrated that other emission control measures may provide a higher level of environmental protection taking into account the costs and advantages of the various techniques
- e) there are no commonly understood performance criteria for a vapour treatment installation
- f) this does not take into account the costs or advantages of other techniques
- g) this does not provide the flexibility to take into account the technical characteristics of the installation concerned, its geographical location and the local environmental

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conditions

h) there is no proportionality in this conclusion.

## **Annex I: Comparison of the processes at Facility with the BREF for Industrial cooling systems (published December 2001).**

### **1. A horizontal approach to defining BAT for cooling systems**

<b>Aspect of BAT</b>	<b>BAT</b>	<b>Status at Installation</b>
<b>Introduction</b>	<p>Before summarising the BAT conclusions in this chapter, a short explanation is given on how the horizontal character of this BREF should be interpreted.</p> <p>In a horizontal approach it is assumed that the environmental aspects of the applied techniques and the associated reduction measures can be assessed and that generic BAT can be identified that are independent of the industrial processes in which techniques are applied.</p> <p>Industrial cooling systems are an integrated part of the industrial process to be cooled. The cooling systems within the scope of this document are used in many of the industrial sectors under the scope of IPPC. Consequently, the variety of applications, techniques and operational practices is enormous. Additionally, the thermodynamic character of the process leads to further variations in performance and consequently in the environmental effects.</p> <p>Due to this large variation, comparisons between techniques leading to general conclusions on BAT are difficult. The identification of a general preventive approach is considered to be possible, based on practical experience with reduction of emissions from cooling systems.</p> <p>In this preventive approach or, primary BAT-approach,</p>	

Aspect of BAT	BAT	Status at Installation
	<p>attention is firstly given to the process to be cooled. The design and the construction of the cooling system are an essential second step, in particular for new installations. Finally, changes of equipment and the way in which the cooling system should be operated will address new installations, but are particularly important in existing systems, where technological options are considerably limited and cost-intensive. Careful evaluations must be performed case by case.</p>	
<p><b>Integrated heat management</b>  <b>Industrial cooling = Heat management</b></p>	<p>Cooling of industrial processes can be considered as heat management and is part of the total energy management within a plant. The amount and level of heat to be dissipated requires a certain level of cooling systems performance. This performance level will in turn affect the system configuration, design and operation and consequently the cooling systems' environmental performance (direct impact). Reversibly, the cooling performance will also affect the overall efficiency of the industrial process (indirect impact). Both impacts, direct and indirect, need to be balanced, taking into account all variables. Every change in the cooling system has to be considered against the consequences it may have for this balance.</p> <p>This concept can be used as a starting point to formulate the first principle of BAT for cooling systems. BAT for all installations is an integrated approach to reduce the environmental impact of industrial cooling systems maintaining the balance between both the direct and indirect impacts. In other words, the effect of an emission reduction</p>	<p>An integrated approach that maintains a balance between the energy efficiency of the plant and the resulting environmental impact, shall be implemented. The seawater cooling system for the converted engines in D3 will remain the same as that for the existing plant.</p>

Aspect of BAT	BAT	Status at Installation
	<p>has to be balanced against the potential change in the overall energy efficiency. There is currently no minimum ratio in terms of the environmental benefits and the possible loss in overall energy efficiency that can be used as a benchmark to arrive at techniques that can be considered BAT. Nevertheless, this concept can be used to compare alternatives (Chapter 3.2 and Annex II).</p>	
<p><b>Integrated heat management</b>  <b>Reduction of the level of heat discharge by optimization of internal/external heat reuse</b></p>	<p>A preventive approach should start with the industrial process requiring heat dissipation and aim to reduce the need for heat discharge in the first place. In fact, discharge of heat is wasting energy and as such not BAT. Reuse of heat within the process should always be a first step in the evaluation of cooling needs. Process-integrated energy measures are outside the scope of this document, but reference is made to other BAT Reference Documents drafted in the framework of IPPC describing options for energy measures.</p> <p>In a greenfield situation, assessment of the required heat capacity can only be BAT if it is the outcome of maximum use of the internal and external available and applicable options for reuse of excess heat.</p> <p>In an existing installation, optimizing internal and external reuse and reducing the amount and level of heat to be discharged must also precede any change to the potential capacity of the applied cooling system. Increasing the efficiency of an existing cooling system by improving systems operation must be evaluated against an increase of efficiency by technological measures through retrofit or</p>	<p>Seawater is pumped from the Marsaxlokk inlet to cool the operating diesel engines. A portion of this seawater is not used for this purpose, but is converted to freshwater thanks to FWGs installed at D3. The process involves the conversion of seawater into water vapour by making use of the waste heat extracted from the diesel engines' cooling water system. The resultant steam forms due to a higher pressure within the FGW, and will pass through a demister to collect the mineral particles (salt). This steam is converted back to liquid water by making contact with cooler temperatures. This water is now known as demineralised water (DM) and is stored in an appropriate area. D3 supplies such DM to Enemalta, to replace the evaporated water that is provided.</p> <p>In addition to this, another sea water pumping station is available and is used to dissipate the heat from the engine cooling system, in order to obtain lower temperatures at the marine discharge point.</p> <p>In doing so, the energy efficiency of D3 is drastically improved. The resultant environmental impact is that the</p>

Aspect of BAT	BAT	Status at Installation
	<p>technological change. In general and for large existing cooling systems, the improvement of the systems operation is considered to be more cost effective than the application of new or improved technology and can therefore be regarded as BAT.</p>	<p>effluent discharge at Hofra ż-Żghira has a temperature difference of 8°C when compared to the temperature of water that was extracted from Marsaxlokk. This value is adhered to by legal obligations, and is based on scientific surveys that predicted that such a temperature flux would only cause a minor to negligible impact on the surrounding marine environments.</p>
<p><b>Integrated heat management</b> <b>Cooling system and process requirements</b></p>	<p>Once the level and amount of waste heat generated by the process is established and no further reduction of waste heat can be achieved, an initial selection of a cooling system can be made in the light of the process requirements discussed in Chapter 1. Every process has its unique combination of requirements, where the level of control of the process, process reliability and safety play an important role. This makes it almost impossible at this stage to make a first characterisation of BAT, but the following conclusions can be drawn with respect to a number of process characteristics.</p> <p>The application of the ambient temperature levels is based on the experiences in Europe in applying cooling systems under different climatic conditions. Generally, dry bulb temperatures do not justify cooling away low level waste, heat and water-cooling is preferred. But in areas with low average dry bulb temperatures dry air-cooling is applied to cool down to lower process temperatures (after options for reuse have been explored). Water-cooling, if sufficient water is available, can then dissipate the residual amount of waste heat.</p>	<p>In previous studies conducted by Enemalta in conjunction with the EIA published in 2009, seawater cooling was considered to be the most effective and environmental friendly option in the local circumstances. The cooling system that is adopted has been explained in the previous note.</p>

Aspect of BAT	BAT	Status at Installation
	<p>Hazardous process substances, which involve a high environmental risk to the aquatic environment in case of leakage, should be cooled by means of indirect cooling systems to prevent an uncontrollable situation.</p> <p>The selection of a cooling configuration should be based on a comparison between the different feasible alternatives within all requirements of the process. Process requirements are for example control of chemical reactions, reliability of process performance and maintenance of required safety levels. The aim is to minimise the indirect impact of the selected alternative. For each alternative the environmental performances can be best compared if expressed in direct and indirect use of energy (kWe) per unit of energy discharged (kWth). Another way to compare configurations is to express the change in direct energy use (kWe) of the cooling system and the change in production level of the process in tonnes, both per unit of energy discharged (kWth).</p> <p>A change in cooling technology to reduce the environmental impact can only be considered BAT if the efficiency of cooling is maintained at the same level or, even better, at an increased level.</p> <p>See Figure 1.</p>	
<b>Integrated heat management</b> <b>Cooling system and site requirements</b>	<p>The site-imposed limits apply particularly to new installations, where a cooling system must still be selected. If the required heat discharge capacity is known it may</p>	<p>It is important to note that the pumping of sea water and dosing for the cooling water system lies within the responsibility of Enemalta.</p>



Aspect of BAT	BAT	Status at Installation
	<p>influence the selection of an appropriate site. For temperature-sensitive processes it is BAT to select the site with the required availability of cooling water.</p> <p>For many reasons new installations are not always erected on a site that is preferred from a cooling technology point of view, whereas for both new and existing installations the site characteristics are clear once the site is known. The most important thermodynamic characteristic of a site is its annual climatic pattern described by the dry and wet bulb temperatures.</p> <p>Other characteristics identified are space, water availability to cool and to discharge and the surrounding sensitive areas (urban and industrial). With respect to groundwater, it can be BAT to apply a dry cooling system following the principle to minimise the use of groundwater, particularly in those areas where depletion of aquifers cannot be ruled out. In Figure 2, BAT examples are shown that have been identified for a few site characteristics.</p>	<p>An alternative assessment report was published in 2010, describing potential technologies that could be applied for the disposal of cooling water at Delimara. The report concluded that most of the options that were available would have resulted in a reduced thermal input to the surrounding marine environment.</p> <p>However, these technologies would have also contributed to significant visual and noise impacts within constrained areas of land. It was therefore recommended to keep the technology simple and ensure that the repercussions of the thermal effluent are regularly monitored and controlled.</p> <p>By using such a cooling system, the heat emitted at the heat exchanger could contribute to the production of demineralised (DM) water by converting sea water into steam at FWGs. This increases the energy efficiency of the plant, along the BAT guidelines.</p> <p>Dosing of sea water is performed to prevent fouling via the formation of organisms in the heat exchangers and condensers which would reduce the efficiency of the processes that are occurring. Two stages of coarse filtration are in place upstream of the sea water pumps to prevent the entry of aquatic organisms and infiltration of debris into the cooling systems. Additional filtration systems are installed upstream of the heat exchangers.</p>
<b>Application of BAT in industrial</b>	In Chapter 1 the outline of a preventive approach is presented showing how a step-by-step evaluation of all	Refer to above point on how the industrial cooling system was chosen.

Aspect of BAT	BAT	Status at Installation
cooling systems	<p>constraints can lead to what may be called “Best available cooling technique”. Within the framework of this approach, Chapter 1 and Chapter 3 and the associated Annexes discuss the factors and offer techniques involved in the identification of potential BAT for the major cooling configurations using water and/or air. The optimization of a cooling system to reduce its environmental impact is a complex exercise and not an exact mathematical comparison. In other words, combining techniques selected from the BAT-tables does not lead to a BAT cooling system. The final BAT solution will be a site-specific solution. However, it is believed that, based on experience in industry, conclusions can be drawn on BAT, in quantified terms where possible.</p> <p>In Chapter 3 options for reducing emissions into the environment have been presented based on the information submitted by the TWG. For each environmental issue and for each relevant cooling configuration an attempt has been made to identify a general approach and arrive at BAT. Some techniques are described in more detail in the Annexes. Emphasis is clearly on the water-related problems with a focus on reduction of the application of biocides and blacklisted substances.</p> <p>The proposed techniques are applied techniques. They have proven to be effective, although quantification is difficult and they may create unrealistic expectations. It can be assumed that all measures proposed as BAT, and which are not entirely dependant on the local situation, can be</p>	

Aspect of BAT	BAT	Status at Installation
	<p>considered for new systems. With respect to existing installations, care must be taken as the assessment is more difficult where options are limited and depend on a multitude of (process) factors. There do not seem to be many obstacles to implementation of operational measures in existing cooling systems, unless the technological design limits the number of options for modification.</p> <p>In Figure 3 to Figure 11, techniques are presented that are considered BAT, following on from the primary BAT-approach for:</p> <ul style="list-style-type: none"> <li>• increasing the overall energy efficiency,</li> <li>• reduction of use of water and of cooling water additives,</li> <li>• reduction of emissions to air and water,</li> <li>• reduction of noise,</li> <li>• reduction of entrainment of aquatic organisms and</li> <li>• reduction of biological risks.</li> </ul> <p>No clear BAT has been identified on the reduction of waste or techniques to handle waste avoiding environmental problems, such as contamination of soil and water, or air in the case of incineration.</p> <p>For each environmental issue the consequences for other media of the application of a reduction technique have been identified. Generally speaking every change made to a cooling system must be carefully balanced against the associated effects and in this sense the optimisation of industrial cooling is a cross-media issue.</p>	<p>D3 will be discharging 14,700m<sup>3</sup>/h at il-Hofra z-Zghira</p> <p>Waste generation and soil contamination are not applicable impacts for the identified cooling system for D3.</p> <p>The major environmental impact generated due to the cooling system is increased temperature and discharge of biocide in the marine environment. At the water outlet, a concentration of 0.1ppm of chlorine dioxide is expected. This normally decomposes to chlorine and oxygen and absorbed by the sea water, limiting the harm caused to the</p>

Aspect of BAT	BAT	Status at Installation
	<p>For some measures BAT-values have been identified. However, addressing the application of different cooling techniques in a multitude of varying process conditions does not allow for clear associated levels. In those cases a qualitative description is given.</p> <p>For new cooling installations it is BAT to start identifying reduction measures in the design phase, applying equipment with low energy requiring requirement and by choosing the appropriate material for equipment in contact with the process substance and/or the cooling water. In this sense the following quotation is exemplary: “in practice... attention to design, layout and maintenance of the cooling water system has a relatively low priority compared to the environmental consequences of a poorly designed and/or operated cooling water system. Since little attention is paid to design factors, treatments often have to make up for bad design, and therefore need to be chosen in such a way that they minimize risks of fouling. Few changes of this attitude are to be expected as long as there is a low level of awareness of the long-term costs of operating and maintaining poorly designed CWS” [tm005, Van Donk and Jenner, 1996].</p> <p>If dry air cooling systems are the preferred option, measures are primarily related to reduction of direct energy consumption and noise emissions and the optimization of size with respect to the required cooling surface.</p> <p>For existing installations, technological measures can be</p>	<p>surrounding marine environment.</p>

Aspect of BAT	BAT	Status at Installation
	<p>BAT under certain circumstances. Generally, a change in technology is cost-intensive where overall efficiency must be maintained. Cost evaluation should then compare investment costs of the change versus the change in operational costs and validate the reduction effect versus other environmental consequences. For example, it would need a comparison between the environmental effect of recirculating the cooling water - requiring the application of biocidal water treatment - against a once-through system without biocides, but a large heat emission to the aquatic environment.</p> <p>In the case of pre-assembled off-the-peg cooling towers, a change in technology seems feasible both technically and economically. No comparable data have been submitted that can support this, but supplier experience is that it is relatively easy to change small size cooling towers, for example, from a closed recirculating wet to a closed recirculating hybrid or wet/dry configuration. This would not need major process modifications or construction work. For large custom-designed towers that are erected on-site, technological changes are not easy to make. A different technology generally means a completely new cooling tower.</p> <p>For existing wet cooling systems, where the focus is largely on environmental measures to reduce water use and to emissions of chemicals to the surface water, BAT has not so much technological but rather an operational character. Monitoring, operation and maintenance are the key issues</p>	

Aspect of BAT	BAT	Status at Installation
	here.	

Figure 1:

**Table 4.1: Examples of process requirements and BAT**

Process characteristics	Criteria	Primary BAT approach	Remark	Reference
Level of dissipated heat high (> 60°C)	Reduce use of water and chemicals and improve overall energy efficiency	(Pre-) cooling with dry air	Energy efficiency and size of cooling system are limiting factors	Section 1.1/1.3
Level of dissipated heat medium (25-60°C)	Improve overall energy efficiency	Not evident	Site-specific	Section 1.1/1.3
Level of dissipated heat low (<25°C)	Improve overall energy efficiency	Water cooling	Site selection	Section 1.1/1.3
Low and medium heat level and capacity	Optimum overall energy efficiency with water saving and visible plume reduction	Wet and hybrid cooling system	Dry cooling less suitable due to required space and loss of overall energy efficiency	Section 1.4
Hazardous substances to be cooled involving high environmental risk	Reduction of risk of leakage	Indirect cooling system	Accept an increase in approach	Section 1.4 and Annex VI

Figure 2:

Table 4.2: Examples of site characteristics and BAT

Characteristics of site	Criteria	Primary BAT approach	Remarks	Reference
Climate	Required design temperature	Assess variation in wet and dry bulb T	With high dry bulb T dry air cooling generally has lower Energy efficiency	Section 1.4.3
Space	Restricted surface on-site	(Pre-assembled) Roof type constructions	Limits to size and weight of the cooling system	Section 1.4.2
Surface water availability	Restricted availability	Recirculating systems	Wet, dry or hybrid feasible	Section 2.3 and 3.3
Sensitivity of receiving water body for thermal loads	Meet capacity to accommodate thermal load	<ul style="list-style-type: none"> <li>- Optimise level of heat reuse</li> <li>- Use recirculating systems</li> <li>- Site selection (new cooling system)</li> </ul>		Section 1.1
Restricted availability of groundwater	Minimisation of groundwater use	Air cooling if no adequate alternative water source is available	Accept energy penalty	Section 3.3
Coastal area	Large capacity > 10 MW <sub>th</sub>	Once-through systems	Avoid mixing of local thermal plume near intake point, e.g. by deep water extraction below mixing zone using temperature stratification	Section 1.2.1 / Section 3.2 / Annex XI.3
Specific site requirements	In case of obligation for plume reduction and reduced tower height	Apply hybrid cooling system	Accept energy penalty	Ch.2



## 2. Reduction of energy consumption

Aspect of BAT	BAT	Status at Installation
<b>General</b>	<p>It is BAT in the design phase of a cooling system:</p> <ul style="list-style-type: none"> <li>• To reduce resistance to water and airflow</li> <li>• To apply high efficiency/low energy equipment</li> <li>• To reduce the amount of energy demanding equipment (Annex XI.8.1)</li> <li>• To apply optimised cooling water treatment in once-through systems and wet cooling towers to keep surfaces clean and avoid scaling, fouling and corrosion.</li> </ul> <p>For each individual case a combination of the above-mentioned factors should lead to the lowest attainable energy consumption to operate a cooling system. Concerning BAT a number of techniques/approaches have been identified.</p>	<p>The pumping system is designed to reduce pumping losses, thus improving the energy consumption of the entire pumping process.</p> <p>Enemalta is aiming to guarantee standards of pumping efficiency to the various operators at DPS. A chemist is occasionally brought on site to perform REDOX monitoring tests of the pumped sea water. According to the readings that are recorded, the chemist may manually shift the computer timed dose of biocide that is supplied to prevent fouling by marine organisms.</p>
<b>Identified reduction techniques within the BAT-approach</b>	<p>In an integrated approach to cooling an industrial process, both the direct and indirect use of energy are taken into account. In terms of the overall energy efficiency of an installation, the use of once-through systems is BAT, in particular for processes requiring large cooling capacities (e.g. &gt; 10 MWth). In the case of rivers and/or estuaries once-through can be acceptable if also:</p> <ul style="list-style-type: none"> <li>▪ extension of heat plume in the surface water leaves passage for fish migration;</li> <li>▪ cooling water intake is designed aiming at reduced fish entrainment;</li> </ul>	<p>Once-through system is currently in place at DPS.</p>

Aspect of BAT	BAT	Status at Installation
	<ul style="list-style-type: none"> <li>▪ heat load does not interfere with other users of receiving surface water.</li> </ul> <p>For power stations, if once-through is not possible, natural draught wet cooling towers are most energy-efficient than other cooling configurations, but application can be restricted because of the visual impact of their overall height.</p> <p>See Figure 3.</p>	

Figure 3:

**Table 4.3: BAT for increasing overall energy efficiency**

Relevance	Criterion	Primary BAT approach	Remarks	Reference
Large cooling capacity	Overall energy efficiency	Select site for once-through option	See text above table	Section 3.2
All systems	Overall energy efficiency	Apply option for variable operation	Identify required cooling range	Section 1.4
All systems	Variable operation	Modulation of air/ water flow	Avoid instability cavitation in system (corrosion and erosion)	
All wet systems	Clean circuit/ exchanger surfaces	Optimised water treatment and pipe surface treatment	Requires adequate monitoring	Section 3.4
Once-through systems	Maintain cooling efficiency	Avoid recirculation of warm water plume in rivers and minimise it in estuaries and on marine sites		Annex XII
All cooling towers	Reduce specific energy consumption	Apply pumping heads and fans with reduced energy consumption		

### 3. Reduction of water requirements

Aspect of BAT	BAT	Status at Installation
<b>General</b>	<p>For new systems the following statements can be made:</p> <ul style="list-style-type: none"> <li>• In the light of the overall energy balance, cooling with water is most efficient;</li> <li>• For new installations a site should be selected for the availability of sufficient quantities of (surface) water in the case of large cooling water demand;</li> <li>• The cooling demand should be reduced by optimising heat reuse;</li> <li>• For new installations a site should be selected for the availability of an adequate receiving water, particularly in case of large cooling water discharges;</li> <li>• Where water availability is limited, a technology should be chosen that enables different modes of operation requiring less water for achieving the required cooling capacity at all times;</li> <li>• In all cases recirculating cooling is an option, but this needs careful balancing with other factors, such as the required water conditioning and a lower overall Energy efficiency.</li> </ul> <p>For existing water cooling systems, increasing heat reuse and improving operation of the system can reduce the required amount of cooling water. In the case of rivers with limited availability of surface water, a change from a once-through system to recirculating cooling systems is a technological option and may be considered BAT.</p>	<p>The integration between the cooling system and the generation of demineralised water from FWG, ensures that the process is efficient and optimised.</p>

Aspect of BAT	BAT	Status at Installation
	For power stations with large cooling capacities, this is generally considered as a cost-intensive exercise requiring a new construction. Space requirements must be taken into account.	
<b>Identified reduction techniques within the BAT-approach</b>	<p>See Figure 4.</p> <p>Application of dry air-cooling has been suggested on a number of occasions. If the overall Energy efficiency is taken into account, dry air-cooling is less attractive than wet cooling. With this the dry technology is not disqualified. For shorter lifetime periods it was calculated that the differences in costs between dry and wet become less than for longer lifetime periods. When costs for water and water treatment are taken into account, differences also become smaller. Dry cooling can be recommended in certain circumstances and for precooling at higher temperature levels, where excessive water would be needed.</p>	Not applicable. Seawater cooling is best suited in view of the local conditions.

Figure 4:

**Table 4.4: BAT for reduction of water requirements**

Relevance	Criterion	Primary BAT approach	Remarks	Ref.
All wet cooling systems	Reduction of need for cooling	Optimisation of heat reuse		Ch.1
	Reduction of use of limited sources	Use of groundwater is not BAT	Site-specific in particular for existing systems	Ch.2
	Reduction of water use	Apply recirculating systems	Different demand on water conditioning	Ch.2/3.3
	Reduction of water use, where obligation for plume reduction and reduced tower height	Apply hybrid cooling system	Accept energy penalty	Ch.2.6/ 3.3.1.2
	Where water (make-up water) is not available during (part of) process period or very limited (drought-stricken areas)	Apply dry cooling	Accept energy penalty	Section 3.2 and 3.3 Annex XII.6
All recirculating wet and wet/dry cooling systems	Reduction of water use	Optimization of cycles of concentration	Increased demand on conditioning of water, such as use of softened make-up water	Section 3.2 and section XI

#### 4. Reduction of entrainment of organisms

Aspect of BAT	BAT	Status at Installation
<b>General</b>	<p>The adaptation of water intake devices to lower the entrainment of fish and other organisms is highly complex and site-specific. Changes to an existing water intake are possible but costly.</p> <p>From the applied or tested fish protection or repulsive technologies, no particular techniques can yet be identified as BAT. The local situation will determine which fish protection or repulsive technique will be BAT. Some general applied strategies in design and position of the intake can be considered as BAT, but these are particularly valid for new systems.</p> <p>On the application of sieves it should be noted that costs of disposal of the resulting organic waste collected from the sieves can be considerable.</p>	<p>Two stages of course filtration are in place upstream of the sea water pumps to prevent the entry of aquatic organisms and infiltration of debris into the cooling systems. Additional filtration systems are installed upstream of the heat exchangers.</p>
<b>Identified reduction techniques within the BAT-approach</b>	See Figure 5.	

Figure 5:

**Table 4.5: BAT for reduction of entrainment**

Relevance	Criterion	Primary BAT approach	Remarks	Ref.
All once-through systems or cooling systems with intakes of surface water	Appropriate position and design of intake and selection of protection technique	Analysis of the biotope in surface water source	Also critical areas, such as spawning grounds, migration areas and fish nurseries	Section 3.3.3 and Annex XII.3.3
	Construction of intake channels	Optimise water velocities in intake channels to limit sedimentation; watch for seasonal occurrence of macrofouling		Section 3.3.3



## 5. Reduction of emissions to water

Aspect of BAT	BAT	Status at Installation
<b>General BAT approach to reduce heat emissions</b>	<p>Whether heat emissions into the surface water will have an environmental impact strongly depends on the local conditions. Such site conditions have been described, but do not lead to a conclusion on BAT in general terms.</p> <p>Where, in practice, limits to heat discharge were applicable, the solution was to change from once-through technology to open recirculating cooling (open wet cooling tower). From the available information, and considering all possible aspects, care must be taken in concluding that this can be qualified as BAT. It would need to balance the penalty increase in overall energy efficiency of applying a wet cooling tower (Chapter 3.2) against the effect of reduced environmental impact of reduced heat discharge. In a fully integrated assessment at the level of a river catchment, this could for example include the raised overall efficiency levels of other processes using the same, but now colder, water source, which becomes available because there is no longer a large warm water discharge into it.</p> <p>Where the measures generally aim at reducing the <math>\Delta T</math> of the discharged cooling water, a few conclusions on BAT can be drawn. Pre-cooling (Annex XII) has been applied for large power plants where the specific situation requires this, e.g. to avoid raised temperature of the intake water.</p> <p>Discharges will have to be limited with reference to the constraints of the requirements of Directive 78/659/EEC for</p>	<p>A flux of 8°C is set as the limit value for the thermal effluent at Hofra ž-Žghira. This value was set to minimise the impact and to allow for sufficient dissipation of heat at sea. However, if not monitored correctly, this could eventually lead to a shift in community composition in favour of heat tolerant species, with biodiversity and sensitive species such as <i>P.oceanica</i> and the endemic <i>P.nobilis</i> expected to decrease. This could also affect fish physiology by impacting spawning, egg hatching, development, feeding, digestion, growth and cause potential diseases or cell growth malfunction. The thermal effluent would also cause lower dissolved oxygen levels due to increased metabolic rates and higher oxygen demands.</p>

Aspect of BAT	BAT	Status at Installation
	fresh water sources. The criteria are summarised in BREF Table 3.6. Reference is made to a provision in Article 11 of this directive regarding derogation of the requirements in certain circumstances.	
<b>General BAT approach to reduce chemical emissions to water</b>	<p>Prevention and control of chemical emissions resulting from cooling systems have received the most attention in Member States' policies and industry. Next to heat discharge they are still considered to be the most important issue in cooling.</p> <p>Referring to the statement that 80% of the environmental impact is decided on the design table, measures should be taken in the design phase of wet cooling system using the following order of approach:</p> <ul style="list-style-type: none"> <li>○ identify process conditions (pressure, T, corrosiveness of substance),</li> <li>○ identify chemical characteristics of cooling water source,</li> <li>○ select the appropriate material for heat exchanger combining both process conditions and cooling water characteristics,</li> <li>○ select the appropriate material for other parts of the cooling system,</li> <li>○ identify operational requirements of the cooling system,</li> <li>○ select feasible cooling water treatment (chemical composition) using less hazardous chemicals or chemicals that have lower potential for impact on</li> </ul>	<p>The choice of materials used in the cooling systems is appropriate for sea water use, thus minimising corrosion during the plant's operational lifetime.</p> <p>Dosing of sea water is performed to prevent fouling via the formation of organisms in the heat exchangers and condensers which would reduce the efficiency of the processes that are occurring. In the summer season, the volume of chemicals used is increased:</p> <ul style="list-style-type: none"> <li>● Biocaf (25% by mass, sodium chlorite)</li> <li>● Sulphuric acid (diluted, 40% by mass)</li> </ul> <p>Currently 1450L/wk of Biocaf and sulphuric acid are used in the summer season; whilst the quantities are reduced to 480L/wk during winter. These values are not expected to change significantly with the proposed changes at D3.</p> <p>The concentration of chlorine dioxide (biocide) that is formed at the outlet is equal to 0.1ppm. This chemical typically decomposes to chlorine and oxygen which are easily absorbed by sea water and subsequently limit the chemical harm to the surrounding marine environment.</p>

Aspect of BAT	BAT	Status at Installation
	<p>the environment (Section 3.4.5, Annex VI and VIII)</p> <ul style="list-style-type: none"> <li>○ apply the biocide selection scheme (Chapter 3, Figure 3.2) and</li> <li>○ optimise dosage regime by monitoring of cooling water and systems conditions.</li> </ul>	
	<p>This approach intends to reduce the need for cooling water treatment in the first place. For existing systems technological changes or changes to the equipment are difficult and generally cost-intensive. Focus should be on the operation of the systems using monitoring linked to optimized dosage. A few examples of techniques with good performances have been identified. They are generally applicable for certain categories of systems, they are considered cost effective and do not need large changes to the cooling installation.</p>	
	<p>After reducing the sensitivity of the cooling system to fouling and corrosion, treatment may still be needed to maintain an efficient heat exchange. Selecting cooling water additives less harmful to the aquatic environment and to applying them in the most efficient way is then the next step.</p>	
	<p>With respect to the selection of chemicals, it has been concluded that a ranking of treatments and the chemicals of which they are composed is difficult if not impossible to carry out in a general way and would be unlikely to lead to BAT conclusions. Due to the large variation in conditions and treatments only a site-by-site assessment will lead to the</p>	

Aspect of BAT	BAT	Status at Installation
	appropriate solution.	
	Such an assessment and its constituent parts could represent an approach that can be considered BAT.	
	This approach is offered in this BREF and consists of a tool that can assist in a first ranking of selected chemicals and of an approach to assess biocides, linking the requirements of the cooling system to requirements of the receiving aquatic ecosystem (Annex VIII). The approach aims at minimising the impact of cooling water additives and, in particular, biocides. The Biocidal Products Directive 98/8/EC (BPD) and the Water Framework Directive (WFD) form the key building blocks for this approach. It is essential to use PEC and PNEC values for the different substances, where the PEC/PNEC ratio could function as a yardstick for BAT determination.	
	On the application of specific substances, much experience has been obtained in once-through systems with chlorine-derived components (in particular hypochlorite, chloramine) and chlorine/bromine combinations, as well as with the application of reduced concentration levels.	
	The same applies to the use of biocides for conditioning of recirculating systems. Treatments for these systems are often multisubstances. It is clear that some components or substances can be identified as not BAT or should not be applied at all. A general approach to select the appropriate biocide will include local aspects, such as the water quality	

Aspect of BAT	BAT	Status at Installation
	objectives of the receiving surface water.	
<b>Identified reduction techniques within the BAT-approach</b> Prevention by design and maintenance	See Figure 6.	The system will be maintained according to a set programme under the responsibility of Enemalta.
<b>Identified reduction techniques within the BAT-approach</b> Control by optimised cooling water treatment	See Figure 7.	

Figure 6:

**Table 4.6: BAT for reduction of emissions to water by design and maintenance techniques**

Relevance	Criterion	Primary BAT approach	Remarks	Reference
All wet cooling systems	Apply less corrosion-sensitive material	Analysis of corrosiveness of process substance as well as of cooling water to select the right material		Ch.3.4
	Reduction of fouling and corrosion	Design cooling system to avoid stagnant zones		Annex XI.3.3.2.1
Shell&tube heat exchanger	Design to facilitate cleaning	Cooling water flow inside tube and heavy fouling medium on tube side	Depending on design, process T and pressure	Annex III.1
Condensers of power plants	Reduce corrosion-sensitiveness	Application of Ti in condensers using seawater or brackish water		Annex XII
	Reduce corrosion-sensitiveness	Application of low corrosion alloys (Stainless Steel with high pitting index or Copper Nickel)	Change to low corrosion alloys can affect formation of pathogens	Annex XII.5.1

	Mechanical cleaning	Use of automated cleaning systems with foam balls or brushes	In addition mechanical cleaning and high water pressure may be necessary	Annex XII.5.1
Condensers and heat exchangers	Reduce deposition (fouling) in condensers	Water velocity > 1.8 m/s for new equipment and 1.5 m/s in case of tube bundle retrofit	Depending on corrosion sensitivity of material, water quality and surface treatment	Annex XII.5.1
	Reduce deposition (fouling) in heat exchangers	Water velocity > 0.8 m/s	Depending on corrosion sensitivity of material, water quality and surface treatment	Annex XII.3.2
	Avoid clogging	Use debris filters to protect the heat exchangers where clogging is a risk		Annex XII

Table 4.6 (continued): BAT for reduction of emissions to water by design and maintenance techniques

Relevance	Criterion	Primary BAT approach	Remarks	Reference
Once-through cooling system	Reduce corrosion-sensitiveness	Apply carbon steel in cooling water systems if corrosion allowance can be met	Not for brackish water	Annex IV.1
	Reduce corrosion-sensitiveness	Apply reinforced glass fibre plastics, coated reinforced concrete or coated carbon steel in case of underground conduits		Annex IV.2
	Reduce corrosion-sensitiveness	Apply Ti for tubes of shell&tube heat exchanger in highly corrosive environment or high quality stainless steel with similar performance	Ti not in reducing environment, optimised biofouling control may be necessary	Annex IV.2
Open wet cooling towers	Reduce fouling in salt water condition	Apply fill that is open low fouling with high load support		Annex IV.4
	Avoid hazardous substances due to anti-fouling treatment	CCA treatment of wooden parts or TBTO containing paints is <u>not BAT</u>		Section 3.4 Annex IV.4
Natural draught wet cooling towers	Reduce anti-fouling treatment	Apply fill under consideration of local water quality (e.g. high solid content, scale)		Annex XII.8.3



Figure 7:

**Table 4.7: BAT for reduction of emissions to water by optimised cooling water treatment**

Relevance	Criterion	Primary BAT approach	Remarks	Reference
All wet systems	Reduce additive application	Monitoring and control of cooling water chemistry		Section 3.4 and Annex XI.7.3
	Use of less hazardous chemicals	<p>It is <u>not BAT</u> to use</p> <ul style="list-style-type: none"> <li>chromium compounds</li> <li>mercury compounds</li> <li>organometallic compounds (e.g. organotin compounds)</li> <li>mercaptobenzothiazole</li> <li>shock treatment with biocidal substances other than chlorine, bromine, ozone and H<sub>2</sub>O<sub>2</sub></li> </ul>		Section 3.4/ Annex VI
Once-through cooling system and open wet cooling towers	Target biocide dosage	To monitor macrofouling for optimising biocide dosage		Annex XI.3.3.1.1
	Limit application of biocides	With sea water temperature below 10-12°C no use of biocides	In some areas winter treatment may be needed (harbours)	Annex V

Once-through cooling system	Reduction of FO emission	Use of variation of residence times and water velocities with an associated FO or FRO-level of 0.1 mg/l at the outlet	Not applicable for condensers	Ch.3.4 Annex XI.3.3.2
	Emissions of free (residual) oxidant	FO or FRO $\leq 0.2$ mg/l at the outlet for continuous chlorination of sea water	Daily (24h) average value	Annex XI.3.3.2
	Emissions of free (residual) oxidant	FO or FRO $\leq 0.2$ mg/l at the outlet for intermittent and shock chlorination of sea water	Daily (24h) average value	Annex XI.3.3.2
	Emissions of free (residual) oxidant	FO or FRO $\leq 0.5$ mg/l at the outlet for intermittent and shock chlorination of sea water	Hourly average value within one day used for process control requirements	Annex XI.3.3.2
	Reduce amount of OX-forming compounds in fresh water	Continuous chlorinating in fresh water is <u>not BAT</u>		Ch.3.4 Annex XII

**Table 4.7 continued: BAT for reduction of emissions to water by optimised cooling water treatment**

Relevance	Criterion	Primary BAT approach	Remarks	Reference
Open wet cooling towers	Reduce amount of hypochlorite	Operate at $7 \leq \text{pH} \leq 9$ of the cooling water		Annex XI
	Reduce amount of biocide and reduce blowdown	Application of side-stream biofiltration is BAT		Annex XI.3.1.1
	Reduce emission of fast hydrolyzing biocides	Close blowdown temporarily after dosage		Section 3.4
	Application of ozone	Treatment levels of $\leq 0.1 \text{ mg O}_3/\text{l}$	Assessment of total cost against the application of other biocides	Annex XI.3.4.1

## 6. Reduction of emissions to air

Aspect of BAT	BAT	Status at Installation
<b>General approach</b>	<p>Comparatively, air emissions from cooling towers have not been given much attention, except for the effects of plume formation. From some reported data it is concluded that levels are generally low but that these emissions should not be neglected.</p> <p>Lowering concentration levels in the circulating cooling water will obviously affect the potential emission of substances in the plume. Some general recommendations can be made which have a BAT-character.</p>	Not applicable. The cooling system does not emit any atmospheric emissions.
<b>Identified reduction techniques within the BAT-approach</b>	<p>Avoid.</p> <p>See Figure 8.</p>	

Figure 8:

Table 4.8: BAT for reduction of emissions to air

Relevance	Criterion	Primary BAT approach	Remarks	Reference
All wet cooling towers	Avoid plume reaching ground level	Plume emission at sufficient height and with a minimum discharge air velocity at the tower outlet		Chapter 3.5.3
	Avoid plume formation	Application of hybrid technique or other plume suppressing techniques such as reheating of air	Need local assessment (urban areas, traffic)	Chapter 3.5.3
All wet cooling towers	Use of less hazardous material	Use of asbestos, or wood preserved with CCA (or similar) or TBTO is <u>not BAT</u>		Chapter 3.8.3
	Avoid affecting indoor air quality	Design and positioning of tower outlet to avoid risk of air intake by air conditioning systems	Is expected to be less important for large natural draught CT with considerable height	Section 3.5
All wet cooling towers	Reduction of drift loss	Apply drift eliminators with a loss <0.01% of total recirculating flow	Low resistance to airflow to be maintained	Section 3.5 and XI.5.1

## 7. Reduction of noise emissions

Aspect of BAT	BAT	Status at Installation
<b>General</b>	Noise emissions have local impact. Noise emissions of cooling installations are part of the total noise emissions from the site. A number of primary and secondary measures have been identified that can be applied to reduce noise emissions where necessary. The primary measures change the sound power level of the source, where the secondary measures reduce the emitted noise level. The secondary measures in particular will lead to pressure loss, which has to be compensated by extra energy input, which reduces overall energy efficiency of the cooling system. The ultimate choice for a noise abatement technique will be an individual matter, as will the resulting associated performance level. The following measures and minimum reduction levels are considered as BAT.	The limited noise emissions generated from the selected cooling water system has been one of the major factors in determining the choice of the system.
<b>Identified reduction techniques within the BAT-approach</b>	See Figure 9.	

Figure 9:

**Table 4.9: BAT for the reduction of noise emissions**

Cooling system	Criterion	Primary BAT approach	Associated reduction levels	Ref.
Natural draught cooling towers	Reduce noise of cascading water at air inlet	Different techniques available	$\geq 5$ dB(A)	Section 3.6
	Reduce noise emission around tower base	E.g application of earth barrier or noise attenuating wall	$< 10$ dB(A)	Section 3.6
Mechanical draught cooling towers	Reduction of fan noise	Apply low noise fan with characteristics, e.g.: - larger diameter fans; - Reduced tip speed ( $\leq 40$ m/s)	$< 5$ dB(A)	Section 3.6
				Section 3.6
	Optimised diffuser design	Sufficient height or installation of sound attenuators	Variable	Section 3.6
	Noise reduction	Apply attenuation measures to inlet and outlet	$\geq 15$ dB(A)	Section 3.6

## 8. Reduction of risk of leakage

Aspect of BAT	BAT	Status at Installation
<b>General approach</b>	<p>To reduce the risk of leakage, attention must be paid to the design of the heat exchanger, the hazardousness of the process substances and the cooling configuration. The following general measures to reduce the occurrence of leakages can be applied:</p> <ul style="list-style-type: none"> <li>• select material for equipment of wet cooling systems according to the applied water quality;</li> <li>• operate the system according to its design,</li> <li>• if cooling water treatment is needed, select the right cooling water treatment programme,</li> <li>• monitor leakage in cooling water discharge in recirculating wet cooling systems by analysing the blowdown.</li> </ul>	<p>Regular inspections and check-ups are conducted by personnel to ensure that any leakages arising from the cooling system are quickly secured. Dosing by Enemalta is also accurately monitored to ensure that cooling system remains efficient. A computer controlled timing system is in place to ensure that the dosage supplied is appropriate. Regular check-ups are made by a qualified chemist to determine whether the dosage supplied needs to be altered according to the circumstances.</p>
<b>Identified reduction techniques within the BAT-approach</b>	See Figure 10.	



Figure 10:

**Table 4.10: BAT to reduce the risk of leakage**

Relevance <sup>1)</sup>	Criterion	Primary BAT approach	Remarks	Reference
All heat exchangers	Avoid small cracks	$\Delta T$ over heat exchanger of $\leq 50^\circ\text{C}$	Technical solution for higher $\Delta T$ on case-by-case basis	Annex III
Shell&tube heat exchanger	Operate within design limits	Monitor process operation		Annex III.1
	Strength of tube/tube plate construction	Apply welding technology	Welding not always applicable	Annex III.3
Equipment	Reduce corrosion	T of metal on cooling water side $< 60^\circ\text{C}$	Temp. affects inhibition of corrosion	Annex IV.1
	VCI score of 5-8	Direct system $P_{\text{cooling water}} > P_{\text{process}}$ and monitoring	Immediate measures in case of leakage	Annex VII
	VCI score of 5-8	Direct system $P_{\text{cooling water}} = P_{\text{process}}$ and automatic analytical monitoring	Immediate measures in case of leakage	Annex VII
	VCI score of $\geq 9$	Direct system $P_{\text{cooling water}} > P_{\text{process}}$ and automatic analytical monitoring	Immediate measures in case of leakage	Annex VII

Once-through cooling systems	VCI score of $\geq 9$	Direct system with heat exchanger of highly anticorrosive material/ automatic analytical monitoring	Automatic measures in case of leakage	Annex VII
	VCI score of $\geq 9$	Change technology - indirect cooling - recirculating cooling - air cooling		Annex VII
	Cooling of dangerous substances	Always monitoring of cooling water		Annex VII
	Apply preventive maintenance	Inspection by means of eddy current	Other non-destructive inspection techniques are available	
Recirculating cooling systems	Cooling of dangerous substances	Constant monitoring of blowdown		
1) Table not applicable for condensers				

## 9. Reduction of biological risk

Aspect of BAT	BAT	Status at Installation
<b>General approach</b>	To reduce the biological risk due to cooling systems operation, it is important to control temperature, maintain the system on a regular basis and avoid scale and corrosion. All measures are more or less within the good maintenance practice that would apply to a recirculating wet cooling system in general. The more critical moments are start-up periods, where systems' operation is not optimal, and standstill for repair or maintenance. For new towers consideration must be given to design and position with respect to surrounding sensitive objects, such as hospitals, schools and accommodation for elderly people.	<p>Noted and implemented by good maintenance programmes performed by Enemalta. The cooling system is designed in such a way to prevent/reduce biological infestation, as long as good operating and maintenance practices are performed.</p> <p>Dosing of sea water is performed to prevent fouling via the formation of organisms in the heat exchangers and condensers which would reduce the efficiency of the processes that are occurring. In the summer season, the volume of chemicals used is increased:</p> <ul style="list-style-type: none"> <li>• Biocaf (25% by mass, sodium chlorite)</li> <li>• Sulphuric acid (diluted, 40% by mass)</li> </ul> <p>Currently 1450L/wk of Biocaf and sulphuric acid are used in the summer season; whilst the quantities are reduced to 480L/wk during winter. These values are not expected to change significantly with the proposed changes at D3.</p> <p>The concentration of chlorine dioxide (biocide) that is formed at the outlet is equal to 0.1ppm. This chemical typically decomposes to chlorine and oxygen which are easily absorbed by sea water and subsequently limit the chemical harm to the surrounding marine environment.</p>
<b>Identified reduction techniques within the BAT-approach</b>	See Figure 11.	

Figure 11:

**Table 4.11: BAT to reduce biological growth**

Cooling system	Criterion	Primary BAT approach	Remarks	Reference
All wet recirculating cooling systems	Reduce algae formation	Reduce light energy reaching the cooling water		Section 3.7.3
	Reduce biological growth	Avoid stagnant zones (design) and apply optimized chemical treatment		
	Cleaning after outbreak	A combination of mechanical and chemical cleaning		Section 3.7.3
	Control of pathogens	Periodic monitoring of pathogens in the cooling systems		Section 3.7.3
Open wet cooling towers	Reduce risk of infection	Operators should wear nose and mouth protection (P3-mask) when entering a wet cooling tower	If spraying equipment is on or when high-pressure cleaning	Section 3.7.3

## Annex I: Comparison of the processes at Facility with the BREF for Large Combustion Plants (published July 2006).

Parts 1, 2, 3 & 5 have been excluded from this report because they are not applicable to the proposed LCP at Delimara Power station D3. Justification is provided below:

*Part 1: Combustion techniques for coal and lignite – This is not applicable to D3 as D3 will be operated on gaseous fuels.*

*Part 2: Combustion techniques for biomass and peat - This is not applicable to D3 as D3 will be operated on gaseous fuels.*

*Part 3: Combustion techniques for liquid fuels – This is not applicable to D3 even if four out of the eight diesel engines are dual-fuel engine with the capacity to operate on diesel. However, diesel is considered to be an emergency fuel and will be used only in emergency situations specified in Section 1.1.2.5 of the IPPC report presented for D3.*

*Part 5: Co-combustion of waste and recovered fuel – This is not applicable to D3 as D3 will be operated on gaseous fuels.*

### Part 4. Combustion techniques for gaseous fuels

Should there be a requirement for operating the dual-fuel engines on diesel, BAT is still being utilised

Aspect of BAT	BAT	Status at Installation
<b>Supply and handling of gaseous fuels and additives</b>	BAT in preventing releases related to the supply and handling of gaseous fuels, but also for storage and handling of additives such as ammonia etc. are summarised in Figure 22.	At D3, the BATs suggested in Figure 22 are applied to prevent fugitive emissions and to ensure efficient use of natural resources available on site. Ammonia is not used. Urea is used as an alternative to abate NO <sub>x</sub> emissions.
<b>Thermal efficiency of gas-fired combustion plants</b>	To reduce greenhouse gases, in particular releases of CO <sub>2</sub> from gas-fired combustion plants such as gas turbines, gas engines and gas-fired boilers, the best available options from today's point of view are techniques and operational measures to increase the thermal efficiency of the plant. Secondary measures, i.e. CO <sub>2</sub> capture and disposal as described in Annex 10.2 of BREF, are at a very early stage of development. These emerging techniques might be available in the future, but they cannot yet be considered as BAT.	No abatement techniques are being proposed for the capture of greenhouse gases from the gas fired diesel engines.
The energy efficiency has been considered as heat rate (fuel		The energy efficiency (heat rate) for the two engines is:

Aspect of BAT	BAT	Status at Installation
	input energy/energy output at power plant border) and as power plant efficiency, which here is the inverse of heat rate, i.e. the percentage of produced energy/fuel input energy. The fuel energy is measured as the lower heating value.	<ul style="list-style-type: none"> <li>• Dual fuel = 45.53% (7,924kJ/kWh)</li> <li>• Single gas = 45.93% (7,838kJ/kWh)</li> </ul>
	For gas-fired combustion plants, the application of gas turbine combined cycles and the co-generation of heat and power (CHP) are technically the most efficient means of increasing the energy efficiency (fuel utilisation) of an energy supply system. A combined cycle operation and co-generation of heat and power is, therefore, to be considered as the first BAT option, i.e. whenever the local heat demand is great enough to warrant the construction of such a system. The use of an advanced computerised control system in order to achieve a high boiler performance with increased combustion conditions that support the reduction of emissions are also considered as BAT.	The system at D3 is gas-fired diesel engine with heat resistance steam generator in CHP mode. This is classified as the first BAT option.
	Improvement of the efficiency can also be obtained by preheating the natural gas, before its supply to the combustion chambers or burners. The heat can be obtained from low temperature sources, such as the exhaust gases from cooling from other regenerative processes.	Liquefied natural gas (LNG) supply is converted to the gaseous phase thanks to a preheating process occurring at D4's gas reduction station. The resulting natural gas is heated to temperatures up to 50°C, subsequently increasing the efficiency of the plant.
	Gas engine driven power plants are suited for both decentralised heat and power production (CHP) as well as for bigger base load applications. The BAT associated total efficiencies are up to 60 – 70 % in low pressure steam generation. With supplementary firing (i.e. when the oxygen	Boilers produce three types of steam: <ul style="list-style-type: none"> <li>• Superheated steam (12 bar) – transferred to turbines for electricity generation</li> <li>• High pressure saturated steam (12 bar)</li> </ul>

Aspect of BAT	BAT	Status at Installation
	<p>content of the engine flue-gas acts as the main ‘combustion air’ in the burner) a large amount of low pressure or high pressure steam can be generated in an efficient way, In hot water production (with outlet temperatures typically in range of 80 – 120°C), a total efficiency (fuel utilisation) of up to 90 % in gas fuel mode can be seen as BAT, although highly depending on the portion of the engine cooling water energy recovered in the application. Hot water of up to 200°C can, of course, be produced by utilising the energy in the flue-gas and part of the engine cooling energy. Another advantage is the high thermal efficiency (i.e. low fuel consumption, and consequently low specific CO<sub>2</sub> emissions) of the engines. The BAT electrical efficiency (at alternator terminals) ranges from about 40 to 45 % (depending on the engine size) and is calculated on the lower heating value of the fuel.</p>	<ul style="list-style-type: none"> <li>○ Used for hot purging of air</li> <li>○ Used to keep warm engines that are shutdown</li> <li>○ Used in the deaerator system that requires boiling</li> <li>● Low pressure steam (4 bar) <ul style="list-style-type: none"> <li>○ Used to heat lube oil separators (heats oil to reduce its viscosity and improve separation via centrifugal force)</li> <li>○ Used for the engine’s jacket water, this is required for the warm stand-by of engines and to prevent cranking.</li> <li>○ Used for the preheating of water that is used for the urea mixture</li> </ul> </li> </ul>
	<p>For existing plants, a number of retrofit and repowering techniques can be applied to improve the thermal efficiency. The technical measures described in BREF Section 2.7.8 should be taken into account as part of BAT options to improve the efficiency of existing plants. By applying the techniques and the measures listed in BREF Section 7.4.2, to improve the thermal efficiency such as double reheat, and using the most advanced high temperature materials for gas turbines and boilers, energy efficiencies associated with the use of BAT can be achieved as summarised in Figure 23.</p>	<p>Freshwater generators at D3 produce demineralised water and function by using the waste heat extracted from the diesel engine’s cooling water system.</p> <p>Not applicable. The converted D3 plant shall be reaching the quoted BAT efficiencies without any need to make additional improvements.</p>
	<p>In addition, the following measures also needs to be taken into consideration to increase the efficiency:</p>	<p>Not applicable. The converted D3 plant shall be reaching the quoted BAT efficiencies without any need to make</p>

Aspect of BAT	BAT	Status at Installation
	<ul style="list-style-type: none"> <li>➤ combustion: minimising the heat loss due to unburned gases</li> <li>➤ the highest possible pressure and temperature of the working medium gas or steam</li> <li>➤ the highest possible pressure drop in the low pressure end of the steam turbine through the lowest possible temperature of the cooling water (fresh water cooling) for boilers and CCGT plants</li> <li>➤ minimising the heat loss through the flue-gas (utilisation of residual heat or district heating)</li> <li>➤ minimising the heat loss through conduction and radiation with isolation</li> <li>➤ minimising the internal energy consumption by taking appropriate measures, e.g. scorification of the evaporator, greater efficiency of the feed water pump, etc.)</li> <li>➤ preheating the fuel gas and or the boiler feed water with steam</li> <li>➤ improved blade geometry of the turbines.<sup>1</sup></li> </ul>	<p>additional improvements.</p>
	<p>It should be borne in mind that these BAT levels are not achievable in all operation conditions.</p> <p>The energy efficiency is at its best at the design point of the plant. The actual energy efficiencies throughout the operational period of the plants may also be lower due to changes, for instance changes in the load during the operation, quality of the fuel, etc. The energy efficiency also depends on the cooling system of the power plant, and on the energy consumption of the flue-gas cleaning system. It</p>	<p>The energy efficiencies being quoted in this document have been configured at design stage. The figures are calculated at 100% load for each operating engine.</p>



Aspect of BAT	BAT	Status at Installation
	<p>should also be recognised that high efficiency gas turbine systems may generate problems such as vibration and higher short term NO<sub>x</sub> emissions.</p>	
<b>Dust and SO<sub>2</sub> emissions from gas fired combustion plants</b>	<p>For gas-fired combustion plants using natural gas as a fuel, emissions of dust and SO<sub>2</sub> are very low. The emission levels of dust by using natural gas as a fuel are normally well below 5 mg/Nm<sup>3</sup> and SO<sub>2</sub> emissions are well below 10 mg/Nm<sup>3</sup> (15 % O<sub>2</sub>), without any additional technical measures being applied.</p> <p>If other industrial gases are used as a fuel such as refinery gas or blast furnace gas, pre treatment gas cleaning measures (such as fabric filters) needs to be applied and considered as BAT, in order to reduce the dust content and the amount of SO<sub>2</sub> in the flue-gas, which may otherwise damage the gas turbines or engines. As mentioned in the Refinery BREF, BAT is to limit the H<sub>2</sub>S content of the refinery gas to 20 – 150 mg/Nm<sup>3</sup> leading to an emission of 5 – 20 mg of SO<sub>2</sub>/Nm<sup>3</sup>. Such gas does not create particulate emissions. In the case of natural gas refineries, also refer to the Mineral Oil and Gas Refinery BREF.</p>	<p>It is to be noted that the quoted ELVs strictly apply to “gas engines” as described in LN 9 of 2013:</p> <p><i>“internal combustion engine which operates according to the Otto cycle and uses spark ignition or, in case of dual fuel engines, compression ignition to burn fuel.”</i></p> <p>The engines in D3 are not gas engines but diesel engines defined as:</p> <p><i>“internal combustion engines which operate according to the diesel cycle and use compression ignition to burn fuel.”</i></p> <p>The diesel engines at D3 are proposed to be converted from running on liquid fuels to operating on natural gas.</p> <p>The proposed design for the conversion has eliminated the bag filters as abatement technology for particulate matter. The maximum concentration of PM to be emitted from the converted engines with the worst gas specification agreed with the supplier is that of 10mg/Nm<sup>3</sup>. The concentration of PM is directly dependent on the gas composition. The threshold of 10mg/Nm<sup>3</sup> takes into consideration the upper range value of the contractual gas specification.</p> <p>Dual fuel = 9mg/Nm<sup>3</sup> SO<sub>x</sub> and 10mg/Nm<sup>3</sup> PM Single gas = 9mg/Nm<sup>3</sup> SO<sub>x</sub> and 10mg/Nm<sup>3</sup> PM</p>

Aspect of BAT	BAT	Status at Installation
<b>NO<sub>x</sub> and CO emissions from gas-fired combustion plants</b>	<p>In general, for gas turbines, gas engines and gas fired boilers, reduction of nitrogen oxides (NO<sub>x</sub>) is considered to be BAT. The nitrogen compounds of interest are nitric oxide (NO) and nitrogen dioxide (NO<sub>2</sub>), collectively referred to as NO<sub>x</sub>.</p> <p>For new gas turbines, dry low NO<sub>x</sub> premix burners (DLN) are BAT. Most existing gas turbines can be converted to the dry low NO<sub>x</sub> premix burner (DLN) technique, but sometimes the use of water and steam injection can be a better solution. This needs to be decided case by case.</p> <p>Several gas turbine and gas engines operating in Europe, Japan and the US have also applied SCR to reduce the emissions of NO<sub>x</sub>. Beside the dry low NO<sub>x</sub> premix burner technique (DLN) and the injection of water and steam, SCR is also considered to be part of the BAT conclusion.</p> <p>For new gas turbines, the DLN burners can be seen as the standard technique so that the application of an additional SCR system is, in general, not necessary. For further reduction of NO<sub>x</sub>, SCR can be considered where local air quality standards request a further reduction of NO<sub>x</sub> emissions compared to the levels given in Figure 24 (e.g. operation in densely populated urban areas). In Figure 24 emergency machinery has not be taken into account.</p> <p>For existing gas turbines, water and steam injection or conversion to the DLN technique is BAT. Gas turbines of unchanged combustion design, but with higher inlet temperatures, have higher efficiencies and higher NO<sub>x</sub> values. In this context, it should be noted that with a higher</p>	<p>Selective Catalytic Reduction using urea is the NO<sub>x</sub> abatement measure adopted at D3. For the SG engines this abatement measure is expected to reduce NO<sub>x</sub> emissions from 185mg/Nm<sup>3</sup> to 75mg/Nm<sup>3</sup>, whilst for DF engines this is expected to diminish emissions from 369mg/Nm<sup>3</sup> to 75mg/Nm<sup>3</sup>.</p>

Aspect of BAT	BAT	Status at Installation
	<p>efficiency the specific NO<sub>x</sub> emission per kWh are still lower.</p> <p>SCR retrofitting is technically feasible, but not economical for existing CCGT plants if the required space in the HRSG was not foreseen in the project and is therefore not available.<sup>2</sup></p> <p>For gas-fired stationary engine plants, the lean-burn approach is BAT analogous to the dry low NO<sub>x</sub> technique used in gas turbines. This is an inbuilt method and no extra reagents or water need to be supplied to the site for NO<sub>x</sub> reduction. Because gas engines are sometimes equipped with an SCR, these techniques can also be considered as part of BAT. To reduce the CO emissions, the application of oxidation catalysts is BAT with the associated emission levels for natural gas firing mentioned in Figure 25. In the case of burning other gaseous fuels such as biogas or landfill gases, the CO emission can be higher due to the specific fuel used.</p> <p>The NMVOC emissions from spark ignited lean burn gas (SG) engines and dual fuel (DF) engines in gas mode depend on the composition of natural gas. NMVOC secondary emission reduction techniques might, in some cases, be needed and an oxidation catalyst for simultaneous CO and NMVOC reduction can be applied. CO values kept below 100 mg/Nm<sup>3</sup> (15 % O<sub>2</sub>) and formaldehyde values below 23 mg/Nm<sup>3</sup> (15 % O<sub>2</sub>) are considered as BAT for a gas-fired engine equipped with an oxidation catalyst.</p>	<p>Oxidation catalysts have been applied to reduce CO emissions according to BAT. CO values are kept below 100mg/Nm<sup>3</sup>. The abatement technology used is expected to diminish the values from 186 and 208mg/Nm<sup>3</sup> to 100mg/Nm<sup>3</sup> for DF and SG engines, respectively, to reach the established ELV. All of these values are recorded at 15% vol. O<sub>2</sub>.</p>

Aspect of BAT	BAT	Status at Installation
	<p>BAT for the minimisation of CO emissions is complete combustion, which goes along with good furnace design, the use of high performance monitoring and process control techniques and maintenance of the combustion system. Besides the combustion conditions, a well optimised system to reduce emissions of NO<sub>x</sub> will also keep the CO levels below 100 mg/Nm<sup>3</sup>.</p> <p>In addition, the application of an oxidation catalyst for CO can be seen as BAT when it is operated in densely populated urban areas.</p>	
	<p>The BAT conclusion for the prevention and control of NO<sub>x</sub> and CO emissions and the associated emission levels are summarised in Figure 24 and Figure 25. Flue-gases from gas turbines and gas engines typically contain about 11 – 16 vol-% O<sub>2</sub> and, therefore, the emission levels associated with the use of BAT for turbines and engines have been based on an O<sub>2</sub> level of 15 vol-%, and standard conditions as the reference point. For gas-fired boilers, 3 vol-% O<sub>2</sub> is usually used as a reference level. The BAT associated emission levels are based on daily average, standard conditions and represents a typical load situation. For peak load, start up and shut down periods as well as for operational problems of the flue-gas cleaning systems, short-term peak values, which could be higher have to be regarded.</p>	<p>According to Figure 25, D3 classifies as “New gas engine with heat resistance steam generator in CHP mode” and shall adhere to the ELVs quoted for CO and NO<sub>x</sub>.</p>
	<p>For refinery gas refer to Mineral Oil and Gas Refinery BREF. In the case of Natural gas refineries, also refer to the Mineral Oil and Gas Refinery BREF.</p>	<p>Not applicable as natural gas will be used.</p>

Aspect of BAT	BAT	Status at Installation
<b>Water pollution</b>	<p>Different waste water streams (see BREF Chapter 1) are generated by gas-fired combustion plants. To reduce emissions to water and to avoid water contamination, all measures that have been presented in BREF Section 7.4.4 are considered to be BAT.</p> <p>Small amounts of oil contaminated (washing) water cannot be prevented from occurring occasionally at a power plant. Oil separation wells are, in general, sufficient to avoid any environmental damage.</p> <p>The other techniques described for waste water treatment in BREF Chapter 3 can, in general, also be considered as BAT for this sector.</p>	<p><b>The quantity of cooling water discharged by D3 at Hofra z-Zghira is equal to 14,700m<sup>3</sup>/h, whilst retaining a maximum temperature of 8°C above ambient water temperature</b></p> <p>Oil separation wells are already placed on site. This is expected to generate approximately 86,670kg of oily water after the proposed conversion of the diesel engines at D3. The boiler cleaning waste is also expected to decrease, with 1,260kg being predicted.</p> <p>The effluent treatment plant and oily water treatment plant are designed so that the reception lagoons/tanks can accommodate up to two to three times an average daily flow, with flow being permitted to divert around the coalescer and returned to the reception lagoons/tanks. A discharge shut off is incorporated to retain liquids and prevent discharge in the event of site spillage.</p>
<b>Combustion residues</b>	A lot of attention has already been paid by industry to the utilisation of combustion residues and by-products instead of depositing them in landfills. Utilisation and re-use is, therefore, the best available option.	Not applicable. No combustion residue will be disposed of in the landfill.
<b>BAT for combustion installations operated on offshore platforms</b>	The conclusions on BAT for the offshore sector have taken into account that combustion installations operated offshore are used in a more complex and potentially hazardous environment than in onshore power stations. In addition, space and weight are at a premium, leading to a much higher equipment density than is common in onshore	Not applicable. D3 is not an offshore installation.

Aspect of BAT	BAT	Status at Installation
	<p>applications. In addition, any undue complexity is generally avoided offshore, because of weight, space, safety and operability factors. Therefore, techniques such as water and steam injection, which require a high quality water treatment plant or SCR with additional storage of ammonia, have not been considered as BAT for offshore applications to reduce NO<sub>x</sub> emissions.</p> <p>In general, for new gas turbines operated on offshore platforms, the reduction of nitrogen oxides (NO<sub>x</sub>) by using primary measures such as dry low NO<sub>x</sub> premix burners (DLN) is considered to be BAT as far as this technique is available. The associated emission level of NO<sub>x</sub> by using the dry low NO<sub>x</sub> premix burners (DLN) for gas turbines is less than 50 mg/Nm<sup>3</sup>. As the flame stability needs to be maintained over the full range of operating conditions, it may not be practical to maintain staged combustion at low rates, such as at start-up and part load operation. The formation of NO<sub>x</sub> is not reduced during such periods and hence the occurrence and duration of these periods should be minimised.</p> <p>Retrofitting of existing offshore gas turbines is much more expensive compared to land-based turbines due to the modification work costs. Retrofitting the DLN technology in existing offshore gas turbines is limited due to higher costs and a restriction of space within the turbine package for new fuel manifolds or combustion chambers. For aeroderivative turbines often used offshore, retrofitting to DLN is generally much more complex than for industrial turbines.</p>	

Aspect of BAT	BAT	Status at Installation
	<p>The whole combustion section has to be replaced, and due to the larger outer diameter of the DLN combustion section, the gas turbine centreline is shifted. The applicability of retrofitting the DLN technology will, therefore, differ from platform to platform due to the type of turbine, the complexity, the age, etc. The BAT level for existing installations has to be determined on a case by case basis.</p> <p>To reduce the environmental impact of offshore gas turbines, the following measures are part of the BAT conclusion:</p> <ul style="list-style-type: none"> <li>➤ for new installations, selecting turbines which can achieve both a high thermal efficiency and a low emissions spectrum</li> <li>➤ using dual fuel turbines only where operationally necessary</li> <li>➤ minimising ‘spinning reserve’</li> <li>➤ providing a fuel gas supply from a point in the topside oil and gas process which offers a minimum range of fuel gas combustion parameters, e.g. calorific value, etc.</li> <li>➤ providing a fuel gas supply from a point in the topside oil and gas process which offers minimum concentrations of sulphurous compounds – to minimise SO<sub>2</sub> formation</li> <li>➤ operating multiple generator or compressor sets at load points which minimise pollution</li> <li>➤ optimising the maintenance and refurbishment programmes</li> </ul>	

Aspect of BAT	BAT	Status at Installation
	<ul style="list-style-type: none"> <li>➤ optimise and maintain inlet and exhaust systems in a way that keeps the pressure losses as low as possible</li> <li>➤ optimise the process in order to minimise the mechanical power requirements and pollution</li> <li>➤ utilisation of gas turbine exhaust heat for platform heating purposes.</li> </ul> <p>Modern ‘diesel’ engines are available with high pressure fuel injection controlled by electronics. Additionally, optimised combustion chambers and portings have been developed. This technology can result in increased fuel economy, reduced NO<sub>x</sub> and other gaseous emissions and reduced smoke, particularly during acceleration and start-up. Where available, it represents the BAT for minimising emissions such as SO<sub>2</sub> and NO<sub>x</sub>.</p> <p>To reduce the environmental impact of offshore engines, the following measures are part of the BAT conclusion:</p> <ul style="list-style-type: none"> <li>○ for new engines, selecting diesels which achieve both high thermal efficiency and a low emissions spectrum</li> <li>○ where process gas is used as fuel, providing a supply from a point in the topside process which will offer minimum emissions of, e.g. SO<sub>2</sub>. For liquid distillate fuels, preference should be given to low sulphur types</li> <li>○ for larger diesels, considering gas fuelling with a ‘torch oil’ ignition charge</li> <li>○ optimising injection timing</li> </ul>	



Aspect of BAT	BAT	Status at Installation
	<ul style="list-style-type: none"> <li>○ operating multiple generator or compressor sets at load points which minimise pollution</li> <li>○ optimising maintenance and refurbishment programmes.</li> </ul> <p>Low NO<sub>x</sub> burners are available for many gas fired heaters, boilers and furnaces. This represents BAT for minimising NO<sub>x</sub>, although the effect and trade off with fuel consumption must be evaluated.</p> <p>Other measures to increase the energy efficiency of offshore installations and thus to reduce the emissions per unit of energy used, such as the application of CHP plants, are part of the BAT conclusion. Techniques that assist the optimised use of equipment such as those based on operational monitoring approaches are BAT. In this case, the gas turbine is ‘baselined’, and predictive software is used to calculate the emissions. This software may also be used to indicate to the offshore operation personnel the optimum operating point(s) for single or multiple turbine installations. Such systems do not remove the need for emission compliance checks, but may assist personnel to operate the overall combustion system more efficiently.</p> <p>Other techniques, like PEMS (parametric emission monitoring system) are BAT for both new and existing combustion installations operating offshore. The system offers cost effective solutions for emission monitoring and calculating the emissions. In addition it can also be used to optimise the combustion processes and maintenance</p>	

Aspect of BAT	BAT	Status at Installation
	<p>schedule of gas turbines.</p> <p>Power integration of multiple fields is BAT and, where applicable, needs to be decided on a platform by platform and field by field basis.</p>	

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<sup>1</sup> There was a split view from industry about the efficiency measures applied to CCGT plants, because the proposed measures will only have a marginal improvement of the total combined cycle efficiency. It should be noted that improvements of the gas turbine efficiency may result in a decrease of efficiency of the steam cycle. Therefore, the improvement of efficiency of the total cycle will be less than the improvement of the efficiency of the gas turbine only. Based on the above given rationale, industry is of the opinion that the proposed measures shall not be incorporated in the final draft of the BREF LCP.

<sup>2</sup> A split view was declared by industry saying that in the case of combined cycles, the HRSG has to be modified, which means dismantled and retrofitted to enable the incorporation of an SCR.

This will increase the already high investments of SCR. Furthermore, the operation and maintenance costs of an SCR are relatively high, therefore, SCR is not cost effective for existing combined cycles. Industry also declared that, in the case of simple cycle gas turbines, SCR is not cost effective, because

- a) the gases have to be cooled down. This requires an additional cooler to reduce the gas temperature to a level to enable the SCR to operate. This cooler will increase the already high investments and operational costs, and
- b) simple cycle gas turbines in Europe are peak load plants, which run in emergency cases only. The high investment, operation and maintenance costs make the implementation of an SCR in a gas turbine economically unviable.

Figure 22:

Material	Environmental effect	BAT
Natural gas	Fugitive emissions	∞ using fuel gas leak detection systems and alarms.
	Efficient use of natural resources	<ul style="list-style-type: none"> <li>∞ using expansion turbines to recover the energy content of the pressurised fuel gases</li> <li>∞ preheating the fuel gas by using waste heat from the boiler or gas turbine</li> </ul>
Pure liquified ammonia (if used)	Health and safety risk according to ammonia	<ul style="list-style-type: none"> <li>∞ for handling and storage of pure liquified ammonia, pressure reservoirs for pure liquified ammonia &gt;100 m<sup>3</sup> should be constructed as double wall and should be located subterraneously; reservoirs of 100 m<sup>3</sup> and smaller should be manufactured including annealing process</li> <li>∞ 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.</li> </ul>

Table 7.34: BAT for the supply and handling of gaseous fuels

Figure 23:

Plant type	Electrical efficiency (%)		Fuel utilisation (%)	Remarks
	New plants	Existing plants	New and existing plants	
Gas turbine				
Gas turbine	36 – 40	32 – 35	-	
Gas engine				
Gas engine	38 – 45		-	
Gas engine with HRSG in CHP mode	>38	>35	75 – 85	The wide range of energy efficiency in CHP plants is very much dependent upon the specific situation and the local demand of electricity and heat
Gas-fired boiler				
Gas-fired boiler	40 – 42	38 – 40		
CCGT				
Combined cycle with or without supplementary firing (HRSG) for electricity generation only	54 – 58	50 – 54	-	
Combined cycle without supplementary firing (HRSG) in CHP mode	<38	<35	75 – 85	The wide range of the electrical and energy efficiency of CHP plants very much depends on the specific local demand for electricity and heat. By operating the CCGT in the CHP mode, the energy efficiency includes the amount of the electrical efficiency and should always be seen together to achieve the best overall exergetic efficiency.
Combined cycle with supplementary firing in CHP mode	<40	<35	75 – 85	

Table 7.35: Efficiency of gas-fired combustion plants associated to the use of BAT (based on ISO conditions)

Figure 24:

Plant type	Emission level associated with BAT (mg/Nm <sup>3</sup> )		O <sub>2</sub> level 1 (%)	BAT options to reach these levels	Monitoring
	NO <sub>x</sub>	CO			
Gas-fired boilers					
New gas-fired boilers	50 – 100 <sup>(1)</sup>	30 – 100	3	Low-NO <sub>x</sub> burners or SCR or SNCR	Continuous
Existing gas-fired boiler	50 – 100 <sup>(2)</sup>	30 – 100	3	Low-NO <sub>x</sub> burners or SCR or SNCR	Continuous
CCGT					
New CCGT without supplementary firing (HRSG)	20 – 50	5 – 100	15	Dry low-NO <sub>x</sub> premix burners or SCR	Continuous
Existing CCGT without supplementary firing (HRSG)	20 – 90 <sup>(3)</sup>	5 – 100 <sup>(5)</sup>	15	Dry low-NO <sub>x</sub> premix burners or water and steam injection or SCR if the required space has already been foreseen in the HRSG	Continuous
New CCGT with supplementary firing	20 - 50	30 – 100	Plant spec.	Dry low-NO <sub>x</sub> premix burners and low-NO <sub>x</sub> burners for the boiler part or SCR or SNCR	Continuous
Existing CCGT with supplementary firing	20 – 90 <sup>(4)</sup>	30 – 100 <sup>(5)</sup>	Plant spec.	Dry low-NO <sub>x</sub> premix burners or water and steam injection and low-NO <sub>x</sub> burners for the boiler part or SCR if the required space has already been foreseen in the HRSG or SNCR	Continuous

1,2 3	<p>Industry claimed that the ranges need to be changed to: upper end to 120 mg/Nm<sup>3</sup> 80 – 120 mg/Nm<sup>3</sup></p> <p>because gas fired boilers depend on the firing temperature, the type of burners, the size of the boiler, the heating surfaces, the air temperature and the load factor of the power plant. In case the boiler is equipped with flue-gas recycling it is possible to decrease the NO<sub>x</sub> emission to a level of 100 mg/Nm<sup>3</sup>. However, retrofitting an existing boiler with flue-gas recycling will require high (not cost effective) investment costs.</p>
2	<p>One Member State proposed that for existing gas fired boilers, which have been converted recently from heavy fuel oil to burn natural gas, after full modification with primary measures to reduce NO<sub>x</sub> (flue-gas recirculation, fuel and air staging), the BAT achievable emission levels should be modified to 10 – 150 mg/Nm<sup>3</sup>.</p>
4	<p>Industry mentioned that due to the large wall burners which are used for supplementary firing of the HRSG the NO<sub>x</sub> emission of the gas turbine may increase in 10 – 20 mg/Nm<sup>3</sup>. This increase is caused by local high temperatures of these duct burners. Therefore, the level associated with BAT in the case of supplementary firing should be 80 – 140 mg/Nm<sup>3</sup>.</p>
3,4	<p>One Member State claimed that the upper BAT levels for CCGT plants &gt;50 MW cannot be over 80 mg/Nm<sup>3</sup> and for plants over 200 MW the upper BAT level should be below 35 mg/Nm<sup>3</sup> because these levels have already been fixed as ELVs in the Member State in question.</p>
5	<p>One Member State claimed that the upper levels of CO for CCGT plants &gt;50 MW cannot be over 35 mg/Nm<sup>3</sup> because this level has already been fixed as ELV in the Member State in question.</p>

**Table 7.37: BAT for the reduction of NO<sub>x</sub> and CO emissions from some gas-fired combustion plants**

Figure 25:

Plant type	Emission level associated with BAT (mg/Nm <sup>3</sup> )		O <sub>2</sub> level (%)	BAT options to reach these levels	Monitoring
	NO <sub>x</sub>	CO			
Gas turbines					
New gas turbines	20 - 50	5 – 100	15	Dry low-NO <sub>x</sub> premix burners (standard equipment for new gas turbines) or SCR	Continuous
DLN for existing gas turbines	20 - 75	5 - 100	15	Dry low-NO <sub>x</sub> premix burners as retrofitting packages if available	Continuous
Existing gas turbines	50 – 90 <sup>(1)</sup>	30 - 100	15	Water and steam injection or SCR	Continuous
Gas engines					
New gas engines	20 – 75 <sup>(2)</sup>	30 – 100 <sup>(3)</sup>	15	Lean burn concept low-NO <sub>x</sub> tuned and oxidation catalyst for CO or SCR and oxidation catalyst for CO	Continuous <sup>(4)</sup>
New gas engine with HRSG in CHP mode	20 – 75 <sup>(2)</sup>	30 – 100 <sup>(3)</sup>	15	Lean burn concept low-NO <sub>x</sub> tuned and oxidation catalyst for CO or SCR and oxidation catalyst for CO	Continuous <sup>(4)</sup>
Existing gas engines	20 – 100 <sup>(2)</sup>	30 – 100 <sup>(3)</sup>	15	Low-NO <sub>x</sub> tuned	Continuous <sup>(4)</sup>

1	Industry and one Member State claimed that the amount of water or steam that can be injected in an existing gas turbine is limited. Injection high amounts of water or steam may lead to damage of gas turbine components. Therefore, they claimed that the range needs to be substituted by 80 – 120 mg/Nm <sup>3</sup> .
2	Industry claimed that these ranges are not according the BAT approach. The reason given was that the range given as BAT is the same as the one given by the American LAER approach (lowest achievable emission rate). Industry proposed an environmental quality driven approach taking the surrounding (urban/other areas) into account. That means that small plants situated in rural areas shall have leaner BAT levels than large plants in city areas. Industry claimed that levels of 190 mg/Nm <sup>3</sup> (15 % O <sub>2</sub> ) in gas mode represented the overall emission optimum considering the lowest possible fuel consumption and unburned gaseous emission of CO, VOC etc. for spark-ignited (SG) and dual fuel engines (DF) in gas mode.
3	Industry mentioned that due to technical reasons (fuel composition impact), CO should be at a level of 110 – 380 mg/Nm <sup>3</sup> (15 % O <sub>2</sub> ) in order to represent BAT.
2	Another Industry representative claimed that the ranges should be changed to:
3	90 – 190 mg/Nm <sup>3</sup> 100 mg/Nm <sup>3</sup> because the emission levels associated with BAT for gas engines are only applicable for burning natural gas and not for renewable gases like landfill gas, biogas or purification gas. Moreover, they claimed that such levels would create disadvantages for competitiveness in the market for such gases.
4	One Industry representative proposed charging to discontinuous monitoring because continuous engine emission monitoring is not common practice for stationary internal combustion engines.

**Table 7.36: BAT for the reduction of NO<sub>x</sub> and CO emissions from some gas-fired combustion plants**



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## **Appendix V**

- 1) NTS for the proposed local generating capacity at DPS, 2009;*
- 2) Environmental Baseline Report for Land and Water contamination, 2009;*
- 3) Outline Decommissioning Plan, 2012;*
- 4) Noise report, 2012.*
- 5) Report on waste silo incident*

# Proposed Local Generating Capacity at Delimara Powerstation

**ENV/3260/A/08  
PA 03152/05**



## **Volume III**

**Non Technical Summary  
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## **1. The Proposed Development**

### **1.1 General introduction**

Today, electricity contributes directly to the standard of living and economic growth of the nation. With the exception of transport and heating purposes; all economic activities are directly powered by electrical energy produced at the two power stations operated by Enemalta Corporation. Moreover, electricity generation is a significant contributor in the local environmental dynamics in particular in terms of air quality.

Enemalta Corporation is authorised by its constituting legislation – the Enemalta Act, Chapter 272 of the laws of Malta and is currently the sole electricity utility and the major provider of the nation's electrical energy. As long as the current situation remains, Enemalta Corporation has the de facto responsibility of meeting current and anticipated electricity needs and to provide electrical services to electrical consumers in Malta and Gozo. This is currently achieved by operating two power plants at Marsa and Delimara which are both fossil-fuel powered.

Enemalta Corporation continuously faces new challenges in meeting environmental standards, heightened by the more recent European Union Directives. Moreover, in line with the Large Scale Combustion Plant Directive, it has committed itself to decommission the Marsa Power Plant by not later than 31 December 2015 or until the Marsa Plant has operated for 20,000 hours since January 2008, whichever comes first. Considering that a year has 8,766 hrs and that the Marsa Power Plant is currently active for most of the time the allocated operational hours are expected to run out some time in April 2015. Whilst on the one hand the practice of generating 245MW in a highly inefficient manner will stop, this will create a shortage in generating capacity. The current power output of the Delimara Power Plant of 295 MW will not be able to meet the demand for electrical energy.

In order to partly address this shortage in generating capacity, Enemalta seeks to build a 144MW extension to its existing power plant in Delimara. This document, referred to as the Environmental Impact Statement (EIS) is part of the Environmental Impact Assessment (EIA) carried out by the independent consultancy firm AIS Environmental Limited.

### **1.2 Justification for the Development**

The principal objectives and justification for the proposed development are:

- To comply with EU Directives on emissions
- To comply with National Emissions Ceiling Directive
- To comply with Greenhouse Gas Trading Scheme
- To address the increased demand of electrical energy
- To enable the closure of the Marsa Power Station

### **1.3 Proposed timing**

The construction is expected to follow a two year timeframe.

## **1.4 Alternative sites**

The proposal is for an extension to the existing power plant located at Delimara. The site selection process therefore focused on the site suitability. In order for the site to be deemed suitable, various criteria of requirements needed to be satisfied. These included:

- 1 The proposed development must be close to the sea to provide for plant cooling requirements and berthing/transportation requirements; both in terms of fuel transportation and the transportation of the plant itself. Therefore the site needs to be within a sheltered harbour area.
- 2 Close proximity to existing transmission facilities.
- 3 The site is located in an area such that the north-westerly prevailing winds disperse any stack emissions away from land and inhabited areas.
- 4 The site suitability process took also into consideration that the site is free of archaeological deposits, agricultural activity and sensitive ecological areas
- 5 The area is free of industrial activity and is well away from defined and established touristic zones.

Whilst within the Marsa Power Station a site could have been identified to accommodate the proposed new electrical generation plant, providing spatial area to accommodate the new plant would require major alterations with long hours of power cuts. It also does not satisfy criteria 3 above. Additionally the Marsa site is problematic in terms of public nuisance as it is located in a heavily residential area and major traffic zone. When considering all these factors, including the technical limitation associated with linking the Marsa facilities to the Marsa Distribution Centre by excavating trenches causing major traffic interruptions, the Marsa option creates far too many problems than locating the proposed extension at Delimara.

When considering the environmental, social, economic and technical issues, Delimara is seen as the only possible site for developing the proposed project.

## **2. Planning policies and Legislation**

The main legislative provisions are: EU Council Directives; Maltese main legislation: Acts of Parliament; Maltese subsidiary legislation: Legal notices including those which transpose EU Directives into Maltese law. These include the structure plan for the Maltese Islands and various legislation covering the Marine Environment, Solid Wastes, Noise, Disposal of Waste Oils, Air Quality, and Large Installations.

## **3. Land and Sea Use**

The proposed site for the 144MW project lies within the Delimara Power Station complex. Access to the said site is through a separate road network through Powerhouse road. This road leads directly to the Delimara Power Station Complex, which has an apposite internal road network, intended to support the proper and safe operation of the plant.

Since the proposed development is to be situated at a location that is already presently serving as part of the Delimara Power Station site, the addition of the proposed development shall not alter the land use of the site itself.

As the site is earmarked for significant construction activity, the potential for impact on surrounding land uses through nuisance caused by noise and vibration and dust emissions exists.

Further impacts on land use related to the development of the site will not significantly affect neighbouring land uses, though there is also expected to be a traffic increase in the area, especially on arterial and nearby roads, due to the use of vehicles associated with the construction phase of the proposed development.

The proposed development is not anticipated to have any further impact on the bathing sites in its vicinity. This is because cooling water required for this plant is to be taken from the existing sea cooling water inlet and shall be discharged to the existing outfall.

There is likely to be an increase in marine traffic in the area as a result of the waste export by sea during the operational phase of the project. This is considered to be a moderate impact.

#### **4. Geology and Hydrology**

One of the main impacts as a result of the construction phase of the development is expected to be the production of substantial quantities of waste stone material during the excavation of the site to the required invert level.

Another primary concern during construction would be the potential instability of the walls of the excavation. This is considered of being of moderate impact, as the excavation cannot be more than about 2m deep. It is the original excavation which has a high instability risk.

In terms of impact on geology and geomorphology in terms of loss of rock strata and replacement of rock strata with a built development, these are both considered as being of insignificant impact due to the fact that previous excavation has destroyed the geomorphology of I-Inginier.

In terms of hydrogeology, including pollution through spillage of oil fuels associated with a normal construction site, the possibility exists – though it is considered unlikely – of silting of the coastline and pollution of the sea level aquifer. These are considered as having a minor impact.

Likewise the impact in terms of removal of soil is also considered as being insignificant, due to the fact that there are no soils present on site.

#### **5. Landscape and Visual Appraisal of the Proposed Site**

The area under consideration is considered as an Area of High Landscape Value. The Visual Assessment showed that the development has a significant impact from almost all chosen viewpoints in spite of the fact that part of it is partly sunken into the sloping landscape. This assessment recommends the mitigation of visual impacts through landscaping and use of natural earth colours and textures. This does not imply that the development will become invisible if all the recommended mitigation measures are taken on board, however, such measures will render it less conspicuous.

## **6. Air Quality**

An assessment of the air quality impacts associated with the Proposed Development at Delimara Power Station has been undertaken. The assessment has focussed on the principal emissions to air, including:

- Dust emissions during the construction phases;
- Air Quality Strategy Pollutants and other trace emissions from Combustion Processes; and
- Greenhouse gas emissions arising from the operation of the proposed plant.

A qualitative dust assessment has been undertaken and required mitigation measures determined. The residual effects after application of the mitigation measures is considered to result in a low risk of adverse dust impact, limited to the local area within 100m. The risk of impacts would be temporary and short term and reversible.

The assessment of combustion emissions from the proposed plant has found:

- that for all pollutants the maximum predicted long-term and short term impacts would be below Air Quality Standards limit values and other Environmental Assessment Levels;
- the impact of combustion emissions from the proposed plant on sensitive ecosystems are predicted to lead to a very small increase in nitrogen deposition and acid deposition loads; and
- Greenhouse gas emissions are predicted to remain within limits specified with the National Allocation Plan under the EU Emissions Trading Scheme.

## **7. Noise and Vibration**

An environmental noise and vibration survey was carried out around the Delimara Power Station, Delimara to evaluate the noise impacts arising from construction works and during operation of the proposed plant.

The assessment concludes:

- The off-site noise levels measured were within the range of values expected for such locations.
- Construction noise levels at all sensitive receptors will be lower than the chosen day-time criteria (75 dB (A)) and evening criteria (65 dB (A)) for dwellings. However, noise levels will be above the night-time criteria (45 dB (A)).
- Due to the temporary construction works, the increase in noise levels increases the likelihood of complaints.
- The magnitude of vibration is below the threshold of cosmetic or structural damage in all classes of buildings.
- These vibrations would also be barely perceivable to humans in the buildings.

## **8. Quality of the Marine Environment**

The predominant impacts of the power plant operations at Delimara are those of the thermal effluent at Hofra z-Zghira and the hydrodynamic changes resulting from the quay and breakwater construction along the eastern side of Marsaxlokk Bay. With the proposed plant extension, thermal effects on marine benthic communities at Hofra z-Zghira will be aggravated in view of higher volumes of thermal effluent being discharged.

With careful thermal outfall design considerations being implemented, most of the assumed impacts can be mitigated, although a number of residual impacts are expected to persist.

An extensive seagrass-specific monitoring programme should be adopted at Hofra z-Zghira and contingency plans for major oil spills within Marsaxlokk Bay should be adopted.

## **9. Infrastructure and Utilities**

The site of the proposed development is already committed to the generation of electricity. The site already benefits from all the required utilities and infrastructure including potable and cooling water supply, the required drainage systems, and adequate road access including an internal road network. The current infrastructure and utilities shall sustain the proposed development without the need of upgrading. Only minor, previously planned, road network upgrades shall be required.

## **10. Land and Water Contamination**

The measurements of various chemical and physical parameters were conducted around the Delimara Power Station, in order to evaluate the contamination that may have resulted over the past twenty odd years of its operation. The measured pollutants included heavy metals, solvents and hydrocarbons. These parameters are directly related to possible mineral oil spillages and emissions that may have resulted from the PS, contaminating the soil, ground water and sea in the process.

All the measured levels were considered to be within the acceptable limits.

It is expected that the proposed development will generate a range of by-products during its operation. Various operational provisions are being proposed to limit the potential of contamination by such substances to land and water exists. The provisions cater for the supply, storage and final disposal of chemicals and process by-products.

## **11. Waste Management**

Minimal excavation works are being proposed and limited materials are expected to be generated during construction.

It is the intention of Enemalta to operate the plant on Heavy Fuel Oil (HFO) having a maximum sulphur content of 1% by weight. It is believed that when the proposed plant is operated in this manner the waste arising will be:

- Solid waste generation from the flue gas purification will be some 10,000 tonnes/yr;
- Sludge oil approximately 1,000 tonnes/yr;
- Discharge of treated oily water to sea around 10,000m<sup>3</sup>/yr;



- Sea water cooling system will increase the current discharge by some 50% (an increase of 13,500 m<sup>3</sup>/hr on the current flow of 29,500m<sup>3</sup>/hr);
- Sludge generated from the Boiler Wash Down treatment facility will generate 8m<sup>3</sup>/yr of sludge.

The bulk of the wastes will be exported for treatment abroad as no facilities exist in Malta to treat the hazardous wastes generated by the plant.

## **12. Risk Assessment**

An independent Risk Assessment examined the environmental risks from the storage, handling and use of potentially hazardous materials such as fuels, chemicals and hazardous wastes. The study found that with the mitigation measures that are already in place or are proposed to be put in place; environmental risks would generally be low to moderate and therefore acceptable.

The most significant risks were the same as those for the existing development and namely:-

- Prevention of spillage during quayside oil offloading and transfer through training and equipment selection and use and the maintenance of a spill response capability.
- Catastrophic incident such as fire and loss of containment with application of substantial quantities of firewater. The likelihood of such an incident occurring is very small and current measures for control are generally appropriate to the risk.

Other risks requiring a high standard of management and control were the storage and handling of bulk chemicals and hazardous waste residues, and the design and operation of site drainage and the Effluent Treatment Plant.

Recommendations for updating risk management measures and contingency plans include the development of a major accident prevention policy and safety management system that includes organisation and responsibilities, procedures, training, equipment, actions, contacts, location drawings, sensitivity plans, etc.

## **13. Public Health**

This Health Impact Assessment looks at those areas which historically have been noted to impact on factors which may have a temporary or permanent health effect namely:

- 1) Impacts of particulate and gas emissions on ambient air quality;
- 2) Impacts of solid waste created during the construction and operational phases;
- 3) Impacts of noise and vibration during the operational and construction phases;
- 4) Impacts on bathing water quality;
- 5) Impacts on health due to increase in light production at the Delimara Plant;
- 6) Impacts caused by any increased traffic during both the construction phase and the operational phase.

The analysis concluded that the proposed development shall not constitute any negative significant impacts on public health. The major concern was related to noise impacts during the construction phase; these can be limited through the suggested mitigation measures. The Health Impact Assessment makes reference to the closure of the Marsa Power Station and identifies this as a significant beneficial outcome.

#### **14. Impacts on Human Populations**

A general lack of trust in public authorities and in the scientific studies associated with various developments, such as those undertaken for this EIA was observed. The local community is increasingly becoming disillusioned about the whole permitting process since whilst the development conditions cites high standards, there is lack of enforcement of such standards once the development occurs.

The envisaged and perceived impacts from the construction phase were associated to traffic, dust, and noise. The analysis of the operational phase of the proposed power plant on the other hand resulted in both beneficial and adverse impacts. These included: improvements in energy efficiency and environmental standards, better security of supply, air quality impacts, waste generation impacts, and visual impacts.

#### **15. Secondary, Indirect and Cumulative Impacts**

The failure to export in a timely fashion the solid wastes generated could cause a disruption to the provision of electricity supply. The complete or partial switching off of the plant due to a failure to export the wastes in a timely fashion is considered to have a significant cumulative effect with multiple secondary impacts.

During operation, it is expected that there will be an increase in vessel movements in the Marsaxlokk harbour. This increase in marine traffic is expected due to oil tankers providing fuel to the power plant, ships supplying the station with flue abatement chemicals and vessels exporting the waste by-products for treatment abroad. This increase of movement could have cumulative and secondary impacts on the fish farms around the area and interact with the Malta Freeport vessel movements. The impact significance of the increase in vessel movements is however believed to be of minor.

The closure of the MPS is seen as a positive cumulative impact with multiple secondary positive impacts such improvement in the air quality, removal of outdated unreliable plant and allowing the possibility for the rehabilitation of a sizeable area within the inner harbour region.

**Report on the  
Environmental Baseline Survey,  
for Water and Land Contamination,  
as part of the  
Environment Impact Assessment  
of the Proposed 144MW Local Generating Capacity  
Phase III at the Delimara Power Station.  
(PA 03512/05)**

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**On behalf of AIS Environmental Ltd.**

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## **TABLE OF CONTENTS**

### **Index**

- 1.0 Introduction.
- 2.0 Location and Measurements of Samples.
- 3.0 Methodology.
- 4.0 Observations and Conclusions of the EBS.

### **List of Tables**

- Table 1A. Laboratory Analytical Measurements of the Land Samples within 3 metres Depth.
- Table 1B. Laboratory Analytical Measurements of the Land Samples within 3 metres Depth.
- Table 2A. Laboratory Analytical Measurements of the Land Samples at 3 metres Depth.
- Table 2B. Laboratory Analytical Measurements of the Land Samples at 3 metres Depth.
- Table 3A. Laboratory Analytical Measurements of the Sea Bottom Sediment Samples at the respective GPS Points.
- Table 3B. Laboratory Analytical Measurements of the Sea Bottom Sediment Samples at the respective GPS Points.
- Table 4A. Laboratory Analytical Measurements of Sea Water Samples at the respective GPS Points.
- Table 4B. Laboratory Analytical Measurements of Sea Water Samples at the respective GPS Points.
- Table 5A. Laboratory Analytical Measurements of Groundwater Samples.
- Table 5B. Laboratory Analytical Measurements of Groundwater Samples.
- Table 6. List of Laboratory Methods for Analytical Measurements.

### **LIST OF FIGURES**

- Figure 1. Location of Land Sampling Points.
- Figure 2. Location of Ground Water Sampling Points.

## **Executive summary**

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The measurements of various chemical and physical parameters were conducted around the Delimara Power Station, in order to evaluate the contamination that may have resulted over the past twenty odd years of its operation. The measured pollutants included heavy metals, solvents and hydrocarbons. These parameters are directly related to possible mineral oil spillages and emissions that may have resulted from the PS, contaminating the soil, ground water and sea in the process.

All the measured levels were considered to be within the levels found in uncontaminated environmental soil, aquifer and sea water sediments. No contaminants were detected in the seawater samples.

## 1.0 Introduction

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- 1.1 The objectives of this EBS were established by the report submitted by AIS Ltd to MEPA and which were eventually approved.
- 1.2 The area of influence for the effect of fuel discharges was considered to be the low land area surrounding and including the Power Station (PS) itself, considering that Enemalta discharges water effluent inside the Hofra z-Zghira bay.
- 1.3 Inshore seawater samples from this area were collected, including sediment samples, in order to monitor the state of contamination in the sea water as well as the sea bottom.
- 1.4 Two ground water samples were collected from the land area in order to measure the effect of contamination on the water table within the area.
- 1.5 A background sample for land contamination studies was collected from the higher grounds, to the north of the PS, in order to compare the measurements with the samples collected from the lower levels.
- 1.6 The following parameters were measured on the collected samples:
  - heavy metals,
  - anions,
  - physical laboratory tests,
  - hydrocarbons

## 2.0 LOCATIONS AND MEASUREMENTS OF SAMPLES.

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- 2.1 The locations for land sampling were those indicated in Figure 1. There were some very slight modifications to the locations approved by MEPA due to the feasibility of coring the ground for sampling purposes. Core samples were collected down to about 3 metres from the surface of the sampling point.
- 2.2 The respective sites are as follows:
  - Site L1: a point towards the north-north-east of the PS, at a point to the south of the Fortizza tas-Silg.
  - Site L2: a point located above the north end of the PS, in a path known as il-Batterija ta' Wolsely.
  - Site L3: a point to the south of the three oil reservoirs located at the south end of the PS.
  - Site L4: a point within the PS, between two large reservoir tanks, located to the east side of the PS.
  - Site L5: a sampling point located inside the entrance to the plant.
- 2.3 The laboratory measurements of the land samples are shown in Tables 1A, 1B, 2A and 2B.
- 2.4 Figure 2 gives the location of the two ground water samples collected. The analytical measurements are given in Table 5.
- 2.5 The GPS locations for sea bottom sediment samples were identified by the sampling team directed by Dr Alan Deidun, and are given in Tables 3A and 3B. The seawater sampling points are identified in Figure 2, and the results given in Tables 4A and 4B. There were some very slight modifications to the locations approved by MEPA due to the prevailing sea water current prevailing at the time of the sampling operation.
- 2.6 The respective sea water sampling sites are as follows:
  - Site W1: a point immediately inshore to Ras il-Fniek point.
  - Site W2: a point at the central part of the il-Hofra z-Zghira Bay.
  - Site W3: a point immediately inshore to the entry gate of the PS.
  - Site W4: a point immediately inshore to the Kalanka l-Fonda.

### 3.0 Methodology

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- 3.1 The analytical methods that were used throughout the survey are listed in Table 6.

PARAMETERS	ANALYTICAL METHOD
Nitrates	UV/vis method
Carbonates	titrimetric method
Sulphates	turbidity method
Hydroxides	titrimetric method
pH	pH Meter CNR IRSA 1 Q. 64 1985
Salinity	Chloride and sodium measurement APAT CNR IRSA 2070 Man 29 2003
BTEX	Gas chromatographic method according to CNR-IRSA 23 b Q 64 Vol 3 1990
METALS	Atomic Absorption Graphite Furnace Method according to EPA 3051A:2007+ EPA 6010C:2007
PAH	Gas Chromatographic Method according to CNR-IRSA 25 a Q 64 Vol 3 1998

Table 6. List of Laboratory Methods for Analytical Measurements.

### 4.0 Observations and Conclusions on the Baseline Study

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- 4.1 The analytical measurements reported in Table 1 to 5 for the land, seawater sediments, seawater samples, and ground water samples, gave results that were compatible to environmental samples. No contamination from the measured parameters was observed, and can therefore be considered to comply to local legal notices and EU Directives.
- 4.2 This means that the sampled area is free from contamination with possible mineral oil or allied contaminants.
- 4.3 The levels of the anions measured in the soil samples, are compatible to local limestone and concrete mixes, as can be verified from the levels of carbonates and sulphates.
- 4.4 No contamination with PAH's was observed in any of the samples.
- 4.5 The levels of detected metal concentration in the land and sediment samples were within the levels normally found in environmental soil and sediment samples.
- 4.6 The following legal notices were referenced:

- a) LN 213 of 2001. Pollution Caused by Certain Dangerous Substances Discharged into the aquatic Environment Regulations.

The analytical measures show that the ground water and sea water and sediment samples collected did not show evidence of contamination from discharges into the sea or ground water.

- b) LN 218 of 2001. Limit Values and Quantity Objectives for Hexachlorocyclohexane Discharges Regulations.

In view of the fact that the samples collected from the Delimara site, contains BTEX and PAH levels that were below the limit of detection, indicate that the presence of this chemical would also be below the limit of detection, even though this substance was not measured.

- c) LN 203 of 2002. Regulations for the Protection of Ground water against Pollution caused by Certain Dangerous Substances.

The analytical measures show that the ground water and soil samples collected did not show evidence of contamination from discharges into the ground water.



PARAMETERS	UNIT OF MEASURE	CORE SAMPLES					ANALYTICAL METHOD
		Surface Samples 0-3 metres					
		Sample L1 RESULTS	Sample L2 RESULTS	Sample L3 RESULTS	Sample L4 RESULTS	Sample L5 RESULTS	
ANIONS and PHYSICAL							
Nitrates	mg/Kg	137	56	56	167	88	UV/vis method
Carbonates	% w/w	56	51	44	43	48	titrimetric method
Sulphates	% w/w	4	3.6	23	27	13	turbidity method
Hydroxides	% w/w	2.3	1.8	1.2	2.1	1	titrimetric method
pH		7.8	7.2	7.4	7.6	7.7	CNR IRSA 1 Q. 64 1985
Salinity	µS/cm	376.00	231.00	423.00	316.00	333.00	APAT CNR IRSA 2070 Man 29 2003
BTEX							
Benzene	mg/Kg	<0,1	<0,1	<0,1	<0,1	<0,1	CNR-IRSA 23 b Q 64 Vol 3 1990
Ethylbenzene	mg/Kg	<0,1	<0,1	<0,1	<0,1	<0,1	CNR-IRSA 23 b Q 64 Vol 3 1990
Styrene	mg/Kg	<0,1	<0,1	<0,1	<0,1	<0,1	CNR-IRSA 23 b Q 64 Vol 3 1990
Toluene	mg/Kg	<0,1	<0,1	<0,1	<0,1	<0,1	CNR-IRSA 23 b Q 64 Vol 3 1990
Xylene	mg/Kg	<0,1	<0,1	<0,1	<0,1	<0,1	CNR-IRSA 23 b Q 64 Vol 3 1990
METALS							
Chromium	mg/Kg	3.3	5.2	6.9	4.8	11.7	EPA 3051A:2007+ EPA 6010C:2007
Nickel	mg/Kg	2.3	6.8	7.1	7.9	7.2	EPA 3051A:2007+ EPA 6010C:2007
Lead	mg/Kg	6	10.2	6.7	9	9.2	EPA 3051A:2007+ EPA 6010C:2007
Vanadium	mg/Kg	3.1	6.7	9.3	9.2	11.7	EPA 3051A:2007+ EPA 6010C:2007

Table 1A. Laboratory Analytical Measurements of the Land Samples within 3 metres Depth.

PARAMETERS	UNIT OF MEASURE	CORE SAMPLES					ANALYTICAL METHOD
		Surface Samples 0-3 metres					
		Sample L1 RESULTS	Sample L2 RESULTS	Sample L3 RESULTS	Sample L4 RESULTS	Sample L5 RESULTS	
Acenaphthene	mg/Kg	<0,05	<0,05	<0,05	<0,05	<0,05	CNR-IRSA 25 a Q 64 Vol 3 1998
Acenaphthylene	mg/Kg	<0,05	<0,05	<0,05	<0,05	<0,05	CNR-IRSA 25 a Q 64 Vol 3 1998
Anthracene	mg/Kg	<0,05	<0,05	<0,05	<0,05	<0,05	CNR-IRSA 25 a Q 64 Vol 3 1998
Benzo(a)anthracene	mg/Kg	<0,05	<0,05	<0,05	<0,05	<0,05	CNR-IRSA 25 a Q 64 Vol 3 1998
*Benzo(a)fluoranthene	mg/Kg	<0,05	<0,05	<0,05	<0,05	<0,05	CNR-IRSA 25 a Q 64 Vol 3 1998
Benzo(a)pyrene	mg/Kg	<0,05	<0,05	<0,05	<0,05	<0,05	CNR-IRSA 25 a Q 64 Vol 3 1998
Benzo(b)fluoranthene	mg/Kg	<0,05	<0,05	<0,05	<0,05	<0,05	CNR-IRSA 25 a Q 64 Vol 3 1998
Benzo(k)fluoranthene	mg/Kg	<0,05	<0,05	<0,05	<0,05	<0,05	CNR-IRSA 25 a Q 64 Vol 3 1998
Benzo(g,h,i)perylene	mg/Kg	<0,05	<0,05	<0,05	<0,05	<0,05	CNR-IRSA 25 a Q 64 Vol 3 1998
Chrysene	mg/Kg	<0,05	<0,05	<0,05	<0,05	<0,05	CNR-IRSA 25 a Q 64 Vol 3 1998
Dibenzo(a,h)anthracene	mg/Kg	<0,05	<0,05	<0,05	<0,05	<0,05	CNR-IRSA 25 a Q 64 Vol 3 1998
Fluoranthene	mg/Kg	<0,05	<0,05	<0,05	<0,05	<0,05	CNR-IRSA 25 a Q 64 Vol 3 1998
Fluorene	mg/Kg	<0,05	<0,05	<0,05	<0,05	<0,05	CNR-IRSA 25 a Q 64 Vol 3 1998
Indeno (1,2,3,-cd)pyrene	mg/Kg	<0,05	<0,05	<0,05	<0,05	<0,05	CNR-IRSA 25 a Q 64 Vol 3 1998
Naphthalene	mg/Kg	<0,05	<0,05	<0,05	<0,05	<0,05	CNR-IRSA 25 a Q 64 Vol 3 1998
Phenanthrene	mg/Kg	<0,05	<0,05	<0,05	<0,05	<0,05	CNR-IRSA 25 a Q 64 Vol 3 1998
Pyrene	mg/Kg	<0,05	<0,05	<0,05	<0,05	<0,05	CNR-IRSA 25 a Q 64 Vol 3 1998

Table 1B. Laboratory Analytical Measurements of the Land Samples within 3 metres Depth.

PARAMETERS	UNIT OF MEASURE	CORE SAMPLES					ANALYTICAL METHOD
		Sub-surface Samples 3 metres					
		Sample L1 RESULTS	Sample L2 RESULTS	Sample L3 RESULTS	Sample L4 RESULTS	Sample L5 RESULTS	
ANIONS and PHYSICAL							
Nitrates	mg/Kg	210	73	44	108	102	UV/vis method
Carbonates	% w/w	57	53	44	47	47	titrimetric method
Sulphates	% w/w	6	6.7	27	30	16	turbidity method
Hydroxides	% w/w	1.8	2.2	1.9	1.9	1.3	titrimetric method
pH		7.8	7.4	7.5	7.5	7.8	CNR IRSA 1 Q. 64 1985
Salinity	µS/cm	233.00	259.00	366.00	401.00	428.00	APAT CNR IRSA 2070 Man 29 2003
BTEX							
Benzene	mg/Kg	<0,1	<0,1	<0,1	<0,1	<0,1	CNR-IRSA 23 b Q 64 Vol 3 1990
Ethylbenzene	mg/Kg	<0,1	<0,1	<0,1	<0,1	<0,1	CNR-IRSA 23 b Q 64 Vol 3 1990
Styrene	mg/Kg	<0,1	<0,1	<0,1	<0,1	<0,1	CNR-IRSA 23 b Q 64 Vol 3 1990
Toluene	mg/Kg	<0,1	<0,1	<0,1	<0,1	<0,1	CNR-IRSA 23 b Q 64 Vol 3 1990
Xylene	mg/Kg	<0,1	<0,1	<0,1	<0,1	<0,1	CNR-IRSA 23 b Q 64 Vol 3 1990
METALS							
Chromium	mg/Kg	3.3	5.2	6.9	4.8	11.7	EPA 3051A:2007+ EPA 6010C:2007
Nickel	mg/Kg	2.3	6.8	7.1	7.9	7.2	EPA 3051A:2007+ EPA 6010C:2007
Lead	mg/Kg	6	10.2	6.7	9	9.2	EPA 3051A:2007+ EPA 6010C:2007
Vanadium	mg/Kg	3.1	6.7	9.3	9.2	11.7	EPA 3051A:2007+ EPA 6010C:2007

Table 2A. Laboratory Analytical Measurements of the Land Samples at 3 metres Depth.

PARAMETERS	UNIT OF MEASURE	CORE SAMPLES					ANALYTICAL METHOD
		Sub-surface Samples 3 metres					
		Sample L1 RESULTS	Sample L2 RESULTS	Sample L3 RESULTS	Sample L4 RESULTS	Sample L5 RESULTS	
Acenaphthene	mg/Kg	<0,05	<0,05	<0,05	<0,05	<0,05	CNR-IRSA 25 a Q 64 Vol 3 1998
Acenaphthylene	mg/Kg	<0,05	<0,05	<0,05	<0,05	<0,05	CNR-IRSA 25 a Q 64 Vol 3 1998
Anthracene	mg/Kg	<0,05	<0,05	<0,05	<0,05	<0,05	CNR-IRSA 25 a Q 64 Vol 3 1998
Benzo(a)anthracene	mg/Kg	<0,05	<0,05	<0,05	<0,05	<0,05	CNR-IRSA 25 a Q 64 Vol 3 1998
*Benzo(a)fluoranthene	mg/Kg	<0,05	<0,05	<0,05	<0,05	<0,05	CNR-IRSA 25 a Q 64 Vol 3 1998
Benzo(a)pyrene	mg/Kg	<0,05	<0,05	<0,05	<0,05	<0,05	CNR-IRSA 25 a Q 64 Vol 3 1998
Benzo(b)fluoranthene	mg/Kg	<0,05	<0,05	<0,05	<0,05	<0,05	CNR-IRSA 25 a Q 64 Vol 3 1998
Benzo(k)fluoranthene	mg/Kg	<0,05	<0,05	<0,05	<0,05	<0,05	CNR-IRSA 25 a Q 64 Vol 3 1998
Benzo(g,h,i)perylene	mg/Kg	<0,05	<0,05	<0,05	<0,05	<0,05	CNR-IRSA 25 a Q 64 Vol 3 1998
Chrysene	mg/Kg	<0,05	<0,05	<0,05	<0,05	<0,05	CNR-IRSA 25 a Q 64 Vol 3 1998
Dibenzo(a,h)anthracene	mg/Kg	<0,05	<0,05	<0,05	<0,05	<0,05	CNR-IRSA 25 a Q 64 Vol 3 1998
Fluoranthene	mg/Kg	<0,05	<0,05	<0,05	<0,05	<0,05	CNR-IRSA 25 a Q 64 Vol 3 1998
Fluorene	mg/Kg	<0,05	<0,05	<0,05	<0,05	<0,05	CNR-IRSA 25 a Q 64 Vol 3 1998
Indeno (1,2,3,-cd)pyrene	mg/Kg	<0,05	<0,05	<0,05	<0,05	<0,05	CNR-IRSA 25 a Q 64 Vol 3 1998
Naphthalene	mg/Kg	<0,05	<0,05	<0,05	<0,05	<0,05	CNR-IRSA 25 a Q 64 Vol 3 1998
Phenanthrene	mg/Kg	<0,05	<0,05	<0,05	<0,05	<0,05	CNR-IRSA 25 a Q 64 Vol 3 1998
Pyrene	mg/Kg	<0,05	<0,05	<0,05	<0,05	<0,05	CNR-IRSA 25 a Q 64 Vol 3 1998

Table 2B. Laboratory Analytical Measurements of the Land Samples at 3 metres Depth.

PARAMETERS		SEDIMENTS SAMPLES										ANALYTICAL METHOD
		Sample A		Sample B		Sample C		Sample D		Sample E		
		GPS Locations	33460735 E 3965787 N	33460563 E 3965899 N	33460563 E 3965899 N	33460563 E 3965899 N	33460563 E 3965899 N	33460563 E 3965899 N	33460563 E 3965899 N	33460563 E 3965899 N		
UNIT OF MEASURE		RESULTS	RESULTS	RESULTS	RESULTS	RESULTS	RESULTS	RESULTS	RESULTS	RESULTS		
BTEX												
Benzene		mg/Kg	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	CNR-IRSA 23 b Q 64 Vol 3 1990	
Ethylbenzene		mg/Kg	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	CNR-IRSA 23 b Q 64 Vol 3 1990	
Styrene		mg/Kg	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	CNR-IRSA 23 b Q 64 Vol 3 1990	
Toluene		mg/Kg	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	CNR-IRSA 23 b Q 64 Vol 3 1990	
Xylene		mg/Kg	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	CNR-IRSA 23 b Q 64 Vol 3 1990	
METALS												
Chromium		mg/Kg	11.7	10.4	10.2	10.2	16.1	14.5			EPA 3051A:2007+ EPA 6010C:2007	
Nickel		mg/Kg	3.7	3.2	4.5	4.5	10.9	11.2			EPA 3051A:2007+ EPA 6010C:2007	
Lead		mg/Kg	8.9	8.1	9.9	9.9	16.7	12.6			EPA 3051A:2007+ EPA 6010C:2007	
Vanadium		mg/Kg	8.2	6.7	4.7	4.7	10.2	7.4			EPA 3051A:2007+ EPA 6010C:2007	

Table 3A. Laboratory Analytical Measurements of the Sea Bottom Sediment Samples at the respective GPS Points.

PARAMETERS	SEDIMENTS SAMPLES							ANALYTICAL METHOD
	Sample A	Sample B	Sample C	Sample D	Sample E			
	33460735 E 3965787 N	33460563 E 3965899 N	33460563 E 3965899 N	33460563 E 3965899 N	33460563 E 3965899 N			
UNIT OF MEASURE	RESULTS	RESULTS	RESULTS	RESULTS	RESULTS	RESULTS		
PAH								
Acenaphthene	mg/Kg	<0,05	<0,05	<0,05	<0,05	<0,05	CNR-IRSA 25 a Q 64 Vol 3 1998	
Acenaphthylene	mg/Kg	<0,05	<0,05	<0,05	<0,05	<0,05	CNR-IRSA 25 a Q 64 Vol 3 1998	
Anthracene	mg/Kg	<0,05	<0,05	<0,05	<0,05	<0,05	CNR-IRSA 25 a Q 64 Vol 3 1998	
Benzo(a)anthracene	mg/Kg	<0,05	<0,05	<0,05	<0,05	<0,05	CNR-IRSA 25 a Q 64 Vol 3 1998	
*Benzo(a)fluoranthene	mg/Kg	<0,05	<0,05	<0,05	<0,05	<0,05	CNR-IRSA 25 a Q 64 Vol 3 1998	
Benzo(a)pyrene	mg/Kg	<0,05	<0,05	<0,05	<0,05	<0,05	CNR-IRSA 25 a Q 64 Vol 3 1998	
Benzo(b)fluoranthene	mg/Kg	<0,05	<0,05	<0,05	<0,05	<0,05	CNR-IRSA 25 a Q 64 Vol 3 1998	
Benzo(k)fluoranthene	mg/Kg	<0,05	<0,05	<0,05	<0,05	<0,05	CNR-IRSA 25 a Q 64 Vol 3 1998	
Benzo(g,h,i)perylene	mg/Kg	<0,05	<0,05	<0,05	<0,05	<0,05	CNR-IRSA 25 a Q 64 Vol 3 1998	
Chrysene	mg/Kg	<0,05	<0,05	<0,05	<0,05	<0,05	CNR-IRSA 25 a Q 64 Vol 3 1998	
Dibenzo(a,h)anthracene	mg/Kg	<0,05	<0,05	<0,05	<0,05	<0,05	CNR-IRSA 25 a Q 64 Vol 3 1998	
Fluoranthene	mg/Kg	<0,05	<0,05	<0,05	<0,05	<0,05	CNR-IRSA 25 a Q 64 Vol 3 1998	
Fluorene	mg/Kg	<0,05	<0,05	<0,05	<0,05	<0,05	CNR-IRSA 25 a Q 64 Vol 3 1998	
Indeno (1,2,3,-cd)pyrene	mg/Kg	<0,05	<0,05	<0,05	<0,05	<0,05	CNR-IRSA 25 a Q 64 Vol 3 1998	
Naphthalene	mg/Kg	<0,05	<0,05	<0,05	<0,05	<0,05	CNR-IRSA 25 a Q 64 Vol 3 1998	
Phenanthrene	mg/Kg	<0,05	<0,05	<0,05	<0,05	<0,05	CNR-IRSA 25 a Q 64 Vol 3 1998	
Pyrene	mg/Kg	<0,05	<0,05	<0,05	<0,05	<0,05	CNR-IRSA 25 a Q 64 Vol 3 1998	

Table 3B. Laboratory Analytical Measurements of the Sea Bottom Sediment Samples at the respective GPS Points.

PARAMETERS	UNIT OF MEASURE	SEA WATER SAMPLES				ANALYTICAL METHOD
		Sample W1	Sample W2	Sample W3	Sample W4	
		RESULTS	RESULTS	RESULTS	RESULTS	
pH		8,2	8,2	8,2	8,2	APAT CNR IRSA 2060 Man 29 2003
Conductivity	µS/cm	49900	48400	49900	48800	APAT CNR IRSA 2030 Man 29 2003
Salinity	PSU	35.3	34.3	35.3	34.5	APAT CNR IRSA 2070 Man 29 2003
BTEX						
Benzene	µg/l	<0,1	<0,1	<0,1	<0,1	APAT CNR IRSA 5140 Man 29 2003
Ethylbenzene	µg/l	<0,1	<0,1	<0,1	<0,1	APAT CNR IRSA 5140 Man 29 2003
Styrene	µg/l	<0,1	<0,1	<0,1	<0,1	APAT CNR IRSA 5140 Man 29 2003
Toluene	µg/l	<0,1	<0,1	<0,1	<0,1	APAT CNR IRSA 5140 Man 29 2003
Xylene	µg/l	<0,1	<0,1	<0,1	<0,1	APAT CNR IRSA 5140 Man 29 2003
METALS						
Chromium	µg/l	<5	<5	<5	<5	EPA 3005A 1992+EPA 6010C 2007
Nickel	µg/l	<2	<2	<2	<2	EPA 3005A 1992+EPA 6010C 2007
Lead	µg/l	<2	<2	<2	<2	EPA 3005A 1992+EPA 6010C 2007
Vanadium	µg/l	<5	<5	<5	<5	EPA 3005A 1992+EPA 6010C 2007

Table 4A. Laboratory Analytical Measurements of Sea Water Samples at the respective GPS Points.

PARAMETERS	UNIT OF MEASURE	SEA WATER SAMPLES				ANALYTICAL METHOD
		Sample W1	Sample W2	Sample W3	Sample W4	
		RESULTS	RESULTS	RESULTS	RESULTS	
PAH						
Acenaphthene	µg/l	<0,1	<0,1	<0,1	<0,1	APAT CNR IRSA 5080 Man 29 2003
Acenaphthylene	µg/l	<0,1	<0,1	<0,1	<0,1	APAT CNR IRSA 5080 Man 29 2003
Anthracene	µg/l	<0,1	<0,1	<0,1	<0,1	APAT CNR IRSA 5080 Man 29 2003
Benzo(a)anthracene	µg/l	<0,1	<0,1	<0,1	<0,1	APAT CNR IRSA 5080 Man 29 2003
*Benzo(a)fluoranthene	µg/l	<0,1	<0,1	<0,1	<0,1	APAT CNR IRSA 5080 Man 29 2003
Benzo(a)pyrene	µg/l	<0,1	<0,1	<0,1	<0,1	APAT CNR IRSA 5080 Man 29 2003
Benzo(b)fluoranthene	µg/l	<0,1	<0,1	<0,1	<0,1	APAT CNR IRSA 5080 Man 29 2003
Benzo(k)fluoranthene	µg/l	<0,1	<0,1	<0,1	<0,1	APAT CNR IRSA 5080 Man 29 2003
Benzo(g,h,i)perylene	µg/l	<0,1	<0,1	<0,1	<0,1	APAT CNR IRSA 5080 Man 29 2003
Chrysene	µg/l	<0,1	<0,1	<0,1	<0,1	APAT CNR IRSA 5080 Man 29 2003
Dibenzo(a,h)anthracene	µg/l	<0,1	<0,1	<0,1	<0,1	APAT CNR IRSA 5080 Man 29 2003
Fluoranthene	µg/l	<0,1	<0,1	<0,1	<0,1	APAT CNR IRSA 5080 Man 29 2003
Fluorene	µg/l	<0,1	<0,1	<0,1	<0,1	APAT CNR IRSA 5080 Man 29 2003
Indeno (1,2,3,-cd)pyrene	µg/l	<0,1	<0,1	<0,1	<0,1	APAT CNR IRSA 5080 Man 29 2003
Naphthalene	µg/l	<0,1	<0,1	<0,1	<0,1	APAT CNR IRSA 5080 Man 29 2003
Phenanthrene	µg/l	<0,1	<0,1	<0,1	<0,1	APAT CNR IRSA 5080 Man 29 2003
Pyrene	µg/l	<0,1	<0,1	<0,1	<0,1	APAT CNR IRSA 5080 Man 29 2003

Table 4B. Laboratory Analytical Measurements of Sea Water Samples at the respective GPS Points.



PARAMETERS	UNIT OF MEASURE	GROUND WATER SAMPLES		ANALYTICAL METHOD
		Sample 1	Sample 2	
		RESULTS	RESULTS	
pH		7.9	7.9	APAT CNR RSA 2060 Man 29 2003
Conductivity	µS/cm	1135	1989	APAT CNR RSA 2030 Man 29 2003
Salinity	PSU	13.2	19	APAT CNR RSA 2070 Man 29 2003
BTEX				
Benzene	µg/l	<0,1	<0,1	APAT CNR RSA 5140 Man 29 2003
Ethylbenzene	µg/l	<0,1	<0,1	APAT CNR RSA 5140 Man 29 2003
Styrene	µg/l	<0,1	<0,1	APAT CNR RSA 5140 Man 29 2003
Toluene	µg/l	<0,1	<0,1	APAT CNR RSA 5140 Man 29 2003
Xylene	µg/l	<0,1	<0,1	APAT CNR RSA 5140 Man 29 2003
METALS				
Chromium	µg/l	<5	<5	EPA 3005A 1992+EPA 6010C 2007
Nickel	µg/l	<2	<2	EPA 3005A 1992+EPA 6010C 2007
Lead	µg/l	<2	<2	EPA 3005A 1992+EPA 6010C 2007
Vanadium	µg/l	<5	<5	EPA 3005A 1992+EPA 6010C 2007

Table 5A. Laboratory Analytical Measurements of Groundwater Samples.

PARAMETERS	UNIT OF MEASURE	GROUND WATER SAMPLES		ANALYTICAL METHOD
		Sample 1	Sample 2	
		RESULTS	RESULTS	
PAH				
Acenaphthene	µg/l	<0,1	<0,1	APAT CNR IRSA 5080 Man 29 2003
Acenaphthylene	µg/l	<0,1	<0,1	APAT CNR IRSA 5080 Man 29 2003
Anthracene	µg/l	<0,1	<0,1	APAT CNR IRSA 5080 Man 29 2003
Benzo(a)anthracene	µg/l	<0,1	<0,1	APAT CNR IRSA 5080 Man 29 2003
*Benzo(a)fluoranthene	µg/l	<0,1	<0,1	APAT CNR IRSA 5080 Man 29 2003
Benzo(a)pyrene	µg/l	<0,1	<0,1	APAT CNR IRSA 5080 Man 29 2003
Benzo(b)fluoranthene	µg/l	<0,1	<0,1	APAT CNR IRSA 5080 Man 29 2003
Benzo(k)fluoranthene	µg/l	<0,1	<0,1	APAT CNR IRSA 5080 Man 29 2003
Benzo(g,h,i)perylene	µg/l	<0,1	<0,1	APAT CNR IRSA 5080 Man 29 2003
Chrysene	µg/l	<0,1	<0,1	APAT CNR IRSA 5080 Man 29 2003
Dibenzo(a,h)anthracene	µg/l	<0,1	<0,1	APAT CNR IRSA 5080 Man 29 2003
Fluoranthene	µg/l	<0,1	<0,1	APAT CNR IRSA 5080 Man 29 2003
Fluorene	µg/l	<0,1	<0,1	APAT CNR IRSA 5080 Man 29 2003
Indeno (1,2,3,-cd)pyrene	µg/l	<0,1	<0,1	APAT CNR IRSA 5080 Man 29 2003
Naphthalene	µg/l	<0,1	<0,1	APAT CNR IRSA 5080 Man 29 2003
Phenanthrene	µg/l	<0,1	<0,1	APAT CNR IRSA 5080 Man 29 2003
Pyrene	µg/l	<0,1	<0,1	APAT CNR IRSA 5080 Man 29 2003

Table 5B. Laboratory Analytical Measurements of Groundwater Samples.



Sample 2

Sample 1



Figure 2. Location of Ground Water Sampling Points.



RVA GROUP

Decommissioning,  
decontamination,  
dismantling and demolition  
consulting engineers

## **Decommissioning Plan**

**For the Enemalta Corporation**

**Delimara Power Station**

**at Delimara, Malta**





# **Delimara Power Station, Delimara, Marsaxlokk**

## **Decommissioning Plan**

### **SCP Phase 1**





## **Executive Summary**

Laboratory analysis of soil samples from Delimara has identified low concentrations of metals in all samples. Low concentrations of polycyclic aromatic hydrocarbons (PAHs), volatile and semi-volatile organic compounds (VOCs and SVOCs), and extractable petroleum hydrocarbons (EPH) were identified in localised areas. All concentrations of contaminants did not exceed Generic Assessment Criteria (GACs) for a commercial/industrial end use.

Elevated concentrations of petroleum hydrocarbons (i.e. above method detection limit of 35mg/kg) were identified in the natural mudstone between depths of 1.8m and 3.0m bgl at BH08, which suggests there may be localised leakage from a sump. The pollution prevention measures may be inadequate in this area. Concentrations of petroleum hydrocarbons were assessed against the relevant Generic Assessment Criteria and were not found to exceed the values.

The likelihood of their being significant contamination of the land was assessed and no present risk was identified.

As a result of the initial findings of the land investigation in relation to contamination, it is recommended that as a minimum an additional soil monitoring investigation is undertaken immediately prior to the IPPC permit surrender. The investigation should be at least equal in detail to the current investigation, but should also take into account any polluting incidents.

The dismantling of the Phase 1 Power Generating Plant will not have any effect on the original conclusions of the Outline Decommissioning Plan.

It is understood that MEPA has agreed that the IPPC permit will not require surrender at this stage and the boundary of the permit will not change. For this reason, there is no requirement at this stage to undertake remediation of Phase 1 Area; remediation will be undertaken for Phase 1 as part of the whole site when the IPPC permit is surrendered.

It is anticipated that no sub-surface ground excavation will be undertaken during the Phase 1 decommissioning works. However, should these Phase 1 decommissioning works involve excavation of the sub-surface, then in accordance with best practice guidance, a 'watching brief' should be implemented during the programme, whereby unusual or 'out-of-character' materials (if identified) can be assessed or stockpiled/contained until such assessment can be undertaken. If hazardous





materials such as asbestos containing materials etc are identified, these should be subject to site contingency plans, health & safety risk assessment and outline method statements/procedures for their identification, handling, removal and disposal. All remedial activities would be validated and a completion report generated.



**ENEMALTA CORPORATION**  
**DELIMARA POWER STATION, DELIMARA, MARSAXLOKK**  
**DECOMMISSIONING PLAN**

**Contents**

Introduction

Terms of reference

Layout of DP

Section 1 – Site Condition Report

Section 2 – Waste Management Plan



## **Introduction**

From the requirements of the Integrated Pollution Prevention and Control Regulations (LN 10 of 2013) Delimara Power Station (DPS) operates under an IPPC Environmental Permit (EP), number IP 0002/07/E.

As part of the requirements of this EP there is a need to provide an Outline Decommissioning Plan (ODP) for the site – Condition 2.16.1 of the EP – which needs to be reviewed and updated during the operational life of the site.

RVA has been appointed to produce this revised Decommissioning Plan (DP) (an update of the ODP) on behalf of the Enemalta Corporation (Enemalta), who have in turn appointed ENVIRON to assist in the execution and production of a report associated with the ground conditions at the site.

The requirement for an updated DP is due to the proposal to dismantle the Phase 1 Power Generating Plant and hence to assess the effects of these works on the conclusions of the ODP.

This DP covers the following requirements of the EP (note the number of the Conditions mirrors that in the EP):

- 2.16.3            The operator shall submit to the Authority a report by a qualified geologist on the likelihood of their being a significant contamination of the land on the site by any of the pollutants in Schedule 9. Should it result that the land is likely to contain environmentally significant amounts of these pollutants, this report shall contain as a minimum the measured concentrations of the substances specified in Schedule 9:
  - 2.16.3.1        This monitoring programme shall amongst other things include the location of the points for the sampling of land, information on the sampling methods, the handling of the samples, the pretreatment/extraction of the analytes (where applicable) and the methods used in order to analyse the samples.
  - 2.16.3.2        Samples should be analysed to the relevant EN or EN ISO standards or equivalent.



- 2.16.3.3 Samples shall be managed by a lab accredited (or in the process of accreditation, as confirmed by the National Accreditation Body (NAB-Malta) or equivalent) to at least EN ISO 17025:2005/Cor 1:2006 and preferably accredited for each and every analysis
- 2.16.3.4 Land monitoring shall be repeated at least every four years, and results included in the AER
- 2.16.5 The operator shall submit to the Authority for review a full Decommissioning Plan. This full Decommissioning Plan shall at least include the following information:
  - 2.16.5.1 A detailed monitoring programme which will illustrate how the operator will measure the current levels of various pollutants in the land:
    - 2.16.5.1.1 The list of the pollutants to be monitored for shall be as per Schedule 9.
    - 2.16.5.1.2 The monitoring programme shall amongst other things include the location of the points for the sampling of land, the sampling methods, the handling of the samples, the pretreatment/extraction of the analytes (where applicable) and the methods used in order to analyse the samples.
    - 2.16.5.1.3 Samples should be analysed to the relevant EN or EN ISO standards or equivalent.
    - 2.16.5.1.4 Samples shall be managed by a lab accredited (or in the process of accreditation, as confirmed by the National Accreditation Body (NAB-Malta) or equivalent) to at least EN ISO 17025:2005/Cor 1:2006 and preferably accredited for each and every analysis



2.16.5.4 A Waste Management Plan which shall include:

- 2.16.5.4.1 The identification and characterisation of sources, types and quantities of waste (including equipment, fuels, by-products such as ash, etc.);
- 2.16.5.4.2 Criteria for segregation of wastes;
- 2.16.5.4.3 Proposed treatment, conditioning, transport, storage and disposal/recovery methods;
- 2.16.5.4.4 Potential reuse/recycling of such wastes.

2.16.5.5 The identification of potential sources of emissions to the atmosphere, land and water (both seawater and groundwater) pollution which might arise from the decontamination process and corresponding mitigation measures to minimise the likelihood of such emissions.

Both Enemalta and RVA (including ENVIRON) place EHS excellence as prime business drivers and this philosophy has been taken as the base criteria for the compilation of this document.

**Terms of reference**

DPS is located to the south of the island of Malta on the edge of Marsaxlokk Bay, on the west side of the Delimara Peninsula. The site is constructed on flat ground that has been formed by cutting the cliff and constructing a platform that protrudes into the bay. This has resulted in the majority of the major plant being built on rock while the support network systems (cooling water intake and network, diesel storage tanks, etc.) are constructed on made land.

The site contains several different power generating plants:

**Phase 1**

This was the initial construction phase which was commissioned in 1992 and included two steam units each with a generating capacity of 60MW. Each unit comprise of:

- 260t/hr Waagner-Biro steam raising boiler (110barA at 513degrees Celsius, firing Heavy Fuel Oil [HFO])
- GHEL fully condensing steam turbine (87bar, 510 degrees Celsius)



- 75MW (60MW at 0.8pF) BHEL generator, generating at 11kV, stepped up to 132kV

These steam units utilise the following ancillary equipment and systems:

- Cooling water intake, outlet, and distribution network
- Water treatment plant, including storage
- Heavy Fuel Oil (HFO) storage tanks and distribution network
- Outgoing substation

Also as part of this phase the support structures built included:

- Gatehouse
- Administration building
- Workshop and storage
- Laboratory and fire station
- Quay

The Phase 1 Power Generating Plant dismantling includes the removal of:

- 2no. Waagner Biro Steam Boilers rated at 260T/H steam flow fired by Heavy Fuel Oil
- 2no. BHEL Steam turbines/Generators rated at 60MW output with all auxiliary equipment found inside the Turbine Hall.
- Phase 1 chimney, (consisting of chimneys D1A and D1B 150m high with concrete wind shield).

The Turbine Hall structure and site service electrical systems (including the pipebridge between the boilers and the Turbine Hall) are not included in the removal works.

### Phase 2A

This phase was commissioned in 1995 and is an open cycle gas turbine (OCGT). The system comprises of:

- 2x John Brown (JBE) (GE) MS6001B gas turbines
- 2x 47MVA (37.5MW at 0.8pF) Brush generators, generating at 11KV, stepped up to 33Kv.



The OCGT's utilise sections of the Phase 1 ancillary equipment, systems and support buildings, however in addition the following was built to support their operation:

- 4xgas/diesel oil (GDO) storage tanks and distribution network

### Phase 2B

This phase was commissioned in 1999 and is a combined cycle gas turbine (CCGT). The system comprises of:

- 2x NP (GE) MS6001B gas turbines
- 1x GE fully condensing steam turbine (sliding pressure 17-50barA, 504 degrees Celsius)
- 2x 65t/hr Stork Ketel heat recovery steam raising boilers (50barA at 504 degrees Celsius, unfired)
- 3x 55MVA (44MW at 0.8pF) Brush generators, generating at 13.8kV, stepped up to 132kV

Again this phase utilises the systems and support buildings from the previous phases however the following additional was built to support the site network:

- New site control room
- Additional treated water storage tanks

### Phase 3

This phase was commissioned in 2012. The plant consists of:

- 8x Wartsila 18V46 medium speed diesel engines
- 8x Wartsila AMG generators
- 8x selective catalytic reduction (SCR) units
- 8x exhaust waste heat recovery boilers
- 4x de-sulphurisation units
- 1x fully condensing steam turbine
- 1x 13MW generator



As the previous phases this one utilises existing site systems and support buildings but in addition this phase includes:

- Fuel treatment facility
- Urea plant
- Flue gas desulphurisation reagent and waste handling plant

### **Layout of decommissioning plan**

The two main sections of this report – Site Condition Report and Waste Management Plan – are two separate stand alone documents.

#### **Site Condition Report**

A Site Condition Report describes and records the condition of the land and groundwater at a site; it enables the operator to demonstrate that they have protected land and groundwater during the lifetime of the site's permitted activities and it is in a satisfactory state when they plan to surrender the permit.

The Site Condition Report provides a point of reference at the start of operations or at the time the permit is issued so that when it time to surrender the permit, it can decide whether there has been any additional contamination of the site during the operation and ensure that the condition of the land and groundwater are in a “satisfactory state” when they apply to surrender of the permit.

Therefore a Site Condition Report has three stages; an Application Site Condition Report (Application Site Report) - issued to define a point of reference; an Operational Site Condition Report (Site Protection and Monitoring Plan) - which is used during the operational life of the plant; and a Surrender Site Condition Report (Closure Site Report) – which details the work required to surrender the EP.

#### **Site Waste Management Plan**

It is intended that the Waste Management Plan will be maintained and then utilised as the base estimate document for the actual decommissioning and demolition activities – whenever they may be.





## **Section 1 – Site Condition Report**

Covering EP Conditions: 2.16.3  
2.16.5.1  
2.16.5.5



## Site Condition Report (SCR)



Delimara Power Station  
Delimara  
Marsaxlokk  
MXK 1320  
Malta

Prepared for:  
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Prepared by:  
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Date:  
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Contract No:	UK22-20354
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Date:	August 2014

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## Contents

1	Introduction	1
1.1	Background to the Site Condition Report	1
1.2	Revisions to the Site Condition Report	1
1.3	Updates to the Environmental Permit	2
2	Location of the Installation	1
2.1	Site Operations	2
2.2	Condition of the Land at Permit Application	4
2.3	Pollution History	5
3	Conceptual Site Model	8
3.1	Environmental Receptor Summary	8
3.2	Potential Sources of Contamination	9
3.3	Initial Conceptual Site Model	11
4	Dangerous Substances Associated with Permitted Activities	13
5	Changes to the Activity	14
6	Measures Taken to Protect Land	15
7	Soil Quality Monitoring	16
7.1	Intrusive Investigation	16
7.2	Investigation and Sampling Strategy	16
7.3	Constraints on Investigations	17
7.4	Soil Investigation and Sampling Techniques and Protocols	18
7.5	Sample Locations	19
7.6	Sampling Techniques	21
7.7	Analytical Strategy	21
7.8	Findings of the Ground Investigation	26
7.9	Chemical Analyses	27
7.10	Refined Conceptual Site Model	31
8	Monitoring Programme and Decommissioning	33
8.1	Decontamination Plans	34
9	Options Appraisal	37
10	Reference Data and Remediation	38
11	Statement of Site Condition	39
Annex A: Figures and Plans		
Annex B: Records of Investigation Findings		
Annex C: Summary of Analytical Results		

Annex D: Laboratory Analytical Certificates

Annex E: ENVIRON Generic Assessment Criteria

## List of Tables

Table 2.1: Surrounding Land Uses	1
Table 2.2: Site Operations	2
Table 2.3: Plant of Delimara Power Station	2
Table 3.1: Summary of Receptors	8
Table 3.2: Potentially Polluting Materials Located Within the Installation	9
Table 3.3: Initial Source-Pathway-Receptor Risk Assessment	11
Table 4.1: Potentially Polluting Materials Located Within the Installation	13
Table 8.1: Potential Sources of Emissions and Mitigation Measures	34

# 1 Introduction

## 1.1 Background to the Site Condition Report

This document has been prepared by ENVIRON UK Limited (ENVIRON) in support of the requirements for land monitoring data and an Outline Decommissioning Plan under Regulation 7 of Industrial Emissions (Integrated Pollution Prevention and Control) Regulations (LN 10 of 2013), which transpose the EU Industrial Emissions (IPPC) Directive (2010/75/EU) into Maltese law.

An Environmental Permit (EP) is required where an operator carries out certain prescribed activities, namely installations that undertake Schedule 1 activities, a waste operation or a mobile plant (carrying out either one of the Schedule 1 activities or a waste operation). Enemalta Corporation carry out activities covered in Section 1.1 of the IPPC regulations, comprising:

- Combustion installations with a rated thermal input exceeding 50 MW

Where the main activity of the installation is as follows:

- Generation of electrical energy through the combustion of heavy fuel oil (HFO) and gasoil.

In the absence of Maltese guidance, ENVIRON was commissioned by the RVA Group to undertake the production of the SCR in accordance with the Environment Agency of England and Wales (EA) Guidance Document H5 Site Condition Reports Guidance and Templates (Version 080328). The EA regulate IPPC permitting in the United Kingdom under EU IPPC Directive (2008/1/EC). Since Version 1 of the SCR was issued, an update to the H5 Site Condition Reports Guidance and Templates has been released in April 2013 (LIT 8001 Version 3.0).

## 1.2 Revisions to the Site Condition Report

This document represents an update to Version 1 of the Site Condition Report (SCR) (reference RUK22-16873 dated August 2011) which formed part of a package that was submitted to the IPPC Committee of the Competent Authority by Enemalta Corporation ('the Operator') to satisfy the requirements of the Improvement Programme of IPPC permit number IP 0002/07/A dated March 2010, specified in Condition 1.5.1. The Programme required the submission of land monitoring data (as per Condition 2.16.1) of the permit and an Outline Decommissioning Plan (as per condition 2.16) within three and six months respectively of issue of the IPPC permit.

This document, Version 2 of the SCR has been produced in response to the proposed decommissioning / demolition of the Phase 1 Power Generating plant and equipment (only) of Delimara Power Station, and resultant change in activities, discussed further in Section 5.0 of this report. The decommissioning will be performed on the completion of the commissioning, and commencement of operations, of the proposed new Gas Plant at Delimara Power Station.

No revisions to the figures have been made since the last issue of the report reference RUK22-16873 dated August 2011.

No soil monitoring or sampling has been undertaken by ENVIRON since the Phase II Intrusive Investigation completed in July 2014.

### 1.3 Updates to the Environmental Permit

The original permit, reference IP 0002/07/A issued March 2010, has been varied on four occasions since the first version of this report was generated in August 2011. The latest permit is referenced IP 0002/07/E dated 1<sup>st</sup> April 2014; ENVIRON have not considered Versions B to D inclusive. The requirements of the Improvement Programme (Condition 1.5) of the latest IPPC permit have been extended from the original version to include the following items relating to land condition:

- Reference 12: Submission of land and groundwater monitoring proposal in conformity with Articles 16(2) and 22 of the Industrial Emissions Directive, 2010/75/EU. To be submitted by the end of January 2013.

As far as ENVIRON are aware, the proposal will be completed by the issue of this document.

The permit requirements have also been extended; Condition 2.16.3.4 states 'land monitoring shall be repeated at least every four years, and results included in the Annual Environmental Report (AER)'.

## 2 Location of the Installation

<b>Name of Installation</b>	Delimara Power Station
<b>Permit Number</b>	IP 0002/07/E
<b>Date, Reference and Version of SCR</b>	Version 02: RUK22-20354_ August 2014

Delimara Power Station (DPS) is located on the Delimara Peninsula in Marsaxlokk Bay, on the south east coast of Malta (Figure 1). The site is located at an elevation of between 1.8m and approximately 6.0m metres above local sea level (ALSL). The majority of the installation boundary comprises relatively flat topography ranging from approximately 1.85m to 3.4m ALSL, the exceptions being the bunded storage tanks and adjacent area in the south of site which are located on a manmade platform at approximately 5.6m ALSL and the residual fuel oil (RFO) tanks 1 to 3 located in the east of site which are elevated on the Peninsula at approximately 15m ALSL.

Commissioned in 1992, DPS was excavated into the cliff face to create an even platform on which to situate the facility. The most western portion of the site closest to the coast extends beyond the natural coastline and has been constructed on land reclaimed from the sea. The IPPC permitted boundary includes all the facility.

Immediately off-site to the south (external to the Permit boundary) the land is raised and forms a mound approximately 20m in height, which anecdotally comprises excess waste rock.

The site comprises operational plant in the centre and south of site, and a workshop, administration buildings and a medical centre in the north of site.

Surrounding land uses are detailed in Table 2.1.

<b>Table 2.1: Surrounding Land Uses</b>			
<b>Direction</b>	<b>Description</b>	<b>Company Name</b>	<b>Distance</b>
To the North	Agricultural land and agricultural-type properties	N/A	Immediately north
To the South	Agricultural land and agricultural-type properties	N/A	Immediately south
To the East	Agricultural land	N/A	Adjacent to site
	Residential house	N/A	40 m south east
To the West	Marsaxlokk Bay	N/A	Immediately west.

Plans showing the location of installation and the installation boundary are provided in Annex A (Ref. RUK2220354\_DPS\_02 Figure 1 Site Location and RUK2220354\_DPS\_02 Figure 2 Installation Boundary).



## 2.1 Site Operations

Permitted activities in accordance with Schedule 1 of the IPPC regulations are listed in Table 2.2 (taken from Table 1.1.1 of the IPPC permit):

<b>Table 2.2: Site Operations</b>		
<b>Activity / Associated Activity</b>	<b>Description</b>	<b>Limits of activity</b>
Combustion installations with a rated thermal input exceeding 50 MW	Generation of electrical energy through the combustion of heavy fuel oil and gas oil	From receipt of fuel to delivery of utility
Associated activity of fuel handling and storage	Handling and storage of heavy fuel oil and gas oil	From receipt of the fuel to combustion in the combustion plant
Associated activity of utilities	Sea water pre-treatment plant	From intake of sea water to delivery of utility.
Associated activity of storage, treatment and disposal / recycling of waste materials	Handling, storage, treatment and disposal / recovery of wastes from installation	From generation of waste to disposal or recycling on site or off site
Associated activity of maintenance	Maintenance carried out in any workshop in the installation	From maintenance activity to appropriate recovery / disposal of any wastes created.

Delimara Power Station was commissioned in three phases between 1992 and 1999 (Phase 1, 2a and 2b). An extension to the power station was completed in 2012 to increase the power output into the electrical network. The extension was within the original IPPC boundary. Operational plant at DPS is listed in Table 2.3 (taken from Table B1.3.1: Plant Listing of Delimara Power Station in Part B of the Supporting Document submitted in support of the IPPC permit).

<b>Table 2.3: Plant of Delimara Power Station</b>				
<b>Phase of Installation</b>	<b>Plant</b>	<b>Details</b>	<b>Fuel</b>	<b>Year Commissioned</b>
Phase 1 Power Generating plant and equipment (only)	Steam unit x 2	Each comprise a boiler, a steam turbine and a 60MW capacity generator.	HFO	1992
Phase 2a	Gas Turbine x 2	Open cycle 37.5 MW gas turbine / generator units.	Gas oil	1994

<b>Table 2.3: Plant of Delimara Power Station</b>				
<b>Phase of Installation</b>	<b>Plant</b>	<b>Details</b>	<b>Fuel</b>	<b>Year Commissioned</b>
Phase 2b	Combined cycle gas turbine x 2	Form the combined cycle gas turbine block with associated generators with a total capacity of 110 MW.	Gas oil	1999
	Heat recovery steam generators x 2 and steam turbine		Recover heat from the exhaust of the gas turbines to generate power steam to drive the steam turbine.	1999
Phase 3	<p>Diesel engines x 8, exhaust heat recovery, a steam generator, a steam turbine and necessary ancillary plant.</p> <p>Emission abatement equipment, including a Selective Catalytic Reducer and a Flue Gas Desulphurisation unit will be installed to reduce emissions of nitrogen oxide, sulphur oxides and dust.</p>	Engine and steam turbine plant with a generation capacity of 144MW.	Gas oil or HFO	2012

Phase 1 Power Generating plant and equipment is to be decommissioned on the commissioning and operation of a proposed new Gas Plant at Delimara Power Station.

Within the IPPC permitted boundary the site also comprises an administration building, mechanical workshop and medical centre in the north east of site. The operational facilities are concentrated in centre and southern portions of site.

## 2.2 Condition of the Land at Permit Application

### 2.2.1 Geology

According to the soil geology map (Geological Map of the Maltese Islands, Sheet 1 Malta, 1:25,000), the central portion of DPS orientated north to south is directly underlain by solid geology of Middle Globigerina Limestone Member, the thickness of which ranges from 15m to 38m. The description states that the limestone comprises a planktonic foraminifera-rich sequence of massive, white, soft carbonate mudstones locally passing into pale-grey marl mudstones.

The western and central portions of site located closest to the coast line, on which several of the operational plant are situated, is constructed on a man-made platform reclaimed from the sea by cut and fill activities.

The eastern portion of the site is underlain by the natural Delimara Peninsula formed from Upper Globigerina Limestone member comprising a tripartite, fine grained planktonic foraminiferal limestone sequence comprised of a lower cream coloured wakestone, central pale grey marl and an upper pale cream coloured wakestone.

### 2.2.2 Hydrogeology

According to the Malta Resources Authority (2004), the Globigerina Limestone functions as an aquifer where it is highly fractured.

The groundwater body underlying the site is classified as Malta Main Mean Sea Level Groundwater Body, sustained in the Lower Coralline limestone aquifer which is present beneath the Globigerina Limestone. The aquifer is in free contact with sea-water, and is described as 'a lens-shaped body of freshwater floating on more saline water, with a thickness of freshwater below sea level approximately thirty-six times its piezometric height above sea level'. The Malta Main Mean Sea Level Groundwater Body is classed as 'waters used for the abstraction of drinking water'.

Where the land has been reclaimed from the sea in the west of site, the groundwater is likely to exist as a sea-level aquifer.

According to MEPA's report Establishing Drinking Water Protection Areas under the Water Policy Framework Regulations 2004, the site is not located in a Groundwater Protected Zone. Groundwater Protection Zones have a radii of approximately 300m from a potable abstraction point in order to preserve the quality of the drinking water obtained from the Lower Coralline Limestone aquifer.

### 2.2.3 Hydrology

According to MEPA<sup>1</sup>, the nearest water body to Delimara Power Station is Il-Port ta' Marsaxlokk (Marsaxlokk Bay), a coastal water body located immediately off-site to the west.

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<sup>1</sup> Article 5 Summary Reports for Surface Water, Malta. Water Framework Directive CD 2000/60/EC. Prepared by Maltese Environment and Planning Authority, 2005.

MEPA have classified the water body as a Category 1 (Water bodies at risk), for which it is already relatively clear that the objectives of the WFD will be failed due to diffuse source pollution and morphological alterations.

According to Form IPPC Part B2, four waste streams are discharged to the sea at Hofra z-Zghira Bay located approximately 300m east across Delimara Peninsula via a tunnel.; cooling water, brine discharged from the seawater evaporator, surface water run-off from buildings and roads and boiler blow down.

According to the Environmental Impact Statement for the proposed Local Generating Capacity at Delimara Power Station (prepared by AIS Environmental Ltd, October 2009 reference ENV/3260/A/08 PA 03152/05) the bay of Hofra z-Zghira may also be affected by thermal effluent discharged from the extension to the power station, once complete.

#### **2.2.4 Any additional sensitive issues e.g. Protected Habitats**

All of Malta was designated as a nitrate vulnerable zone under L.N. 233 of 2004.

The land surrounding the installation to the east and south is classified as an Area of Ecological Importance; an area encompassing habitats of conservation value and its associated buffer zone(s). Areas of Ecological Importance (AEIs) are designated to regulate their conservation in accordance with Section 46 of the Development Planning Act 1992. The area has been awarded the status due to the globigerina limestone cliff formations.

Approximately 150m north of the installation boundary is a Special Area of Conservation – International Importance / Bird Sanctuary.

The site of il-Ballut ta' Marsaxlokk located approximately 750m north of DPS is classified as a Special Area of importance. The site comprises a coastal salt marsh located off Xatt is-Sajjieda, limits of Marsaxlokk. The salt marsh at Il-Ballut provides a habitat for a number of rare species.

### **2.3 Pollution History**

There is no known history of pollution at Delimara Power Station.

#### **2.3.1 Pollution Incidents at the Site**

There are no known incidents of pollution at the site.

#### **2.3.2 Historical Land Uses and Associated Contaminants**

The site history prior to Enemalta occupying the site is unknown.

#### **2.3.3 Visual or Olfactory Evidence of Existing Contamination**

A site surveillance visit was undertaken in 2011. During the visit no visual and/or olfactory evidence of significant existing contamination was identified.

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<sup>2</sup> IPPC Permit Part B (Supporting Documents) prepared by Enemalta dated January 2007

ENVIRON have not revisited the site since 2011; however were provided with a record of environmental incidents at the site as part of an Environmental Management System (EMS) maintained by DPS as a condition of the IPPC Permit. Since the Phase II intrusive investigation was completed in 2011, a number of minor leaks and spills were recorded. ENVIRON understands that these were contained and have not resulted in contamination of the land.

### **2.3.4 Evidence of Damage to Pollution Prevention Measures**

During the site surveillance in 2011 there was no generic evidence of damage to pollution prevention measures (i.e. bunds, concrete, and interceptors).

ENVIRON have not revisited the site since 2011; however were provided with the Annual Environmental Report (AER) for Delimara Power Station, dated 2011, 2012 and 2013. Weekly visual inspections of bunds, flanges, valves and overground pipes was undertaken in line with Condition 2.5.4.4 (with the exception of in 2011 when inspections were less than weekly). A number of minor faults were identified, generally surface cracks. According to the AER, all faults were rectified, or are undergoing rectification. Cleaning and inspection of the four oil interceptors present on-site is undertaken twice annually. Records of pressure testing of HFO and diesel unloading lines and the flexible fuel line for HFO dated 2013 were provided to ENVIRON. Lines tested were found to be in a satisfactory condition.

### **2.3.5 Baseline Intrusive Data**

Detailed baseline data were not submitted to the Authority in support of the IPPC permit application. The Environmental Impact Statement<sup>3</sup> for the extension to the power station (Phase III) includes the following reports relating to the assessment of ground conditions and contamination:

1. Sub-Surface Geological Investigation Report prepared by Terracore Geo Services dated November 2008;
  2. Report on the Environmental Baseline Survey for Water and Land Contamination prepared by Dr George Peplow on behalf of AIS Environmental dated 27th June 2009.
- 
1. Sub-Surface Geological Investigation Report prepared by Terracore Geo Services dated November 2008

Intrusive investigation was undertaken comprising four (4) boreholes drilled by rotary open hole and closed hole techniques to depths of between 6.0m and 23.0m below ground level (bgl). The boreholes were located in the footprint of the extension to the power station. A borehole location plan is presented in Figure 4 of Annex A. Approximately 3.0m of continuous rock core was recovered in each borehole. Strata was logged and photographed. Samples of rock core were submitted for geological testing. No laboratory testing for contamination was undertaken.

The strata recorded on geological borehole logs in two (2) of the four (4) boreholes comprised topsoil / fill (described as 'overburden') to depths ranging between 2.5m and 15.0m bgl. Underlying the

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<sup>3</sup> for the Proposed Local Generating Capacity at Delimara Power Station, prepared by AIS Environmental Ltd (Volume II, Reference ENV/3260/A/08 PA 03152/05 dated August 2009)

overburden was natural solid geology Middle Globigerina Limestone comprising grey fine bedded moderately weak marl.

In one (1) location, the overburden was logged as grey waste globigerina and brown soil to a depth of 2.9m bgl overlying Middle Globigerina Limestone. At the remaining location, the solid geology of Middle Globigerina Limestone was found directly underlying the concrete hard standing, to a maximum depth of 6.0m bgl.

All boreholes were terminated in Middle Globigerina Limestone.

2. Report on the Environmental Baseline Survey for Water and Land Contamination prepared by Dr George Peplow on behalf of AIS Environmental dated 27<sup>th</sup> June 2009.

The investigation comprised five (5) exploratory hole locations, of which three were drilled within the IPPC boundary for Delimara Power Station and the remaining two (2) were positioned off-site to the north west on the Delimara Peninsula. One (1) sample was obtained from the upper 3m of strata at each location and tested for a limited suite of metals (Cr, Ni, Pb and Va), polycyclic aromatic hydrocarbons (PAHs); BTEX compounds (benzene, toluene, ethyl benzene and xylene) and inorganic parameters (nitrates, carbonates, sulphates, hydroxides, pH and salinity).

Concentrations of BTEX compounds and PAHs did not exceed laboratory detection limits (0.1 mg/kg and 0.05 mg/kg respectively). Low concentrations of metals were detected in all five soil samples. The report considers the concentrations to be 'within the levels normally found in environmental soil samples', on Malta.

In addition to the soil samples, the following groundwater, sea water and sediment sampling was undertaken:

- Two (2) groundwater samples were collected; one from a point immediately off-site to the north, and a second off-site to the North West. No details of the methods by which the groundwater samples were collected are provided in the report.
- Four (4) sea water samples were obtained from four locations; immediately inshore to Ras il-Fniek point; at the central part of the il-Hofra z-Zghira Bay; immediately onshore to the entry gate of the power station and immediately inshore to the Kalanka l-Fonda.
- Five (5) sediment samples were obtained from the sea bed near to DPS.

The groundwater, sea water and sediment samples were analysed for the same suite of contaminants as the soil samples (metals, PAHs, BTEX and inorganic compounds). Concentrations of contaminants analysed did not exceed laboratory method detection limits, with the exception of metals, where low concentrations were detected in all five (5) sediment samples.

The report concluded:

- 'No contamination from the measured parameters was observed, and can therefore be considered to comply with local legal notices and EU Directives.'

### 3 Conceptual Site Model

The preliminary conceptual site model is a simplified representation of the environmental conditions and potential risks that exist at and in the vicinity of the site. It is based on the presentation and interpretation of information gathered during the environmental review presented in Sections 2.0 to 2.4. This allows for the identification of potential pollutant linkages and, therefore, an interpretation of the potential risk to receptors in relation to site operational activities. The principal sources of contamination, receptors and potential pollutant linkages have been assessed using a qualitative source-pathway-receptor approach in line with current guidance.

Information obtained during the environmental site investigation, described in the following sections of this report, is further used to refine and update the conceptual model. The refined conceptual site model is presented in Section 7.10.

#### 3.1 Environmental Receptor Summary

A summary of environmental receptors is presented in Table 3.1.

<b>Table 3.1: Summary of Receptors</b>	
<b>Receptor</b>	<b>Description</b>
Human health	Site workers Site visitors Construction workers Neighbours
Land	Middle / Upper Globigerina Limestone
Water	Malta Main Mean Sea Level, the Lower Coralline Limestone Aquifer across Malta is a Drinking Water Safeguard Zone. Coastal Water (Marsaxlokk Bay and Il-Hofra z-Zghira. The whole of Malta is a Nitrate Vulnerable Zone.
Nearby industry e.g. Control of Major Accident Hazards (COMAH) sites	DPS is a registered COMAH site as the quantity of gas oil exceeds the threshold for an upper tier site. The site is located in a predominantly agricultural setting with some residential properties
Sensitive land uses	The site does not lie in a habitat protected zone. The surrounding area is classified as an Area of Ecological Importance Approximately 150m north is a Special Area of Conservation – International Importance / Bird Sanctuary. Il-Ballut ta' Marsaxlokk (salt marsh) is located approximately 750m north of DPS and is classified as a Special Area of importance.
Coastal/estuarine areas	Marsaxlokk Bay.

**Table 3.1: Summary of Receptors**

Receptor	Description
Drainage systems/sewers	<p>The site discharges surface water and process water into Il-Hofra z-Zghira. Prior to discharge, water is treated or passes through a separator and/or an oil interceptor, where required.</p> <p>Foul water from personnel toilets discharges into the main municipal sewer.</p>

### 3.2 Potential Sources of Contamination

Potentially polluting materials located within the installation are presented in Table 3.2

**Table 3.2: Potentially Polluting Materials Located Within the Installation**

Process	Activity	Potential Polluting Activity	Potential Polluting Substances
Fuel System Operations	Storage and intermediate transfer via pipelines and pump bays of fuel oil and solid, liquid or sludge waste from fuel oil spillage.	Potential for leaks and spills from primary and secondary containment to occur or have occurred.	Hydrocarbon mixtures may be paraffinic, naphthenic or aromatic, potentially containing sulphur compounds and sulphides, nitrogen compounds, trace metals such as nickel, iron, vanadium, salts such as magnesium chloride or sodium chloride, may contain naphthenic acid.
	Filing of bulk process tanks.	Potential for overflow, blockages causing sumps to backup; and potential for leakage or seepage from any discontinuities to the surrounding soils and/or seawater.	Various chemicals including fuel oil additives (magnesium oxide slurry emulsifier), treatment chemicals, fuel sediments and suspended organic compounds.
	Cleaning operations.		Toxic, oxidising, corrosive, carcinogenic or ozone-depleting substances which may affect the aquatic or non-aquatic environment.
Boiler Water Preparation and Treatment	Discharge of brine and chemical treatment deposits in evaporators	Potential for release of chemicals deposits to occur or have occurred.	Water treatment chemical deposits including Tri Sodium Phosphate and Ammonia Solution.
	Liquid waste generated from make-up water demineralisation	Potential for leakage or seepage from any discontinuities to the surrounding soils and/or seawater.	Chemical Regeneration Effluent – inorganic salts, suspended solids, trace metals and oils.  May affect the aquatic or non-aquatic environment.



**Table 3.2: Potentially Polluting Materials Located Within the Installation**

Process	Activity	Potential Polluting Activity	Potential Polluting Substances
Boiler Operation and Cleaning	Dust and gaseous emissions generated from combustion of fuels for boiler /s and gas turbine plant	Potential for release of contaminant emissions and dust to occur or have occurred.	Dust and gaseous emissions generated include particulate matter (fly ash), oxides of sulphur, nitrogen, carbon, organic compounds and traces of oil.
	Fireside boiler/s maintenance and cleaning operations.	Potential for leaks and spills from primary, secondary or intermediate containment, or from pipework to occur or have occurred.	Solid, sludge and liquid wastes generated include bottom ash and boiler slag, unburnt fuel deposits. These potentially have elevated hydrocarbons, treatment chemicals, anti-scaling chemicals, acids and trace metals.
	Waterside boiler/s cleaning and blowdown		
	Fuel oil filtration		
Cooling Systems Operations	Sea water cooling systems.	Potential for leaks or spillage of chemicals.	Liquid waste or contaminants from sea water cooling include treatment chemicals (chlorine dioxide among others).
Plant Maintenance	Changeover of lubricating oils used in stationary and mobile plant	Potential for release of contaminant, from effluent discharge or emissions and dust to occur or have occurred.	Hydrocarbons, other organic compounds (PCBs) generated from renewing oils.
	Changeover of transformer / switchgear oils.		
	General plant maintenance and repair work	Potential for leaks and spills from primary, secondary or intermediate containment, or from pipework to occur or have occurred.	Other wastes generated include metals, plastics and detergents.

**Table 3.2: Potentially Polluting Materials Located Within the Installation**

Process	Activity	Potential Polluting Activity	Potential Polluting Substances
Storm Water Collection	Liquid waste from surface water runoff at oil interceptors	Potential for overflow, blockages causing sumps to backup; and potential for leakage or seepage from any discontinuities to the surrounding soils and/or seawater.	Effluent – oil, oily water containing hydrocarbons, inorganic salts, suspended solids, trace metals.
Administrative Operations	General solid waste generated from administrative work and use of electrical / non-electrical equipment	Potential for leaks and/or leaching from primary and secondary containment to occur or have occurred.	General cleaning chemicals, toner (printer inks), and electrical components.

### 3.3 Initial Conceptual Site Model

The initial conceptual site model is presented in Table 3.3.

The conceptual site model is based on the site remaining in a commercial/industrial use.

**Table 3.3: Initial Source-Pathway-Receptor Risk Assessment**

Pollutant Linkage	Description	Receptor(s)	Discussion	Pathway Status	Risk Ranking
PL1	Dermal Contact & Ingestion	Humans – Site maintenance workers	There is potential for site maintenance workers to come into contact with contaminated soils, if present (for example during excavation works). However, the use of appropriate risk assessments and control measures will mitigate the potential risks associated with short term maintenance works.	Active	Low based on mitigation measures
PL2	Inhalation – dust, particulates and asbestos fibres	Site visitors		Active	Low based on mitigation measures
PL3	Inhalation - vapours			Active	Low based on mitigation measures

**Table 3.3: Initial Source-Pathway-Receptor Risk Assessment**

Pollutant Linkage	Description	Receptor(s)	Discussion	Pathway Status	Risk Ranking
PL4	Leaching and migration of contaminants in unsaturated zone to groundwater	Controlled Waters (Malta Mean Groundwater Body, Marsaxlokk Bay and Il-Hofra z-Zghira Bay)	Potential for leaching of contaminants into the groundwater body and surface water. Infiltration is limited in areas covered by hardstanding but not in areas where hardstanding is absent. The geology beneath comprises of limestone which has a low effective porosity, groundwater flow is commonly restricted to fractures and discontinuities.	Active	Moderate
PL5	Migration of contaminated perched water off-site via the surface water drain.	Controlled Waters (Marsaxlokk Bay and Il-Hofra z-Zghira Bay)	Surface water drains are at a shallow depth, and typically are laid directly into the limestone. There is potential for any shallow contaminated to travel along conduits created during the construction of the drains. However, all surface water on-site passes through oil interceptors before discharge to the sea. These are regularly inspected and maintained by site operatives.	Active	Low
PL6	Vertical migration of groundwater to groundwater body	Controlled Waters (Malta Mean Groundwater Body)	There is potential for contaminants to migrate vertically. Foundations and footings of buildings, plant and sumps may create a vertical pathway for contaminants. Migration is limited to the horizontal bedding planes. Vertical migration is limited in the limestone to fractures and fissures.	Active	Low
PL7	Migration of land gases into buildings and structures.	Built Environment	There is a small risk from the generation of land gases and volatile gases from hydrocarbons in soil and/or groundwater. However, the majority of the hydrocarbons used on-site are heavy end and less volatile.	Active	Low

## 4 Dangerous Substances Associated with Permitted Activities

The permitted operations will encompass the use, storage, treatment and/or disposal of a wide-range of materials. The main material categories are outlined within Table 4.0.

Where a material is specifically listed under Schedule 1 Part 2 (Named Substances) of The Control of Major Accident Hazards Regulations 2003 (COMAH) (Legal Notice (L.N. 37), and amendments (L.N. 6, 2005 and L.N 4, 2014) this has been indicated within the Table 4.0. The regulations transpose into Maltese law the overarching EU Seveso II Directive enforced by the Council Directive 96/82/EC and extended by the Directive 2003/105/EC and the Seveso III Directive 2012/18/EU which is to be implemented by Member States by 1st June 2015.

The gas oil storage capacity at DPS exceeds the threshold level for an upper tier site, thus DPS is classified as a COMAH site.

<b>Table 4.1: Potentially Polluting Materials Located Within the Installation</b>		
<b>Material Type</b>	<b>Additional Information</b>	<b>COMAH Listed Substance</b>
Heavy Fuel Oil	With maximum sulphur content of 1% and low ash	No
Gas Oil	With maximum sulphur content of 0.2%	Yes
Fuel oil additives	Magnesium Oxide (MgO) slurry emulsifier	No
Sea water treatment chemicals	Chemical to generate Chlorine Dioxide in situ (Biocaf 1320)	No
Boiler water intake treatment chemical	Tri Sodium Phosphate	No
Evaporators chemical treatments	Anti-scaling chemical, sulfamic acid and corrosion inhibitor	No
Demineralisation plant regeneration chemicals	Sulphuric acid 98% and caustic soda flakes	No
Gas turbine compressor cleaning	Industrial detergent (Zok 27)	No
Acid Spills	Sodium bicarbonate (acid neutraliser)	No

## 5 Changes to the Activity

There are no known changes to the permitted activity boundary since the first IPPC permit issue in March 2010.

This document, Version 2 of the Site Condition Report has been produced in response to the proposed decommissioning / demolition of Phase 1 Power Generating plant and equipment is to be decommissioned on the commissioning and operation of a proposed new Gas Plant at Delimara Power Station, and resultant change in activities. The estimated timescale for Phase 1 generating units to be shut down is in the first quarter of 2016.

Decommissioning of Phase I will cover the following equipment only:

1. 2 in no. Waagner Biro Steam Boilers rated at 260T/H steam flow fired by Heavy Fuel Oil
2. 2 in no. BHEL Steam turbines/Generators rated at 60MW output with all auxiliary equipment found inside the Turbine hall.
3. Phase 1 chimney, (consisting of chimneys D1A and D1B 150m high with concrete wind shield).

Some associated services such as demin water, steam and air control piping and electrical cables currently situated on a pipe trestle between the Boiler and Turbine Hall are to be retained.

The decommissioning works will comprise the following activities:

- Removal and transfer as necessary of fuel stock and other materials in stores.
- Waste oil removal from oil tank farm and turbines
- Dismantling of all mechanical equipment connected with Boiler and Turbines operations of Phase 1 generating units
- Dismantling of all electrical plant and equipment associated strictly with phase 1 operations only
- Dismantling of and removal of Boiler structural steel works
- Dismantling and removal of Phase 1 chimney structure
- Dismantling and removal of Phase 1 steam turbine civil work structures.

It is understood that MEPA has agreed that the IPPC permit will not require surrender at this stage and the boundary of the permit will not change. For this reason, there is no requirement at this stage to undertake remediation of Phase I area; remediation will be undertaken for Phase I as part of the whole site when the IPPC permit is surrendered.

This report represents an update to the Conceptual Site Model (Section 7.1) and the Monitoring and Decommissioning Plan (Section 8) in response to the above activities relating to decommissioning / demolition of Phase I.

## 6 Measures Taken to Protect Land

Operational conditions are specified by the IPPC to control the release of substances to the environment. Records are to be maintained and either submitted as part of the Annual Environmental Report (AER) or held to be made available for inspection.

Annual Environmental Reports (AER) are submitted to MEPA as a requirement of Condition 4.1 of the permit. AERs from 2009 to 2013 have been provided to ENVIRON. The following parameters are monitored and recorded as part of the AER:

- Complaints concerning effects on the environment
- Plant and equipment and its maintenance
- Non-compliance with the operating procedures
- Waste management practices and control measures
- Waste oil storage including quantities, nature, manner and date of dispatch of the oil.
- Laboratory analyses of emissions to water.
- Laboratory analyses of discharges to water.
- Results of the laboratory analysis of effluent samples arising from process water and non-process water (surface drainage, fuel bunds drainage etc)
- Daily visual examination of the surface water discharge
- Inspection Reports and Certification by Approved Auditors for:
  - Testing of bunds;
  - Pipes, pumps, valves and flanges for fuel delivery from delivery ship to tank farm;
  - Other flanges, valves and over-ground pipes on site; and
  - Oil interceptors including a log of monthly monitoring and interceptor waste removal.

In addition, the IPPC permit specifies the requirements for physical pollution prevention measures including bunds and high level liquid alarms on pump sumps. In the event of accidental contamination of land or observations of surface water indicate contamination has taken place, the permit requires for the operator to notify the Authority immediately and submit and implement a decommissioning plan within one week of the event.

## 7 Soil Quality Monitoring

### 7.1 Intrusive Investigation

#### 7.1.1 Objectives

Condition 1.5.1 of the initial IPPC permit (version IP 0002/07/A dated March 2010) specifically required for the operator to submit land monitoring data to the Authority within three months of issue of the permit as part of the Improvement Programme (Condition 1.5.1) of the installation. The condition also required for an Outline Decommissioning Plan to be submitted within six months of permit issue.

The objectives of the intrusive investigation were:

- to collect sufficient data on the potentially polluting substances identified in Schedule 9 of the IPPC Permit in order to set Reference Data for the site;
- to collect data to assess the likelihood of their being significant contamination of the land on the site by any of the pollutants specified in Schedule 9 of the permit and thus reduce the uncertainties in the conceptual model presented as Section 4 of this report;

The investigation was undertaken in accordance with conditions 2.16.3 (covered in Section 7.0-7.10), 2.16.5.1 (covered in Section 8.0), 2.16.5.4 (not covered in this report) and 2.16.5.5 (covered in Section 8.1) of the IPPC permit.

Independent to the soil monitoring investigation for the IPPC permit, MEPA requested that the mound ('landfill') outside (and to the south) of the IPPC permit is investigated to characterise ground conditions and take samples for analysis of contamination.

### 7.2 Investigation and Sampling Strategy

#### 7.2.1 General

ENVIRON UK Limited undertook and managed an intrusive site investigation on behalf of Enemalta Corporation in order to collect the site reference data. This involved the use of suitable third parties (i.e. drilling contractors etc.). All contractors used are vetted and approved and agree to ENVIRON's site protocols and health and safety (H&S) requirements.

The main site investigation was undertaken between the 2<sup>nd</sup> June and the 28<sup>th</sup> June 2011. All subcontractors were employed under contract and supervision of ENVIRON. All soil sampling was undertaken directly by ENVIRON.

Sample locations were positioned to provide general coverage across the site and to target known current potential sources of contamination. Potential sampling locations were restricted to some degree by the location of current buildings and infrastructure (including foul/surface water drains, cables and cable ducts, and pipelines, as well as access for equipment and plant).

The scope of works comprised the following:

- Service clearance undertaken on 2nd June 2011 by qualified utility surveyors to ensure the drilling locations were clear of services prior to drilling.

- Drilling of twenty (20) boreholes within the IPPC permit boundary to depths of 5m to 10m using solid stem auger rotary drilling techniques to allow the sampling of the soil. The drilling works were undertaken between 4th and 28th June 2011.
- Drilling of three (3) boreholes on an area of 'landfill' outside (and south of) the IPPC permit boundary to prove the base of the 'landfill'. The boreholes were drilled to depths of between 19.0m bgl and 42.0m bgl using solid stem auger to 6.0m bgl, continued to depth using rotary open hole drilling. One (1) metre of rock core sample was taken at one (1) location (LF02) for identification and sampling of the geology. The drilling was undertaken between 9th and 11th June 2011.
- On site screening for hydrocarbon vapours using a portable handheld photo ionization detector (PID) to assist the selection for laboratory analysis by experienced ENVIRON field personnel.
- Analysis of up to thirty two (32) soil samples for a range of determinands specified in Schedule 9 of the IPPC permit, including a suite of metals, total petroleum hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAHs), volatile and semi-volatile organic compounds, polychlorinated biphenyls (PCBs) and asbestos. The analytical suite is presented in Table 7.7. Analysis of samples in accordance with the relevant British Standards.

## **7.3 Constraints on Investigations**

### **7.3.1 Health and Safety**

All work was undertaken in accordance with ENVIRON Safe Working Procedure #2, Underground/Overhead Services, which controls risk through a safe system of work by using service location plans for the site, where available, contracted utility surveyors and trained site investigation staff that are competent using cable avoidance tools (CAT & GENNY).

Prior to commencing the intrusive works, each of the boring locations were agreed between ENVIRON and Enemalta. Enemalta undertook an initial utility screening check, and subsequently some of the locations were moved nearby to avoid underground services. As part of ENVIRON's H&S procedures a specialist utility clearance team (an approved ENVIRON contractor) undertook a utility survey of each location. As a final check each location was scanned by ENVIRON personnel using a Cable Avoidance Tool (CAT) immediately prior to the excavation. Due to the presence of underground services in a number of proposed borehole locations, boreholes were relocated to a 'safe' location free of services, ensuring that the borehole location rationale provided in Table 7.5 was still applicable.

### **7.3.2 Drilling Techniques**

The justification for the drilling technique selected for the investigation, rotary solid stem auger, is presented in Section 7.4.2. The constraints of using this technique were:

- Arising's returned from the auger were effectively 'disturbed'; caused when the soil removed from the base of the borehole travels up the flights and emerges at the ground surface. As such, the quality of the sample taken is reduced. The disturbance may result in some loss of volatile contaminants. However, for the purposes of the investigation the benefits of the technique were considered to outweigh the detriment of a 'disturbed sample'.



- The use of one set of drilling equipment (primarily rods) at each location provided the potential for cross contamination. As such, a 'wash down' area was established and drilling rods were thoroughly washed with a jet spray after use at each location. Waste water drained into the surface drainage system which was served by an oil / water interceptor. In the eventuality of contamination being identified in boreholes, the equipment would be rinsed with a decontamination solution (Decon 90) prior to jet spraying.
- The auger is unable to penetrate reinforced concrete at depth, which resulted in one boring location being abandoned.

### **7.3.3 Minimisation of Disruption to Site**

Borehole locations were positioned to minimize disruption to the site. Areas of soft landscaping or soft rock were selected over areas of concrete or gravel hard standing, where it was possible to do so without compromising the quality of the sampling rationale in Table 7.5. Additionally, locations were positioned to minimize disruption to site traffic.

## **7.4 Soil Investigation and Sampling Techniques and Protocols**

### **7.4.1 Concrete Coring**

Prior to soil sampling, drilling locations positioned on concrete were 'cored'; the concrete corer unit allowed samples of surface concrete 150mm in diameter and up to 300mm thick to be recovered.

This method also allows the surface to be successfully reinstated on completion of the sampling.

### **7.4.2 Rotary Techniques**

#### *Solid Stem Auger*

Solid stem continuous flight auger is a fast method of drilling to the depths required in this investigation. As the auger is rotated and pushed downwards the soil removed from the base of the borehole travels up the flights and emerges at the ground surface. The boreholes drilled using this method are circa 150mm to 200mm in diameter, depending on the size of rods used to drill the hole.

The drilling rig used was a Beretta T44; a tracked drilling rig with reducible tracks enabling it to move over soft ground and width restricted areas with minimal damage.

Solid stem augers have the ability to drill into soft rock, which makes it suitable for this investigation given the geology of Middle Globigerina Limestone. The soil and rock recovered allows for a detailed inspection and logging of the ground conditions encountered and the recovery of disturbed soil samples. As such it is an appropriate and widely used method for investigating shallow soils.

#### *Open Hole & Continuous Rock Coring*

Due to the elevation of locations on the landfill, the boreholes need to be drilled to >15m bgl which is not possible using the solid stem continuous flight augers. The most appropriate technique was to use open hole rotary drilling.

Open hole drilling involves the rotation of a drill-pipe and bit to cut the rock. A water flush is pumped down the drill-pipe to flush out the debris. The technique allows rapid progression through solid rock, however there is no sample recovery. In order to take a sample from the upper strata and from the strata from the lower strata (approximately level with base of underground station), continuous rock coring was undertaken. This involves using rotary flush to penetrate the rock with a hollow tube; the

tube is drilled to a known depth then withdrawn. A continuous rock core can then be logged and sampled. This technique is much slower than open hole drilling but allows for detailed logging of the rock and sample collection.

The drilling rig used was a Beretta T44; a tracked drilling rig with reducible tracks enabling it to move over soft ground and width restricted areas with minimal damage.

## 7.5 Sample Locations

Sample locations were positioned to provide general coverage across the site and to target potential sources of contamination. Sampling locations were restricted due to location of current buildings and underground services (including foul/surface water drains, oil/water interceptors, gas, electric and water mains etc.). Sample locations for the site are shown on Figure 4 of Annex A.

Samples are referenced using the following classification system:

Investigation Method + Unique ID
<i>i.e.</i> BH1 (Borehole One) or WS1 (Window Sample One)

Sample locations were approved in principal by MEPA prior to undertaking the investigation. MEPA also confirmed that the sample locations could be relocated on site, to avoid underground services etc., providing the justification in Table 7.5 was applicable.

The sample location rationale for Delimara Power Station is shown in Table 7.5. The proposed sample locations are presented in Figure 3 Annex A and the actual sample locations as drilled are presented in Figure 4 Annex A. The reference to Phase 1, Phase 2A and Phase 2B are the stages of development when the power station was constructed.

Table 7.5: Delimara Sampling Rationale				
Proposed Location ID	Location ID	Location		Rationale for Sample Location
B	BH01	-	Temporary storage compound	General site coverage (reclaimed land)
C	BH02	Phase 2A	West of Open Cycle Gas Turbines (OCGT)	OCGT and general site coverage (reclaimed land)
R	BH03	Phase 1	South entrance to CCGT	CCGT general site coverage (reclaimed land)
K	BH04	Phase 1	West of pump house	Pump house
J	BH05	Phase 1	Adjacent to pump house, fuel oil interceptor pit and pipelines.	Oil pit and pipelines
L	BH06	Phase 1	Outside bund wall of RFO tanks, at a level approximately 10m lower.	Integrity of RFO bund

Table 7.5: Delimara Sampling Rationale				
Proposed Location ID	Location ID	Location		Rationale for Sample Location
A	BH07	-	Entrance of waste storage compound	Waste storage compound and general site coverage (reclaimed land)
N	BH08	Phase 1	Adjacent to Boiler No2	Boiler Power Plant and general site coverage (natural land)
D	SB01	Phase 1	Adjacent to oily water pipe	Drainage system, and down hydraulic gradient of turbine house.
T	SB02	-	Adjacent to extra high voltage building	Extra high voltage building and general site coverage (reclaimed land)
Q	SB03	Phase 2B	Adjacent to fuel tanks	Fuel tanks
M	SB04	Phase 2B	Adjacent to Chimney D5A	Combine Cycle Gas Turbine (CCGT)
S	SB05	-	Adjacent to temporary contractors storage yard for Phase 3 construction	Storage yard and general site coverage (reclaimed land)
I	SB06 /SB06A	Phase 2B	Adjacent to interceptor	Oil interceptor
O	SB07	Phase 2B	Adjacent to Chimney D4B	CCGT
E	SB08	Phase 2B	Adjacent to cooling water intake	Cooling water intake
P	SB09	Phase 1	Adjacent to Chimney D1	Main chimney stack, location of temporary drum storage and general site coverage (natural land)
H	SB10	Phase 2A	Bulk diesel tank / pipelines	Integrity of bulk diesel tank bund and pipelines
G	SB11	Phase 2A	Bulk diesel tank	Integrity of bulk diesel tank bund
F	SB12	Phase 2B	Bulk diesel tank	Integrity of bulk diesel tank bund

All borehole locations except SB03 (Q) were positioned within 3m of the proposed location. Due to the presence of a high voltage power cable, SB03 was relocated approximately 5m east. The proposed sample location plan is presented in Figure 3 of Annex A. The actual sample location plan is presented in Figure 4 of Annex A

The three (3) boreholes on the 'raised land' outside of the IPPC permit boundary were positioned to provide a general assessment of the tipped materials.

## 7.6 Sampling Techniques

Soil samples were obtained from the boreholes by ENVIRON personnel at regular intervals. The soil samples were placed in containers appropriate to the type of analysis to be undertaken. The samples were stored in cool boxes and/or a refrigerator to maintain an appropriate temperature prior to being couriered to the local DHL depot and air freighted to an approved laboratory in the UK.

## 7.7 Analytical Strategy

Conditions 2.16.3 and 2.16.5.1.1 of the IPPC permit requires monitoring of the substances specified in Schedule 9 of the permit. The analytical strategy was devised in accordance with Schedule 9 and presented in Table 7.7.

Table 7.7: Analytical Strategy				
Analytical Suite	Determinand			Qty
Metals	Arsenic	Mercury	Vanadium	31
	Cadmium	Nickel	Cobalt	
	Chromium	Tin	Thallium	
	Copper	Antimony	Manganese	
	Lead	Selenium	Zinc	
Inorganic compounds	pH	Sulphate	Sulphide	31
Polycyclic Aromatic Hydrocarbon (PAHs) (US EPA Priority 16 Speciated)	Naphthalene	Fluoranthene	Benzo(a)pyrene	31
	Acenaphthylene	Pyrene	Indeno(123cd)pyrene	
	Acenaphthene	Benz(a)anthracene	Dibenzo(ah)anthracen	
	Fluorene	Chrysene	Benzo(ghi)perylene	
	Phenanthrene	Benzo(b)fluoranthene	PAH 16 Total	
	Anthracene	Benzo(k)fluoranthene		
BTEX Compounds (analysed as Volatile Organic Compounds (VOCs))	Benzene	Ethyl Benzene	m/p-xylene	10
	Toluene	o-xylene		
Total Petroleum Hydrocarbons/mineral	EPH >C8-C10	EPH >C20-C30	EPH >C8-C40	31
	EPH >C10-C20	EPH >C30-C40		
Polychlorinated biphenyls (PCBs)	PCB 28	PCB 118	PCB 153	9
	PCB 52	PCB 138	PCB 180	
	PCB 101			
Alkyl benzenes (Volatile organic compounds (VOCs) and tentatively identified VOCs)	Dichlorodifluoromethane	Benzene	1,1,2,2-Tetrachloroethane	10
	Methyl Tertiary Butyl	Trichloroethene	Bromobenzene	
	Chloromethane	1,2-Dichloropropane	1,2,3-Trichloropropane	
	Vinyl Chloride	Dibromomethane	Propylbenzene	
	Bromomethane	Bromodichloromethane	2-Chlorotoluene	
	Chloroethane	cis-1-3-Dichloropropene	1,3,5-Trimethylbenzene	
	Trichlorofluoromethane	Toluene	4-Chlorotoluene	

Table 7.7: Analytical Strategy				
Analytical Suite	Determinand			Qty
	Chloroethane	trans-1-3-Dichloropropene	tert-Butylbenzene	
	Trichlorofluoromethane	1,1,2-Trichloroethane	1,2,4-Trimethylbenzene	
	1,1-Dichloroethene	Tetrachloroethene	sec-Butylbenzene	
	Dichloromethane	1,3-Dichloropropane	4-Isopropyltoluene	
	trans-1-2-Dichloroethene	Dibromochloromethane	1,3-Dichlorobenzene	
	1,1-Dichloroethane	1,2-Dibromoethane	1,4-Dichlorobenzene	
	cis-1-2-Dichloroethene	Chlorobenzene	n-Butylbenzene	
	2,2-Dichloropropane	1,1,1,2-Tetrachloroethane	1,2-Dichlorobenzene	
	Bromochloromethane	Ethylbenzene	1,2-Dibromo-3-chloropropane #	
	Chloroform	p/m-Xylene	1,2,4-Trichlorobenzene	
	1,1,1-Trichloroethane	o-Xylene	Hexachlorobutadiene	
	1,1-Dichloropropene	Styrene	Naphthalene	
	Carbon tetrachloride	Bromoform	1,2,3-Trichlorobenzene	
	1,2-Dichloroethane	Isopropylbenzene		
Cycloalkanes Semi-volatile Organic Compounds (SVOC) and Tentatively Identified Compounds (SVOC TICs).	2-Chlorophenol	Dimethyl phthalate	Hexachlorocyclopentadiene	10
	2-Methylphenol	1,2-Dichlorobenzene	Hexachloroethane	
	2-Nitrophenol	1,2,4-Trichlorobenzene	Isophorone	
	2,4-Dichlorophenol	1,3-Dichlorobenzene	N-nitrosodi-n-propylamine	
	2,4-Dimethylphenol	1,4-Dichlorobenzene	Nitrobenzene	
	2,4,5-Trichlorophenol	2-Nitroaniline	Benzenesulfonamide, N-ethyl-2-methyl-	
	2,4,6-Trichlorophenol	2,4-Dinitrotoluene	Benzenesulfonamide, N-ethyl-4-methyl-	
	4-Chloro-3-methylphenol	2,6-Dinitrotoluene	Cyclic octatomic sulfur	
	4-Methylphenol	3-Nitroaniline	Dodecane, 2,6,11-trimethyl-	

Table 7.7: Analytical Strategy				
Analytical Suite	Determinand			Qty
	4-Nitrophenol	4-Bromophenylphenylether	Eicosane	
	Pentachlorophenol	4-Chloroaniline	Heneicosane	
	Phenol	4-Chlorophenylphenylether	Heptadecane	
	2-Chloronaphthalene	4-Nitroaniline	Hexadecane	
	2-Methylnaphthalene	Azobenzene	Hexadecane, 2,6,10,14-tetramethyl-	
	Bis(2-ethylhexyl) phthalate	Bis(2-chloroethoxy)methane	Methoxyacetic acid, 4-tetradecyl ester	
	Butylbenzyl phthalate	Bis(2-chloroethyl)ether	Nonadecane	
	Di-n-butyl phthalate	Carbazole	Octadecane	
	Di-n-Octyl phthalate	Dibenzofuran	Pentadecane	
	Diethyl phthalate	Hexachlorobenzene	Phenol, 2,4-bis(1,1-dimethylethyl)-	
		Hexachlorobutadiene	9-Octadecenamide, (Z)-	
Asbestos Screen	N/A			10

One sample from the upper 5.0m of strata was taken from each of the three (3) boreholes drilled into the mound outside of the IPPC permit. Each sample was tested for metals, polycyclic aromatic hydrocarbons (PAHs), EPH and inorganics as per the specification in Table 7.7.

### 7.7.1 Justification of Analytical Suites

Where specific compounds were not specified in Schedule 9 of the permit, justification for the testing criteria selected is as follows:

- Cycloalkanes – there is no specification for any individual compounds in this group. ENVIRON recommends that analysis be undertaken for semi-volatile organic compounds (SVOCs) to cover this group of compounds.
- Alkyl-benzenes – whilst the common alkyl benzene are listed (methyl benzene – toluene, ethyl benzene, xylene), there is no specification for which others are required in the analysis. ENVIRON therefore recommend that analysis be undertaken for volatile organic compounds (VOCs) to cover this group of compounds.
- Straight chain alkane C10-C70 – whilst heavy fuel oil used on site can contain hydrocarbons up to C70, analysis is only common for C10 to C40 carbon banding groups, and this would address the key hydrocarbons used on the facility. Analysis has also been requested for 'mineral oil' which is essentially duplicating this analysis.

### 7.7.2 Justification of Analytical Field Techniques and Detection Limits

No field testing of samples occurred beyond the screening of soil gas headspace using a Photo-ionisation Detector (PID).

Substances have been analysed in soil phase only.

### 7.7.3 Laboratory Accreditation / Quality Assurance and Quality Control

Conditions 2.16.3.2 and 2.16.3.3 of the IPPC permit require for samples to be analysed to the relevant EN or EN ISO standards or equivalent, and for samples to be tested by a lab accredited by the National Accreditation Body (NAB-Malta or equivalent) or at least EN ISO 17025:2005 / Cor 1:2006.

Analytical testing was contracted to Jones Environmental Laboratory (Jones); an ENVIRON approved ISO 17025 and MCERTS accredited laboratory, working to a recognised international standard and a Quality Management System (QMS). ISO/IEC 17025 specifies the general requirements for the competence to carry out tests and/or calibrations, including sampling. It covers testing and calibration performed using standard methods, non-standard methods and laboratory-developed methods. MCERTS is the Monitoring Certification Scheme established by the UK Environment Agency to deliver high quality environmental measurements. It provides for product certification of instruments, competency certification of personnel and the accreditation of laboratories based on international standards. MCERTS requires laboratories to first be accredited to the current version of the European and international standard ISO/IEC 17025. MCERTS requires a more stringent level of control for laboratory practices. In the UK the Environment Agency will only accept analytical data from laboratories who are accredited under the MCERTS Chemical Testing of Soil scheme.

ISO/IEC 17025 requires laboratories to validate non-standard methods, laboratory-designed/developed methods, standard methods used outside their intended scope and amplifications and modifications of standard methods, to confirm the methods are fit for the intended use. All but one of the below methods are accredited to ISO/IEC 17025 as a minimum, the SVOC method is included in the laboratories ongoing validation plan, but is based on USEPA 8270.

The analytical testing method, accreditation and limits of detection are presented in Table 7.7.3.

Table 7.7.3 Analytical Methods and Accreditations						
Test Method	Code	SOILS	Sampling Method	ISO 17025	MCERTS	MDL
005S	EPH	Total EPH (C8-40) by GC-FID (calibrated against diesel and lube oil )	Determination of Extractable Petroleum Hydrocarbons by GC-FID. Following extraction of as-received sample with hexane/acetone. Extraction using end/end, orbital shaker or soxhlet. Calibrated against diesel and lube oil.	Y	Y	30mg/kg
004S	PAH 16/17	Total PAH 16 by GC-MS	Determination of Polynuclear Aromatic Hydrocarbons by GC-MS. End/end extraction using DCM on as received sample. In house method modified USEPA 8270.	Y	Y	0.02-0.07mg/kg
015S	VOC	VOC target list (inc BTEX/MTBE) by GC-MS	VOC target list by Headspace GC-MS - modified USEPA 8260	Y	N	2-27/100ug/kg
016S	SVOC	SVOC target list including PAHs, phenol and chlorinated phenols by GC-MS	SVOC target list by GC-MS - modified USEPA 8270 on as received sample extracted with DCM or hexane acetone	N	N	10/100ug/kg
086S	PCB 7	PCB 7 congeners	7 congeners (101,118,138,153,180,28,52) by GC-ECD - modified USEPA 8250/625	Y	N	5ug/kg (per cong)
030S	Short CLEA metals	Short CLEA metals (excluding WSB, Cr III, Cr VI): As(0.5), Ba(10), Be(0.5), Cd(0.1), Cr(0.5), Cu(1), Hg(0.1), Ni(0.7), Pb(5), Se(1), V(1), Zn(5)	ICP-OES	Y	Y	Various (mg/kg)
074S	WSB	Water Soluble Boron	ICP-OES	Y	Y	1mg/kg



## 7.8 Findings of the Ground Investigation

### 7.8.1 General Observations

The majority of the site surface comprises concrete hard standing, of thickness varying from approximately 100mm to 400mm. The concrete was reinforced with metal bars at SB07. In roads the surface generally comprised tarmac, thickness varying between 150mm and 200mm. In peripheral areas and surrounding the tanks in the east of site the surface was found to be 'soft rock' of reworked globigerina limestone.

At SB08 adjacent to the cooling water intake, the presence of a reinforced concrete slab at 2.5m bgl resulted in the borehole being terminated. The 'spare' location that had been cleared for services by ENVIRON's subcontracted utility surveyor was subsequently drilled and a concrete slab was encountered at the same depth. As such a borehole was not progressed adjacent to the cooling water intake.

### 7.8.2 Geology

Made ground was encountered immediately beneath the surface at ten (10) of the twenty (20) locations drilled. Made ground generally comprised gravelly sand / sandy gravel with secondary constituents of clay, ground limestone and silt. The made ground was encountered to a depths of between 0.3m bgl (SB07 and BH07) and 1.25m bgl (SB06a/b).

At the remaining ten (10) locations, the geology beneath the surface comprised reworked mudstone with frequent to occasional gravel of tarmac and concrete at some locations, and frequent to occasional fragments of plaster, metal strips (c. 5cm in length) and plastic. Fibrous plant remains (sea grass) were encountered at BH03, BH04, and BH05 from a minimum depth of 3.75m bgl to a maximum depth of 6.0m bgl (the termination depth). Reworked material was proven to a maximum depth of 8.0m bgl in SB10, SB11 and SB12. Reworked material was encountered in the western and central portions of the site adjacent to the coast line and is likely to represent the man-made platform reclaimed from the sea.

Of the nineteen (19) boreholes successfully progressed to depth, thirteen (13) of these were terminated in reworked natural material between 3.0m bgl and 12.0m bgl.

Natural geology was encountered in five (5) boreholes and comprised green-brown grey mudstone, recovered as clay and gravel. Mudstone was encountered at depths of between 0.5m and 1.2m bgl and proven to a maximum depth of 6.5m bgl in SB04. One (1) borehole (BH06) was progressed to from 6.0m bgl to 12.0m bgl using rotary open hole techniques. The arising's were not returned to the surface, but based on the drilling progress it is likely that the geology was mudstone.

Boreholes in which natural material was encountered (SB03, SB04, SB07, BH06 and BH08) were located in the east of site, adjacent to the cliffs and are likely to represent the natural platform cut into the Delimara Peninsula on which DPS is situated. Made ground was encountered in one borehole in this area (SB09). Given the location of this borehole, it was anticipated that natural material would be identified, however the borehole was terminated at 6.0m bgl in made ground and no natural material was encountered. Bedrock encountered is consistent with the geological description for the site of Middle Globigerina Limestone.

'Soft rock' comprising mudstone and limestone, was recorded in the three (3) samples drilled into the 'mound' outside of the IPPC permit boundary to depths of between 15.3m to 23m bgl. Small pieces of electrical components, wires, casing was encountered up to 6.0m bgl in LF03. Drilling progress indicated that the rock comprised gravel, cobbles and boulders. At depths of between 15.3m and 23m the rock became generally 'hard' which possibly indicated boulders of limestone, with a smaller proportion of mudstone. In borehole LF02 a core was taken from 25.4m bgl to 26.4 m bgl. The core comprised sub-rounded gravel of cream limestone and grey mudstone. LF02 was continued to 42m bgl; marine deposits comprising fine gravel and shell debris were encountered at 33m bgl, indicating the natural sea bed.

### 7.8.3 Hydrology

Groundwater was encountered in ten (10) of the twenty (20) borehole locations between depths of 1.8m and 3.42m bgl (0.056m and -0.116m ALSL respectively), all of which were located in the man-made platform in the centre and west of site. The strata were found to be 'damp' but not wet in a further five (5) boreholes in the west of site. Groundwater was not encountered in the five (5) of the six (6) boreholes located in the eastern portion of site, where natural mudstone (and made ground in SB09) was encountered. In one of the boreholes (BH08), groundwater was encountered at 2.2m bgl in the natural mudstone. This is not consistent with the hydrology of nearby boreholes, and may indicate a local seepage, for example from the nearby sump.

Groundwater was encountered in one (1) of the three (3) boreholes on the 'landfill' at a depth of 19.7m bgl.

### 7.8.4 Evidence of Contamination

No visual or olfactory evidence of hydrocarbon contamination was identified in the soil during the investigation. Concentrations of volatile organic compounds detected using the photo ionization detector (PID) were very low and did not exceed 10ppm by volume. The maximum concentration was 2.7ppm, identified in SB08 (1.8m to 2.0m). The PID readings do not indicate the presence of volatile hydrocarbon contamination. PID readings are presented on the exploratory borehole logs in Annex B1.

## 7.9 Chemical Analyses

### 7.9.1 Criteria for Assessment

In the absence of current Maltese guidance, the UK risk-based approach to contaminated land has been adopted. In accordance with UK statutory guidance and based on the principles of risk assessment, ENVIRON has derived generic criteria (ENVIRON Generic Assessment Criteria – ENVIRON GAC) for the assessment of soil. The assessment of chemical data from an intrusive investigation is undertaken in a tiered approach, and the first stage is a Generic Quantitative Risk Assessment (GQRA). The ENVIRON GACs are considered to be threshold based screening concentrations, at which a significant risk is not considered to be present to the relevant receptors.

The ENVIRON GACs for soil assessment are based on the generic scenarios outlined in the Contaminated Land Exposure Assessment (CLEA) methodology and guidance documents, and include inhalation, ingestion, dermal contact of soil and dust as pathways for commercial and residential scenarios; as well as ingestion of vegetables for residential with gardens scenario. A commercial / industrial scenario has been selected for comparison as it is most applicable for the continued use of the Delimara Power Station site. These have been calculated by use of two

proprietary risk assessment models (CLEA Version 1.06 and the ASTM RBCA4 Tool Kit Version 2.5 for Chemical Releases) which have been amended, where necessary, to reflect the current UK approach to human health risk assessment as set out in the Contaminated Land Report (CLR) 11 and the CLEA guidance documents (incorporating Science Reports SC050021/SR2, SR3 and SR4 published in January 2009). The physiochemical data has been taken from or derived using the methodology detailed in SR7 (November 2008), where feasible. The toxicology data has been taken from the current published EA toxicology documents.

## 7.9.2 Results of Intrusive Investigation

Results of the soil laboratory analyses are summarised in Annex C and the full analytical results are presented in the original laboratory reports in Annex D. The key analytical findings from the investigation within the IPPC permit boundary are summarized as follows:

### Metals:

- Concentrations of arsenic, barium, cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel, tin, vanadium and zinc exceeded laboratory method detection limits in all of the thirty one (31) samples analysed.
- Concentrations of antimony, beryllium and thallium did not exceed laboratory method detection limits in any of the samples analysed.
- Where concentrations were detected, they were found to be low. The maximum concentration identified was 95 mg/kg of manganese detected in SB05 (2.5 – 3.0m bgl).
- The concentrations of metals in all soil samples did not exceed the respective ENVIRON guideline limits (GAC's) for industrial/commercial land use.

### Inorganics:

- pH ranged from 7.82 in SB01 (2.5 – 3.0) to 11.15 in SB12 (0.8 – 1.0).
- Sulphide ranged from below laboratory method detection limits to a maximum of 1.7 mg/kg in SB03 (0.5 – 1.0)
- Total sulphate ranged from 915 mg/kg in BH07 (0 – 0.5m) to 5213 mg/kg in BH03 (0 – 0.5m).
- Asbestos fibres were not detected in any of the ten (10) samples analysed.

### Polycyclic Aromatic Hydrocarbons (PAHs)

- Concentrations of PAHs were detected above method detection limits in four (4) of the thirty one (31) samples analysed. All four samples were taken from the made ground / reworked natural material. In two (2) of the four samples (BH07 0.0 – 0.5m bgl and SB06 0.0 – 0.5m bgl), concentrations of phenanthrene, fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(a)pyrene, indeno (1,2,3)pyrene, dibenzo(a,h) anthracene and benzo(g,h,i)perylene exceeded method detection limits. The maximum concentration was

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<sup>4</sup> American Society for Testing and Materials Risk Based Corrective Action Model.

0.11mg/kg of benzo(g,h,i)perylene and indeno(1,2,3-cd)pyrene detected in BH07 (0.0-0.5m bgl).

- In two samples (BH04 3.0 – 3.5m bgl and BH05 0.0 – 0.5m bgl), only chrysene was found to exceed detection limits at a maximum concentration of 0.04mg/kg in BH04 (3.0 – 3.5m bgl).
- In the four samples where individual PAHs were detected above method detection limits, concentrations of total PAHs were detected in two of the samples (BH07 0.0 – 0.5m bgl and SB06 0.0 – 0.5m bgl). The maximum concentration was 0.9mg/kg detected in BH07 (0.0 – 0.5m bgl).
- Concentrations of individual and total PAHs did not exceed ENVIRON's generic assessment criteria.

#### Total Petroleum Hydrocarbons (TPHs)

- Thirty one (31) samples were tested for extractable petroleum hydrocarbons (EPH) with aliphatic and aromatic banding. Concentrations of EPH were detected above laboratory method detection limits in eight (8) samples (BH01 0.5m, BH02 0.5m, BH04 0.0 - 0.5m, BH08 1.8 – 2.0m, BH08 2.8 – 3.0m, SB01 0.0 - 0.5m, SB04 0.5 – 1.0m, SB11 0.3 – 0.5m), all except BH08 are located in the man-made platform in the west of site. BH08 is located on the natural Delimara Platform in the east of site. All samples with the exception of the two samples taken from BH08 comprise made ground. The maximum concentration of total EPH detected was 739mg/kg at BH08 1.8m – 2.0m bgl which does not exceed the ENVIRON GAC of 5,000mg/kg for total TPH.
- The samples at depths of 1.8m – 2.0m and 2.8m – 3.0m in BH08 both comprised natural mudstone according to the geological borehole logs. EPH were identified in the bands C10-C20 and C20-C30 in both samples. The maximum concentrations were 408 mg/kg for C10-C20 and 331 mg/kg for C20-C30, both in the sample taken from 1.8m – 2.0m. No ENVIRON GACs are available for the hydrocarbon bands. The total EPH did not exceed the ENVIRON GAC in either sample.
- Of the extractable petroleum hydrocarbon bands detected, concentrations were in the ranges EPH>C20-C30 and EPH>C30-C40 for BH01, BH02, BH04, SB01 and SB11. Petroleum hydrocarbons were detected in the ranges EPH>C10-C20 and EPH C20-C30 for BH08, SB01 and SB04.
- The greatest concentration of EPH banding was 549 mg/kg of EPH>C30-40 detected in SB01.
- No GACs are available for hydrocarbon banding. All concentrations of total EPH did not exceed the ENVIRON's GAC of 5,000 mg/kg.

#### Volatile Organic Compounds

- Concentrations of Volatile Organic Compounds (VOCs) were less than detection limits in seven (7) of the ten (10) samples analysed. In the remaining three samples (SB03 0.5 – 1.0m, SB05 0.5 – 1.0m and SB09 0.3 – 0.5m) only ethylbenzene was found to exceed

detection limits, at a maximum concentration of 0.018mg/kg detected in SB03, which does not exceed the ENVIRON GAC.

#### Semi-Volatile Organic Compounds

- Of the ten (10) samples analysed for semi-volatile organic compounds, concentrations were detected above detection limits in three (3) of the samples. In BH08 (1.8 – 2.0m), 2-methylnaphthalene was detected at 0.057mg/kg. In SB04 (0.5 – 1.0m) and SB05 (0.5 – 1.0m) diethyl phthalate was found at 0.092mg/kg and 0.061mg/kg respectively. The concentrations identified did not exceed the ENVIRON GACs.
- Of the ten (10) samples analysed for tentatively identified compounds (TICs), SVOCs were detected in three (3) of the samples. In SB03 (0.5 – 1.0m), two TICs were identified, the maximum concentration was 0.209mg/kg of cyclic octaatomic sulphur. Eleven TICs were detected in SB04 (0.5 – 1.0m), the maximum concentration being N-ethyl-2-methyl-Benzenesulfonamide, detected at a concentration of 0.490mg/kg. Four (4) TICs were identified in SB05 (0.5 – 1.0m), the greatest being (Z)- 9-Octadecenamide at a concentration of 1.308 mg/kg. No ENVIRON GACs are available for TICs.

#### Polychlorinated Biphenyls (PCBs)

- Concentrations of polychlorinated biphenyls (PCBs) were below laboratory detection limits in all nine (9) samples analysed.

#### 'Landfilled mound'

Of the three (3) samples taken from the mound to the south of the permit boundary, the following was identified:

- Low concentrations of metals were identified in all samples. Concentrations did not exceed relevant ENVIRON GACs.
- PAHs were not identified above laboratory method detection limits.
- Low concentrations of EPH in the bands C10-C20, C20-C30 and C30-C40 were identified in one (1) sample taken from LF01 (0.0m – 0.5m). The maximum concentration of banded hydrocarbons was in the band C20-C30 at 90mg/kg. The concentration of total EPH was 198 mg/kg which is less than the ENVIRON GAC. EPH were not identified above detection limits in the remaining two (2) samples.
- An asbestos screen was undertaken on all samples. Asbestos fibres were not detected.
- pH ranged from 7.87 to 8.69.
- Total sulphate ranged from 1169 mg/kg in LF02 to 7110 mg/kg in LF03.
- Suphide ranged from less than detection limits to 0.8 mg/kg in LF03.

### 7.9.3 Summary of Results

Low concentrations of metals were identified site wide. Low concentrations of PAHs, VOCs, SVOCs and EPH were identified in localised areas.

EPH were identified above detection limits in two samples of natural material in BH08, located in close proximity to a sump associated with Boiler No2, approximately 2.0 – 2.5m bgl in depth. The borehole logs identify that water was encountered at 2.2m bgl at this location which is not consistent with the geological logs from boreholes located in natural mudstone on the Delimara Peninsula. The presence of water may indicate a local seepage, for example from the nearby sump, which is a potential source of hydrocarbon contamination. The presence of petroleum hydrocarbons suggests that the pollution prevention measures may be inadequate in this area.

### 7.10 Refined Conceptual Site Model

Condition 2.16.3 of the initial permit version IP 0002/07/A required for an assessment of the likelihood of their being significant contamination of the land on the site by the pollutants specified in Schedule 9. Given the findings of the investigation, the initial conceptual model can be refined conceptual model, and it is presented in Table 7.10. The proposed decommissioning / demolition of Phase I is also considered as part of the refined conceptual model. The refined conceptual site model is presented in diagrammatic format in Figure 5 Annex A.

Table 7.10: Refined Source-Pathway-Receptor Risk Assessment					
Pollutant Linkage	Description	Receptor(s)	Discussion	Pathway Status	Risk Ranking
PL1	Dermal Contact & Ingestion	Humans – Site maintenance workers Site visitors	No evidence of contamination was identified in the site investigation. No contamination was identified above ENVIRON Generic Assessment Criteria (GACs).	Inactive	Low
PL2	Inhalation – dust, particulates and asbestos fibres			Inactive	Low
PL3	Inhalation - vapours			Inactive	Low
PL4	Leaching and migration of contaminants in unsaturated zone to groundwater and surface water.	Controlled Waters (Malta Mean Groundwater Body, Marsaxlokk Bay and Il-Hofra z-Zghira Bay)	No evidence of contamination was identified in the site investigation. Petroleum hydrocarbons were identified in the natural mudstone at one location (BH08). No contamination was identified above ENVIRON Generic Assessment Criteria (GACs) and the risk is considered low.	Inactive	Low
PL5	Migration of contaminated perched water off-site via the surface water drain.	Controlled Waters (Marsaxlokk Bay and Il-Hofra z-Zghira)	No evidence of contamination was identified in the site investigation. No contamination was identified above ENVIRON Generic Assessment Criteria (GACs).	Inactive	Low
PL6	Migration of groundwater in Limestone Aquifer	Controlled Waters (Malta Mean Groundwater Body)	No evidence of contamination was identified in the site investigation. No contamination was identified above ENVIRON Generic Assessment Criteria (GACs). Malta Mean Groundwater Body was not encountered during drilling.	Inactive	Low
PL7	Migration of land gases into buildings and structures.	Built Environment	Migration of gases is likely to be limited by clay. Volatile compounds were not detected at concentrations exceeding the ENVIRON GAC therefore the risk is deemed low.	Inactive	Low

## 8 Monitoring Programme and Decommissioning

It is a requirement of the IPPC permit that two years prior to the overall decommissioning of Delimara Power Station that the operator must submit a Site Closure Report as part of the Decommissioning plan, to the Regulator. The report should provide detail of the soil quality to determine whether any contamination has had an impact on the land during the operational stage of the permitted activities.

Land monitoring is to be repeated at least every four years (Condition 2.16.3.4) and results included in the Annual Environmental Report (AER). A review of the outline Decommissioning Plan is also to be completed every four years (Condition 2.16.7). If contamination is identified as a result of the permitted activities, the land (site) must be returned to an agreed 'satisfactory state' prior to the permit surrendered.

The outputs of the refined conceptual model (refer Section 7.10) do not identify a significant pollution risk from the concentrations of contaminants measured in soil and rock samples during the initial land investigation. The potential sources, pathways and receptors associated with the proposed decommissioning / demolition of Phase I have been considered within the Conceptual Site Model. No additional pollutant linkages were identified.

During the 2011 investigation, sampling locations were limited by the presence of infrastructure and equipment. It is recommended, following decommissioning / demolition of Phase I additional monitoring locations are positioned in the footprint of the infrastructure / equipment to assess ground conditions in previously inaccessible areas.

As a result of the initial findings of the land investigation in relation to contamination, it was recommended that as a minimum, a soil monitoring investigation is undertaken immediately prior to the permit surrender. However, as a requirement of the latest Permit version (E), Condition 2.16.3.4, land monitoring is required at least every four years. The investigation should be at least equal in detail to the current investigation, but should also take into account any potential polluting incidents, with the scope modified accordingly in order to satisfy Condition 2.16.2 of the IPPC permit. The investigation is used to determine whether soil contamination has taken place during the operation of the permitted activity in the intervening period. Operational conditions specified within the permit are required to control the release of substances to the environment, with records to be maintained. Such records are required to be submitted as part of the Annual Environmental Review, maintained within the EMS and to be made available for inspection, by the Regulator; however they can also be used to determine the scope of the pre surrender investigation.

There is no requirement for an investigation of the hydrogeological conditions at the site; nor is there a requirement for the installation of monitoring wells or for groundwater sampling and analysis. However a detailed monitoring plan would typically consider groundwater monitoring to assess the potential impacts from site activities, especially in areas of raw material, chemical storage and handling. Generally, a 'decontamination plan' would be expected to address the risk of impacts to all potential receptors, i.e., sensitive water bodies. By excluding a groundwater assessment from this initial study, the risk assessment process may result in uncertainty when fully developing the decontamination plans.

Installation of groundwater wells at selected permanent borehole locations at the initial stage, with an appropriate sampling and testing regime allows for a more robust site monitoring programme to be put



in place. By assessing on-going impacts to groundwater during the 'lifetime' of the permitted activities allows for more informed decision making with regard to decommissioning planning.

Should significant contamination be identified as a consequence of the operation of the permitted activities, ENVIRON recommend that land is 'decontaminated' so that concentrations of substances specified in Schedule 8 of the IPPC Permit are below those identified within ENVIRON's Generic Assessment Criteria (GACs) for a generic commercial / industrial land use scenario (unless an alternative land use is identified at the time of surrender). These GACs represent those minimal risk levels, below which there is no perceived risk to human health receptors (GACs are presented in Annex E). Concentrations exceeding the GACs may be considered 'acceptable', however use of such concentrations for risk assessment purposes would require a further detailed assessment and consultation with MEPA.

## 8.1 Decontamination Plans

During the decontamination process there is the potential for 'contaminative emissions' to impact the atmosphere, land and water (groundwater and sea water). In accordance with Condition 2.16.5.5 of the IPPC Permit, the potential sources of emissions and corresponding mitigation measures required to minimize the likelihood of the emissions, during any generic decontamination process, are summarized in Table 8.1.

Table 8.1: Potential Sources of Emissions and Mitigation Measures		
Environmental Media	Potential Sources	Mitigation Measures
Land	Spillage of potentially polluting substances listed in Table 4.0 during removal of soil / rock, storage containers (e.g. tanks and sumps) and equipment.	Preparation of method statements, management plans, health and safety plans prior to undertaking decontamination, including an emergency response plan.
		Loading of vehicles in an organised manner so as to prevent the spread of substances. Sheeting and cleaning vehicles prior to leaving site, if required. All reasonable and applicable measures taken to prevent the escape of material during transportation.
		Storage of liquids and solids of a potentially hazardous nature (e.g. diesel fuel, oils, solvents) in designated areas, for example on surfaced areas, with appropriate containment measures (e.g. bunding) in place during the decontamination process.
		To prevent cross contamination, segregation of substances (including chemicals, contaminated soil/rock, materials, equipment) into hazardous and non-hazardous.
Water	Spillage of potentially polluting substances listed in	Preparation of method statements, management plans, health and safety plans prior to undertaking

Table 8.1: Potential Sources of Emissions and Mitigation Measures		
Environmental Media	Potential Sources	Mitigation Measures
	Table 4.1 and migration or leaching to groundwater and coastal water	decontamination, including an emergency response plan.
		Loading of tankers in an organised manner so as to prevent the spread of contaminants. Sheeting and cleaning vehicles if required, prior to leaving site. All reasonable and applicable measures taken to prevent the escape of material during transportation.
		Where drains are not served by an interceptor, suitable 'drain stops' should be employed to intercept direct run-off from any disturbed areas, or to seal off ingress points to the system, thereby stopping any potential impact to the overall drainage system, and discharge points.
		Storage of liquids and solids of a potentially hazardous nature (e.g. diesel fuel, oils, solvents) in designated areas, for example on surfaced areas, with appropriate containment measures (e.g. bunding) in place during the decontamination process. Use of dedicated spill kits.
		To prevent cross contamination, segregation of substances (including chemicals, contaminated soil/rock, materials, equipment) into hazardous and non-hazardous.
Atmosphere	Dust generated by the movement of soil.	Appropriate Personal Protective Equipment (PPE) (e.g. dust masks).
		Continuous monitoring of the quality of the atmospheric environment, both on site and at the site boundary.
		Provision of appropriate dust suppression infrastructure (i.e. water sprinklers and sprayers)
		Use of covered trucks for the movement of materials.
	Vapours that may be present in chemical storage	Appropriate Personal Protective Equipment (PPE) (e.g. personal vapour alarms).

Table 8.1: Potential Sources of Emissions and Mitigation Measures		
Environmental Media	Potential Sources	Mitigation Measures
	containers (i.e. tanks, sumps) and released to the atmosphere when disturbed.	Releasing vapours into open air rather than confined spaces. Ensuring vapour release occurs away from personnel and buildings in a controlled manner.
	Noise	Continuous monitoring of noise, where required and identification of dedicated noise control areas, where standards are exceeded. Provision of appropriate PPE.

## 9 Options Appraisal

A requirement for a full decommissioning plan has not been identified at this stage.

It is understood that MEPA has agreed that the IPPC permit will not require surrender at this stage and the boundary of the permit will not change. For this reason, there is no requirement at this stage to undertake remediation of Phase I area; remediation will be undertaken for Phase I as part of the whole site when the IPPC permit is surrendered.

It is anticipated that no sub-surface ground excavation will be undertaken during the Phase I decommissioning works. However, should these Phase I decommissioning works involve excavation of the sub-surface, then in accordance with best practice guidance, a 'watching brief' should be implemented during the programme, whereby unusual or 'out-of-character' materials (if identified) can be assessed or stockpiled/contained until such assessment can be undertaken. If hazardous materials such as asbestos containing materials etc are identified, these should be subject to site contingency plans, health & safety and risk assessment and method statements/procedures for their identification, handling, removal and disposal. All remedial activities would be validated and a completion report generated.

## **10 Reference Data and Remediation**

Reference Data for the site has been collected by this report and these are presented in summary in Annex C. The laboratory testing certificates are presented in Annex D.

## 11 Statement of Site Condition

ENVIRON undertook a soil monitoring investigation in 2011 to satisfy Conditions 1.5.1, 2.16.1, 2.16.3, 2.16.5 (Points 1, 4 and 5) of the original IPPC permit (version reference IP 0002/07/A dated March 2010). The land investigation comprised the advancement of twenty (20) boreholes to depths of 5m to 10m using solid stem auger rotary drilling techniques to allow the sampling of the soil. Soil samples were tested for the range of substances in Schedule 9 of the original IPPC permit.

Laboratory analysis identified low concentrations of metals in all samples. Low concentrations of PAHs, VOCs, SVOCs and EPH were identified in localised areas. All concentrations of contaminants did not exceed ENVIRON's Generic Assessment Criteria (GACs) for a commercial / industrial end use.

Elevated concentrations of petroleum hydrocarbons (i.e. above method detection limit of 35mg/kg) were identified in the natural mudstone between depths of 1.8m and 3.0m bgl at BH08, which suggests there may be localised leakage from a sump. The pollution prevention measures may be inadequate in this area. Concentrations of petroleum hydrocarbons were assessed against the relevant ENVIRON Generic Assessment Criteria and were not found to exceed the values.

At that time, the likelihood of their being significant contamination of the land was assessed and no present risk was identified. ENVIRON has subsequently reviewed the Annual Environmental Reports (AER) from 2011 to 2013 produced by Enemalta and submitted to MEPA. Records indicate that no substantial deterioration of the land condition has occurred. ENVIRON has not revisited the site since 2011.

The potential sources, pathways and receptors associated with the proposed decommissioning / demolition of Phase I have been considered within the Conceptual Site Model. No additional pollutant linkages were identified.

As a result of the initial findings of the land investigation in relation to contamination, it is recommended that as a minimum, a soil monitoring investigation is repeated every four years, and prior to permit surrender. The investigation should be at least equal in detail to the current investigation, and consider the recommendations made in Section 8 of this report. It should also take into account any potential polluting incidents, with the scope modified accordingly in order to satisfy Condition 2.16.2 of the IPPC permit. The investigation is used to determine whether soil contamination has taken place during the operation of the permitted activity in the intervening period. Operational conditions specified within the permit are required to control the release of substances to the environment, with records to be maintained. Such records are required to be submitted as part of the Annual Environmental Review, maintained within the EMS and to be made available for inspection, by the Regulator; however they can also be used to determine the scope of the pre surrender investigation.

## **Annex A: Figures and Plans**

### **Figure 1: Site Location**

### **Figure 2: Installation Boundary and Layout**

### **Figure 3: Proposed Sample Location Plan**

### **Figure 4: Actual Sample Location Plan**

### **Figure 5: Conceptual Site Model**

## **Annex B: Records of Investigation Findings**

### **Annex B.1: Borehole Logs**

### **Annex B.2: Photographs**



**Project No:** UK22-20345

**Client:** Enemalta

**Location:** Delimara Power Station

**Datum:** 2.11m AOD

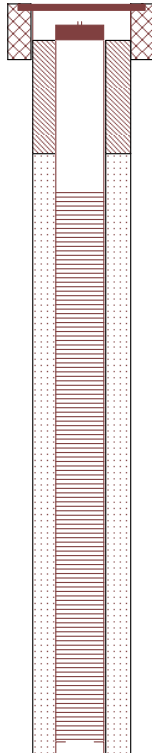
**Window Sample:** BH01

**Date:** 8th June 2011

**Plant Used:** Beretta T44

**Logged by:** KW

**ENVIRON**

SUBSURFACE PROFILE			SAMPLE			PID Reading ppm 50 150	Well Installation
Depth	Symbol	Description	Elevation	Sample	Lab Analysis		
0.0		Ground Surface	0.00	1			
		<b>MADE GROUND</b> Beige slightly silty sandy limestone (recovered as gravel and powder)				2.00	
1.0		<b>MADE GROUND</b> Greyey brown slightly gravelly Mudstone (recovered as clay) .Gravel is fine to medium, angular of mudstone.	-1.00			1.40	
2.0		<b>MADE GROUND</b> Grey greeny brown gravelly slightly silty Mudstone (recovered as clay).  Strata wet at 3.5m bgl.	-2.00	2		1.30	
3.0						0.90	
4.0						0.60	
5.0		<b>MADE GROUND</b> Greeny grey brown coarse angular gravel of mudstone.	-5.00			2.20	
		5.5 m bgl	-5.50				
6.0							

Remarks:

Checked by:

Sheet: 1 of 1

**Project No:** UK22-20354

**Client:** Enemalta

**Location:** Delimara Power Station

**Datum:** 3.294m ASL

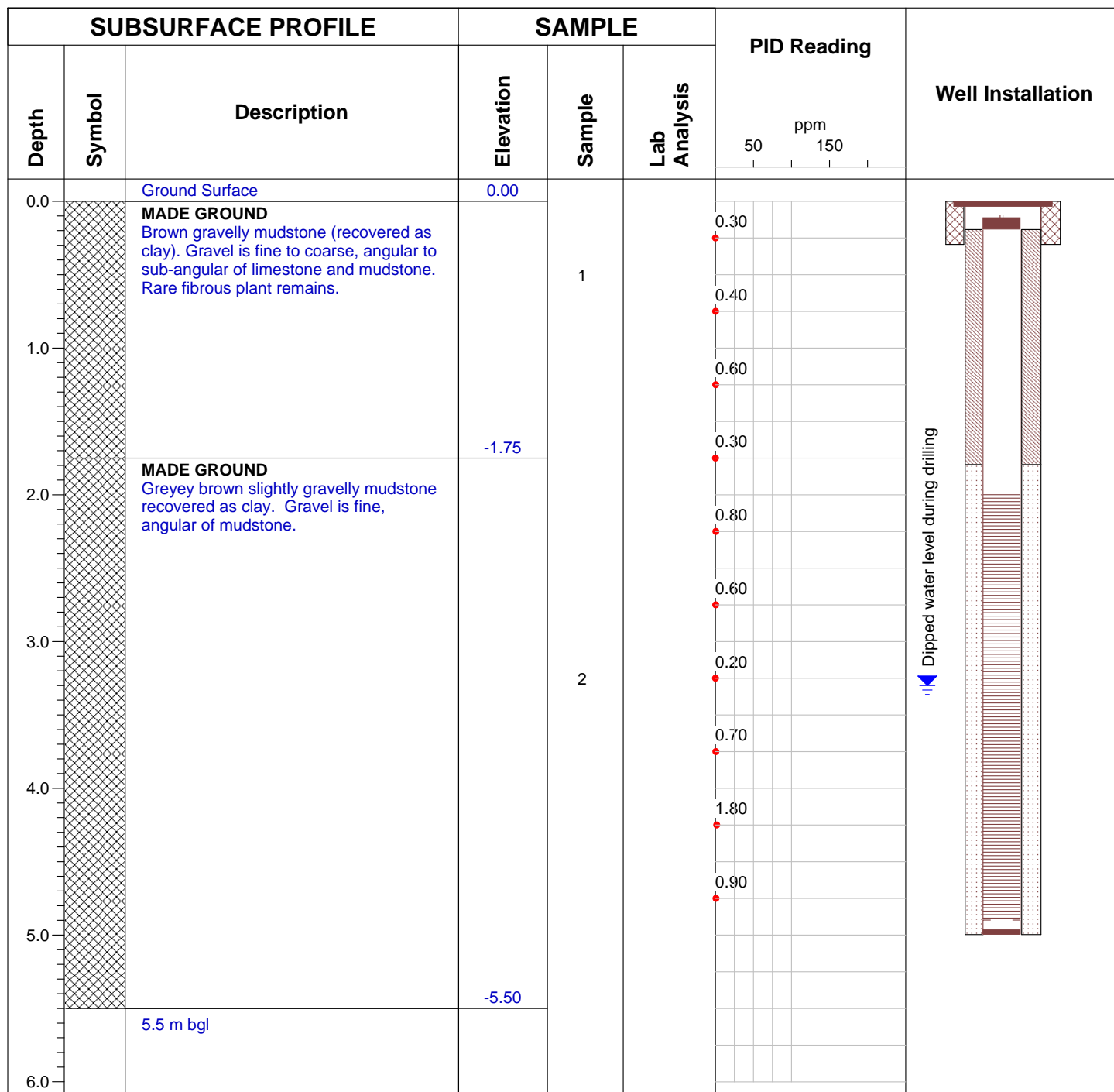
**Window Sample:** BH02

**Date:** 8th July 2011

**Plant Used:** Beretta T44

**Logged by:** KW

**ENVIRON**



Remarks:

Checked by:

Sheet: 1 of 1

**Project No:** UK22-20354

**Window Sample:** BH03

**Client:** Enemalta

**Date:** 13th June 2011

**Location:** Delimara Power Station

**Plant Used:** Beretta T44

**Datum:** 3.21m ASL

**Logged by:** KW

**ENVIRON**

SUBSURFACE PROFILE			SAMPLE			PID Reading ppm 50 150	Well Installation
Depth	Symbol	Description	Elevation	Sample	Lab Analysis		
0.0		Ground Surface	0.00	1			Borehole backfilled with arisings
		MADE GROUND Concrete	-0.16				
1.0		MADE GROUND Beige becoming greeny brown gravelly clay. Gravel is fine to coarse, angular to sub-rounded of mudstone. Occasional fibrous plant remains.		2		0.00	Dipped water level during drilling
2.0						0.00	
3.0		MADE GROUND Damp beigey brown silty gravelly clay. Gravel is fine to medium, angular to sub-rounded of mudstone.	-2.50			0.20	
4.0						0.50	
5.0		MADE GROUND Beigy brown very silty clay with frequent fibrous plant remains (seagrass). Strong organic odour.	-4.00			0.30	
6.0		5.5 m bgl	-5.50			0.00	

Remarks:

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Sheet: 1 of 1

**Project No:** UK22-20354

**Client:** Enemalta

**Location:** Delimara Power Station

**Datum:** 3.32m ASL

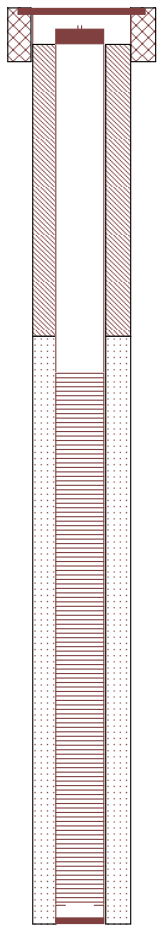
**Window Sample:** BH04

**Date:** 13th June 2011

**Plant Used:** Beretta T44

**Logged by:** KW

**ENVIRON**

SUBSURFACE PROFILE			SAMPLE			PID Reading ppm 50 150	Well Installation
Depth	Symbol	Description	Elevation	Sample	Lab Analysis		
0.0		Ground Surface	0.00	1			 Dipped water level during drilling
		MADE GROUND Concrete	-0.17				
		MADE GROUND Light brown silty gravelly clay. Gravel s fine to coarse, angular to sub-angular of mudstone and limestone.	-0.50			0.10	
1.0		MADE GROUND Brown gravelly silty CLAY. Gravel is fine to coarse, angular to sub-angular of mudstone.				0.10	
		1.0...clay becoming damp.				0.50	
2.0		2.0...concrete slab (0.05m thick).				0.50	
		2.5...clay is also cream and silty.				0.10	
3.0				2		0.10	
			-3.50			1.20	
		MADE GROUND Concrete.	-3.65				
4.0		MADE GROUND Dry brown silty gravelly clay.				1.00	
		4.2...becoming damp.				1.10	
5.0		MADE GROUND Wet greyey brown slightly gravelly silty clay. Frequent fibrous plant remains (seagrass).	-4.75				
			-6.00				
6.0		6 m bgl					

Remarks:

Checked by:

Sheet: 1 of 1

**Project No:** UK22-20354

**Client:** Enemalta

**Location:** Delimara Power Station

**Datum:** 3.153m ASL

**Window Sample:** BH05

**Date:** 13th June 2011

**Plant Used:** Beretta T44

**Logged by:** KW

**ENVIRON**

SUBSURFACE PROFILE			SAMPLE			PID Reading ppm 50 150	Well Installation
Depth	Symbol	Description	Elevation	Sample	Lab Analysis		
0.0		Ground Surface	0.00	1			Borehole backfilled with arisings
		<b>MADE GROUND</b> Light brown gravelly silty clay (mudstone) and limestone (recovered as powder) Gravel is fine to coarse, angular to sub-rounded of mudstone and limestone.	-0.30			1.90	
			-0.50			0.20	
1.0		<b>MADE GROUND</b> Limestone boulder.	-1.00			0.00	
		<b>MADE GROUND</b> Light brown gravelly silty clay and limestone (recovered as powder). Gravel is fine to coarse, angular to sub-rounded of mudstone and limestone.		2		0.20	Dipped water level during drilling
2.0		<b>MADE GROUND</b> Greeny brown gravelly clay (mudstone).				1.60	
		2.0...becoming damp.				1.30	
		3.75...frequent fine organic fibres (likely sea grass).				1.50	
3.0		4.0...clay is saturated.				1.40	
		6.0...limestone boulder (thickness approx 0.5m)					
4.0							
5.0							
6.0			-6.00				
		6 m bgl					

Remarks:

Checked by:

Sheet: 1 of 1

**Project No:** UK22-20354

**Window Sample:** BH06

**Client:** Enemalta

**Date:** 14th June 2011

**Location:** Delimara Power Station

**Plant Used:** Beretta T44

**Datum:** 3.38m ASL

**Logged by:** KW

**ENVIRON**

SUBSURFACE PROFILE			SAMPLE			PID Reading ppm 50 150	Well Installation
Depth	Symbol	Description	Elevation	Sample	Lab Analysis		
0.0		Ground Surface	0.00	1		0.30	Borehole backfilled with arisings
		<b>MADE GROUND</b> Beige becoming yellowish light brown slightly sandy slightly silty gravelly clay. Gravel is fine to coarse, angular to sub-angular of limestone and mudstone.	-0.70				
1.0		<b>MIDDLE GLOBIGERINA LIMESTONE FORMATION</b> Greenish brownish grey MUDSTONE (recovered as clay and gravel).		2		0.50	
2.0						0.90	
3.0						0.70	
4.0						0.50	
5.0						0.50	
6.0						0.80	
		<b>LIKELY MIDDLE GLOBIGERINA LIMESTONE FORMATION</b> No returns to due rotary open hole drilling with water flush.	-6.00				
7.0							
8.0							
9.0							
10.0			-10.00				
		10 m bgl					

Remarks: No groundwater encountered during drilling

Checked by:

Sheet: 1 of 1

**Project No:** UK22-20354

**Client:** Enemalta

**Location:** Delimara Power Station

**Datum:**

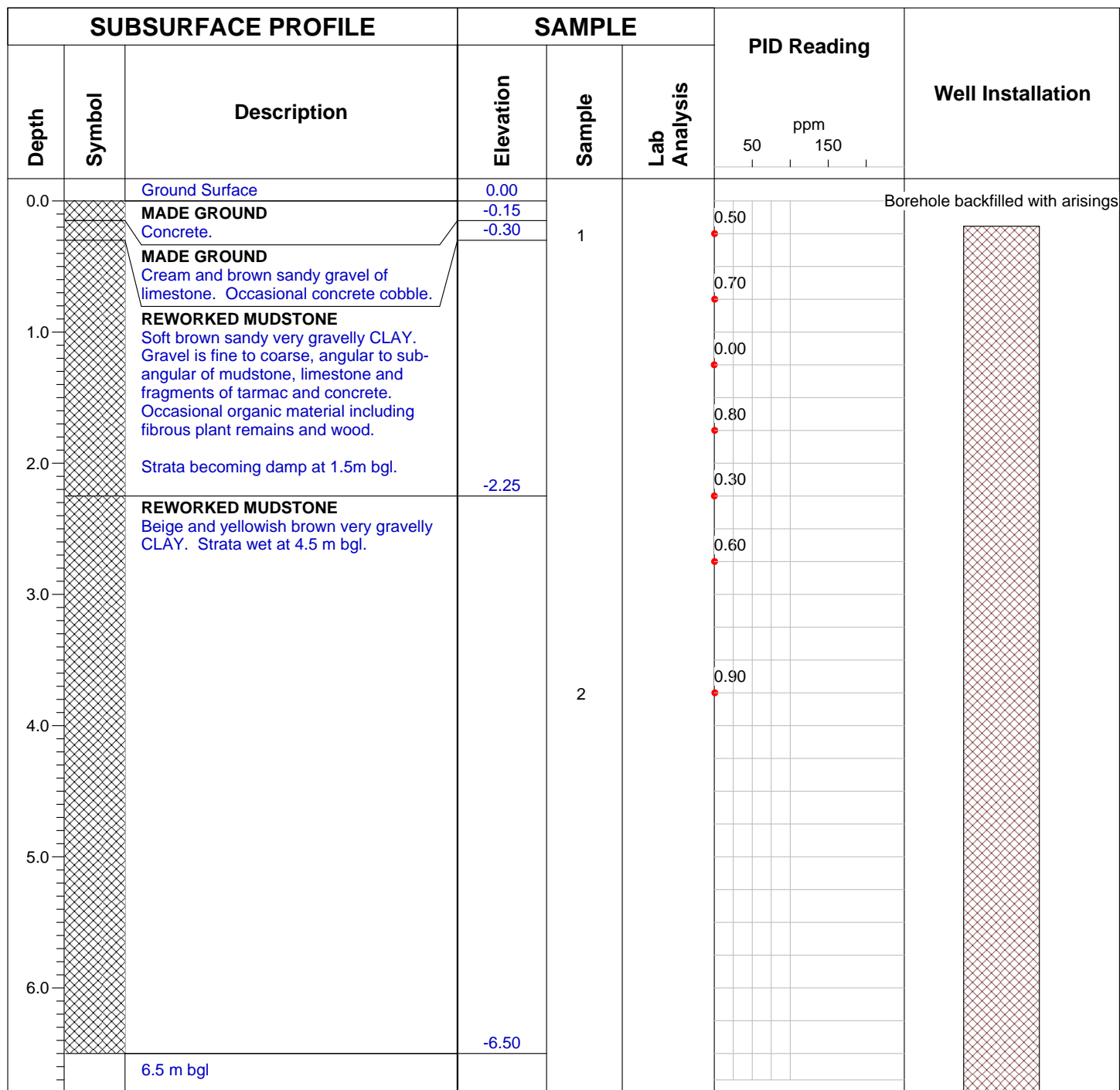
**Window Sample:** BH07

**Date:** 14th June 2011

**Plant Used:** Beretta T44

**Logged by:** MH

**ENVIRON**



Remarks: Standing groundwater level encountered at 2.27m bgl.

Checked by:

Sheet: 1 of 1

**Project No:** UK22-20354

**Window Sample:** BH08

**Client:** Enemalta

**Date:** 27th June 2011

**Location:** Delimara Power Station

**Plant Used:** Beretta T44

**Datum:** 3.20m ASL

**Logged by:** MH

**ENVIRON**

SUBSURFACE PROFILE			SAMPLE			PID Reading ppm 50 150	Well Installation
Depth	Symbol	Description	Elevation	Sample	Lab Analysis		
0.0		Ground Surface	0.00	1			Backfilled with arisings
		MADE GROUND Tarmac	-0.20				
		MADE GROUND Hardcore	-0.40				
		REWORKED MUDSTONE Soft brown CLAY. Gravel is fine to coarse, angular to sub-angular of mudstone.				0.00	
1.0						0.00	
			-1.50			0.40	Water encountered during drilling
		Middle Globigerina Limestone Formation Grey Mudstone.				2.70	
2.0		Drill rods struggled to penetrate wet rock.				2.60	
						2.60	
3.0			-3.00				
		3 m bgl					

Remarks: Hand dug pit to 1.0m bgl. Water encountered at 2.2m bgl (possible leakage from local sump).

Checked by:

Sheet: 1 of 1



**Project No:** UK22-20354

**Client:** Enemalta

**Location:** Delimara Power Station

**Datum:**

**Window Sample:** LF01

**Date:** 9th June 2011

**Plant Used:** Beretta T44

**Logged by:** KW

**ENVIRON**

SUBSURFACE PROFILE			SAMPLE			PID Reading	Well Installation
Depth	Symbol	Description	Elevation	Sample	Lab Analysis		
0.0		Ground Surface	0.00			0.40	
1.0		<b>MADE GROUND</b> Cream and brown gravelly $\text{CaCO}_3$ . Gravel is fine to coarse, angular to sub-rounded of limestone with rare gravel sized fragments of wood and plastic.	-1.75			0.10	
2.0		<b>MADE GROUND</b> Cream medium to coarse angular to sub-rounded gravel of limestone. Rare electronic equipment, cables, plastic, fine metal wire.				0.30	
3.0						0.90	
4.0						0.50	
5.0			-5.75				
6.0		<b>MADE GROUND</b> Cream medium to coarse angular to sub-rounded gravel of limestone. Occasional fragments of fine wood and plant fibres.	-6.50				
7.0							
8.0		<b>MADE GROUND</b> No returns due to rotary open hole technique. Strata is soft material, possibly limestone and mudstone fill.					
9.0							
10.0							
11.0							
12.0							
13.0							
14.0							
15.0							
16.0			-16.00				
17.0		<b>MADE GROUND</b> No returns due to rotary open hole technique. Strata is hard, possibly limestone cobble / boulders.					
18.0							
19.0			-19.30				
20.0		19.3 m bgl					

Remarks: Presence of groundwater not confirmed due to use of water flush during rotary drilling.

Checked by:

Sheet: 1 of 1

**Project No:** UK22-20354

**Window Sample:** LF02

**Client:** Enemalta

**Date:** 9th to 11th June 2011

**Location:** Delimara Power Station

**Plant Used:** Beretta T44

**Datum:**

**Logged by:** KW

**ENVIRON**

SUBSURFACE PROFILE			SAMPLE			PID Reading	Well Installation
Depth	Symbol	Description	Elevation	Sample	Lab Analysis		
						50      ppm      150	
0.0		Ground Surface	0.00	1		1.00	Borehole backfilled with arisings
0.5		<b>MADE GROUND</b> Light grey brown limestone and mudstone (recovered as ground calcium carbonate, clay and gravel). Occasional to rare fragments of plaster.	-2.50			0.70	
1.0						1.20	
1.5						1.90	
2.0						2.30	
2.5		0.5...becoming light brown with no fragments of plaster.	-2.50	1.20			
3.0				1.40			
3.5				1.40			
4.0		<b>MADE GROUND</b>	-5.00	2	0.90		
4.5		Cream limestone (recovered as ground calcium carbonate and gravel).					
5.0							
5.5		<b>LIKELY MADE GROUND</b>	-6.00				
6.0		No recovery					
6.5							
7.0		<b>LIKELY MADE GROUND</b>					
7.5		No returns due to rotary open hole drilling technique used. Material is soft (possibly limestone and mudstone fill)					
8.0							
9.0							
10.0							
11.0							
12.0							
13.0							
14.0							
15.0							
16.0							
17.0							
18.0							
19.0							
20.0							
21.0							
22.0							

Remarks:

Checked by:

Sheet: 1 of 2

**Project No:** UK22-20354

**Client:** Enemalta

**Location:** Delimara Power Station

**Datum:**

**Window Sample:** LF02

**Date:** 9th to 11th June 2011

**Plant Used:** Beretta T44

**Logged by:** KW

**ENVIRON**

SUBSURFACE PROFILE			SAMPLE			PID Reading	Well Installation
Depth	Symbol	Description	Elevation	Sample	Lab Analysis		
23.0						50 ppm 150	
24.0							
25.0			-25.40				
26.0		<b>MADE GROUND</b> Core taken: recovery comprised coarse, sub-rounded gravel of cream limestone and grey mudstone.	-26.40				
27.0		<b>POSSIBLE MADE GROUND</b> No returns					
28.0							
29.0							
30.0							
31.0							
32.0							
33.0			-33.00				
34.0		<b>MARINE DEPOSITS</b> Grey fine to coarse GRAVEL and shell debris.					
35.0							Borehole collapsed at base
36.0							
37.0							
38.0							
39.0							
40.0							
41.0							
42.0			-42.00				
43.0		42 m bgl					
44.0							

Remarks:

Checked by:

Sheet: 2 of 2

**Project No:** UK22-20354

**Client:** Enemalta

**Location:** Delimara Power Station

**Datum:**

**Window Sample:** LF03

**Date:** 10th June 2011

**Plant Used:** Beretta T44

**Logged by:** KW

**ENVIRON**

SUBSURFACE PROFILE			SAMPLE			PID Reading ppm 50 150	Well Installation
Depth	Symbol	Description	Elevation	Sample	Lab Analysis		
0.0		Ground Surface	0.00	1		0.80	Borehole backfilled with arisings
1.0		<b>MADE GROUND</b> Brown mudstone (recovered as clay and gravel). Rare gravel-sized concrete..				0.10	
2.0			-2.50	2		0.40	
3.0		<b>MADE GROUND</b> Greeny brown silty mudstone (recovered as gravel and clay nodules)				0.50	
4.0						0.90	
5.0						0.80	
6.0			-6.00			1.10	
7.0		<b>LIKELY MADE GROUND</b> No returns due to rotary open hole drilling technique used. Material is soft (possibly limestone and mudstone fill)				1.10	
8.0						0.60	
9.0							
10.0							
11.0							
12.0							
13.0							
14.0							
15.0			-15.30				
16.0		<b>LIKELY MADE GROUND</b> No returns. Material is 'hard' (possible limestone boulders)					
17.0							
18.0							
19.0			-19.00				
		19 m bgl					

Remarks: Presence of water not confirmed due to use of water flush during rotary drilling.

Checked by:

Sheet: 1 of 1

**Project No:** UK22-20354

**Client:** Enemalta

**Location:** Delimara Power Station

**Datum:** 3.14m ASL

**Window Sample:** SB01

**Date:** 8th July 2011

**Plant Used:** Beretta T44

**Logged by:** KW

**ENVIRON**

SUBSURFACE PROFILE			SAMPLE			PID Reading ppm 50 150	Well Installation
Depth	Symbol	Description	Elevation	Sample	Lab Analysis		
0.0		Ground Surface	0.00	1			Backfilled with arisings  Dipped water level during drilling
		MADE GROUND Concrete				1.10	
		MADE GROUND Greyey brown black and beige gravel with nodules of clay. Gravel is medium, angular of limestone, tarmac and mudstone.	-0.40			0.90	
			-0.70				
1.0		MADE GROUND Beige medium sub-angular gravel of limestone (Hardcore)	-1.00	2		1.50	
		MADE GROUND Cream limestone (recovered as gravel and powder).				1.50	
2.0		MADE GROUND Greeny grey gravelly CLAY. Gravel is fine, angular of mudstone and occasional limestone. Rare fragments of rubber.	-2.25			1.40	
		MADE GROUND Greeny browny grey gravelly CLAY (recovered as nodules). Gravel is fine to medium, angular of mudstone. Rare fragments of rubber.				2.10	
3.0						1.30	
		Strata becoming wet at 3.75m bgl.				1.80	
		Gravel becoming coarse between 3.75m and 4.0m bgl.				1.10	
4.0							
5.0							
6.0		5.5 m bgl	-5.50				

Remarks:

Checked by:

Sheet: 1 of 1

**Project No:** UK22-20354

**Client:** Enemalta

**Location:** Delimara Power Station

**Datum:** 3.30m ASL

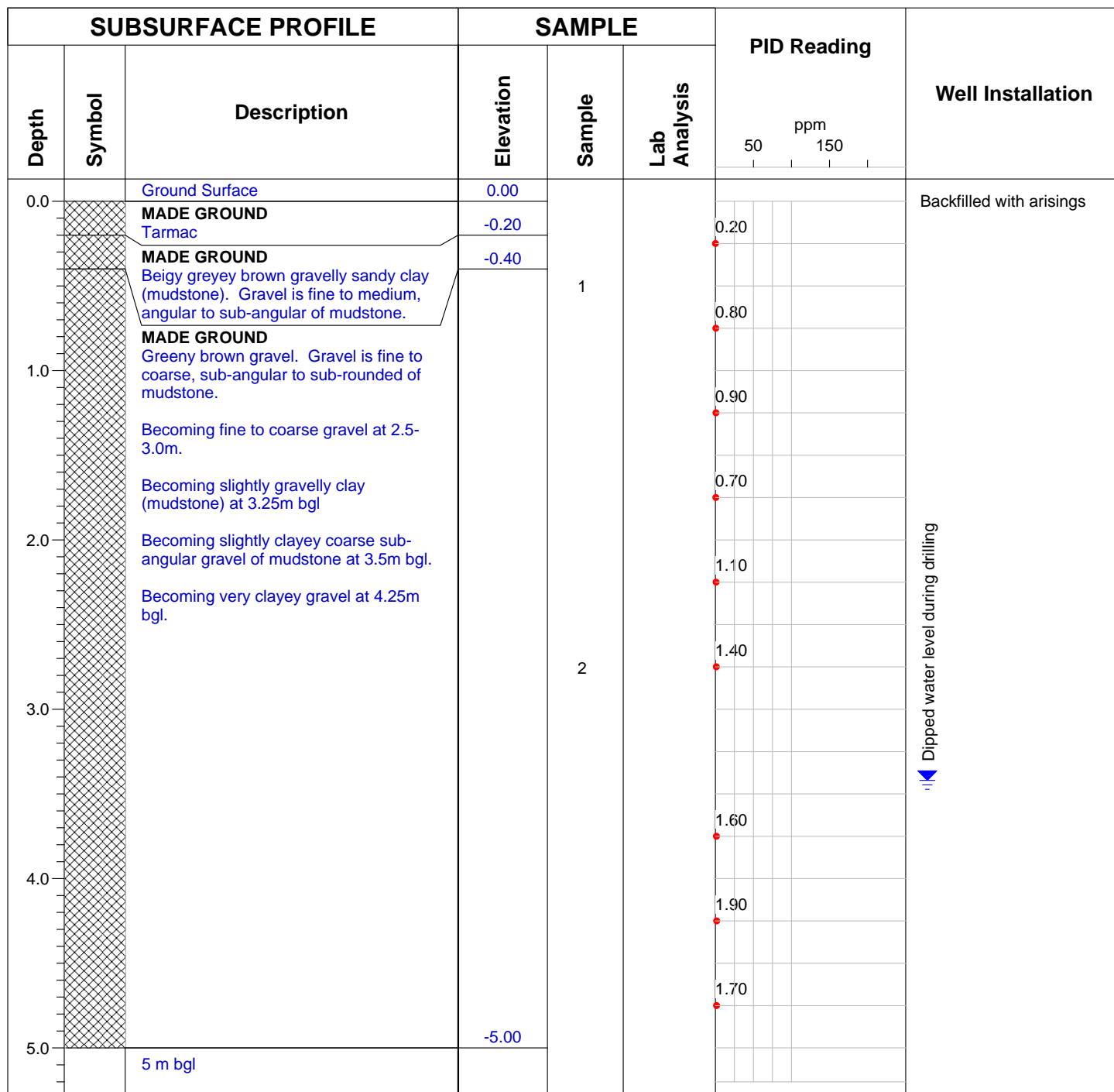
**Window Sample:** SB02

**Date:** 8th July 2011

**Plant Used:** Beretta T44

**Logged by:** KW

**ENVIRON**



Remarks:

Checked by:

Sheet: 1 of 1

**Project No:** UK22-20354

**Window Sample:** SB03

**Client:** Enemalta

**Date:** 8th July 2011

**Location:** Delimara Power Station

**Plant Used:** Beretta T44

**Datum:** 3.26m ASL

**Logged by:** KW

**ENVIRON**

SUBSURFACE PROFILE			SAMPLE			PID Reading ppm 50 150	Well Installation
Depth	Symbol	Description	Elevation	Sample	Lab Analysis		
0.0		Ground Surface	0.00	1			Backfilled with arisings  Dipped water level during drilling
		MADE GROUND Tarmac	-0.20			0.20	
		MADE GROUND Beigy greyey brown gravelly calcareous clay. Gravel is fine to medium,angular to sub-angular of limestone and mudstone.	-0.40			0.80	
1.0		MADE GROUND Greeny brown clayey gravel of mudstone. Gravel is fine to coarse, sub-angular of mudstone.		2		0.90	
		3.25...becoming damp slightly gravelly clay (recovered as nodules).				0.70	
2.0		3.5...becoming coarse sub-angular gravel of mudstone.				1.10	
		4.25...becoming very clayey gravel of mudstone.				1.40	
3.0						1.60	
4.0						1.90	
5.0						1.70	
		5 m bgl	-5.00				
6.0							

Remarks:

Checked by:

Sheet: 1 of 1

**Project No:** UK22-20354

**Window Sample:** SB04

**Client:** Enemalta

**Date:** 9th June 2011

**Location:** Delimara Power Station

**Plant Used:** Beretta T44

**Datum:** 3.424m ASL

**Logged by:** KW

**ENVIRON**

SUBSURFACE PROFILE			SAMPLE			PID Reading ppm 50 150	Well Installation
Depth	Symbol	Description	Elevation	Sample	Lab Analysis		
0.0		Ground Surface	0.00	1			Backfilled with arisings
		MADE GROUND Concrete	-0.15			0.30	
		MADE GROUND Light greeny grey sandy slightly gravelly CLAY. Gravel is fine to medium, angular of limestone and mudstone.	-0.50			0.70	
1.0		POSSIBLY REWORKED MUDSTONE Light greeny grey sandy slightly gravelly CLAY. Gravel is fine to medium, angular of mudstone	-1.00	2		0.40	
		MIDDLE GLOBIGERINA LIMESTONE FORMATION Greeny grey weathered mudstone (recovered as clay and gravel).				1.40	
2.0						2.50	
						1.40	
3.0							
						1.40	
4.0							
						1.00	
5.0							
						1.80	
6.0						1.00	
			-6.50				
7.0		6.5 m bgl					

Remarks: No groundwater encountered during drilling

Checked by:

Sheet: 1 of 1



**Project No:** UK22-20354

**Client:** Enemalta

**Location:** Delimara Power Station

**Datum:** 3.15m ASL

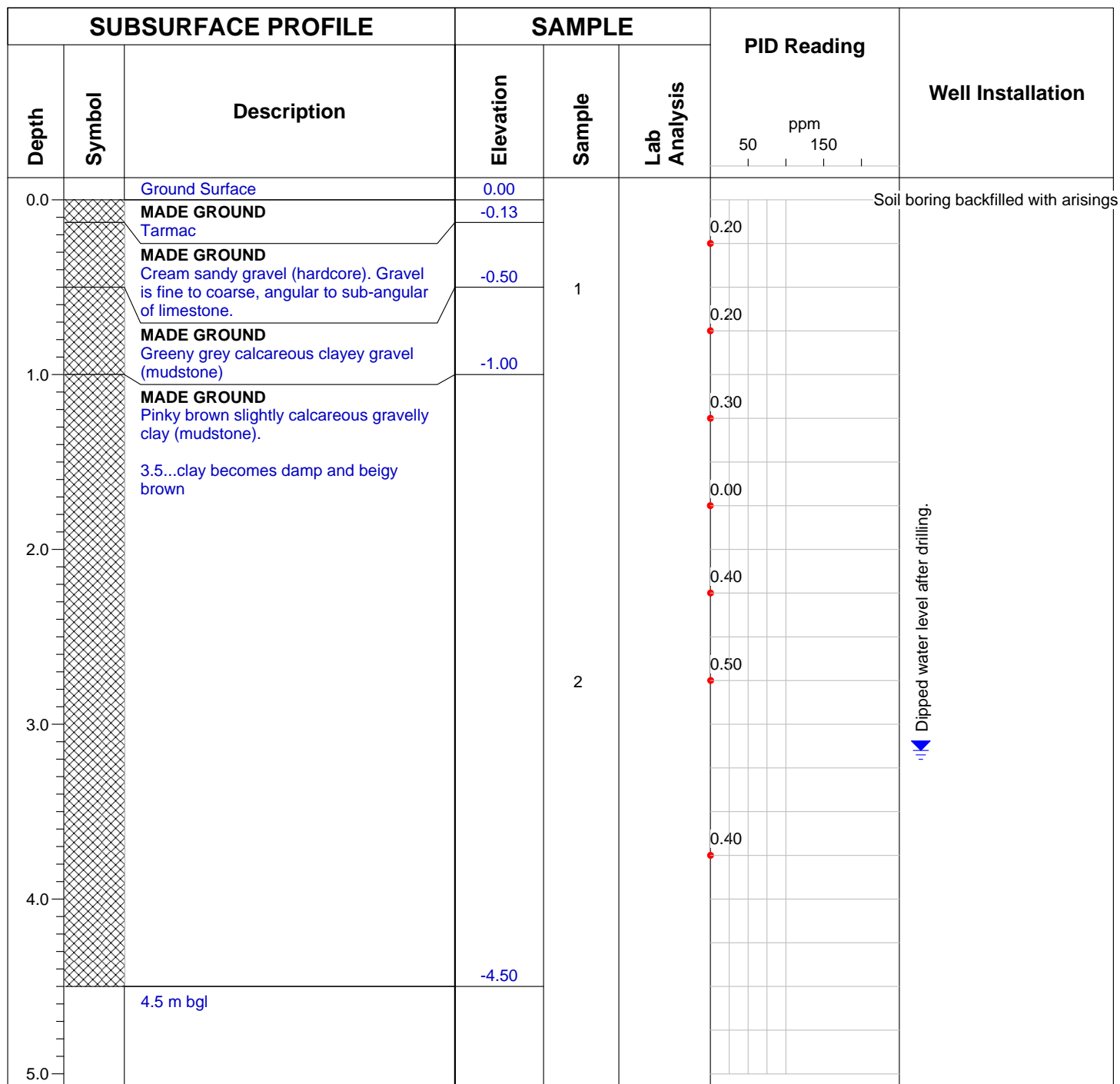
**Window Sample:** SB05

**Date:** 9th June 2011

**Plant Used:** Beretta T44

**Logged by:** KW

**ENVIRON**



Remarks: No groundwater encountered during drilling

Checked by:

Sheet: 1 of 1



**Project No:** UK22-20354

**Window Sample:** SB06B

**Client:** Enemalta

**Date:** 9th June 2011

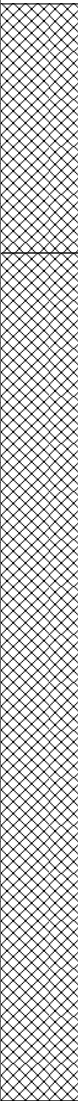
**Location:** Delimara Power Station

**Plant Used:** Beretta T44

**Datum:**

**Logged by:** KW

**ENVIRON**

SUBSURFACE PROFILE			SAMPLE			PID Reading	Well Installation
Depth	Symbol	Description	Elevation	Sample	Lab Analysis		
0.0		Ground Surface	0.00	1		<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></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Remarks:

Checked by:

Sheet: 1 of 1

**Project No:** UK22-20354

**Window Sample:** SB07

**Client:** Enemalta

**Date:** 13th June 2011

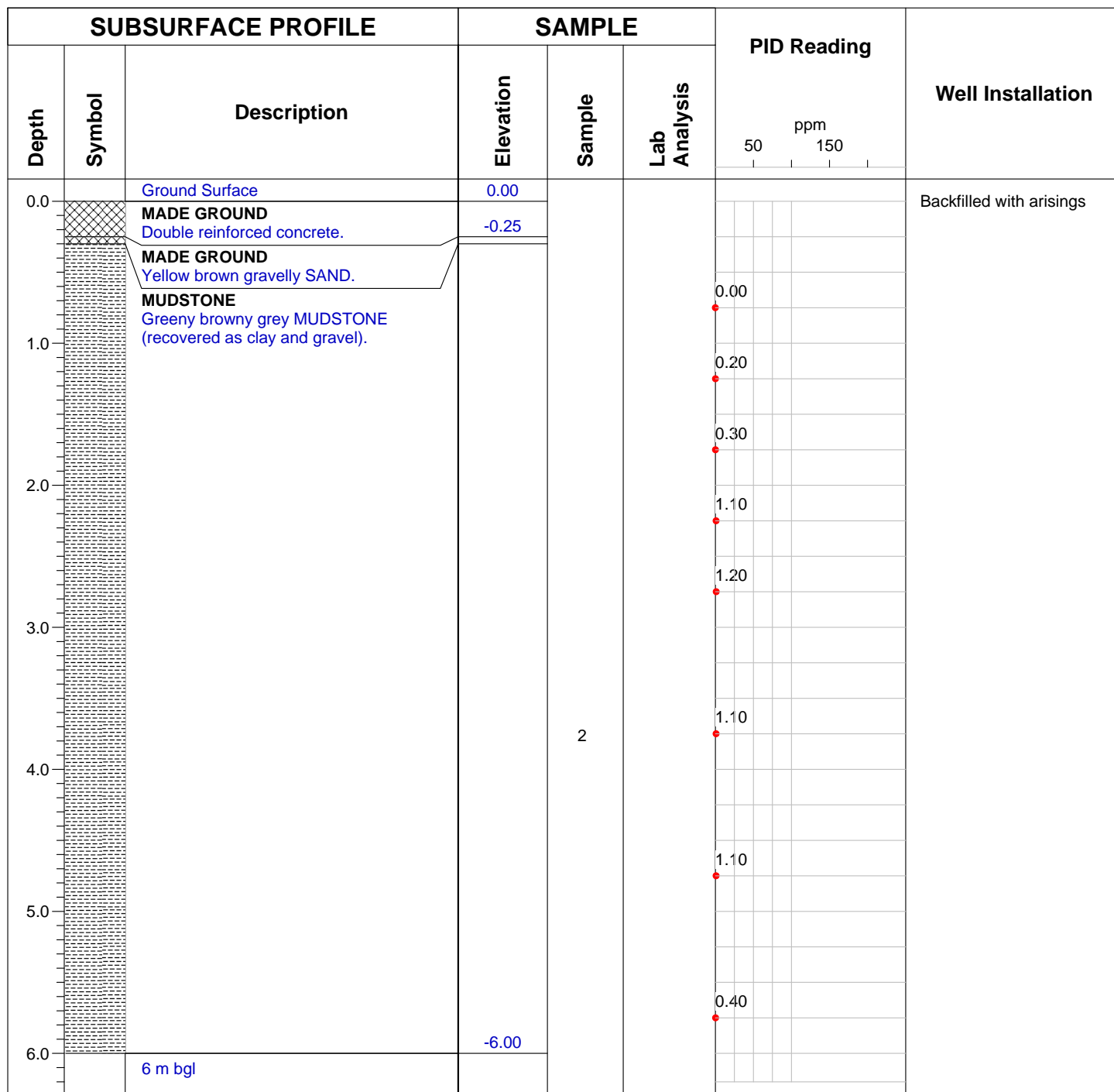
**Location:** Delimara Power Station

**Plant Used:** Beretta T44 Continuous Flight Auger Rig

**Datum:** 3.41m ASL

**Logged by:** KW

**ENVIRON**



Remarks: No groundwater encountered.

Hand dug service pit excavated to 1.0m bgl.

Checked by:

Sheet: 1 of 1

**Project No:** UK22-20354

**Window Sample:** SB08A

**Client:** Enemalta

**Date:** 13th June 2011

**Location:** Delimara Power Station

**Plant Used:** Beretta T44

**Datum:** 3.44m ASL

**Logged by:** KW

**ENVIRON**

SUBSURFACE PROFILE			SAMPLE			PID Reading ppm 50 150	Well Installation
Depth	Symbol	Description	Elevation	Sample	Lab Analysis		
0.0		Ground Surface	0.00				Borehole backfilled with arisings
		MADE GROUND Cream fine to coarse gravel of limestone	-0.10				
		MADE GROUND Greeny brown grey gravelly silty clay. Gravel is fine to coarse, angular to sub- rounded of mudstone. Occasional strips of metal (c. 5cm in length) and rare plastic.		1		0.90	
		1.5...clay becoming damp.				0.10	
1.0						1.10	
2.0				2		0.60	
			-2.50				
		MADE GROUND Reinforced concrete obstruction (thickness not proven). Borehole terminated.					
		2.5 m bgl					
3.0							

Remarks: Borehole terminated at 2.5m bgl due to reinforced concrete obstruction.

Checked by:

Sheet: 1 of 1

**Project No:** UK22-20354

**Window Sample:** SB08B

**Client:** Enemalta

**Date:** 13th June 2011

**Location:** Delimara Power Station

**Plant Used:** Beretta T44

**Datum:** 3.44m ASL

**Logged by:** KW

**ENVIRON**

SUBSURFACE PROFILE			SAMPLE			PID Reading	Well Installation
Depth	Symbol	Description	Elevation	Sample	Lab Analysis		
0.0		Ground Surface	0.00				Backfilled with arisings
		MADE GROUND	-0.10				
		Cream fine to coarse gravel of limestone					
		MADE GROUND					
		Greeny brown grey gravelly silty clay.					
		Gravel is fine to coarse, angular to sub-					
		rounded of mudstone. Occasional strips					
		of metal (c. 5cm in length) and rare					
		plastic.					
		1.5...clay becoming damp.					
1.0							
2.0							
			-2.50				
		MADE GROUND					
		Reinforced concrete obstruction					
		(thickness not proven). Borehole					
		terminated.					
		2.5 m bgl					
3.0							

Remarks: Borehole terminated at 2.5m bgl due to reinforced concrete obstruction. No groundwater encountered. Checked by:

**Project No:** UK22-20354

**Window Sample:** SB09

**Client:** Enemalta

**Date:** 27th June 2011

**Location:** Delimara Power Station

**Plant Used:** Beretta T44 Continuous Flight Auger Rig

**Datum:**

**Logged by:** MH

**ENVIRON**

SUBSURFACE PROFILE			SAMPLE			PID Reading ppm 50 150	Well Installation
Depth	Symbol	Description	Elevation	Sample	Lab Analysis		
0.0		Ground Surface	0.00				Backfilled with arisings
		<b>MADE GROUND</b> Grey sandy gravel of mudstone and limestone. Gravel is fine to coarse, sub-angular to sub-rounded.	-0.50			0.20	
		<b>MUDSTONE</b> Greeny brownish grey MUDSTONE (recovered as clay and gravel).				1.70	
1.0						2.30	
						1.20	
2.0							
						2.20	
3.0							
						1.80	
4.0							
						0.90	
5.0							
						1.70	
6.0		6 m bgl	-6.00				

Remarks: No groundwater encountered.

Checked by:

Sheet: 1 of 1

**Project No:** UK22-20354

**Client:** Enemalta

**Location:** Delimara Power Station

**Datum:**

**Window Sample:** SB10

**Date:** 28th June 2011

**Plant Used:** Beretta T44 Continuous Flight Auger Rig

**Logged by:** MH

**ENVIRON**

SUBSURFACE PROFILE			SAMPLE			PID Reading ppm 50 150	Well Installation
Depth	Symbol	Description	Elevation	Sample	Lab Analysis		
0.0		Ground Surface	0.00				Backfilled with arisings
		<b>REWORKED MUDSTONE AND LIMESTONE</b> Cream reworked fine-grained limestone and grey fine and coarse gravel of mudstone.				0.00	
		Becoming brown at 0.3m bgl.	-1.00			0.10	
1.0		<b>REWORKED MUDSTONE</b> Rewoked greeny brown mudstone.				0.10	
		Damp at 2.1m bgl. Mudstone recovered as clay.				0.20	
2.0		Wet at 6.3m bgl.				0.40	
						0.00	
3.0						0.30	
4.0						0.10	
5.0						0.10	
6.0		6 m bgl	-6.00			0.10	

Remarks:

Checked by:

Sheet: 1 of 1



**Project No:** UK22-20354

**Client:** Enemalta

**Location:** Delimara Power Station

**Datum:**

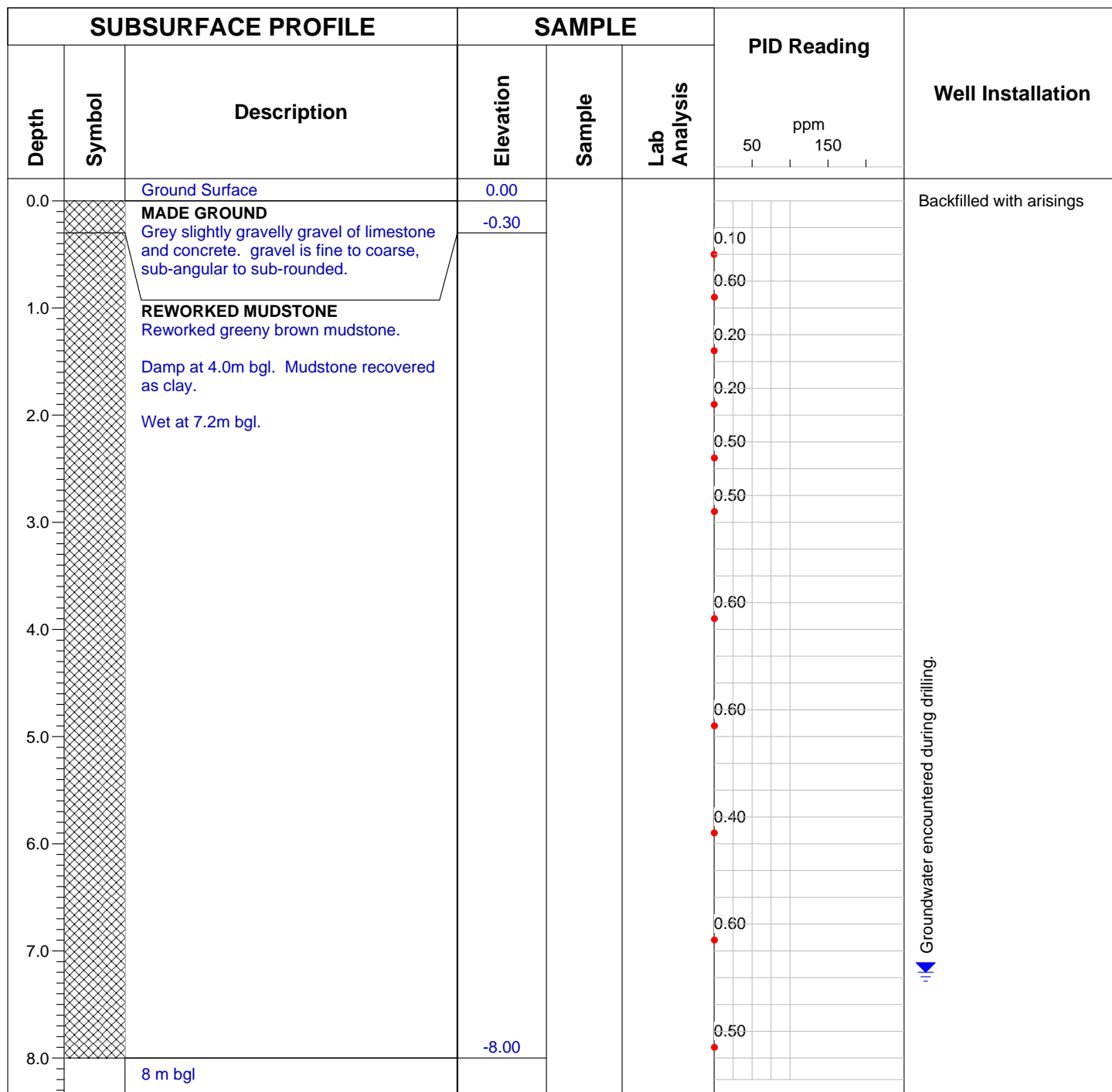
**Window Sample:** SB11

**Date:** 28th June 2011

**Plant Used:** Beretta T44 Continuous Flight Auger Rig

**Logged by:** MH

**ENVIRON**



Remarks:

Checked by:

Sheet: 1 of 1

**Project No:** UK22-20354

**Client:** Enemalta

**Location:** Delimara Power Station

**Datum:**

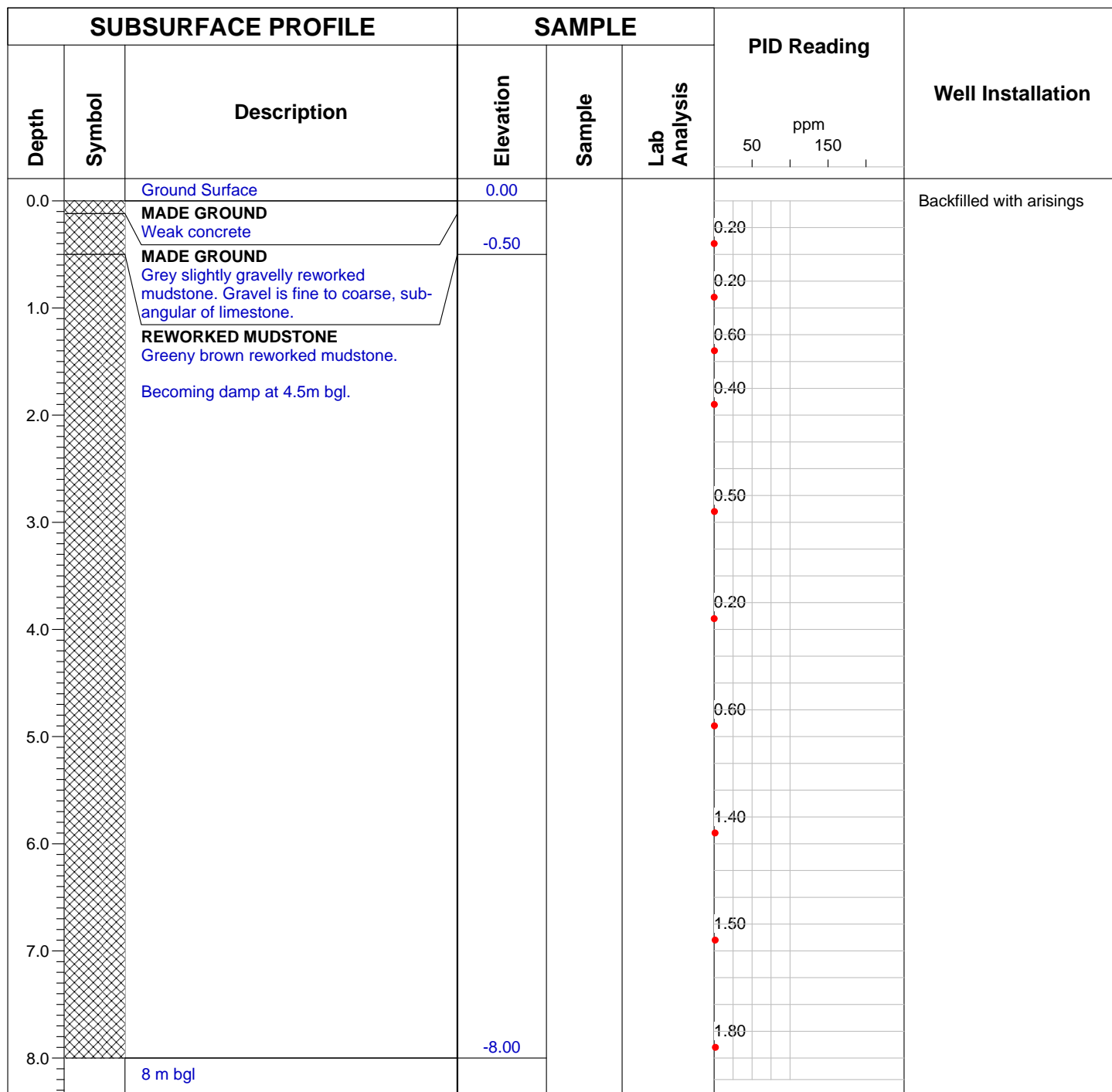
**Window Sample:** SB11

**Date:** 28th June 2011

**Plant Used:** Beretta T44 Continuous Flight Auger Rig

**Logged by:** MH

**ENVIRON**



Remarks:

Checked by:

Sheet: 1 of 1



Photo 1.  
General View of Delimara Power Station  
(Looking North)



Photo 2.  
BH07 – Proposed Location



Photo 3.  
SB04 – Proposed Location



Photo 4.  
SB09 – Proposed Location



Photo 5.  
SB10 - Proposed Location



Photo 6.  
SB12 – Proposed location

**Site:** Delimara Power Station, Malta

**Date:** August 2011

**Client:** Enemalta

**Document Version:** 1



Photo 7.  
Beretta T44 Drilling Rig



Photo 8.  
Beretta T44 Drilling Rig.



Photo 9.  
Arisings from SB02 (0.0 – 5.0m bgl)



Photo 10.  
Arisings from SB04 (0.0m – 2.5m bgl).



Photo 11.  
Arisings from SB04 (0.0m – 6.5m bgl).



Photo 12.  
Arisings from SB05 (0.0m – 4.5m bgl)

**Site:** Delimara Power Station, Malta

**Date:** August 2011

**Client:** Enemalta

**Document Version:** 1





Photo 13.  
Arisings from SB06B (0.0m – 5.5m bgl)



Photo 14.  
SB07 Hand dug service pit to 0.9m bgl



Photo 15.  
Arisings from BH01 (3.0m bgl)



Photo 16  
Arisings from BH01 (5.5m bgl).



Photo 17.  
Arisings from BH02 (0.0m-0.5m bgl)



Photo 18.  
Arisings from LF01 (0.0 – 6.5m bgl)

**Site:** Delimara Power Station, Malta

**Date:** August 2011

**Client:** Enemalta

**Document Version:** 1



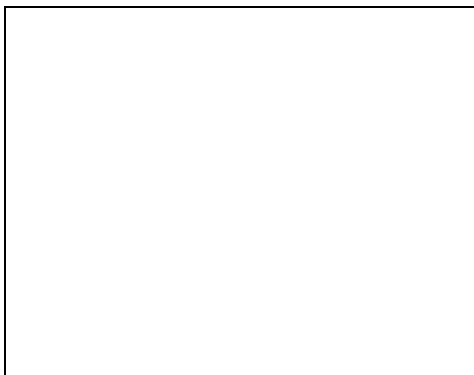
Photo 19.  
Arisings from LF02 (0.0 – 6.0m bgl)



Photo 20.  
Arisings from LF02 (25.4m bgl)



Photo 21.  
Arisings from LF03 (0.0-6.0m bgl)



<b>Site:</b> Delimara Power Station, Malta	<b>Date:</b> August 2011
<b>Client:</b> Enemalta	<b>Document Version:</b> 1

## **Annex C: Summary of Analytical Results**

Delimara Power Station Soil Boring Analytical Results	ENVIRON GAC (Commercial)		SAMPLE ID	DPS-SB01	DPS-SB01	DPS-SB02	DPS-SB03
			DEPTH (m)	0-0.5	2.5-3.0	0-0.5	0.5-1.0
			LOCATION	DPS	DPS	DPS	DPS
			SAMPLE DATE	08/06/2011	08/06/2011	08/06/2011	08/06/2011
Metals		Method	Units				
Antimony	7,550	TM30/PM15	mg/kg	<1	<1	<1	<1
Arsenic	635	TM30/PM15	mg/kg	1.2	2.4	2.3	1.9
Cadmium	230	TM30/PM15	mg/kg	0.2	0.4	0.3	0.4
Chromium	35	TM30/PM15	mg/kg	7.8	20	20	19.8
Cobalt	NG	TM30/PM15	mg/kg	0.9	2.6	2.6	2
Copper	71,700	TM30/PM15	mg/kg	12	16	17	18
Lead	750	TM30/PM15	mg/kg	<5	<5	<5	<5
Manganese	NG	TM30/PM15	mg/kg	40	70	71	56
Mercury	3,640	TM30/PM15	mg/kg	0.4	0.3	0.4	0.5
Nickel	1,790	TM30/PM15	mg/kg	6.6	23.2	21.8	24.7
Selenium	13,000	TM30/PM15	mg/kg	<1	1	<1	2
Thallium	NG	TM30/PM15	mg/kg	<1	<1	<1	<1
Tin	NG	TM30/PM15	mg/kg	<1	<1	<1	<1
Vanadium	3,160	TM30/PM15	mg/kg	13	17	18	20
Zinc	665,000	TM30/PM15	mg/kg	17	56	55	53
Inorganics							
Asbestos Screen	N/A	-	Subcontracted	NAD	-	NAD	NAD
pH	N/A	pH units	TM73/PM11	8.35	7.82	8.01	7.97
Total Sulphate	N/A	mg/kg	TM50/PM15	2248	4721	4916	2190
Fraction Organic Carbon	N/A	None	TM21/PM24	-	-	-	0.012
Sulphide	N/A	mg/kg	Subcontracted	<0.5	<0.5	<0.5	1.7
PAHs							
Naphthalene	75	mg/kg	TM4/PM8	<0.40	<0.04	<0.04	<0.04
Acenaphthylene	162	mg/kg	TM4/PM8	<0.30	<0.03	<0.03	<0.03
Acenaphthene	56.7	mg/kg	TM4/PM8	<0.50	<0.05	<0.05	<0.05
Fluorene	160	mg/kg	TM4/PM8	<0.40	<0.04	<0.04	<0.04
Phenanthrene	21,900	mg/kg	TM4/PM8	<0.30	<0.03	<0.03	<0.03
Anthracene	522,000	mg/kg	TM4/PM8	<0.40	<0.04	<0.04	<0.04
Fluoranthene	22,600	mg/kg	TM4/PM8	<0.30	<0.03	<0.03	<0.03
Pyrene	54,300	mg/kg	TM4/PM8	<0.30	<0.03	<0.03	<0.03
Benz(a)anthracene	91	mg/kg	TM4/PM8	<0.60	<0.06	<0.06	<0.06
Chrysene	140.0	mg/kg	TM4/PM8	<0.20	<0.02	<0.02	<0.02
Benzo(bk)fluoranthene	102	mg/kg	TM4/PM8	<0.70	<0.07	<0.07	<0.07
Benzo(a)pyrene	14	mg/kg	TM4/PM8	<0.40	<0.04	<0.04	<0.04
Indeno(123cd)pyrene	61.0	mg/kg	TM4/PM8	<0.40	<0.04	<0.04	<0.04
Dibenzo(ah)anthracene	13	mg/kg	TM4/PM8	<0.40	<0.04	<0.04	<0.04
Benzo(ghi)perylene	658	mg/kg	TM4/PM8	<0.40	<0.04	<0.04	<0.04
PAH 16 Total	NG	mg/kg	TM4/PM8	<6.0	<0.6	<0.6	<0.6
Benzo(b)fluoranthene	102	mg/kg	TM4/PM8	<0.50	<0.05	<0.05	<0.05
Benzo(k)fluoranthene	143	mg/kg	TM4/PM8	<0.20	<0.02	<0.02	<0.02
PAH Surrogate % Recovery	N/A	%	TM4/PM8	101	109	106	100
Hydrocarbons							
EPH >C8-C10	N/A	mg/kg	TM5/PM8	<5	<5	<5	<5
EPH >C10-C20	N/A	mg/kg	TM5/PM8	<10	<10	<10	<10
EPH >C20-C30	N/A	mg/kg	TM5/PM8	88	<10	<10	<10
EPH >C30-C40	N/A	mg/kg	TM5/PM8	549	<10	<10	<10
EPH >C8-C40	5,000	mg/kg	TM5/PM8	637	<35	<35	<35
PCBs							
PCB 28	240.0	ug/kg	TM86/PM8	-	-	-	<5
PCB 52	240.0	ug/kg	TM86/PM8	-	-	-	<5
PCB 101	240.0	ug/kg	TM86/PM8	-	-	-	<5
PCB 118	240.0	ug/kg	TM86/PM8	-	-	-	<5
PCB 138	240.0	ug/kg	TM86/PM8	-	-	-	<5
PCB 153	240.0	ug/kg	TM86/PM8	-	-	-	<5
PCB 180	240.0	ug/kg	TM86/PM8	-	-	-	<5
Total 7 PCBs	240	ug/kg	TM86/PM8	-	-	-	<35
SVOCs							
2-Chlorophenol	3,590,000	ug/kg	TM16/PM8	-	-	-	<10
2-Methylphenol	14,200,000	ug/kg	TM16/PM8	-	-	-	<10
2-Nitrophenol	910,597	ug/kg	TM16/PM8	-	-	-	<10
2,4-Dichlorophenol	3,530,000	ug/kg	TM16/PM8	-	-	-	<10
2,4-Dimethylphenol	1,330,000	ug/kg	TM16/PM8	-	-	-	<10
2,4,5-Trichlorophenol	2,300,000	ug/kg	TM16/PM8	-	-	-	<10
2,4,6-Trichlorophenol	848,000	ug/kg	TM16/PM8	-	-	-	<10
4-Chloro-3-methylphenol	8,333,156	ug/kg	TM16/PM8	-	-	-	<10
4-Methylphenol	25,800,000	ug/kg	TM16/PM8	-	-	-	<10
4-Nitrophenol	1,000,000	ug/kg	TM16/PM8	-	-	-	<10
Pentachlorophenol	1,230,000	ug/kg	TM16/PM8	-	-	-	<10
Phenol	3,200,000	ug/kg	TM16/PM8	-	-	-	<10
2-Chloronaphthalene	113,000	ug/kg	TM16/PM8	-	-	-	<10



Delimara Power Station Soil Boring Analytical Results	ENVIRON GAC (Commercial)		SAMPLE ID	DPS-SB03	DPS-SB04	DPS-SB05	DPS-SB05
			DEPTH (m)	2.0-2.5	0.5-1.0	0.5-1.0	2.5-3.0
			LOCATION	DPS	DPS	DPS	DPS
			SAMPLE DATE	08/06/2011	08/06/2011	08/06/2011	08/06/2011
Metals		Method	Units				
Antimony	7,550	TM30/PM15	mg/kg	<1	<1	<1	<1
Arsenic	635	TM30/PM15	mg/kg	2.4	2	2.4	4
Cadmium	230	TM30/PM15	mg/kg	0.4	0.5	0.3	0.3
Chromium	35	TM30/PM15	mg/kg	22.6	19.2	15.9	17.1
Cobalt	NG	TM30/PM15	mg/kg	2.4	1	2.2	3
Copper	71,700	TM30/PM15	mg/kg	21	8	12	13
Lead	750	TM30/PM15	mg/kg	<5	<5	<5	<5
Manganese	NG	TM30/PM15	mg/kg	62	61	68	95
Mercury	3,640	TM30/PM15	mg/kg	0.3	0.4	0.4	0.4
Nickel	1,790	TM30/PM15	mg/kg	28.4	10.7	18.5	18.5
Selenium	13,000	TM30/PM15	mg/kg	2	<1	<1	<1
Thallium	NG	TM30/PM15	mg/kg	<1	<1	<1	<1
Tin	NG	TM30/PM15	mg/kg	<1	<1	<1	<1
Vanadium	3,160	TM30/PM15	mg/kg	22	11	14	21
Zinc	665,000	TM30/PM15	mg/kg	62	30	41	41
Inorganics							
Asbestos Screen	N/A	-	Subcontracted	-	NAD	NAD	-
pH	N/A	pH units	TM73/PM11	8.22	8.52	8.15	8.28
Total Sulphate	N/A	mg/kg	TM50/PM15	2333	1186	5384	1937
Fraction Organic Carbon	N/A	None	TM21/PM24	0.014	-	-	-
Sulphide	N/A	mg/kg	Subcontracted	1.0	0.6	<0.5	<0.5
PAHs							
Naphthalene	75	mg/kg	TM4/PM8	<0.04	<0.04	<0.04	<0.04
Acenaphthylene	162	mg/kg	TM4/PM8	<0.03	<0.03	<0.03	<0.03
Acenaphthene	56.7	mg/kg	TM4/PM8	<0.05	<0.05	<0.05	<0.05
Fluorene	160	mg/kg	TM4/PM8	<0.04	<0.04	<0.04	<0.04
Phenanthrene	21,900	mg/kg	TM4/PM8	<0.03	<0.03	<0.03	<0.03
Anthracene	522,000	mg/kg	TM4/PM8	<0.04	<0.04	<0.04	<0.04
Fluoranthene	22,600	mg/kg	TM4/PM8	<0.03	<0.03	<0.03	<0.03
Pyrene	54,300	mg/kg	TM4/PM8	<0.03	<0.03	<0.03	<0.03
Benz(a)anthracene	91	mg/kg	TM4/PM8	<0.06	<0.06	<0.06	<0.06
Chrysene	140.0	mg/kg	TM4/PM8	<0.02	<0.02	<0.02	<0.02
Benzo(bk)fluoranthene	102	mg/kg	TM4/PM8	<0.07	<0.07	<0.07	<0.07
Benzo(a)pyrene	14	mg/kg	TM4/PM8	<0.04	<0.04	<0.04	<0.04
Indeno(123cd)pyrene	61.0	mg/kg	TM4/PM8	<0.04	<0.04	<0.04	<0.04
Dibenzo(ah)anthracene	13	mg/kg	TM4/PM8	<0.04	<0.04	<0.04	<0.04
Benzo(ghi)perylene	658	mg/kg	TM4/PM8	<0.04	<0.04	<0.04	<0.04
PAH 16 Total	NG	mg/kg	TM4/PM8	<0.6	<0.6	<0.6	<0.6
Benzo(b)fluoranthene	102	mg/kg	TM4/PM8	<0.05	<0.05	<0.05	<0.05
Benzo(k)fluoranthene	143	mg/kg	TM4/PM8	<0.02	<0.02	<0.02	<0.02
PAH Surrogate % Recovery	N/A	%	TM4/PM8	112	118	124	121
Hydrocarbons							
EPH >C8-C10	N/A	mg/kg	TM5/PM8	<5	<5	<5	<5
EPH >C10-C20	N/A	mg/kg	TM5/PM8	<10	168	<10	<10
EPH >C20-C30	N/A	mg/kg	TM5/PM8	<10	50	<10	<10
EPH >C30-C40	N/A	mg/kg	TM5/PM8	<10	<10	<10	<10
EPH >C8-C40	5,000	mg/kg	TM5/PM8	<35	218	<35	<35
PCBs							
PCB 28	240.0	ug/kg	TM86/PM8	-	<5	<5	-
PCB 52	240.0	ug/kg	TM86/PM8	-	<5	<5	-
PCB 101	240.0	ug/kg	TM86/PM8	-	<5	<5	-
PCB 118	240.0	ug/kg	TM86/PM8	-	<5	<5	-
PCB 138	240.0	ug/kg	TM86/PM8	-	<5	<5	-
PCB 153	240.0	ug/kg	TM86/PM8	-	<5	<5	-
PCB 180	240.0	ug/kg	TM86/PM8	-	<5	<5	-
Total 7 PCBs	240	ug/kg	TM86/PM8	-	<35	<35	-
SVOCs							
2-Chlorophenol	3,590,000	ug/kg	TM16/PM8	-	<10	<10	-
2-Methylphenol	14,200,000	ug/kg	TM16/PM8	-	<10	<10	-
2-Nitrophenol	910,597	ug/kg	TM16/PM8	-	<10	<10	-
2,4-Dichlorophenol	3,530,000	ug/kg	TM16/PM8	-	<10	<10	-
2,4-Dimethylphenol	1,330,000	ug/kg	TM16/PM8	-	<10	<10	-
2,4,5-Trichlorophenol	2,300,000	ug/kg	TM16/PM8	-	<10	<10	-
2,4,6-Trichlorophenol	848,000	ug/kg	TM16/PM8	-	<10	<10	-
4-Chloro-3-methylphenol	8,333,156	ug/kg	TM16/PM8	-	<10	<10	-
4-Methylphenol	25,800,000	ug/kg	TM16/PM8	-	<10	<10	-
4-Nitrophenol	1,000,000	ug/kg	TM16/PM8	-	<10	<10	-
Pentachlorophenol	1,230,000	ug/kg	TM16/PM8	-	<10	<10	-
Phenol	3,200,000	ug/kg	TM16/PM8	-	<10	<10	-
2-Chloronaphthalene	113,000	ug/kg	TM16/PM8	-	<10	<10	-

Delimara Power Station Soil Boring Analytical Results	ENVIRON GAC (Commercial)		SAMPLE ID	DPS-SB06	DPS-SB07	DPS-SB08	SB-09
			DEPTH (m)	0-0.5	0.4	2.0-2.5	0.3-0.5
			LOCATION	DPS	DPS	DPS	DPS
			SAMPLE DATE	08/06/2011	13/06/2011	13/06/2011	27/06/2011
Metals		Method	Units				
Antimony	7,550	TM30/PM15	mg/kg	1	<1	<1	<1
Arsenic	635	TM30/PM15	mg/kg	6.1	2.1	3	2.6
Cadmium	230	TM30/PM15	mg/kg	0.5	0.4	0.4	0.4
Chromium	35	TM30/PM15	mg/kg	17.8	19.1	20.5	19.5
Cobalt	NG	TM30/PM15	mg/kg	3	2.5	2.1	2.6
Copper	71,700	TM30/PM15	mg/kg	17	15	14	15
Lead	750	TM30/PM15	mg/kg	<5	<5	<5	<5
Manganese	NG	TM30/PM15	mg/kg	82	65	77	68
Mercury	3,640	TM30/PM15	mg/kg	0.3	0.4	0.4	0.4
Nickel	1,790	TM30/PM15	mg/kg	24.1	24.4	21.8	34.3
Selenium	13,000	TM30/PM15	mg/kg	2	1	<1	<1
Thallium	NG	TM30/PM15	mg/kg	<1	<1	<1	<1
Tin	NG	TM30/PM15	mg/kg	<1	1	2	<1
Vanadium	3,160	TM30/PM15	mg/kg	19	17	17	53
Zinc	665,000	TM30/PM15	mg/kg	55	53	48	52
Inorganics							
Asbestos Screen	N/A	-	Subcontracted	NAD	-	-	-
pH	N/A	pH units	TM73/PM11	8.03	8.38	8.06	7.96
Total Sulphate	N/A	mg/kg	TM50/PM15	4505	1802	5607	-
Fraction Organic Carbon	N/A	None	TM21/PM24	-	-	-	-
Sulphide	N/A	mg/kg	Subcontracted	<0.5	<0.5	<0.5	<0.5
PAHs							
Naphthalene	75	mg/kg	TM4/PM8	<0.04	<0.04	<0.04	<0.04
Acenaphthylene	162	mg/kg	TM4/PM8	<0.03	<0.03	<0.03	<0.03
Acenaphthene	56.7	mg/kg	TM4/PM8	<0.05	<0.05	<0.05	<0.05
Fluorene	160	mg/kg	TM4/PM8	<0.04	<0.04	<0.04	<0.04
Phenanthrene	21,900	mg/kg	TM4/PM8	0.03	<0.03	<0.03	<0.03
Anthracene	522,000	mg/kg	TM4/PM8	<0.04	<0.04	<0.04	<0.04
Fluoranthene	22,600	mg/kg	TM4/PM8	0.05	<0.03	<0.03	<0.03
Pyrene	54,300	mg/kg	TM4/PM8	0.05	<0.03	<0.03	<0.03
Benz(a)anthracene	91	mg/kg	TM4/PM8	0.07	<0.06	<0.06	<0.06
Chrysene	140.0	mg/kg	TM4/PM8	0.07	<0.02	<0.02	<0.02
Benzo(bk)fluoranthene	102	mg/kg	TM4/PM8	0.17	<0.07	<0.07	<0.07
Benzo(a)pyrene	14	mg/kg	TM4/PM8	0.07	<0.04	<0.04	<0.04
Indeno(123cd)pyrene	61.0	mg/kg	TM4/PM8	0.06	<0.04	<0.04	<0.04
Dibenzo(ah)anthracene	13	mg/kg	TM4/PM8	0.06	<0.04	<0.04	<0.04
Benzo(ghi)perylene	658	mg/kg	TM4/PM8	0.09	<0.04	<0.04	<0.04
PAH 16 Total	NG	mg/kg	TM4/PM8	0.7	<0.6	<0.6	<0.6
Benzo(b)fluoranthene	102	mg/kg	TM4/PM8	0.12	<0.05	<0.05	<0.05
Benzo(k)fluoranthene	143	mg/kg	TM4/PM8	0.05	<0.02	<0.02	<0.02
PAH Surrogate % Recovery	N/A	%	TM4/PM8	117	86	97	103
Hydrocarbons							
EPH >C8-C10	N/A	mg/kg	TM5/PM8	<5	<5	<5	<5
EPH >C10-C20	N/A	mg/kg	TM5/PM8	<10	<10	<10	<10
EPH >C20-C30	N/A	mg/kg	TM5/PM8	<10	<10	<10	<10
EPH >C30-C40	N/A	mg/kg	TM5/PM8	<10	<10	<10	<10
EPH >C8-C40	5,000	mg/kg	TM5/PM8	<35	<35	<35	<35
PCBs							
PCB 28	240.0	ug/kg	TM86/PM8	-	<5	-	-
PCB 52	240.0	ug/kg	TM86/PM8	-	<5	-	-
PCB 101	240.0	ug/kg	TM86/PM8	-	<5	-	-
PCB 118	240.0	ug/kg	TM86/PM8	-	<5	-	-
PCB 138	240.0	ug/kg	TM86/PM8	-	<5	-	-
PCB 153	240.0	ug/kg	TM86/PM8	-	<5	-	-
PCB 180	240.0	ug/kg	TM86/PM8	-	<5	-	-
Total 7 PCBs	240	ug/kg	TM86/PM8	-	<35	-	-
SVOCs							
2-Chlorophenol	3,590,000	ug/kg	TM16/PM8	-	-	-	<10
2-Methylphenol	14,200,000	ug/kg	TM16/PM8	-	-	-	<10
2-Nitrophenol	910,597	ug/kg	TM16/PM8	-	-	-	<10
2,4-Dichlorophenol	3,530,000	ug/kg	TM16/PM8	-	-	-	<10
2,4-Dimethylphenol	1,330,000	ug/kg	TM16/PM8	-	-	-	<10
2,4,5-Trichlorophenol	2,300,000	ug/kg	TM16/PM8	-	-	-	<10
2,4,6-Trichlorophenol	848,000	ug/kg	TM16/PM8	-	-	-	<10
4-Chloro-3-methylphenol	8,333,156	ug/kg	TM16/PM8	-	-	-	<10
4-Methylphenol	25,800,000	ug/kg	TM16/PM8	-	-	-	<10
4-Nitrophenol	1,000,000	ug/kg	TM16/PM8	-	-	-	<10
Pentachlorophenol	1,230,000	ug/kg	TM16/PM8	-	-	-	<10
Phenol	3,200,000	ug/kg	TM16/PM8	-	-	-	<10
2-Chloronaphthalene	113,000	ug/kg	TM16/PM8	-	-	-	<10

Delimara Power Station Soil Boring Analytical Results	ENVIRON GAC (Commercial)		SAMPLE ID	SB-09	SB-10	SB-10-DS	SB-11
			DEPTH (m)	1.3-1.5	2.3-2.5	2.3-2.5	0.3-0.5
			LOCATION	DPS	DPS	DPS	DPS
			SAMPLE DATE	27/06/2011	28/06/2011	28/06/2011	28/06/2011
Metals		Method	Units				
Antimony	7,550	TM30/PM15	mg/kg	<1	<1	<1	<1
Arsenic	635	TM30/PM15	mg/kg	2.3	2.9	2.4	2.4
Cadmium	230	TM30/PM15	mg/kg	0.4	0.4	0.4	0.2
Chromium	35	TM30/PM15	mg/kg	20.7	14.9	13.3	9.8
Cobalt	NG	TM30/PM15	mg/kg	3	2.3	1.8	1.1
Copper	71,700	TM30/PM15	mg/kg	16	12	10	9
Lead	750	TM30/PM15	mg/kg	<5	13	<5	<5
Manganese	NG	TM30/PM15	mg/kg	66	57	50	54
Mercury	3,640	TM30/PM15	mg/kg	0.3	0.4	0.4	0.4
Nickel	1,790	TM30/PM15	mg/kg	23.8	17.1	13.7	10.5
Selenium	13,000	TM30/PM15	mg/kg	<1	<1	<1	<1
Thallium	NG	TM30/PM15	mg/kg	<1	<1	<1	<1
Tin	NG	TM30/PM15	mg/kg	<1	<1	<1	4
Vanadium	3,160	TM30/PM15	mg/kg	17	16	14	8
Zinc	665,000	TM30/PM15	mg/kg	58	43	31	29
Inorganics							
Asbestos Screen	N/A	-	Subcontracted	-	-	-	-
pH	N/A	pH units	TM73/PM11	8.49	8.14	8.15	8.61
Total Sulphate	N/A	mg/kg	TM50/PM15	-	-	-	-
Fraction Organic Carbon	N/A	None	TM21/PM24	-	-	-	-
Sulphide	N/A	mg/kg	Subcontracted	<0.5	<0.5	<0.5	<0.5
PAHs							
Naphthalene	75	mg/kg	TM4/PM8	<0.04	<0.04	<0.04	<0.04
Acenaphthylene	162	mg/kg	TM4/PM8	<0.03	<0.03	<0.03	<0.03
Acenaphthene	56.7	mg/kg	TM4/PM8	<0.05	<0.05	<0.05	<0.05
Fluorene	160	mg/kg	TM4/PM8	<0.04	<0.04	<0.04	<0.04
Phenanthrene	21,900	mg/kg	TM4/PM8	<0.03	<0.03	<0.03	<0.03
Anthracene	522,000	mg/kg	TM4/PM8	<0.04	<0.04	<0.04	<0.04
Fluoranthene	22,600	mg/kg	TM4/PM8	<0.03	<0.03	<0.03	<0.03
Pyrene	54,300	mg/kg	TM4/PM8	<0.03	<0.03	<0.03	<0.03
Benz(a)anthracene	91	mg/kg	TM4/PM8	<0.06	<0.06	<0.06	<0.06
Chrysene	140.0	mg/kg	TM4/PM8	<0.02	<0.02	<0.02	<0.02
Benzo(bk)fluoranthene	102	mg/kg	TM4/PM8	<0.07	<0.07	<0.07	<0.07
Benzo(a)pyrene	14	mg/kg	TM4/PM8	<0.04	<0.04	<0.04	<0.04
Indeno(123cd)pyrene	61.0	mg/kg	TM4/PM8	<0.04	<0.04	<0.04	<0.04
Dibenzo(ah)anthracene	13	mg/kg	TM4/PM8	<0.04	<0.04	<0.04	<0.04
Benzo(ghi)perylene	658	mg/kg	TM4/PM8	<0.04	<0.04	<0.04	<0.04
PAH 16 Total	NG	mg/kg	TM4/PM8	<0.6	<0.6	<0.6	<0.6
Benzo(b)fluoranthene	102	mg/kg	TM4/PM8	<0.05	<0.05	<0.05	<0.05
Benzo(k)fluoranthene	143	mg/kg	TM4/PM8	<0.02	<0.02	<0.02	<0.02
PAH Surrogate % Recovery	N/A	%	TM4/PM8	113	106	102	105
Hydrocarbons							
EPH >C8-C10	N/A	mg/kg	TM5/PM8	<5	<5	<5	<5
EPH >C10-C20	N/A	mg/kg	TM5/PM8	<10	<10	<10	76
EPH >C20-C30	N/A	mg/kg	TM5/PM8	<10	<10	<10	42
EPH >C30-C40	N/A	mg/kg	TM5/PM8	<10	<10	<10	23
EPH >C8-C40	5,000	mg/kg	TM5/PM8	<35	<35	<35	141
PCBs							
PCB 28	240.0	ug/kg	TM86/PM8	<5	<5	-	-
PCB 52	240.0	ug/kg	TM86/PM8	<5	<5	-	-
PCB 101	240.0	ug/kg	TM86/PM8	<5	<5	-	-
PCB 118	240.0	ug/kg	TM86/PM8	<5	<5	-	-
PCB 138	240.0	ug/kg	TM86/PM8	<5	<5	-	-
PCB 153	240.0	ug/kg	TM86/PM8	<5	<5	-	-
PCB 180	240.0	ug/kg	TM86/PM8	<5	<5	-	-
Total 7 PCBs	240	ug/kg	TM86/PM8	<35	<35	-	-
SVOCs							
2-Chlorophenol	3,590,000	ug/kg	TM16/PM8	-	<10	-	-
2-Methylphenol	14,200,000	ug/kg	TM16/PM8	-	<10	-	-
2-Nitrophenol	910,597	ug/kg	TM16/PM8	-	<10	-	-
2,4-Dichlorophenol	3,530,000	ug/kg	TM16/PM8	-	<10	-	-
2,4-Dimethylphenol	1,330,000	ug/kg	TM16/PM8	-	<10	-	-
2,4,5-Trichlorophenol	2,300,000	ug/kg	TM16/PM8	-	<10	-	-
2,4,6-Trichlorophenol	848,000	ug/kg	TM16/PM8	-	<10	-	-
4-Chloro-3-methylphenol	8,333,156	ug/kg	TM16/PM8	-	<10	-	-
4-Methylphenol	25,800,000	ug/kg	TM16/PM8	-	<10	-	-
4-Nitrophenol	1,000,000	ug/kg	TM16/PM8	-	<10	-	-
Pentachlorophenol	1,230,000	ug/kg	TM16/PM8	-	<10	-	-
Phenol	3,200,000	ug/kg	TM16/PM8	-	<10	-	-
2-Chloronaphthalene	113,000	ug/kg	TM16/PM8	-	<10	-	-

Delimara Power Station Soil Boring Analytical Results	ENVIRON GAC (Commercial)		SAMPLE ID	SB-12
			DEPTH (m)	0.8-1.0
			LOCATION	DPS
			SAMPLE DATE	28/06/2011
Metals		Method	Units	
Antimony	7,550	TM30/PM15	mg/kg	<1
Arsenic	635	TM30/PM15	mg/kg	2.8
Cadmium	230	TM30/PM15	mg/kg	0.3
Chromium	35	TM30/PM15	mg/kg	20.6
Cobalt	NG	TM30/PM15	mg/kg	2.8
Copper	71,700	TM30/PM15	mg/kg	14
Lead	750	TM30/PM15	mg/kg	<5
Manganese	NG	TM30/PM15	mg/kg	77
Mercury	3,640	TM30/PM15	mg/kg	0.3
Nickel	1,790	TM30/PM15	mg/kg	22.2
Selenium	13,000	TM30/PM15	mg/kg	4
Thallium	NG	TM30/PM15	mg/kg	<1
Tin	NG	TM30/PM15	mg/kg	<1
Vanadium	3,160	TM30/PM15	mg/kg	17
Zinc	665,000	TM30/PM15	mg/kg	51
Inorganics				
Asbestos Screen	N/A	-	Subcontracted	-
pH	N/A	pH units	TM73/PM11	11.15
Total Sulphate	N/A	mg/kg	TM50/PM15	-
Fraction Organic Carbon	N/A	None	TM21/PM24	-
Sulphide	N/A	mg/kg	Subcontracted	<0.5
PAHs				
Naphthalene	75	mg/kg	TM4/PM8	<0.04
Acenaphthylene	162	mg/kg	TM4/PM8	<0.03
Acenaphthene	56.7	mg/kg	TM4/PM8	<0.05
Fluorene	160	mg/kg	TM4/PM8	<0.04
Phenanthrene	21,900	mg/kg	TM4/PM8	<0.03
Anthracene	522,000	mg/kg	TM4/PM8	<0.04
Fluoranthene	22,600	mg/kg	TM4/PM8	<0.03
Pyrene	54,300	mg/kg	TM4/PM8	<0.03
Benz(a)anthracene	91	mg/kg	TM4/PM8	<0.06
Chrysene	140.0	mg/kg	TM4/PM8	<0.02
Benzo(bk)fluoranthene	102	mg/kg	TM4/PM8	<0.07
Benzo(a)pyrene	14	mg/kg	TM4/PM8	<0.04
Indeno(123cd)pyrene	61.0	mg/kg	TM4/PM8	<0.04
Dibenzo(ah)anthracene	13	mg/kg	TM4/PM8	<0.04
Benzo(ghi)perylene	658	mg/kg	TM4/PM8	<0.04
PAH 16 Total	NG	mg/kg	TM4/PM8	<0.6
Benzo(b)fluoranthene	102	mg/kg	TM4/PM8	<0.05
Benzo(k)fluoranthene	143	mg/kg	TM4/PM8	<0.02
PAH Surrogate % Recovery	N/A	%	TM4/PM8	109
Hydrocarbons				
EPH >C8-C10	N/A	mg/kg	TM5/PM8	<5
EPH >C10-C20	N/A	mg/kg	TM5/PM8	<10
EPH >C20-C30	N/A	mg/kg	TM5/PM8	<10
EPH >C30-C40	N/A	mg/kg	TM5/PM8	<10
EPH >C8-C40	5,000	mg/kg	TM5/PM8	<35
PCBs				
PCB 28	240.0	ug/kg	TM86/PM8	<5
PCB 52	240.0	ug/kg	TM86/PM8	<5
PCB 101	240.0	ug/kg	TM86/PM8	<5
PCB 118	240.0	ug/kg	TM86/PM8	<5
PCB 138	240.0	ug/kg	TM86/PM8	<5
PCB 153	240.0	ug/kg	TM86/PM8	<5
PCB 180	240.0	ug/kg	TM86/PM8	<5
Total 7 PCBs	240	ug/kg	TM86/PM8	<35
SVOCs				
2-Chlorophenol	3,590,000	ug/kg	TM16/PM8	<10
2-Methylphenol	14,200,000	ug/kg	TM16/PM8	<10
2-Nitrophenol	910,597	ug/kg	TM16/PM8	<10
2,4-Dichlorophenol	3,530,000	ug/kg	TM16/PM8	<10
2,4-Dimethylphenol	1,330,000	ug/kg	TM16/PM8	<10
2,4,5-Trichlorophenol	2,300,000	ug/kg	TM16/PM8	<10
2,4,6-Trichlorophenol	848,000	ug/kg	TM16/PM8	<10
4-Chloro-3-methylphenol	8,333,156	ug/kg	TM16/PM8	<10
4-Methylphenol	25,800,000	ug/kg	TM16/PM8	<10
4-Nitrophenol	1,000,000	ug/kg	TM16/PM8	<10
Pentachlorophenol	1,230,000	ug/kg	TM16/PM8	<10
Phenol	3,200,000	ug/kg	TM16/PM8	<10
2-Chloronaphthalene	113,000	ug/kg	TM16/PM8	<10

Delimara Power Station Soil Boring Analytical Results	ENVIRON GAC (Commercial)		SAMPLE ID	DPS-SB01	DPS-SB01	DPS-SB02	DPS-SB03
			DEPTH (m)	0-0.5	2.5-3.0	0-0.5	0.5-1.0
			LOCATION	DPS	DPS	DPS	DPS
			SAMPLE DATE	08/06/2011	08/06/2011	08/06/2011	08/06/2011
Metals		Method	Units				
2-Methylnaphthalene	7,148,111	ug/kg	TM16/PM8	-	-	-	<10
Bis(2-ethylhexyl) phthalate	85,400,000	ug/kg	TM16/PM8	-	-	-	<10
Butylbenzyl phthalate	942,000,000	ug/kg	TM16/PM8	-	-	-	<10
Di-n-butyl phthalate	12,900	ug/kg	TM16/PM8	-	-	-	<10
Di-n-Octyl phthalate	89,100,000	ug/kg	TM16/PM8	-	-	-	<10
Diethyl phthalate	109,000	ug/kg	TM16/PM8	-	-	-	<10
Dimethyl phthalate	275,000	ug/kg	TM16/PM8	-	-	-	<10
1,2-Dichlorobenzene	562,000	ug/kg	TM16/PM8	-	-	-	<10
1,2,4-Trichlorobenzene	123,000	ug/kg	TM16/PM8	-	-	-	<10
1,3-Dichlorobenzene	177,000	ug/kg	TM16/PM8	-	-	-	<10
1,4-Dichlorobenzene	221,000	ug/kg	TM16/PM8	-	-	-	<10
2-Nitroaniline	651,305	ug/kg	TM16/PM8	-	-	-	<10
2,4-Dinitrotoluene	3,750,000	ug/kg	TM16/PM8	-	-	-	<10
2,6-Dinitrotoluene	1,860,000	ug/kg	TM16/PM8	-	-	-	<10
3-Nitroaniline	200,000	ug/kg	TM16/PM8	-	-	-	<10
4-Bromophenylphenylether	982.8	ug/kg	TM16/PM8	-	-	-	<10
4-Chloroaniline	2,300,000	ug/kg	TM16/PM8	-	-	-	<10
4-Chlorophenylphenylether	378.3	ug/kg	TM16/PM8	-	-	-	<10
4-Nitroaniline	170,000	ug/kg	TM16/PM8	-	-	-	<10
Azobenzene	151,511	ug/kg	TM16/PM8	-	-	-	<10
Bis(2-chloroethoxy)methane	1,301.7	ug/kg	TM16/PM8	-	-	-	<10
Bis(2-chloroethyl)ether	273.6	ug/kg	TM16/PM8	-	-	-	<10
Carbazole	897,000	ug/kg	TM16/PM8	-	-	-	<10
Dibenzofuran	6,666,492	ug/kg	TM16/PM8	-	-	-	<10
Hexachlorobenzene	199	ug/kg	TM16/PM8	-	-	-	<10
Hexachlorobutadiene	17,600	ug/kg	TM16/PM8	-	-	-	<10
Hexachlorocyclopentadiene	1,091.3	ug/kg	TM16/PM8	-	-	-	<10
Hexachloroethane	8,130	ug/kg	TM16/PM8	-	-	-	<10
Isophorone	887,232	ug/kg	TM16/PM8	-	-	-	<10
N-nitrosodi-n-propylamine	1,904.9	ug/kg	TM16/PM8	-	-	-	<10
Nitrobenzene	131,262	ug/kg	TM16/PM8	-	-	-	<10
VOCs							
Dichlorodifluoromethane	1,500,000	ug/kg	TM15/PM10	-	-	-	<2
Methyl Tertiary Butyl Ether	-	ug/kg	TM15/PM10	-	-	-	<2
Chloromethane	593	ug/kg	TM15/PM10	-	-	-	<3
Vinyl Chloride	40.3	ug/kg	TM15/PM10	-	-	-	<2
Bromomethane	27,046	ug/kg	TM15/PM10	-	-	-	<1
Chloroethane	567,000	ug/kg	TM15/PM10	-	-	-	<2
Trichlorofluoromethane	2,200,000	ug/kg	TM15/PM10	-	-	-	<2
1,1-Dichloroethene	-	ug/kg	TM15/PM10	-	-	-	<6
Dichloromethane	-	ug/kg	TM15/PM10	-	-	-	<7
trans-1-2-Dichloroethene	12,300	ug/kg	TM15/PM10	-	-	-	<3
1,1-Dichloroethane	148,000	ug/kg	TM15/PM10	-	-	-	<3
cis-1-2-Dichloroethene	-	ug/kg	TM15/PM10	-	-	-	<3
2,2-Dichloropropane	20,460	ug/kg	TM15/PM10	-	-	-	<4
Bromochloromethane	-	ug/kg	TM15/PM10	-	-	-	<3
Chloroform	-	ug/kg	TM15/PM10	-	-	-	<3
1,1,1-Trichloroethane	391,511	ug/kg	TM15/PM10	-	-	-	<3
1,1-Dichloropropene	12,853	ug/kg	TM15/PM10	-	-	-	<3
Carbon tetrachloride	1,740	ug/kg	TM15/PM10	-	-	-	<4
1,2-Dichloroethane	356	ug/kg	TM15/PM10	-	-	-	<4
Benzene	15,826	ug/kg	TM15/PM10	-	-	-	<3
Trichloroethene	6,611	ug/kg	TM15/PM10	-	-	-	<3
1,2-Dichloropropane	1,720	ug/kg	TM15/PM10	-	-	-	<6
Dibromomethane	-	ug/kg	TM15/PM10	-	-	-	<3
Bromodichloromethane	1,100	ug/kg	TM15/PM10	-	-	-	<3
cis-1-3-Dichloropropene	19,358	ug/kg	TM15/PM10	-	-	-	<4
Toluene	835,000	ug/kg	TM15/PM10	-	-	-	<3
trans-1-3-Dichloropropene	12,853	ug/kg	TM15/PM10	-	-	-	<3
1,1,2-Trichloroethane	51,100	ug/kg	TM15/PM10	-	-	-	<3
Tetrachloroethene	72,200	ug/kg	TM15/PM10	-	-	-	<3
1,3-Dichloropropane	12,853	ug/kg	TM15/PM10	-	-	-	<3
Dibromochloromethane	-	ug/kg	TM15/PM10	-	-	-	<3
1,2-Dibromoethane	-	ug/kg	TM15/PM10	-	-	-	<3
Chlorobenzene	32,800	ug/kg	TM15/PM10	-	-	-	<3
1,1,1,2-Tetrachloroethane	62,718	ug/kg	TM15/PM10	-	-	-	<3
Ethylbenzene	508,000	ug/kg	TM15/PM10	-	-	-	18
p/m-Xylene	564,000	ug/kg	TM15/PM10	-	-	-	<6
o-Xylene	467,000	ug/kg	TM15/PM10	-	-	-	<3
Styrene	607,000	ug/kg	TM15/PM10	-	-	-	<3

Delimara Power Station Soil Boring Analytical Results	ENVIRON GAC (Commercial)		SAMPLE ID	DPS-SB03	DPS-SB04	DPS-SB05	DPS-SB05
				DEPTH (m)	0.5-1.0	0.5-1.0	2.5-3.0
				LOCATION	DPS	DPS	DPS
				SAMPLE DATE	08/06/2011	08/06/2011	08/06/2011
Metals		Method	Units				
2-Methylnaphthalene	7,148,111	ug/kg	TM16/PM8	-	<10	<10	-
Bis(2-ethylhexyl) phthalate	85,400,000	ug/kg	TM16/PM8	-	<10	<10	-
Butylbenzyl phthalate	942,000,000	ug/kg	TM16/PM8	-	<10	<10	-
Di-n-butyl phthalate	12,900	ug/kg	TM16/PM8	-	<10	<10	-
Di-n-Octyl phthalate	89,100,000	ug/kg	TM16/PM8	-	<10	<10	-
Diethyl phthalate	109,000	ug/kg	TM16/PM8	-	92	61	-
Dimethyl phthalate	275,000	ug/kg	TM16/PM8	-	<10	<10	-
1,2-Dichlorobenzene	562,000	ug/kg	TM16/PM8	-	<10	<10	-
1,2,4-Trichlorobenzene	123,000	ug/kg	TM16/PM8	-	<10	<10	-
1,3-Dichlorobenzene	177,000	ug/kg	TM16/PM8	-	<10	<10	-
1,4-Dichlorobenzene	221,000	ug/kg	TM16/PM8	-	<10	<10	-
2-Nitroaniline	651,305	ug/kg	TM16/PM8	-	<10	<10	-
2,4-Dinitrotoluene	3,750,000	ug/kg	TM16/PM8	-	<10	<10	-
2,6-Dinitrotoluene	1,860,000	ug/kg	TM16/PM8	-	<10	<10	-
3-Nitroaniline	200,000	ug/kg	TM16/PM8	-	<10	<10	-
4-Bromophenylphenylether	982.8	ug/kg	TM16/PM8	-	<10	<10	-
4-Chloroaniline	2,300,000	ug/kg	TM16/PM8	-	<10	<10	-
4-Chlorophenylphenylether	378.3	ug/kg	TM16/PM8	-	<10	<10	-
4-Nitroaniline	170,000	ug/kg	TM16/PM8	-	<10	<10	-
Azobenzene	151,511	ug/kg	TM16/PM8	-	<10	<10	-
Bis(2-chloroethoxy)methane	1,301.7	ug/kg	TM16/PM8	-	<10	<10	-
Bis(2-chloroethyl)ether	273.6	ug/kg	TM16/PM8	-	<10	<10	-
Carbazole	897,000	ug/kg	TM16/PM8	-	<10	<10	-
Dibenzofuran	6,666,492	ug/kg	TM16/PM8	-	<10	<10	-
Hexachlorobenzene	199	ug/kg	TM16/PM8	-	<10	<10	-
Hexachlorobutadiene	17,600	ug/kg	TM16/PM8	-	<10	<10	-
Hexachlorocyclopentadiene	1,091.3	ug/kg	TM16/PM8	-	<10	<10	-
Hexachloroethane	8,130	ug/kg	TM16/PM8	-	<10	<10	-
Isophorone	887,232	ug/kg	TM16/PM8	-	<10	<10	-
N-nitrosodi-n-propylamine	1,904.9	ug/kg	TM16/PM8	-	<10	<10	-
Nitrobenzene	131,262	ug/kg	TM16/PM8	-	<10	<10	-
VOCs							
Dichlorodifluoromethane	1,500,000	ug/kg	TM15/PM10	-	<2	<2	-
Methyl Tertiary Butyl Ether	-	ug/kg	TM15/PM10	-	<2	<2	-
Chloromethane	593	ug/kg	TM15/PM10	-	<3	<3	-
Vinyl Chloride	40.3	ug/kg	TM15/PM10	-	<2	<2	-
Bromomethane	27,046	ug/kg	TM15/PM10	-	<1	<1	-
Chloroethane	567,000	ug/kg	TM15/PM10	-	<2	<2	-
Trichlorofluoromethane	2,200,000	ug/kg	TM15/PM10	-	<2	<2	-
1,1-Dichloroethene	-	ug/kg	TM15/PM10	-	<6	<6	-
Dichloromethane	-	ug/kg	TM15/PM10	-	<7	<7	-
trans-1-2-Dichloroethene	12,300	ug/kg	TM15/PM10	-	<3	<3	-
1,1-Dichloroethane	148,000	ug/kg	TM15/PM10	-	<3	<3	-
cis-1-2-Dichloroethene	-	ug/kg	TM15/PM10	-	<3	<3	-
2,2-Dichloropropane	20,460	ug/kg	TM15/PM10	-	<4	<4	-
Bromochloromethane	-	ug/kg	TM15/PM10	-	<3	<3	-
Chloroform	-	ug/kg	TM15/PM10	-	<3	<3	-
1,1,1-Trichloroethane	391,511	ug/kg	TM15/PM10	-	<3	<3	-
1,1-Dichloropropene	12,853	ug/kg	TM15/PM10	-	<3	<3	-
Carbon tetrachloride	1,740	ug/kg	TM15/PM10	-	<4	<4	-
1,2-Dichloroethane	356	ug/kg	TM15/PM10	-	<4	<4	-
Benzene	15,826	ug/kg	TM15/PM10	-	<3	<3	-
Trichloroethene	6,611	ug/kg	TM15/PM10	-	<3	<3	-
1,2-Dichloropropane	1,720	ug/kg	TM15/PM10	-	<6	<6	-
Dibromomethane	-	ug/kg	TM15/PM10	-	<3	<3	-
Bromodichloromethane	1,100	ug/kg	TM15/PM10	-	<3	<3	-
cis-1-3-Dichloropropene	19,358	ug/kg	TM15/PM10	-	<4	<4	-
Toluene	835,000	ug/kg	TM15/PM10	-	<3	<3	-
trans-1-3-Dichloropropene	12,853	ug/kg	TM15/PM10	-	<3	<3	-
1,1,2-Trichloroethane	51,100	ug/kg	TM15/PM10	-	<3	<3	-
Tetrachloroethene	72,200	ug/kg	TM15/PM10	-	<3	<3	-
1,3-Dichloropropane	12,853	ug/kg	TM15/PM10	-	<3	<3	-
Dibromochloromethane	-	ug/kg	TM15/PM10	-	<3	<3	-
1,2-Dibromoethane	-	ug/kg	TM15/PM10	-	<3	<3	-
Chlorobenzene	32,800	ug/kg	TM15/PM10	-	<3	<3	-
1,1,1,2-Tetrachloroethane	62,718	ug/kg	TM15/PM10	-	<3	<3	-
Ethylbenzene	508,000	ug/kg	TM15/PM10	-	<3	14	-
p/m-Xylene	564,000	ug/kg	TM15/PM10	-	<6	<6	-
o-Xylene	467,000	ug/kg	TM15/PM10	-	<3	<3	-
Styrene	607,000	ug/kg	TM15/PM10	-	<3	<3	-



Delimara Power Station Soil Boring Analytical Results	ENVIRON GAC (Commercial)		SAMPLE ID	DPS-SB06	DPS-SB07	DPS-SB08	SB-09
			DEPTH (m)	0-0.5	0.4	2.0-2.5	0.3-0.5
			LOCATION	DPS	DPS	DPS	DPS
			SAMPLE DATE	08/06/2011	13/06/2011	13/06/2011	27/06/2011
Metals		Method	Units				
2-Methylnaphthalene	7,148,111	ug/kg	TM16/PM8	-	-	-	<10
Bis(2-ethylhexyl) phthalate	85,400,000	ug/kg	TM16/PM8	-	-	-	<10
Butylbenzyl phthalate	942,000,000	ug/kg	TM16/PM8	-	-	-	<10
Di-n-butyl phthalate	12,900	ug/kg	TM16/PM8	-	-	-	<10
Di-n-Octyl phthalate	89,100,000	ug/kg	TM16/PM8	-	-	-	<10
Diethyl phthalate	109,000	ug/kg	TM16/PM8	-	-	-	<10
Dimethyl phthalate	275,000	ug/kg	TM16/PM8	-	-	-	<10
1,2-Dichlorobenzene	562,000	ug/kg	TM16/PM8	-	-	-	<10
1,2,4-Trichlorobenzene	123,000	ug/kg	TM16/PM8	-	-	-	<10
1,3-Dichlorobenzene	177,000	ug/kg	TM16/PM8	-	-	-	<10
1,4-Dichlorobenzene	221,000	ug/kg	TM16/PM8	-	-	-	<10
2-Nitroaniline	651,305	ug/kg	TM16/PM8	-	-	-	<10
2,4-Dinitrotoluene	3,750,000	ug/kg	TM16/PM8	-	-	-	<10
2,6-Dinitrotoluene	1,860,000	ug/kg	TM16/PM8	-	-	-	<10
3-Nitroaniline	200,000	ug/kg	TM16/PM8	-	-	-	<10
4-Bromophenylphenylether	982.8	ug/kg	TM16/PM8	-	-	-	<10
4-Chloroaniline	2,300,000	ug/kg	TM16/PM8	-	-	-	<10
4-Chlorophenylphenylether	378.3	ug/kg	TM16/PM8	-	-	-	<10
4-Nitroaniline	170,000	ug/kg	TM16/PM8	-	-	-	<10
Azobenzene	151,511	ug/kg	TM16/PM8	-	-	-	<10
Bis(2-chloroethoxy)methane	1,301.7	ug/kg	TM16/PM8	-	-	-	<10
Bis(2-chloroethyl)ether	273.6	ug/kg	TM16/PM8	-	-	-	<10
Carbazole	897,000	ug/kg	TM16/PM8	-	-	-	<10
Dibenzofuran	6,666,492	ug/kg	TM16/PM8	-	-	-	<10
Hexachlorobenzene	199	ug/kg	TM16/PM8	-	-	-	<10
Hexachlorobutadiene	17,600	ug/kg	TM16/PM8	-	-	-	<10
Hexachlorocyclopentadiene	1,091.3	ug/kg	TM16/PM8	-	-	-	<10
Hexachloroethane	8,130	ug/kg	TM16/PM8	-	-	-	<10
Isophorone	887,232	ug/kg	TM16/PM8	-	-	-	<10
N-nitrosodi-n-propylamine	1,904.9	ug/kg	TM16/PM8	-	-	-	<10
Nitrobenzene	131,262	ug/kg	TM16/PM8	-	-	-	<10
VOCs							
Dichlorodifluoromethane	1,500,000	ug/kg	TM15/PM10	-	-	-	<2
Methyl Tertiary Butyl Ether	-	ug/kg	TM15/PM10	-	-	-	<2
Chloromethane	593	ug/kg	TM15/PM10	-	-	-	<3
Vinyl Chloride	40.3	ug/kg	TM15/PM10	-	-	-	<2
Bromomethane	27,046	ug/kg	TM15/PM10	-	-	-	<1
Chloroethane	567,000	ug/kg	TM15/PM10	-	-	-	<2
Trichlorofluoromethane	2,200,000	ug/kg	TM15/PM10	-	-	-	<2
1,1-Dichloroethene	-	ug/kg	TM15/PM10	-	-	-	<6
Dichloromethane	-	ug/kg	TM15/PM10	-	-	-	<7
trans-1-2-Dichloroethene	12,300	ug/kg	TM15/PM10	-	-	-	<3
1,1-Dichloroethane	148,000	ug/kg	TM15/PM10	-	-	-	<3
cis-1-2-Dichloroethene	-	ug/kg	TM15/PM10	-	-	-	<3
2,2-Dichloropropane	20,460	ug/kg	TM15/PM10	-	-	-	<4
Bromochloromethane	-	ug/kg	TM15/PM10	-	-	-	<3
Chloroform	-	ug/kg	TM15/PM10	-	-	-	<3
1,1,1-Trichloroethane	391,511	ug/kg	TM15/PM10	-	-	-	<3
1,1-Dichloropropene	12,853	ug/kg	TM15/PM10	-	-	-	<3
Carbon tetrachloride	1,740	ug/kg	TM15/PM10	-	-	-	<4
1,2-Dichloroethane	356	ug/kg	TM15/PM10	-	-	-	<4
Benzene	15,826	ug/kg	TM15/PM10	-	-	-	<3
Trichloroethene	6,611	ug/kg	TM15/PM10	-	-	-	<3
1,2-Dichloropropane	1,720	ug/kg	TM15/PM10	-	-	-	<6
Dibromomethane	-	ug/kg	TM15/PM10	-	-	-	<3
Bromodichloromethane	1,100	ug/kg	TM15/PM10	-	-	-	<3
cis-1-3-Dichloropropene	19,358	ug/kg	TM15/PM10	-	-	-	<4
Toluene	835,000	ug/kg	TM15/PM10	-	-	-	<3
trans-1-3-Dichloropropene	12,853	ug/kg	TM15/PM10	-	-	-	<3
1,1,2-Trichloroethane	51,100	ug/kg	TM15/PM10	-	-	-	<3
Tetrachloroethene	72,200	ug/kg	TM15/PM10	-	-	-	<3
1,3-Dichloropropane	12,853	ug/kg	TM15/PM10	-	-	-	<3
Dibromochloromethane	-	ug/kg	TM15/PM10	-	-	-	<3
1,2-Dibromoethane	-	ug/kg	TM15/PM10	-	-	-	<3
Chlorobenzene	32,800	ug/kg	TM15/PM10	-	-	-	<3
1,1,1,2-Tetrachloroethane	62,718	ug/kg	TM15/PM10	-	-	-	<3
Ethylbenzene	508,000	ug/kg	TM15/PM10	-	-	-	7
p/m-Xylene	564,000	ug/kg	TM15/PM10	-	-	-	16+
o-Xylene	467,000	ug/kg	TM15/PM10	-	-	-	<3+
Styrene	607,000	ug/kg	TM15/PM10	-	-	-	<3

Delimara Power Station Soil Boring Analytical Results	ENVIRON GAC (Commercial)		SAMPLE ID	SB-09	SB-10	SB-10-DS	SB-11
				DEPTH (m)	2.3-2.5	2.3-2.5	0.3-0.5
				LOCATION	DPS	DPS	DPS
				SAMPLE DATE	27/06/2011	28/06/2011	28/06/2011
Metals		Method	Units				
2-Methylnaphthalene	7,148,111	ug/kg	TM16/PM8	-	<10	-	-
Bis(2-ethylhexyl) phthalate	85,400,000	ug/kg	TM16/PM8	-	<10	-	-
Butylbenzyl phthalate	942,000,000	ug/kg	TM16/PM8	-	<10	-	-
Di-n-butyl phthalate	12,900	ug/kg	TM16/PM8	-	<10	-	-
Di-n-Octyl phthalate	89,100,000	ug/kg	TM16/PM8	-	<10	-	-
Diethyl phthalate	109,000	ug/kg	TM16/PM8	-	<10	-	-
Dimethyl phthalate	275,000	ug/kg	TM16/PM8	-	<10	-	-
1,2-Dichlorobenzene	562,000	ug/kg	TM16/PM8	-	<10	-	-
1,2,4-Trichlorobenzene	123,000	ug/kg	TM16/PM8	-	<10	-	-
1,3-Dichlorobenzene	177,000	ug/kg	TM16/PM8	-	<10	-	-
1,4-Dichlorobenzene	221,000	ug/kg	TM16/PM8	-	<10	-	-
2-Nitroaniline	651,305	ug/kg	TM16/PM8	-	<10	-	-
2,4-Dinitrotoluene	3,750,000	ug/kg	TM16/PM8	-	<10	-	-
2,6-Dinitrotoluene	1,860,000	ug/kg	TM16/PM8	-	<10	-	-
3-Nitroaniline	200,000	ug/kg	TM16/PM8	-	<10	-	-
4-Bromophenylphenylether	982.8	ug/kg	TM16/PM8	-	<10	-	-
4-Chloroaniline	2,300,000	ug/kg	TM16/PM8	-	<10	-	-
4-Chlorophenylphenylether	378.3	ug/kg	TM16/PM8	-	<10	-	-
4-Nitroaniline	170,000	ug/kg	TM16/PM8	-	<10	-	-
Azobenzene	151,511	ug/kg	TM16/PM8	-	<10	-	-
Bis(2-chloroethoxy)methane	1,301.7	ug/kg	TM16/PM8	-	<10	-	-
Bis(2-chloroethyl)ether	273.6	ug/kg	TM16/PM8	-	<10	-	-
Carbazole	897,000	ug/kg	TM16/PM8	-	<10	-	-
Dibenzofuran	6,666,492	ug/kg	TM16/PM8	-	<10	-	-
Hexachlorobenzene	199	ug/kg	TM16/PM8	-	<10	-	-
Hexachlorobutadiene	17,600	ug/kg	TM16/PM8	-	<10	-	-
Hexachlorocyclopentadiene	1,091.3	ug/kg	TM16/PM8	-	<10	-	-
Hexachloroethane	8,130	ug/kg	TM16/PM8	-	<10	-	-
Isophorone	887,232	ug/kg	TM16/PM8	-	<10	-	-
N-nitrosodi-n-propylamine	1,904.9	ug/kg	TM16/PM8	-	<10	-	-
Nitrobenzene	131,262	ug/kg	TM16/PM8	-	<10	-	-
VOCs							
Dichlorodifluoromethane	1,500,000	ug/kg	TM15/PM10	-	<2	-	-
Methyl Tertiary Butyl Ether	-	ug/kg	TM15/PM10	-	<2	-	-
Chloromethane	593	ug/kg	TM15/PM10	-	<3	-	-
Vinyl Chloride	40.3	ug/kg	TM15/PM10	-	<2	-	-
Bromomethane	27,046	ug/kg	TM15/PM10	-	<1	-	-
Chloroethane	567,000	ug/kg	TM15/PM10	-	<2	-	-
Trichlorofluoromethane	2,200,000	ug/kg	TM15/PM10	-	<2	-	-
1,1-Dichloroethene	-	ug/kg	TM15/PM10	-	<6	-	-
Dichloromethane	-	ug/kg	TM15/PM10	-	<7	-	-
trans-1-2-Dichloroethene	12,300	ug/kg	TM15/PM10	-	<3	-	-
1,1-Dichloroethane	148,000	ug/kg	TM15/PM10	-	<3	-	-
cis-1-2-Dichloroethene	-	ug/kg	TM15/PM10	-	<3	-	-
2,2-Dichloropropane	20,460	ug/kg	TM15/PM10	-	<4	-	-
Bromochloromethane	-	ug/kg	TM15/PM10	-	<3	-	-
Chloroform	-	ug/kg	TM15/PM10	-	<3	-	-
1,1,1-Trichloroethane	391,511	ug/kg	TM15/PM10	-	<3	-	-
1,1-Dichloropropene	12,853	ug/kg	TM15/PM10	-	<3	-	-
Carbon tetrachloride	1,740	ug/kg	TM15/PM10	-	<4	-	-
1,2-Dichloroethane	356	ug/kg	TM15/PM10	-	<4	-	-
Benzene	15,826	ug/kg	TM15/PM10	-	<3	-	-
Trichloroethene	6,611	ug/kg	TM15/PM10	-	<3	-	-
1,2-Dichloropropane	1,720	ug/kg	TM15/PM10	-	<6	-	-
Dibromomethane	-	ug/kg	TM15/PM10	-	<3	-	-
Bromodichloromethane	1,100	ug/kg	TM15/PM10	-	<3	-	-
cis-1-3-Dichloropropene	19,358	ug/kg	TM15/PM10	-	<4	-	-
Toluene	835,000	ug/kg	TM15/PM10	-	<3	-	-
trans-1-3-Dichloropropene	12,853	ug/kg	TM15/PM10	-	<3	-	-
1,1,2-Trichloroethane	51,100	ug/kg	TM15/PM10	-	<3	-	-
Tetrachloroethene	72,200	ug/kg	TM15/PM10	-	<3	-	-
1,3-Dichloropropane	12,853	ug/kg	TM15/PM10	-	<3	-	-
Dibromochloromethane	-	ug/kg	TM15/PM10	-	<3	-	-
1,2-Dibromoethane	-	ug/kg	TM15/PM10	-	<3	-	-
Chlorobenzene	32,800	ug/kg	TM15/PM10	-	<3	-	-
1,1,1,2-Tetrachloroethane	62,718	ug/kg	TM15/PM10	-	<3	-	-
Ethylbenzene	508,000	ug/kg	TM15/PM10	-	<3	-	-
p/m-Xylene	564,000	ug/kg	TM15/PM10	-	<6+	-	-
o-Xylene	467,000	ug/kg	TM15/PM10	-	<3+	-	-
Styrene	607,000	ug/kg	TM15/PM10	-	<3	-	-



Delimara Power Station Soil Boring Analytical Results	ENVIRON GAC (Commercial)		SAMPLE ID	SB-12
			DEPTH (m)	0.8-1.0
			LOCATION	DPS
			SAMPLE DATE	28/06/2011
Metals		Method	Units	
2-Methylnaphthalene	7,148,111	ug/kg	TM16/PM8	<10
Bis(2-ethylhexyl) phthalate	85,400,000	ug/kg	TM16/PM8	<10
Butylbenzyl phthalate	942,000,000	ug/kg	TM16/PM8	<10
Di-n-butyl phthalate	12,900	ug/kg	TM16/PM8	<10
Di-n-Octyl phthalate	89,100,000	ug/kg	TM16/PM8	<10
Diethyl phthalate	109,000	ug/kg	TM16/PM8	<10
Dimethyl phthalate	275,000	ug/kg	TM16/PM8	<10
1,2-Dichlorobenzene	562,000	ug/kg	TM16/PM8	<10
1,2,4-Trichlorobenzene	123,000	ug/kg	TM16/PM8	<10
1,3-Dichlorobenzene	177,000	ug/kg	TM16/PM8	<10
1,4-Dichlorobenzene	221,000	ug/kg	TM16/PM8	<10
2-Nitroaniline	651,305	ug/kg	TM16/PM8	<10
2,4-Dinitrotoluene	3,750,000	ug/kg	TM16/PM8	<10
2,6-Dinitrotoluene	1,860,000	ug/kg	TM16/PM8	<10
3-Nitroaniline	200,000	ug/kg	TM16/PM8	<10
4-Bromophenylphenylether	982.8	ug/kg	TM16/PM8	<10
4-Chloroaniline	2,300,000	ug/kg	TM16/PM8	<10
4-Chlorophenylphenylether	378.3	ug/kg	TM16/PM8	<10
4-Nitroaniline	170,000	ug/kg	TM16/PM8	<10
Azobenzene	151,511	ug/kg	TM16/PM8	<10
Bis(2-chloroethoxy)methane	1,301.7	ug/kg	TM16/PM8	<10
Bis(2-chloroethyl)ether	273.6	ug/kg	TM16/PM8	<10
Carbazole	897,000	ug/kg	TM16/PM8	<10
Dibenzofuran	6,666,492	ug/kg	TM16/PM8	<10
Hexachlorobenzene	199	ug/kg	TM16/PM8	<10
Hexachlorobutadiene	17,600	ug/kg	TM16/PM8	<10
Hexachlorocyclopentadiene	1,091.3	ug/kg	TM16/PM8	<10
Hexachloroethane	8,130	ug/kg	TM16/PM8	<10
Isophorone	887,232	ug/kg	TM16/PM8	<10
N-nitrosodi-n-propylamine	1,904.9	ug/kg	TM16/PM8	<10
Nitrobenzene	131,262	ug/kg	TM16/PM8	<10
VOCs				
Dichlorodifluoromethane	1,500,000	ug/kg	TM15/PM10	<2
Methyl Tertiary Butyl Ether	-	ug/kg	TM15/PM10	<2
Chloromethane	593	ug/kg	TM15/PM10	<3
Vinyl Chloride	40.3	ug/kg	TM15/PM10	<2
Bromomethane	27,046	ug/kg	TM15/PM10	<1
Chloroethane	567,000	ug/kg	TM15/PM10	<2
Trichlorofluoromethane	2,200,000	ug/kg	TM15/PM10	<2
1,1-Dichloroethene	-	ug/kg	TM15/PM10	<6
Dichloromethane	-	ug/kg	TM15/PM10	<7
trans-1-2-Dichloroethene	12,300	ug/kg	TM15/PM10	<3
1,1-Dichloroethane	148,000	ug/kg	TM15/PM10	<3
cis-1-2-Dichloroethene	-	ug/kg	TM15/PM10	<3
2,2-Dichloropropane	20,460	ug/kg	TM15/PM10	<4
Bromochloromethane	-	ug/kg	TM15/PM10	<3
Chloroform	-	ug/kg	TM15/PM10	<3
1,1,1-Trichloroethane	391,511	ug/kg	TM15/PM10	<3
1,1-Dichloropropene	12,853	ug/kg	TM15/PM10	<3
Carbon tetrachloride	1,740	ug/kg	TM15/PM10	<4
1,2-Dichloroethane	356	ug/kg	TM15/PM10	<4
Benzene	15,826	ug/kg	TM15/PM10	<3
Trichloroethene	6,611	ug/kg	TM15/PM10	<3
1,2-Dichloropropane	1,720	ug/kg	TM15/PM10	<6
Dibromomethane	-	ug/kg	TM15/PM10	<3
Bromodichloromethane	1,100	ug/kg	TM15/PM10	<3
cis-1-3-Dichloropropene	19,358	ug/kg	TM15/PM10	<4
Toluene	835,000	ug/kg	TM15/PM10	<3
trans-1-3-Dichloropropene	12,853	ug/kg	TM15/PM10	<3
1,1,2-Trichloroethane	51,100	ug/kg	TM15/PM10	<3
Tetrachloroethene	72,200	ug/kg	TM15/PM10	<3
1,3-Dichloropropane	12,853	ug/kg	TM15/PM10	<3
Dibromochloromethane	-	ug/kg	TM15/PM10	<3
1,2-Dibromoethane	-	ug/kg	TM15/PM10	<3
Chlorobenzene	32,800	ug/kg	TM15/PM10	<3
1,1,1,2-Tetrachloroethane	62,718	ug/kg	TM15/PM10	<3
Ethylbenzene	508,000	ug/kg	TM15/PM10	<3
p/m-Xylene	564,000	ug/kg	TM15/PM10	<6+
o-Xylene	467,000	ug/kg	TM15/PM10	<3+
Styrene	607,000	ug/kg	TM15/PM10	<3

Delimara Power Station Soil Boring Analytical Results	ENVIRON GAC (Commercial)		SAMPLE ID	DPS-SB01	DPS-SB01	DPS-SB02	DPS-SB03
			DEPTH (m)	0-0.5	2.5-3.0	0-0.5	0.5-1.0
			LOCATION	DPS	DPS	DPS	DPS
			SAMPLE DATE	08/06/2011	08/06/2011	08/06/2011	08/06/2011
Metals		Method	Units				
Bromoform	417,000	ug/kg	TM15/PM10	-	-	-	<3
Isopropylbenzene	753,000	ug/kg	TM15/PM10	-	-	-	<3
1,1,2,2-Tetrachloroethane	156,089	ug/kg	TM15/PM10	-	-	-	<3
Bromobenzene	-	ug/kg	TM15/PM10	-	-	-	<2
1,2,3-Trichloropropane	3143	ug/kg	TM15/PM10	-	-	-	<4
Propylbenzene	399000.0	ug/kg	TM15/PM10	-	-	-	<4
2-Chlorotoluene	-	ug/kg	TM15/PM10	-	-	-	<3
1,3,5-Trimethylbenzene	-	ug/kg	TM15/PM10	-	-	-	<3
4-Chlorotoluene	1,418	ug/kg	TM15/PM10	-	-	-	<3
tert-Butylbenzene	440,000	ug/kg	TM15/PM10	-	-	-	<5
1,2,4-Trimethylbenzene	-	ug/kg	TM15/PM10	-	-	-	<6
sec-Butylbenzene	1,300,000	ug/kg	TM15/PM10	-	-	-	<4
4-Isopropyltoluene	388,000	ug/kg	TM15/PM10	-	-	-	<4
1,3-Dichlorobenzene	17,700	ug/kg	TM15/PM10	-	-	-	<4
1,4-Dichlorobenzene	221,000	ug/kg	TM15/PM10	-	-	-	<4
n-Butylbenzene	430,000	ug/kg	TM15/PM10	-	-	-	<4
1,2-Dichlorobenzene	562,000	ug/kg	TM15/PM10	-	-	-	<4
1,2-Dibromo-3-chloropropane	1,037	ug/kg	TM15/PM10	-	-	-	<4
1,2,4-Trichlorobenzene	123,000	ug/kg	TM15/PM10	-	-	-	<7
Hexachlorobutadiene	17,600	ug/kg	TM15/PM10	-	-	-	<4
Naphthalene	75,000	ug/kg	TM15/PM10	-	-	-	<27
1,2,3-Trichlorobenzene	56,800	ug/kg	TM15/PM10	-	-	-	<7

Delimara Power Station Soil Boring Analytical Results	ENVIRON GAC (Commercial)		SAMPLE ID	DPS-SB03	DPS-SB04	DPS-SB05	DPS-SB05
			DEPTH (m)	2.0-2.5	0.5-1.0	0.5-1.0	2.5-3.0
			LOCATION	DPS	DPS	DPS	DPS
			SAMPLE DATE	08/06/2011	08/06/2011	08/06/2011	08/06/2011
Metals		Method	Units				
Bromoform	417,000	ug/kg	TM15/PM10	-	<3	<3	-
Isopropylbenzene	753,000	ug/kg	TM15/PM10	-	<3	<3	-
1,1,2,2-Tetrachloroethane	156,089	ug/kg	TM15/PM10	-	<3	<3	-
Bromobenzene	-	ug/kg	TM15/PM10	-	<2	<2	-
1,2,3-Trichloropropane	3143	ug/kg	TM15/PM10	-	<4	<4	-
Propylbenzene	399000.0	ug/kg	TM15/PM10	-	<4	<4	-
2-Chlorotoluene	-	ug/kg	TM15/PM10	-	<3	<3	-
1,3,5-Trimethylbenzene	-	ug/kg	TM15/PM10	-	<3	<3	-
4-Chlorotoluene	1,418	ug/kg	TM15/PM10	-	<3	<3	-
tert-Butylbenzene	440,000	ug/kg	TM15/PM10	-	<5	<5	-
1,2,4-Trimethylbenzene	-	ug/kg	TM15/PM10	-	<6	<6	-
sec-Butylbenzene	1,300,000	ug/kg	TM15/PM10	-	<4	<4	-
4-Isopropyltoluene	388,000	ug/kg	TM15/PM10	-	<4	<4	-
1,3-Dichlorobenzene	17,700	ug/kg	TM15/PM10	-	<4	<4	-
1,4-Dichlorobenzene	221,000	ug/kg	TM15/PM10	-	<4	<4	-
n-Butylbenzene	430,000	ug/kg	TM15/PM10	-	<4	<4	-
1,2-Dichlorobenzene	562,000	ug/kg	TM15/PM10	-	<4	<4	-
1,2-Dibromo-3-chloropropane	1,037	ug/kg	TM15/PM10	-	<4	<4	-
1,2,4-Trichlorobenzene	123,000	ug/kg	TM15/PM10	-	<7	<7	-
Hexachlorobutadiene	17,600	ug/kg	TM15/PM10	-	<4	<4	-
Naphthalene	75,000	ug/kg	TM15/PM10	-	<27	<27	-
1,2,3-Trichlorobenzene	56,800	ug/kg	TM15/PM10	-	<7	<7	-

Delimara Power Station Soil Boring Analytical Results	ENVIRON GAC (Commercial)		SAMPLE ID	DPS-SB06	DPS-SB07	DPS-SB08	SB-09
			DEPTH (m)	0-0.5	0.4	2.0-2.5	0.3-0.5
			LOCATION	DPS	DPS	DPS	DPS
			SAMPLE DATE	08/06/2011	13/06/2011	13/06/2011	27/06/2011
Metals		Method	Units				
Bromoform	417,000	ug/kg	TM15/PM10	-	-	-	<3
Isopropylbenzene	753,000	ug/kg	TM15/PM10	-	-	-	<3
1,1,2,2-Tetrachloroethane	156,089	ug/kg	TM15/PM10	-	-	-	<3
Bromobenzene	-	ug/kg	TM15/PM10	-	-	-	<2
1,2,3-Trichloropropane	3143	ug/kg	TM15/PM10	-	-	-	<4
Propylbenzene	399000.0	ug/kg	TM15/PM10	-	-	-	<4+
2-Chlorotoluene	-	ug/kg	TM15/PM10	-	-	-	<3
1,3,5-Trimethylbenzene	-	ug/kg	TM15/PM10	-	-	-	<3
4-Chlorotoluene	1,418	ug/kg	TM15/PM10	-	-	-	<3
tert-Butylbenzene	440,000	ug/kg	TM15/PM10	-	-	-	<5
1,2,4-Trimethylbenzene	-	ug/kg	TM15/PM10	-	-	-	<6
sec-Butylbenzene	1,300,000	ug/kg	TM15/PM10	-	-	-	<4
4-Isopropyltoluene	388,000	ug/kg	TM15/PM10	-	-	-	<4
1,3-Dichlorobenzene	17,700	ug/kg	TM15/PM10	-	-	-	<4
1,4-Dichlorobenzene	221,000	ug/kg	TM15/PM10	-	-	-	<4
n-Butylbenzene	430,000	ug/kg	TM15/PM10	-	-	-	<4
1,2-Dichlorobenzene	562,000	ug/kg	TM15/PM10	-	-	-	<4
1,2-Dibromo-3-chloropropane	1,037	ug/kg	TM15/PM10	-	-	-	<4
1,2,4-Trichlorobenzene	123,000	ug/kg	TM15/PM10	-	-	-	<7
Hexachlorobutadiene	17,600	ug/kg	TM15/PM10	-	-	-	<4
Naphthalene	75,000	ug/kg	TM15/PM10	-	-	-	<27
1,2,3-Trichlorobenzene	56,800	ug/kg	TM15/PM10	-	-	-	<7

Delimara Power Station Soil Boring Analytical Results	ENVIRON GAC (Commercial)		SAMPLE ID	SB-09	SB-10	SB-10-DS	SB-11
			DEPTH (m)	1.3-1.5	2.3-2.5	2.3-2.5	0.3-0.5
			LOCATION	DPS	DPS	DPS	DPS
			SAMPLE DATE	27/06/2011	28/06/2011	28/06/2011	28/06/2011
Metals		Method	Units				
Bromoform	417,000	ug/kg	TM15/PM10	-	<3	-	-
Isopropylbenzene	753,000	ug/kg	TM15/PM10	-	<3	-	-
1,1,2,2-Tetrachloroethane	156,089	ug/kg	TM15/PM10	-	<3	-	-
Bromobenzene	-	ug/kg	TM15/PM10	-	<2	-	-
1,2,3-Trichloropropane	3143	ug/kg	TM15/PM10	-	<4	-	-
Propylbenzene	399000.0	ug/kg	TM15/PM10	-	<4+	-	-
2-Chlorotoluene	-	ug/kg	TM15/PM10	-	<3	-	-
1,3,5-Trimethylbenzene	-	ug/kg	TM15/PM10	-	<3	-	-
4-Chlorotoluene	1,418	ug/kg	TM15/PM10	-	<3	-	-
tert-Butylbenzene	440,000	ug/kg	TM15/PM10	-	<5	-	-
1,2,4-Trimethylbenzene	-	ug/kg	TM15/PM10	-	<6	-	-
sec-Butylbenzene	1,300,000	ug/kg	TM15/PM10	-	<4	-	-
4-Isopropyltoluene	388,000	ug/kg	TM15/PM10	-	<4	-	-
1,3-Dichlorobenzene	17,700	ug/kg	TM15/PM10	-	<4	-	-
1,4-Dichlorobenzene	221,000	ug/kg	TM15/PM10	-	<4	-	-
n-Butylbenzene	430,000	ug/kg	TM15/PM10	-	<4	-	-
1,2-Dichlorobenzene	562,000	ug/kg	TM15/PM10	-	<4	-	-
1,2-Dibromo-3-chloropropane	1,037	ug/kg	TM15/PM10	-	<4	-	-
1,2,4-Trichlorobenzene	123,000	ug/kg	TM15/PM10	-	<7	-	-
Hexachlorobutadiene	17,600	ug/kg	TM15/PM10	-	<4	-	-
Naphthalene	75,000	ug/kg	TM15/PM10	-	<27	-	-
1,2,3-Trichlorobenzene	56,800	ug/kg	TM15/PM10	-	<7	-	-

Delimara Power Station Soil Boring Analytical Results	ENVIRON GAC (Commercial)		SAMPLE ID	SB-12
			DEPTH (m)	0.8-1.0
			LOCATION	DPS
			SAMPLE DATE	28/06/2011
Metals		Method	Units	
Bromoform	417,000	ug/kg	TM15/PM10	<3
Isopropylbenzene	753,000	ug/kg	TM15/PM10	<3
1,1,2,2-Tetrachloroethane	156,089	ug/kg	TM15/PM10	<3
Bromobenzene	-	ug/kg	TM15/PM10	<2
1,2,3-Trichloropropane	3143	ug/kg	TM15/PM10	<4
Propylbenzene	399000.0	ug/kg	TM15/PM10	<4+
2-Chlorotoluene	-	ug/kg	TM15/PM10	<3
1,3,5-Trimethylbenzene	-	ug/kg	TM15/PM10	<3
4-Chlorotoluene	1,418	ug/kg	TM15/PM10	<3
tert-Butylbenzene	440,000	ug/kg	TM15/PM10	<5
1,2,4-Trimethylbenzene	-	ug/kg	TM15/PM10	<6
sec-Butylbenzene	1,300,000	ug/kg	TM15/PM10	<4
4-Isopropyltoluene	388,000	ug/kg	TM15/PM10	<4
1,3-Dichlorobenzene	17,700	ug/kg	TM15/PM10	<4
1,4-Dichlorobenzene	221,000	ug/kg	TM15/PM10	<4
n-Butylbenzene	430,000	ug/kg	TM15/PM10	<4
1,2-Dichlorobenzene	562,000	ug/kg	TM15/PM10	<4
1,2-Dibromo-3-chloropropane	1,037	ug/kg	TM15/PM10	<4
1,2,4-Trichlorobenzene	123,000	ug/kg	TM15/PM10	<7
Hexachlorobutadiene	17,600	ug/kg	TM15/PM10	<4
Naphthalene	75,000	ug/kg	TM15/PM10	<27
1,2,3-Trichlorobenzene	56,800	ug/kg	TM15/PM10	<7

Delimara Power Station Borehole Analytical Results - Landfill Samples	ENVIRON GAC (Commercial)		SAMPLE ID	DPS-LF01	DPS-LF02	DPS-LF03
			DEPTH (m)	0-0.5	4.5-5.0	0.5-1.0
			LOCATION	DPS	DPS	DPS
			SAMPLE DATE	15/06/2011	15/06/2011	15/06/2011
Metals		Units	Method			
Antimony	7,550	mg/kg	TM30/PM15	<1	<1	<1
Arsenic	635	mg/kg	TM30/PM15	2.9	5.4	2.8
Cadmium	230	mg/kg	TM30/PM15	0.4	0.3	0.3
Chromium	35	mg/kg	TM30/PM15	19.1	16.9	16.4
Cobalt	NG	mg/kg	TM30/PM15	2.2	1.9	2.4
Copper	71,700	mg/kg	TM30/PM15	19	10	14
Lead	750	mg/kg	TM30/PM15	12	6	7
Manganese	NG	mg/kg	TM30/PM15	84	73	66
Mercury	3,640	mg/kg	TM30/PM15	0.3	0.5	0.4
Nickel	1,790	mg/kg	TM30/PM15	51.5	15.7	20.1
Selenium	13,000	mg/kg	TM30/PM15	<1	<1	<1
Thallium	NG	mg/kg	TM30/PM15	<1	<1	<1
Tin	NG	mg/kg	TM30/PM15	<1	<1	<1
Vanadium	3,160	mg/kg	TM30/PM15	166	26	16
Zinc	665,000	mg/kg	TM30/PM15	92	44	49
Inorganics						
Asbestos Screen	N/A	-	Subcontracted	NAD	NAD	NAD
pH	N/A	pH units	TM73/PM11	7.87	8.69	7.99
Total Sulphate	N/A	mg/kg	TM50/PM15	2911	1169	7110
Fraction of Organic Carbon	N/A	None	TM21/PM24	-	-	-
Sulphide	N/A	mg/kg	Subcontracted	<0.5	<0.5	0.8
PAHs						
Naphthalene	75	mg/kg	TM4/PM8	<0.04	<0.04	<0.04
Acenaphthylene	162	mg/kg	TM4/PM8	<0.03	<0.03	<0.03
Acenaphthene	56.7	mg/kg	TM4/PM8	<0.05	<0.05	<0.05
Fluorene	160	mg/kg	TM4/PM8	<0.04	<0.04	<0.04
Phenanthrene	21,900	mg/kg	TM4/PM8	<0.03	<0.03	<0.03
Anthracene	522,000	mg/kg	TM4/PM8	<0.04	<0.04	<0.04
Fluoranthene	22,600	mg/kg	TM4/PM8	<0.03	<0.03	<0.03
Pyrene	54,300	mg/kg	TM4/PM8	<0.03	<0.03	<0.03
Benz(a)anthracene	91	mg/kg	TM4/PM8	<0.06	<0.06	<0.06
Chrysene	140.0	mg/kg	TM4/PM8	<0.02	<0.02	<0.02
Benzo(bk)fluoranthene	102	mg/kg	TM4/PM8	<0.07	<0.07	<0.07
Benzo(a)pyrene	14	mg/kg	TM4/PM8	<0.04	<0.04	<0.04
Indeno(123cd)pyrene	61.0	mg/kg	TM4/PM8	<0.04	<0.04	<0.04
Dibenzo(ah)anthracene	13	mg/kg	TM4/PM8	<0.04	<0.04	<0.04
Benzo(ghi)perylene	658	mg/kg	TM4/PM8	<0.04	<0.04	<0.04
PAH 16 Total	NG	mg/kg	TM4/PM8	<0.6	<0.6	<0.6
Benzo(b)fluoranthene	102	mg/kg	TM4/PM8	<0.05	<0.05	<0.05
Benzo(k)fluoranthene	143	mg/kg	TM4/PM8	<0.02	<0.02	<0.02
PAH Surrogate % Recovery	N/A	%	TM4/PM8	93	87	84
Hydrocarbons						
EPH >C8-C10	N/A	mg/kg	TM5/PM8	<5	<5	<5
EPH >C10-C20	N/A	mg/kg	TM5/PM8	21	<10	<10
EPH >C20-C30	N/A	mg/kg	TM5/PM8	90	<10	<10
EPH >C30-C40	N/A	mg/kg	TM5/PM8	87	<10	<10
EPH >C8-C40	5,000	mg/kg	TM5/PM8	198	<35	<35

Delimara Power Station Borehole Analytical Results	ENVIRON GAC (Commercial)		SAMPLE ID	DPS-BH01	DPS-BH02	DPS-BH02	DPS-BH03
				DEPTH (m)	0.5	3.0-3.5	0-0.5
				LOCATION	DPS	DPS	DPS
				SAMPLE DATE	08/06/2011	08/06/2011	13/06/2011
Metals		Units	Method				
Antimony	7,550	mg/kg	TM30/PM15	<1	<1	-	<1
Arsenic	635	mg/kg	TM30/PM15	1.4	3	-	2.5
Cadmium	230	mg/kg	TM30/PM15	0.2	0.3	-	0.3
Chromium	35	mg/kg	TM30/PM15	10.5	14.8	-	15.3
Cobalt	NG	mg/kg	TM30/PM15	1.3	2	-	2.1
Copper	71,700	mg/kg	TM30/PM15	10	15	-	12
Lead	750	mg/kg	TM30/PM15	<5	<5	-	9
Manganese	NG	mg/kg	TM30/PM15	42	67	-	60
Mercury	3,640	mg/kg	TM30/PM15	0.4	0.4	-	0.4
Nickel	1,790	mg/kg	TM30/PM15	12.6	15.1	-	15
Selenium	13,000	mg/kg	TM30/PM15	<1	<1	-	<1
Thallium	NG	mg/kg	TM30/PM15	<1	<1	-	<1
Tin	NG	mg/kg	TM30/PM15	<1	<1	-	<1
Vanadium	3,160	mg/kg	TM30/PM15	11	15	-	15
Zinc	665,000	mg/kg	TM30/PM15	31	49	-	52
Inorganics							
Asbestos Screen	N/A	-	Subcontracted	NAD	-	-	NAD
pH	N/A	pH units	TM73/PM11	8.08	8.41	-	8.05
Total Sulphate	N/A	mg/kg	TM50/PM15	2992	3340	-	5213
Fraction of Organic Carbon	N/A	None	TM21/PM24	-	0.01	0.01	-
Sulphide	N/A	mg/kg	Subcontracted	<0.5	<0.5	-	<0.5
PAHs							
Naphthalene	75	mg/kg	TM4/PM8	<0.04	<0.04	-	<0.04
Acenaphthylene	162	mg/kg	TM4/PM8	<0.03	<0.03	-	<0.03
Acenaphthene	56.7	mg/kg	TM4/PM8	<0.05	<0.05	-	<0.05
Fluorene	160	mg/kg	TM4/PM8	<0.04	<0.04	-	<0.04
Phenanthrene	21,900	mg/kg	TM4/PM8	<0.03	<0.03	-	<0.03
Anthracene	522,000	mg/kg	TM4/PM8	<0.04	<0.04	-	<0.04
Fluoranthene	22,600	mg/kg	TM4/PM8	<0.03	<0.03	-	<0.03
Pyrene	54,300	mg/kg	TM4/PM8	<0.03	<0.03	-	<0.03
Benz(a)anthracene	91	mg/kg	TM4/PM8	<0.06	<0.06	-	<0.06
Chrysene	140.0	mg/kg	TM4/PM8	<0.02	<0.02	-	<0.02
Benzo(bk)fluoranthene	102	mg/kg	TM4/PM8	<0.07	<0.07	-	<0.07
Benzo(a)pyrene	14	mg/kg	TM4/PM8	<0.04	<0.04	-	<0.04
Indeno(123cd)pyrene	61.0	mg/kg	TM4/PM8	<0.04	<0.04	-	<0.04
Dibenzo(ah)anthracene	13	mg/kg	TM4/PM8	<0.04	<0.04	-	<0.04
Benzo(ghi)perylene	658	mg/kg	TM4/PM8	<0.04	<0.04	-	<0.04
PAH 16 Total	NG	mg/kg	TM4/PM8	<0.6	<0.6	-	<0.6
Benzo(b)fluoranthene	102	mg/kg	TM4/PM8	<0.05	<0.05	-	<0.05
Benzo(k)fluoranthene	143	mg/kg	TM4/PM8	<0.02	<0.02	-	<0.02
PAH Surrogate % Recovery	N/A	%	TM4/PM8	93	98	-	104
Hydrocarbons							
EPH >C8-C10	N/A	mg/kg	TM5/PM8	<5	<5	-	<5
EPH >C10-C20	N/A	mg/kg	TM5/PM8	<10	<10	-	<10
EPH >C20-C30	N/A	mg/kg	TM5/PM8	36	79	-	<10
EPH >C30-C40	N/A	mg/kg	TM5/PM8	36	226	-	<10
EPH >C8-C40	5,000	mg/kg	TM5/PM8	72	305	-	<35
PCBs							
PCB 28	240.0	ug/kg	TM86/PM8	-	-	-	-
PCB 52	240.0	ug/kg	TM86/PM8	-	-	-	-
PCB 101	240.0	ug/kg	TM86/PM8	-	-	-	-
PCB 118	240.0	ug/kg	TM86/PM8	-	-	-	-
PCB 138	240.0	ug/kg	TM86/PM8	-	-	-	-
PCB 153	240.0	ug/kg	TM86/PM8	-	-	-	-
PCB 180	240.0	ug/kg	TM86/PM8	-	-	-	-
Total 7 PCBs	240	ug/kg	TM86/PM8	-	-	-	-
SVOCs							
2-Chlorophenol	3,590,000	ug/kg	TM16/PM8	-	-	-	-
2-Methylphenol	14,200,000	ug/kg	TM16/PM8	-	-	-	-
2-Nitrophenol	910,597	ug/kg	TM16/PM8	-	-	-	-
2,4-Dichlorophenol	3,530,000	ug/kg	TM16/PM8	-	-	-	-
2,4-Dimethylphenol	1,330,000	ug/kg	TM16/PM8	-	-	-	-
2,4,5-Trichlorophenol	2,300,000	ug/kg	TM16/PM8	-	-	-	-
2,4,6-Trichlorophenol	848,000	ug/kg	TM16/PM8	-	-	-	-



Delimara Power Station Borehole Analytical Results	ENVIRON GAC (Commercial)		SAMPLE ID	DPS-BH03	DPS-BH04	DPS-BH04	DPS-BH05
				DEPTH (m)	0-0.5	3.0-3.5	0-0.5
				LOCATION	DPS	DPS	DPS
				SAMPLE DATE	13/06/2011	13/06/2011	14/06/2011
Metals		Units	Method				
Antimony	7,550	mg/kg	TM30/PM15	<1	<1	<1	<1
Arsenic	635	mg/kg	TM30/PM15	2.5	4.1	2.1	3.3
Cadmium	230	mg/kg	TM30/PM15	0.3	0.6	0.4	0.4
Chromium	35	mg/kg	TM30/PM15	23.8	20.4	23.7	15.9
Cobalt	NG	mg/kg	TM30/PM15	3.5	2.2	2.4	2.8
Copper	71,700	mg/kg	TM30/PM15	16	16	17	15
Lead	750	mg/kg	TM30/PM15	5	11	<5	<5
Manganese	NG	mg/kg	TM30/PM15	87	63	66	72
Mercury	3,640	mg/kg	TM30/PM15	0.4	0.4	0.5	0.4
Nickel	1,790	mg/kg	TM30/PM15	29.2	26.1	25.4	18.7
Selenium	13,000	mg/kg	TM30/PM15	<1	<1	2	<1
Thallium	NG	mg/kg	TM30/PM15	<1	<1	<1	<1
Tin	NG	mg/kg	TM30/PM15	1	2	<1	<1
Vanadium	3,160	mg/kg	TM30/PM15	22	25	19	18
Zinc	665,000	mg/kg	TM30/PM15	59	59	64	48
Inorganics							
Asbestos Screen	N/A	-	Subcontracted	-	-	-	-
pH	N/A	pH units	TM73/PM11	8.51	8.81	7.97	8.26
Total Sulphate	N/A	mg/kg	TM50/PM15	1795	1454	5144	2545
Fraction of Organic Carbon	N/A	None	TM21/PM24	-	-	-	-
Sulphide	N/A	mg/kg	Subcontracted	<0.5	<0.5	<0.5	<0.5
PAHs							
Naphthalene	75	mg/kg	TM4/PM8	<0.04	<0.04	<0.04	<0.04
Acenaphthylene	162	mg/kg	TM4/PM8	<0.03	<0.03	<0.03	<0.03
Acenaphthene	56.7	mg/kg	TM4/PM8	<0.05	<0.05	<0.05	<0.05
Fluorene	160	mg/kg	TM4/PM8	<0.04	<0.04	<0.04	<0.04
Phenanthrene	21,900	mg/kg	TM4/PM8	<0.03	<0.03	<0.03	<0.03
Anthracene	522,000	mg/kg	TM4/PM8	<0.04	<0.04	<0.04	<0.04
Fluoranthene	22,600	mg/kg	TM4/PM8	<0.03	<0.03	<0.03	<0.03
Pyrene	54,300	mg/kg	TM4/PM8	<0.03	<0.03	<0.03	<0.03
Benz(a)anthracene	91	mg/kg	TM4/PM8	<0.06	<0.06	<0.06	<0.06
Chrysene	140.0	mg/kg	TM4/PM8	<0.02	<0.02	0.04	0.02
Benzo(bk)fluoranthene	102	mg/kg	TM4/PM8	<0.07	<0.07	<0.07	<0.07
Benzo(a)pyrene	14	mg/kg	TM4/PM8	<0.04	<0.04	<0.04	<0.04
Indeno(123cd)pyrene	61.0	mg/kg	TM4/PM8	<0.04	<0.04	<0.04	<0.04
Dibenzo(ah)anthracene	13	mg/kg	TM4/PM8	<0.04	<0.04	<0.04	<0.04
Benzo(ghi)perylene	658	mg/kg	TM4/PM8	<0.04	<0.04	<0.04	<0.04
PAH 16 Total	NG	mg/kg	TM4/PM8	<0.6	<0.6	<0.6	<0.6
Benzo(b)fluoranthene	102	mg/kg	TM4/PM8	<0.05	<0.05	<0.05	<0.05
Benzo(k)fluoranthene	143	mg/kg	TM4/PM8	<0.02	<0.02	<0.02	<0.02
PAH Surrogate % Recovery	N/A	%	TM4/PM8	96	96	94	96
Hydrocarbons							
EPH >C8-C10	N/A	mg/kg	TM5/PM8	<5	<5	<5	<5
EPH >C10-C20	N/A	mg/kg	TM5/PM8	<10	<10	<10	<10
EPH >C20-C30	N/A	mg/kg	TM5/PM8	<10	85	<10	<10
EPH >C30-C40	N/A	mg/kg	TM5/PM8	<10	64	<10	<10
EPH >C8-C40	5,000	mg/kg	TM5/PM8	<35	149	<35	<35
PCBs							
PCB 28	240.0	ug/kg	TM86/PM8	-	-	-	-
PCB 52	240.0	ug/kg	TM86/PM8	-	-	-	-
PCB 101	240.0	ug/kg	TM86/PM8	-	-	-	-
PCB 118	240.0	ug/kg	TM86/PM8	-	-	-	-
PCB 138	240.0	ug/kg	TM86/PM8	-	-	-	-
PCB 153	240.0	ug/kg	TM86/PM8	-	-	-	-
PCB 180	240.0	ug/kg	TM86/PM8	-	-	-	-
Total 7 PCBs	240	ug/kg	TM86/PM8	-	-	-	-
SVOCs							
2-Chlorophenol	3,590,000	ug/kg	TM16/PM8	-	-	<10	-
2-Methylphenol	14,200,000	ug/kg	TM16/PM8	-	-	<10	-
2-Nitrophenol	910,597	ug/kg	TM16/PM8	-	-	<10	-
2,4-Dichlorophenol	3,530,000	ug/kg	TM16/PM8	-	-	<10	-
2,4-Dimethylphenol	1,330,000	ug/kg	TM16/PM8	-	-	<10	-
2,4,5-Trichlorophenol	2,300,000	ug/kg	TM16/PM8	-	-	<10	-
2,4,6-Trichlorophenol	848,000	ug/kg	TM16/PM8	-	-	<10	-

Delimara Power Station Borehole Analytical Results	ENVIRON GAC (Commercial)		SAMPLE ID	DPS-BH05	DPS-BH06	DPS-BH06	DPS-BH07
				DEPTH (m)	0-0.5	3.5-4.0	0-0.5
				LOCATION	DPS	DPS	DPS
				SAMPLE DATE	14/06/2011	14/06/2011	14/06/2011
Metals		Units	Method				
Antimony	7,550	mg/kg	TM30/PM15	1	<1	<1	<1
Arsenic	635	mg/kg	TM30/PM15	5.3	3.2	2.2	1
Cadmium	230	mg/kg	TM30/PM15	0.3	0.3	0.4	0.4
Chromium	35	mg/kg	TM30/PM15	20.5	17	21.7	9.3
Cobalt	NG	mg/kg	TM30/PM15	2.8	1.9	2.5	0.6
Copper	71,700	mg/kg	TM30/PM15	17	9	18	5
Lead	750	mg/kg	TM30/PM15	<5	<5	<5	<5
Manganese	NG	mg/kg	TM30/PM15	73	64	69	32
Mercury	3,640	mg/kg	TM30/PM15	0.3	0.4	0.4	0.4
Nickel	1,790	mg/kg	TM30/PM15	22.9	16.1	25.9	4.8
Selenium	13,000	mg/kg	TM30/PM15	1	<1	2	<1
Thallium	NG	mg/kg	TM30/PM15	<1	<1	<1	<1
Tin	NG	mg/kg	TM30/PM15	<1	<1	<1	<1
Vanadium	3,160	mg/kg	TM30/PM15	23	16	20	10
Zinc	665,000	mg/kg	TM30/PM15	55	39	64	13
Inorganics							
Asbestos Screen	N/A	-	Subcontracted	-	-	-	NAD
pH	N/A	pH units	TM73/PM11	8.26	8.39	8.33	8.77
Total Sulphate	N/A	mg/kg	TM50/PM15	1973	1697	1343	915
Fraction of Organic Carbon	N/A	None	TM21/PM24	-	0.003	0.011	-
Sulphide	N/A	mg/kg	Subcontracted	0.8	<0.5	<0.5	<0.5
PAHs							
Naphthalene	75	mg/kg	TM4/PM8	<0.04	<0.04	<0.04	<0.04
Acenaphthylene	162	mg/kg	TM4/PM8	<0.03	<0.03	<0.03	<0.03
Acenaphthene	56.7	mg/kg	TM4/PM8	<0.05	<0.05	<0.05	<0.05
Fluorene	160	mg/kg	TM4/PM8	<0.04	<0.04	<0.04	<0.04
Phenanthrene	21,900	mg/kg	TM4/PM8	<0.03	<0.03	<0.03	0.03
Anthracene	522,000	mg/kg	TM4/PM8	<0.04	<0.04	<0.04	<0.04
Fluoranthene	22,600	mg/kg	TM4/PM8	<0.03	<0.03	<0.03	0.05
Pyrene	54,300	mg/kg	TM4/PM8	<0.03	<0.03	<0.03	0.05
Benz(a)anthracene	91	mg/kg	TM4/PM8	<0.06	<0.06	<0.06	0.09
Chrysene	140.0	mg/kg	TM4/PM8	<0.02	<0.02	<0.02	0.1
Benzo(bk)fluoranthene	102	mg/kg	TM4/PM8	<0.07	<0.07	<0.07	0.18
Benzo(a)pyrene	14	mg/kg	TM4/PM8	<0.04	<0.04	<0.04	0.09
Indeno(123cd)pyrene	61.0	mg/kg	TM4/PM8	<0.04	<0.04	<0.04	0.11
Dibenzo(ah)anthracene	13	mg/kg	TM4/PM8	<0.04	<0.04	<0.04	0.09
Benzo(ghi)perylene	658	mg/kg	TM4/PM8	<0.04	<0.04	<0.04	0.11
PAH 16 Total	NG	mg/kg	TM4/PM8	<0.6	<0.6	<0.6	0.9
Benzo(b)fluoranthene	102	mg/kg	TM4/PM8	<0.05	<0.05	<0.05	0.13
Benzo(k)fluoranthene	143	mg/kg	TM4/PM8	<0.02	<0.02	<0.02	0.05
PAH Surrogate % Recovery	N/A	%	TM4/PM8	96	103	101	100
Hydrocarbons							
EPH >C8-C10	N/A	mg/kg	TM5/PM8	<5	<5	<5	<5
EPH >C10-C20	N/A	mg/kg	TM5/PM8	<10	<10	<10	<10
EPH >C20-C30	N/A	mg/kg	TM5/PM8	<10	<10	<10	<10
EPH >C30-C40	N/A	mg/kg	TM5/PM8	<10	<10	<10	<10
EPH >C8-C40	5,000	mg/kg	TM5/PM8	<35	<35	<35	<35
PCBs							
PCB 28	240.0	ug/kg	TM86/PM8	-	-	-	-
PCB 52	240.0	ug/kg	TM86/PM8	-	-	-	-
PCB 101	240.0	ug/kg	TM86/PM8	-	-	-	-
PCB 118	240.0	ug/kg	TM86/PM8	-	-	-	-
PCB 138	240.0	ug/kg	TM86/PM8	-	-	-	-
PCB 153	240.0	ug/kg	TM86/PM8	-	-	-	-
PCB 180	240.0	ug/kg	TM86/PM8	-	-	-	-
Total 7 PCBs	240	ug/kg	TM86/PM8	-	-	-	-
SVOCs							
2-Chlorophenol	3,590,000	ug/kg	TM16/PM8	<10	-	-	-
2-Methylphenol	14,200,000	ug/kg	TM16/PM8	<10	-	-	-
2-Nitrophenol	910,597	ug/kg	TM16/PM8	<10	-	-	-
2,4-Dichlorophenol	3,530,000	ug/kg	TM16/PM8	<10	-	-	-
2,4-Dimethylphenol	1,330,000	ug/kg	TM16/PM8	<10	-	-	-
2,4,5-Trichlorophenol	2,300,000	ug/kg	TM16/PM8	<10	-	-	-
2,4,6-Trichlorophenol	848,000	ug/kg	TM16/PM8	<10	-	-	-

Delimara Power Station Borehole Analytical Results	ENVIRON GAC (Commercial)		SAMPLE ID	DPS-BH08	BH-08	BH-08
			DEPTH (m)	0-0.5	1.8-2.0	2.8-3.0
			LOCATION	DPS	DPS	DPS
			SAMPLE DATE	14/06/2011	27/06/2011	27/06/2011
Metals		Units	Method			
Antimony	7,550	mg/kg	TM30/PM15	<1	<1	<1
Arsenic	635	mg/kg	TM30/PM15	3.5	4.9	3.5
Cadmium	230	mg/kg	TM30/PM15	0.4	0.4	0.4
Chromium	35	mg/kg	TM30/PM15	18.3	16.6	19.1
Cobalt	NG	mg/kg	TM30/PM15	1.7	1.8	2.6
Copper	71,700	mg/kg	TM30/PM15	10	12	14
Lead	750	mg/kg	TM30/PM15	5	<5	<5
Manganese	NG	mg/kg	TM30/PM15	79	79	72
Mercury	3,640	mg/kg	TM30/PM15	0.3	0.3	0.3
Nickel	1,790	mg/kg	TM30/PM15	20.2	16.9	22
Selenium	13,000	mg/kg	TM30/PM15	<1	<1	<1
Thallium	NG	mg/kg	TM30/PM15	<1	<1	<1
Tin	NG	mg/kg	TM30/PM15	<1	<1	<1
Vanadium	3,160	mg/kg	TM30/PM15	31	16	17
Zinc	665,000	mg/kg	TM30/PM15	54	41	57
Inorganics						
Asbestos Screen	N/A	-	Subcontracted	NAD	-	-
pH	N/A	pH units	TM73/PM11	8.45	8.41	9.04
Total Sulphate	N/A	mg/kg	TM50/PM15	1159	-	-
Fraction of Organic Carbon	N/A	None	TM21/PM24	-	-	-
Sulphide	N/A	mg/kg	Subcontracted	<0.5	0.6	<0.5
PAHs						
Naphthalene	75	mg/kg	TM4/PM8	<0.04	<0.04	<0.04
Acenaphthylene	162	mg/kg	TM4/PM8	<0.03	<0.03	<0.03
Acenaphthene	56.7	mg/kg	TM4/PM8	<0.05	<0.05	<0.05
Fluorene	160	mg/kg	TM4/PM8	<0.04	<0.04	<0.04
Phenanthrene	21,900	mg/kg	TM4/PM8	<0.03	<0.03	<0.03
Anthracene	522,000	mg/kg	TM4/PM8	<0.04	<0.04	<0.04
Fluoranthene	22,600	mg/kg	TM4/PM8	<0.03	<0.03	<0.03
Pyrene	54,300	mg/kg	TM4/PM8	<0.03	<0.03	<0.03
Benz(a)anthracene	91	mg/kg	TM4/PM8	<0.06	<0.06	<0.06
Chrysene	140.0	mg/kg	TM4/PM8	<0.02	<0.02	<0.02
Benzo(bk)fluoranthene	102	mg/kg	TM4/PM8	<0.07	<0.07	<0.07
Benzo(a)pyrene	14	mg/kg	TM4/PM8	<0.04	<0.04	<0.04
Indeno(123cd)pyrene	61.0	mg/kg	TM4/PM8	<0.04	<0.04	<0.04
Dibenzo(ah)anthracene	13	mg/kg	TM4/PM8	<0.04	<0.04	<0.04
Benzo(ghi)perylene	658	mg/kg	TM4/PM8	<0.04	<0.04	<0.04
PAH 16 Total	NG	mg/kg	TM4/PM8	<0.6	<0.6	<0.6
Benzo(b)fluoranthene	102	mg/kg	TM4/PM8	<0.05	<0.05	<0.05
Benzo(k)fluoranthene	143	mg/kg	TM4/PM8	<0.02	<0.02	<0.02
PAH Surrogate % Recovery	N/A	%	TM4/PM8	100	108	119
Hydrocarbons						
EPH >C8-C10	N/A	mg/kg	TM5/PM8	<5	<5	<5
EPH >C10-C20	N/A	mg/kg	TM5/PM8	<10	—	63
EPH >C20-C30	N/A	mg/kg	TM5/PM8	<10	331	41
EPH >C30-C40	N/A	mg/kg	TM5/PM8	<10	<10	<10
EPH >C8-C40	5,000	mg/kg	TM5/PM8	<35	739	104
PCBs						
PCB 28	240.0	ug/kg	TM86/PM8	-	<5	<5
PCB 52	240.0	ug/kg	TM86/PM8	-	<5	<5
PCB 101	240.0	ug/kg	TM86/PM8	-	<5	<5
PCB 118	240.0	ug/kg	TM86/PM8	-	<5	<5
PCB 138	240.0	ug/kg	TM86/PM8	-	<5	<5
PCB 153	240.0	ug/kg	TM86/PM8	-	<5	<5
PCB 180	240.0	ug/kg	TM86/PM8	-	<5	<5
Total 7 PCBs	240	ug/kg	TM86/PM8	-	<35	<35
SVOCs						
2-Chlorophenol	3,590,000	ug/kg	TM16/PM8	-	<10	<10
2-Methylphenol	14,200,000	ug/kg	TM16/PM8	-	<10	<10
2-Nitrophenol	910,597	ug/kg	TM16/PM8	-	<10	<10
2,4-Dichlorophenol	3,530,000	ug/kg	TM16/PM8	-	<10	<10
2,4-Dimethylphenol	1,330,000	ug/kg	TM16/PM8	-	<10	<10
2,4,5-Trichlorophenol	2,300,000	ug/kg	TM16/PM8	-	<10	<10
2,4,6-Trichlorophenol	848,000	ug/kg	TM16/PM8	-	<10	<10

Delimara Power Station Borehole Analytical Results	ENVIRON GAC (Commercial)		SAMPLE ID	DPS-BH01	DPS-BH02	DPS-BH02	DPS-BH03
				DEPTH (m)	0.5	3.0-3.5	0-0.5
				LOCATION	DPS	DPS	DPS
				SAMPLE DATE	08/06/2011	08/06/2011	13/06/2011
Metals		Units	Method				
4-Chloro-3-methylphenol	8,333,156	ug/kg	TM16/PM8	-	-	-	-
4-Methylphenol	25,800,000	ug/kg	TM16/PM8	-	-	-	-
4-Nitrophenol	1,000,000	ug/kg	TM16/PM8	-	-	-	-
Pentachlorophenol	1,230,000	ug/kg	TM16/PM8	-	-	-	-
Phenol	3,200,000	ug/kg	TM16/PM8	-	-	-	-
2-Chloronaphthalene	113,000	ug/kg	TM16/PM8	-	-	-	-
2-Methylnaphthalene	7,148,111	ug/kg	TM16/PM8	-	-	-	-
Bis(2-ethyl-hexyl) phthalate	85,400,000	ug/kg	TM16/PM8	-	-	-	-
Butylbenzyl phthalate	942,000,000	ug/kg	TM16/PM8	-	-	-	-
Di-n-butyl phthalate	12,900	ug/kg	TM16/PM8	-	-	-	-
Di-n-Octyl phthalate	89,100,000	ug/kg	TM16/PM8	-	-	-	-
Diethyl phthalate	109,000	ug/kg	TM16/PM8	-	-	-	-
Dimethyl phthalate	275,000	ug/kg	TM16/PM8	-	-	-	-
1,2-Dichlorobenzene	562,000	ug/kg	TM16/PM8	-	-	-	-
1,2,4-Trichlorobenzene	123,000	ug/kg	TM16/PM8	-	-	-	-
1,3-Dichlorobenzene	177,000	ug/kg	TM16/PM8	-	-	-	-
1,4-Dichlorobenzene	221,000	ug/kg	TM16/PM8	-	-	-	-
2-Nitroaniline	651,305	ug/kg	TM16/PM8	-	-	-	-
2,4-Dinitrotoluene	3,750,000	ug/kg	TM16/PM8	-	-	-	-
2,6-Dinitrotoluene	1,860,000	ug/kg	TM16/PM8	-	-	-	-
3-Nitroaniline	200,000	ug/kg	TM16/PM8	-	-	-	-
4-Bromophenylphenylether	982.8	ug/kg	TM16/PM8	-	-	-	-
4-Chloroaniline	2,300,000	ug/kg	TM16/PM8	-	-	-	-
4-Chlorophenylphenylether	378.3	ug/kg	TM16/PM8	-	-	-	-
4-Nitroaniline	170,000	ug/kg	TM16/PM8	-	-	-	-
Azobenzene	151,511	ug/kg	TM16/PM8	-	-	-	-
Bis(2-chloro-ethoxy)methane	1,301.7	ug/kg	TM16/PM8	-	-	-	-
Bis(2-chloro-ethyl)ether	273.6	ug/kg	TM16/PM8	-	-	-	-
Carbazole	897,000	ug/kg	TM16/PM8	-	-	-	-
Dibenzofuran	6,666,492	ug/kg	TM16/PM8	-	-	-	-
Hexachlorobenzene	199	ug/kg	TM16/PM8	-	-	-	-
Hexachlorobutadiene	17,600	ug/kg	TM16/PM8	-	-	-	-
Hexachlorocyclopentadiene	1,091.3	ug/kg	TM16/PM8	-	-	-	-
Hexachloroethane	8,130	ug/kg	TM16/PM8	-	-	-	-
Isophorone	887,232	ug/kg	TM16/PM8	-	-	-	-
N-nitrosodi-n-propylamine	1,904.9	ug/kg	TM16/PM8	-	-	-	-
Nitrobenzene	131,262	ug/kg	TM16/PM8	-	-	-	-
VOCs							
Dichlorodifluoromethane	1,500,000	ug/kg	TM15/PM10	-	-	-	-
Methyl Tertiary Butyl Ether	-	ug/kg	TM15/PM10	-	-	-	-
Chloromethane	593	ug/kg	TM15/PM10	-	-	-	-
Vinyl Chloride	40.3	ug/kg	TM15/PM10	-	-	-	-
Bromomethane	27,046	ug/kg	TM15/PM10	-	-	-	-
Chloroethane	567,000	ug/kg	TM15/PM10	-	-	-	-
Trichlorofluoromethane	2,200,000	ug/kg	TM15/PM10	-	-	-	-
1,1-Dichloroethene	-	ug/kg	TM15/PM10	-	-	-	-
Dichloromethane	-	ug/kg	TM15/PM10	-	-	-	-
trans-1-2-Dichloroethene	12,300	ug/kg	TM15/PM10	-	-	-	-
1,1-Dichloroethane	148,000	ug/kg	TM15/PM10	-	-	-	-
cis-1-2-Dichloroethene	-	ug/kg	TM15/PM10	-	-	-	-
2,2-Dichloropropane	20,460	ug/kg	TM15/PM10	-	-	-	-
Bromochloromethane	-	ug/kg	TM15/PM10	-	-	-	-
Chloroform	-	ug/kg	TM15/PM10	-	-	-	-
1,1,1-Trichloroethane	391,511	ug/kg	TM15/PM10	-	-	-	-
1,1-Dichloropropene	12,853	ug/kg	TM15/PM10	-	-	-	-
Carbon tetrachloride	1,740	ug/kg	TM15/PM10	-	-	-	-
1,2-Dichloroethane	356	ug/kg	TM15/PM10	-	-	-	-
Benzene	15,826	ug/kg	TM15/PM10	-	-	-	-
Trichloroethene	6,611	ug/kg	TM15/PM10	-	-	-	-
1,2-Dichloropropane	1,720	ug/kg	TM15/PM10	-	-	-	-
Dibromomethane	-	ug/kg	TM15/PM10	-	-	-	-
Bromodichloromethane	1,100	ug/kg	TM15/PM10	-	-	-	-
cis-1-3-Dichloropropene	19,358	ug/kg	TM15/PM10	-	-	-	-
Toluene	835,000	ug/kg	TM15/PM10	-	-	-	-

Delimara Power Station Borehole Analytical Results	ENVIRON GAC (Commercial)		SAMPLE ID	DPS-BH03	DPS-BH04	DPS-BH04	DPS-BH05
				DEPTH (m)	0-0.5	3.0-3.5	0-0.5
				LOCATION	DPS	DPS	DPS
				SAMPLE DATE	13/06/2011	13/06/2011	14/06/2011
Metals		Units	Method				
4-Chloro-3-methylphenol	8,333,156	ug/kg	TM16/PM8	-	-	<10	-
4-Methylphenol	25,800,000	ug/kg	TM16/PM8	-	-	<10	-
4-Nitrophenol	1,000,000	ug/kg	TM16/PM8	-	-	<10	-
Pentachlorophenol	1,230,000	ug/kg	TM16/PM8	-	-	<10	-
Phenol	3,200,000	ug/kg	TM16/PM8	-	-	<10	-
2-Chloronaphthalene	113,000	ug/kg	TM16/PM8	-	-	<10	-
2-Methylnaphthalene	7,148,111	ug/kg	TM16/PM8	-	-	<10	-
Bis(2-ethyl-hexyl) phthalate	85,400,000	ug/kg	TM16/PM8	-	-	<10	-
Butylbenzyl phthalate	942,000,000	ug/kg	TM16/PM8	-	-	<10	-
Di-n-butyl phthalate	12,900	ug/kg	TM16/PM8	-	-	<10	-
Di-n-Octyl phthalate	89,100,000	ug/kg	TM16/PM8	-	-	<10	-
Diethyl phthalate	109,000	ug/kg	TM16/PM8	-	-	<10	-
Dimethyl phthalate	275,000	ug/kg	TM16/PM8	-	-	<10	-
1,2-Dichlorobenzene	562,000	ug/kg	TM16/PM8	-	-	<10	-
1,2,4-Trichlorobenzene	123,000	ug/kg	TM16/PM8	-	-	<10	-
1,3-Dichlorobenzene	177,000	ug/kg	TM16/PM8	-	-	<10	-
1,4-Dichlorobenzene	221,000	ug/kg	TM16/PM8	-	-	<10	-
2-Nitroaniline	651,305	ug/kg	TM16/PM8	-	-	<10	-
2,4-Dinitrotoluene	3,750,000	ug/kg	TM16/PM8	-	-	<10	-
2,6-Dinitrotoluene	1,860,000	ug/kg	TM16/PM8	-	-	<10	-
3-Nitroaniline	200,000	ug/kg	TM16/PM8	-	-	<10	-
4-Bromophenylphenylether	982.8	ug/kg	TM16/PM8	-	-	<10	-
4-Chloroaniline	2,300,000	ug/kg	TM16/PM8	-	-	<10	-
4-Chlorophenylphenylether	378.3	ug/kg	TM16/PM8	-	-	<10	-
4-Nitroaniline	170,000	ug/kg	TM16/PM8	-	-	<10	-
Azobenzene	151,511	ug/kg	TM16/PM8	-	-	<10	-
Bis(2-chloro-ethoxy)methane	1,301.7	ug/kg	TM16/PM8	-	-	<10	-
Bis(2-chloro-ethyl)ether	273.6	ug/kg	TM16/PM8	-	-	<10	-
Carbazole	897,000	ug/kg	TM16/PM8	-	-	<10	-
Dibenzofuran	6,666,492	ug/kg	TM16/PM8	-	-	<10	-
Hexachlorobenzene	199	ug/kg	TM16/PM8	-	-	<10	-
Hexachlorobutadiene	17,600	ug/kg	TM16/PM8	-	-	<10	-
Hexachlorocyclopentadiene	1,091.3	ug/kg	TM16/PM8	-	-	<10	-
Hexachloroethane	8,130	ug/kg	TM16/PM8	-	-	<10	-
Isophorone	887,232	ug/kg	TM16/PM8	-	-	<10	-
N-nitrosodi-n-propylamine	1,904.9	ug/kg	TM16/PM8	-	-	<10	-
Nitrobenzene	131,262	ug/kg	TM16/PM8	-	-	<10	-
VOCs							
Dichlorodifluoromethane	1,500,000	ug/kg	TM15/PM10	-	-	<2	-
Methyl Tertiary Butyl Ether	-	ug/kg	TM15/PM10	-	-	<2	-
Chloromethane	593	ug/kg	TM15/PM10	-	-	<3	-
Vinyl Chloride	40.3	ug/kg	TM15/PM10	-	-	<2	-
Bromomethane	27,046	ug/kg	TM15/PM10	-	-	<1	-
Chloroethane	567,000	ug/kg	TM15/PM10	-	-	<2	-
Trichlorofluoromethane	2,200,000	ug/kg	TM15/PM10	-	-	<2	-
1,1-Dichloroethene	-	ug/kg	TM15/PM10	-	-	<6	-
Dichloromethane	-	ug/kg	TM15/PM10	-	-	<7	-
trans-1-2-Dichloroethene	12,300	ug/kg	TM15/PM10	-	-	<3	-
1,1-Dichloroethane	148,000	ug/kg	TM15/PM10	-	-	<3	-
cis-1-2-Dichloroethene	-	ug/kg	TM15/PM10	-	-	<3	-
2,2-Dichloropropane	20,460	ug/kg	TM15/PM10	-	-	<4	-
Bromochloromethane	-	ug/kg	TM15/PM10	-	-	<3	-
Chloroform	-	ug/kg	TM15/PM10	-	-	<3	-
1,1,1-Trichloroethane	391,511	ug/kg	TM15/PM10	-	-	<3	-
1,1-Dichloropropene	12,853	ug/kg	TM15/PM10	-	-	<3	-
Carbon tetrachloride	1,740	ug/kg	TM15/PM10	-	-	<4	-
1,2-Dichloroethane	356	ug/kg	TM15/PM10	-	-	<4	-
Benzene	15,826	ug/kg	TM15/PM10	-	-	<3	-
Trichloroethene	6,611	ug/kg	TM15/PM10	-	-	<3	-
1,2-Dichloropropane	1,720	ug/kg	TM15/PM10	-	-	<6	-
Dibromomethane	-	ug/kg	TM15/PM10	-	-	<3	-
Bromodichloromethane	1,100	ug/kg	TM15/PM10	-	-	<3	-
cis-1-3-Dichloropropene	19,358	ug/kg	TM15/PM10	-	-	<4	-
Toluene	835,000	ug/kg	TM15/PM10	-	-	<3	-

Delimara Power Station Borehole Analytical Results	ENVIRON GAC (Commercial)		SAMPLE ID	DPS-BH05	DPS-BH06	DPS-BH06	DPS-BH07
				DEPTH (m)	0-0.5	3.5-4.0	0-0.5
				LOCATION	DPS	DPS	DPS
				SAMPLE DATE	14/06/2011	14/06/2011	14/06/2011
Metals		Units	Method				
4-Chloro-3-methylphenol	8,333,156	ug/kg	TM16/PM8	<10	-	-	-
4-Methylphenol	25,800,000	ug/kg	TM16/PM8	<10	-	-	-
4-Nitrophenol	1,000,000	ug/kg	TM16/PM8	<10	-	-	-
Pentachlorophenol	1,230,000	ug/kg	TM16/PM8	<10	-	-	-
Phenol	3,200,000	ug/kg	TM16/PM8	<10	-	-	-
2-Chloronaphthalene	113,000	ug/kg	TM16/PM8	<10	-	-	-
2-Methylnaphthalene	7,148,111	ug/kg	TM16/PM8	<10	-	-	-
Bis(2-ethyl-hexyl) phthalate	85,400,000	ug/kg	TM16/PM8	<10	-	-	-
Butylbenzyl phthalate	942,000,000	ug/kg	TM16/PM8	<10	-	-	-
Di-n-butyl phthalate	12,900	ug/kg	TM16/PM8	<10	-	-	-
Di-n-Octyl phthalate	89,100,000	ug/kg	TM16/PM8	<10	-	-	-
Diethyl phthalate	109,000	ug/kg	TM16/PM8	<10	-	-	-
Dimethyl phthalate	275,000	ug/kg	TM16/PM8	<10	-	-	-
1,2-Dichlorobenzene	562,000	ug/kg	TM16/PM8	<10	-	-	-
1,2,4-Trichlorobenzene	123,000	ug/kg	TM16/PM8	<10	-	-	-
1,3-Dichlorobenzene	177,000	ug/kg	TM16/PM8	<10	-	-	-
1,4-Dichlorobenzene	221,000	ug/kg	TM16/PM8	<10	-	-	-
2-Nitroaniline	651,305	ug/kg	TM16/PM8	<10	-	-	-
2,4-Dinitrotoluene	3,750,000	ug/kg	TM16/PM8	<10	-	-	-
2,6-Dinitrotoluene	1,860,000	ug/kg	TM16/PM8	<10	-	-	-
3-Nitroaniline	200,000	ug/kg	TM16/PM8	<10	-	-	-
4-Bromophenylphenylether	982.8	ug/kg	TM16/PM8	<10	-	-	-
4-Chloroaniline	2,300,000	ug/kg	TM16/PM8	<10	-	-	-
4-Chlorophenylphenylether	378.3	ug/kg	TM16/PM8	<10	-	-	-
4-Nitroaniline	170,000	ug/kg	TM16/PM8	<10	-	-	-
Azobenzene	151,511	ug/kg	TM16/PM8	<10	-	-	-
Bis(2-chloro-ethoxy)methane	1,301.7	ug/kg	TM16/PM8	<10	-	-	-
Bis(2-chloro-ethyl)ether	273.6	ug/kg	TM16/PM8	<10	-	-	-
Carbazole	897,000	ug/kg	TM16/PM8	<10	-	-	-
Dibenzofuran	6,666,492	ug/kg	TM16/PM8	<10	-	-	-
Hexachlorobenzene	199	ug/kg	TM16/PM8	<10	-	-	-
Hexachlorobutadiene	17,600	ug/kg	TM16/PM8	<10	-	-	-
Hexachlorocyclopentadiene	1,091.3	ug/kg	TM16/PM8	<10	-	-	-
Hexachloroethane	8,130	ug/kg	TM16/PM8	<10	-	-	-
Isophorone	887,232	ug/kg	TM16/PM8	<10	-	-	-
N-nitrosodi-n-propylamine	1,904.9	ug/kg	TM16/PM8	<10	-	-	-
Nitrobenzene	131,262	ug/kg	TM16/PM8	<10	-	-	-
VOCs							
Dichlorodifluoromethane	1,500,000	ug/kg	TM15/PM10	<2	-	-	-
Methyl Tertiary Butyl Ether	-	ug/kg	TM15/PM10	<2	-	-	-
Chloromethane	593	ug/kg	TM15/PM10	<3	-	-	-
Vinyl Chloride	40.3	ug/kg	TM15/PM10	<2	-	-	-
Bromomethane	27,046	ug/kg	TM15/PM10	<1	-	-	-
Chloroethane	567,000	ug/kg	TM15/PM10	<2	-	-	-
Trichlorofluoromethane	2,200,000	ug/kg	TM15/PM10	<2	-	-	-
1,1-Dichloroethene	-	ug/kg	TM15/PM10	<6	-	-	-
Dichloromethane	-	ug/kg	TM15/PM10	<7	-	-	-
trans-1-2-Dichloroethene	12,300	ug/kg	TM15/PM10	<3	-	-	-
1,1-Dichloroethane	148,000	ug/kg	TM15/PM10	<3	-	-	-
cis-1-2-Dichloroethene	-	ug/kg	TM15/PM10	<3	-	-	-
2,2-Dichloropropane	20,460	ug/kg	TM15/PM10	<4	-	-	-
Bromochloromethane	-	ug/kg	TM15/PM10	<3	-	-	-
Chloroform	-	ug/kg	TM15/PM10	<3	-	-	-
1,1,1-Trichloroethane	391,511	ug/kg	TM15/PM10	<3	-	-	-
1,1-Dichloropropene	12,853	ug/kg	TM15/PM10	<3	-	-	-
Carbon tetrachloride	1,740	ug/kg	TM15/PM10	<4	-	-	-
1,2-Dichloroethane	356	ug/kg	TM15/PM10	<4	-	-	-
Benzene	15,826	ug/kg	TM15/PM10	<3	-	-	-
Trichloroethene	6,611	ug/kg	TM15/PM10	<3	-	-	-
1,2-Dichloropropane	1,720	ug/kg	TM15/PM10	<6	-	-	-
Dibromomethane	-	ug/kg	TM15/PM10	<3	-	-	-
Bromodichloromethane	1,100	ug/kg	TM15/PM10	<3	-	-	-
cis-1-3-Dichloropropene	19,358	ug/kg	TM15/PM10	<4	-	-	-
Toluene	835,000	ug/kg	TM15/PM10	<3	-	-	-



Delimara Power Station Borehole Analytical Results	ENVIRON GAC (Commercial)		SAMPLE ID	DPS-BH08	BH-08	BH-08
				DEPTH (m)	1.8-2.0	2.8-3.0
				LOCATION	DPS	DPS
				SAMPLE DATE	14/06/2011	27/06/2011
Metals		Units	Method			
4-Chloro-3-methylphenol	8,333,156	ug/kg	TM16/PM8	-	<10	<10
4-Methylphenol	25,800,000	ug/kg	TM16/PM8	-	<10	<10
4-Nitrophenol	1,000,000	ug/kg	TM16/PM8	-	<10	<10
Pentachlorophenol	1,230,000	ug/kg	TM16/PM8	-	<10	<10
Phenol	3,200,000	ug/kg	TM16/PM8	-	<10	<10
2-Chloronaphthalene	113,000	ug/kg	TM16/PM8	-	<10	<10
2-Methylnaphthalene	7,148,111	ug/kg	TM16/PM8	-	57	<10
Bis(2-ethyl-hexyl) phthalate	85,400,000	ug/kg	TM16/PM8	-	<10	<10
Butylbenzyl phthalate	942,000,000	ug/kg	TM16/PM8	-	<10	<10
Di-n-butyl phthalate	12,900	ug/kg	TM16/PM8	-	<10	<10
Di-n-Octyl phthalate	89,100,000	ug/kg	TM16/PM8	-	<10	<10
Diethyl phthalate	109,000	ug/kg	TM16/PM8	-	<10	<10
Dimethyl phthalate	275,000	ug/kg	TM16/PM8	-	<10	<10
1,2-Dichlorobenzene	562,000	ug/kg	TM16/PM8	-	<10	<10
1,2,4-Trichlorobenzene	123,000	ug/kg	TM16/PM8	-	<10	<10
1,3-Dichlorobenzene	177,000	ug/kg	TM16/PM8	-	<10	<10
1,4-Dichlorobenzene	221,000	ug/kg	TM16/PM8	-	<10	<10
2-Nitroaniline	651,305	ug/kg	TM16/PM8	-	<10	<10
2,4-Dinitrotoluene	3,750,000	ug/kg	TM16/PM8	-	<10	<10
2,6-Dinitrotoluene	1,860,000	ug/kg	TM16/PM8	-	<10	<10
3-Nitroaniline	200,000	ug/kg	TM16/PM8	-	<10	<10
4-Bromophenylphenylether	982.8	ug/kg	TM16/PM8	-	<10	<10
4-Chloroaniline	2,300,000	ug/kg	TM16/PM8	-	<10	<10
4-Chlorophenylphenylether	378.3	ug/kg	TM16/PM8	-	<10	<10
4-Nitroaniline	170,000	ug/kg	TM16/PM8	-	<10	<10
Azobenzene	151,511	ug/kg	TM16/PM8	-	<10	<10
Bis(2-chloro-ethoxy)methane	1,301.7	ug/kg	TM16/PM8	-	<10	<10
Bis(2-chloro-ethyl)ether	273.6	ug/kg	TM16/PM8	-	<10	<10
Carbazole	897,000	ug/kg	TM16/PM8	-	<10	<10
Dibenzofuran	6,666,492	ug/kg	TM16/PM8	-	<10	<10
Hexachlorobenzene	199	ug/kg	TM16/PM8	-	<10	<10
Hexachlorobutadiene	17,600	ug/kg	TM16/PM8	-	<10	<10
Hexachlorocyclopentadiene	1,091.3	ug/kg	TM16/PM8	-	<10	<10
Hexachloroethane	8,130	ug/kg	TM16/PM8	-	<10	<10
Isophorone	887,232	ug/kg	TM16/PM8	-	<10	<10
N-nitrosodi-n-propylamine	1,904.9	ug/kg	TM16/PM8	-	<10	<10
Nitrobenzene	131,262	ug/kg	TM16/PM8	-	<10	<10
VOCs						
Dichlorodifluoromethane	1,500,000	ug/kg	TM15/PM10	-	<2	<2
Methyl Tertiary Butyl Ether	-	ug/kg	TM15/PM10	-	<2	<2
Chloromethane	593	ug/kg	TM15/PM10	-	<3	<3
Vinyl Chloride	40.3	ug/kg	TM15/PM10	-	<2	<2
Bromomethane	27,046	ug/kg	TM15/PM10	-	<1	<1
Chloroethane	567,000	ug/kg	TM15/PM10	-	<2	<2
Trichlorofluoromethane	2,200,000	ug/kg	TM15/PM10	-	<2	<2
1,1-Dichloroethene	-	ug/kg	TM15/PM10	-	<6	<6
Dichloromethane	-	ug/kg	TM15/PM10	-	<7	<7
trans-1-2-Dichloroethene	12,300	ug/kg	TM15/PM10	-	<3	<3
1,1-Dichloroethane	148,000	ug/kg	TM15/PM10	-	<3	<3
cis-1-2-Dichloroethene	-	ug/kg	TM15/PM10	-	<3	<3
2,2-Dichloropropane	20,460	ug/kg	TM15/PM10	-	<4	<4
Bromochloromethane	-	ug/kg	TM15/PM10	-	<3	<3
Chloroform	-	ug/kg	TM15/PM10	-	<3	<3
1,1,1-Trichloroethane	391,511	ug/kg	TM15/PM10	-	<3	<3
1,1-Dichloropropene	12,853	ug/kg	TM15/PM10	-	<3	<3
Carbon tetrachloride	1,740	ug/kg	TM15/PM10	-	<4	<4
1,2-Dichloroethane	356	ug/kg	TM15/PM10	-	<4	<4
Benzene	15,826	ug/kg	TM15/PM10	-	<3	<3
Trichloroethene	6,611	ug/kg	TM15/PM10	-	<3	<3
1,2-Dichloropropane	1,720	ug/kg	TM15/PM10	-	<6	<6
Dibromomethane	-	ug/kg	TM15/PM10	-	<3	<3
Bromodichloromethane	1,100	ug/kg	TM15/PM10	-	<3	<3
cis-1-3-Dichloropropene	19,358	ug/kg	TM15/PM10	-	<4	<4
Toluene	835,000	ug/kg	TM15/PM10	-	<3	<3

Delimara Power Station Borehole Analytical Results	ENVIRON GAC (Commercial)		SAMPLE ID	DPS-BH01	DPS-BH02	DPS-BH02	DPS-BH03
			DEPTH (m)	0.5	0.5	3.0-3.5	0-0.5
			LOCATION	DPS	DPS	DPS	DPS
			SAMPLE DATE	08/06/2011	08/06/2011	08/06/2011	13/06/2011
Metals		Units	Method				
trans-1-3-Dichloropropene	12,853	ug/kg	TM15/PM10	-	-	-	-
1,1,2-Trichloroethane	51,100	ug/kg	TM15/PM10	-	-	-	-
Tetrachloroethene	72,200	ug/kg	TM15/PM10	-	-	-	-
1,3-Dichloropropane	12,853	ug/kg	TM15/PM10	-	-	-	-
Dibromochloromethane	-	ug/kg	TM15/PM10	-	-	-	-
1,2-Dibromoethane	-	ug/kg	TM15/PM10	-	-	-	-
Chlorobenzene	32,800	ug/kg	TM15/PM10	-	-	-	-
1,1,1,2-Tetrachloroethane	62,718	ug/kg	TM15/PM10	-	-	-	-
Ethylbenzene	508,000	ug/kg	TM15/PM10	-	-	-	-
p/m-Xylene	564,000	ug/kg	TM15/PM10	-	-	-	-
o-Xylene	467,000	ug/kg	TM15/PM10	-	-	-	-
Styrene	607,000	ug/kg	TM15/PM10	-	-	-	-
Bromoform	417,000	ug/kg	TM15/PM10	-	-	-	-
Isopropylbenzene	753,000	ug/kg	TM15/PM10	-	-	-	-
1,1,2,2-Tetrachloroethane	156,089	ug/kg	TM15/PM10	-	-	-	-
Bromobenzene	-	ug/kg	TM15/PM10	-	-	-	-
1,2,3-Trichloropropane	3143	ug/kg	TM15/PM10	-	-	-	-
Propylbenzene	399000.0	ug/kg	TM15/PM10	-	-	-	-
2-Chlorotoluene	-	ug/kg	TM15/PM10	-	-	-	-
1,3,5-Trimethylbenzene	-	ug/kg	TM15/PM10	-	-	-	-
4-Chlorotoluene	1,418	ug/kg	TM15/PM10	-	-	-	-
tert-Butylbenzene	440,000	ug/kg	TM15/PM10	-	-	-	-
1,2,4-Trimethylbenzene	-	ug/kg	TM15/PM10	-	-	-	-
sec-Butylbenzene	1,300,000	ug/kg	TM15/PM10	-	-	-	-
4-Isopropyltoluene	388,000	ug/kg	TM15/PM10	-	-	-	-
1,3-Dichlorobenzene	17,700	ug/kg	TM15/PM10	-	-	-	-
1,4-Dichlorobenzene	221,000	ug/kg	TM15/PM10	-	-	-	-
n-Butylbenzene	430,000	ug/kg	TM15/PM10	-	-	-	-
1,2-Dichlorobenzene	562,000	ug/kg	TM15/PM10	-	-	-	-
1,2-Dibromo-3-chloropropane	1,037	ug/kg	TM15/PM10	-	-	-	-
1,2,4-Trichlorobenzene	123,000	ug/kg	TM15/PM10	-	-	-	-
Hexachlorobutadiene	17,600	ug/kg	TM15/PM10	-	-	-	-
Naphthalene	75,000	ug/kg	TM15/PM10	-	-	-	-
1,2,3-Trichlorobenzene	56,800	ug/kg	TM15/PM10	-	-	-	-



Delimara Power Station Borehole Analytical Results	ENVIRON GAC (Commercial)		SAMPLE ID	DPS-BH03	DPS-BH04	DPS-BH04	DPS-BH05
			DEPTH (m)	2.5-3.0	0.-0.5	3.0-3.5	0-0.5
			LOCATION	DPS	DPS	DPS	DPS
			SAMPLE DATE	13/06/2011	13/06/2011	13/06/2011	14/06/2011
Metals		Units	Method				
trans-1-3-Dichloropropene	12,853	ug/kg	TM15/PM10	-	-	<3	-
1,1,2-Trichloroethane	51,100	ug/kg	TM15/PM10	-	-	<3	-
Tetrachloroethene	72,200	ug/kg	TM15/PM10	-	-	<3	-
1,3-Dichloropropane	12,853	ug/kg	TM15/PM10	-	-	<3	-
Dibromochloromethane	-	ug/kg	TM15/PM10	-	-	<3	-
1,2-Dibromoethane	-	ug/kg	TM15/PM10	-	-	<3	-
Chlorobenzene	32,800	ug/kg	TM15/PM10	-	-	<3	-
1,1,1,2-Tetrachloroethane	62,718	ug/kg	TM15/PM10	-	-	<3	-
Ethylbenzene	508,000	ug/kg	TM15/PM10	-	-	<3	-
p/m-Xylene	564,000	ug/kg	TM15/PM10	-	-	<6	-
o-Xylene	467,000	ug/kg	TM15/PM10	-	-	<3	-
Styrene	607,000	ug/kg	TM15/PM10	-	-	<3	-
Bromoform	417,000	ug/kg	TM15/PM10	-	-	<3	-
Isopropylbenzene	753,000	ug/kg	TM15/PM10	-	-	<3	-
1,1,2,2-Tetrachloroethane	156,089	ug/kg	TM15/PM10	-	-	<3	-
Bromobenzene	-	ug/kg	TM15/PM10	-	-	<2	-
1,2,3-Trichloropropane	3143	ug/kg	TM15/PM10	-	-	<4	-
Propylbenzene	399000.0	ug/kg	TM15/PM10	-	-	<4	-
2-Chlorotoluene	-	ug/kg	TM15/PM10	-	-	<3	-
1,3,5-Trimethylbenzene	-	ug/kg	TM15/PM10	-	-	<3	-
4-Chlorotoluene	1,418	ug/kg	TM15/PM10	-	-	<3	-
tert-Butylbenzene	440,000	ug/kg	TM15/PM10	-	-	<5	-
1,2,4-Trimethylbenzene	-	ug/kg	TM15/PM10	-	-	<6	-
sec-Butylbenzene	1,300,000	ug/kg	TM15/PM10	-	-	<4	-
4-Isopropyltoluene	388,000	ug/kg	TM15/PM10	-	-	<4	-
1,3-Dichlorobenzene	17,700	ug/kg	TM15/PM10	-	-	<4	-
1,4-Dichlorobenzene	221,000	ug/kg	TM15/PM10	-	-	<4	-
n-Butylbenzene	430,000	ug/kg	TM15/PM10	-	-	<4	-
1,2-Dichlorobenzene	562,000	ug/kg	TM15/PM10	-	-	<4	-
1,2-Dibromo-3-chloropropane	1,037	ug/kg	TM15/PM10	-	-	<4	-
1,2,4-Trichlorobenzene	123,000	ug/kg	TM15/PM10	-	-	<7	-
Hexachlorobutadiene	17,600	ug/kg	TM15/PM10	-	-	<4	-
Naphthalene	75,000	ug/kg	TM15/PM10	-	-	<27	-
1,2,3-Trichlorobenzene	56,800	ug/kg	TM15/PM10	-	-	<7	-

Delimara Power Station Borehole Analytical Results	ENVIRON GAC (Commercial)		SAMPLE ID	DPS-BH05	DPS-BH06	DPS-BH06	DPS-BH07
			DEPTH (m)	3.0-3.5	0-0.5	3.5-4.0	0-0.5
			LOCATION	DPS	DPS	DPS	DPS
			SAMPLE DATE	14/06/2011	14/06/2011	14/06/2011	14/06/2011
Metals		Units	Method				
trans-1-3-Dichloropropene	12,853	ug/kg	TM15/PM10	<3	-	-	-
1,1,2-Trichloroethane	51,100	ug/kg	TM15/PM10	<3	-	-	-
Tetrachloroethene	72,200	ug/kg	TM15/PM10	<3	-	-	-
1,3-Dichloropropane	12,853	ug/kg	TM15/PM10	<3	-	-	-
Dibromochloromethane	-	ug/kg	TM15/PM10	<3	-	-	-
1,2-Dibromoethane	-	ug/kg	TM15/PM10	<3	-	-	-
Chlorobenzene	32,800	ug/kg	TM15/PM10	<3	-	-	-
1,1,1,2-Tetrachloroethane	62,718	ug/kg	TM15/PM10	<3	-	-	-
Ethylbenzene	508,000	ug/kg	TM15/PM10	<3	-	-	-
p/m-Xylene	564,000	ug/kg	TM15/PM10	<6	-	-	-
o-Xylene	467,000	ug/kg	TM15/PM10	<3	-	-	-
Styrene	607,000	ug/kg	TM15/PM10	<3	-	-	-
Bromoform	417,000	ug/kg	TM15/PM10	<3	-	-	-
Isopropylbenzene	753,000	ug/kg	TM15/PM10	<3	-	-	-
1,1,2,2-Tetrachloroethane	156,089	ug/kg	TM15/PM10	<3	-	-	-
Bromobenzene	-	ug/kg	TM15/PM10	<2	-	-	-
1,2,3-Trichloropropane	3143	ug/kg	TM15/PM10	<4	-	-	-
Propylbenzene	399000.0	ug/kg	TM15/PM10	<4	-	-	-
2-Chlorotoluene	-	ug/kg	TM15/PM10	<3	-	-	-
1,3,5-Trimethylbenzene	-	ug/kg	TM15/PM10	<3	-	-	-
4-Chlorotoluene	1,418	ug/kg	TM15/PM10	<3	-	-	-
tert-Butylbenzene	440,000	ug/kg	TM15/PM10	<5	-	-	-
1,2,4-Trimethylbenzene	-	ug/kg	TM15/PM10	<6	-	-	-
sec-Butylbenzene	1,300,000	ug/kg	TM15/PM10	<4	-	-	-
4-Isopropyltoluene	388,000	ug/kg	TM15/PM10	<4	-	-	-
1,3-Dichlorobenzene	17,700	ug/kg	TM15/PM10	<4	-	-	-
1,4-Dichlorobenzene	221,000	ug/kg	TM15/PM10	<4	-	-	-
n-Butylbenzene	430,000	ug/kg	TM15/PM10	<4	-	-	-
1,2-Dichlorobenzene	562,000	ug/kg	TM15/PM10	<4	-	-	-
1,2-Dibromo-3-chloropropane	1,037	ug/kg	TM15/PM10	<4	-	-	-
1,2,4-Trichlorobenzene	123,000	ug/kg	TM15/PM10	<7	-	-	-
Hexachlorobutadiene	17,600	ug/kg	TM15/PM10	<4	-	-	-
Naphthalene	75,000	ug/kg	TM15/PM10	<27	-	-	-
1,2,3-Trichlorobenzene	56,800	ug/kg	TM15/PM10	<7	-	-	-

Delimara Power Station Borehole Analytical Results	ENVIRON GAC (Commercial)		SAMPLE ID	DPS-BH08	BH-08	BH-08
			DEPTH (m)	0-0.5	1.8-2.0	2.8-3.0
			LOCATION	DPS	DPS	DPS
			SAMPLE DATE	14/06/2011	27/06/2011	27/06/2011
Metals		Units	Method			
trans-1-3-Dichloropropene	12,853	ug/kg	TM15/PM10	-	<3	<3
1,1,2-Trichloroethane	51,100	ug/kg	TM15/PM10	-	<3	<3
Tetrachloroethene	72,200	ug/kg	TM15/PM10	-	<3	<3
1,3-Dichloropropane	12,853	ug/kg	TM15/PM10	-	<3	<3
Dibromochloromethane	-	ug/kg	TM15/PM10	-	<3	<3
1,2-Dibromoethane	-	ug/kg	TM15/PM10	-	<3	<3
Chlorobenzene	32,800	ug/kg	TM15/PM10	-	<3	<3
1,1,1,2-Tetrachloroethane	62,718	ug/kg	TM15/PM10	-	<3	<3
Ethylbenzene	508,000	ug/kg	TM15/PM10	-	<3	<3
p/m-Xylene	564,000	ug/kg	TM15/PM10	-	<6+	<6+
o-Xylene	467,000	ug/kg	TM15/PM10	-	<3+	<3+
Styrene	607,000	ug/kg	TM15/PM10	-	<3	<3
Bromoform	417,000	ug/kg	TM15/PM10	-	<3	<3
Isopropylbenzene	753,000	ug/kg	TM15/PM10	-	<3	<3
1,1,2,2-Tetrachloroethane	156,089	ug/kg	TM15/PM10	-	<3	<3
Bromobenzene	-	ug/kg	TM15/PM10	-	<2	<2
1,2,3-Trichloropropane	3143	ug/kg	TM15/PM10	-	<4	<4
Propylbenzene	399000.0	ug/kg	TM15/PM10	-	<4+	<4+
2-Chlorotoluene	-	ug/kg	TM15/PM10	-	<3	<3
1,3,5-Trimethylbenzene	-	ug/kg	TM15/PM10	-	<3	<3
4-Chlorotoluene	1,418	ug/kg	TM15/PM10	-	<3	<3
tert-Butylbenzene	440,000	ug/kg	TM15/PM10	-	<5	<5
1,2,4-Trimethylbenzene	-	ug/kg	TM15/PM10	-	<6	<6
sec-Butylbenzene	1,300,000	ug/kg	TM15/PM10	-	<4	<4
4-Isopropyltoluene	388,000	ug/kg	TM15/PM10	-	<4	<4
1,3-Dichlorobenzene	17,700	ug/kg	TM15/PM10	-	<4	<4
1,4-Dichlorobenzene	221,000	ug/kg	TM15/PM10	-	<4	<4
n-Butylbenzene	430,000	ug/kg	TM15/PM10	-	<4	<4
1,2-Dichlorobenzene	562,000	ug/kg	TM15/PM10	-	<4	<4
1,2-Dibromo-3-chloropropane	1,037	ug/kg	TM15/PM10	-	<4	<4
1,2,4-Trichlorobenzene	123,000	ug/kg	TM15/PM10	-	<7	<7
Hexachlorobutadiene	17,600	ug/kg	TM15/PM10	-	<4	<4
Naphthalene	75,000	ug/kg	TM15/PM10	-	<27	<27
1,2,3-Trichlorobenzene	56,800	ug/kg	TM15/PM10	-	<7	<7

## **Annex D: Laboratory Analytical Certificates**



# Jones Environmental Laboratory

Environ  
Sterling House  
The Bourse  
Boar Lane  
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LS1 5EQ

Unit 3 Deeside Point  
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No.4225

<b>Attention :</b>	Michael Hazlehurst
<b>Date :</b>	8th July, 2011
<b>Your reference :</b>	UK22-16873
<b>Our reference :</b>	Test Report 11/5009 Batch 1
<b>Location :</b>	DPS
<b>Date samples received :</b>	1st July, 2011
<b>Status :</b>	Final report
<b>Issue :</b>	1

Eleven samples were received for analysis on 1st July, 2011, which was completed on 8th July 2011. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.

All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

**J W Farrell- Jones CChem FRSC**  
**Chartered Chemist**

# **Jones Environmental Laboratory**

**Client Name:** Environ  
**Reference:** UK22-16873  
**Location:** DPS  
**Contact:** Michael Hazlehurst  
**JE Job No.:** 11/5009

**Report : Solid**

**Solids:** V=60g VOC jar, J=250g glass jar, T=plastic tub

J E Sample No.	1-2	3-4	5-7	8-9	13-14	15-16	17-18	21-22			Please see attached notes for all abbreviations and acronyms		
Sample ID	BH-08	BH-08	SB-09	SB-09	SB-10	SB-10-DS	SB-11	SB-12					
Depth	1.8-2.0	2.8-3.0	0.3-0.5	1.3-1.5	2.3-2.5	2.3-2.5	0.3-0.5	0.8-1.0					
COC No / misc													
Containers	V	V	VB	V	V	V	V	V					
Sample Date	27/06/2011	27/06/2011	27/06/2011	27/06/2011	28/06/2011	28/06/2011	28/06/2011	28/06/2011					
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil					
Batch Number	1	1	1	1	1	1	1	1					
Date of Receipt	01/07/2011	01/07/2011	01/07/2011	01/07/2011	01/07/2011	01/07/2011	01/07/2011	01/07/2011			LOD	Units	Method No.
Antimony	<1	<1	<1	<1	<1	<1	<1	<1			<1	mg/kg	TM30/PM15
Arsenic <sup>#</sup>	4.9	3.5	2.6	2.3	2.9	2.4	2.4	2.8			<0.5	mg/kg	TM30/PM15
Cadmium <sup>#</sup>	0.4	0.4	0.4	0.4	0.4	0.4	0.2	0.3			<0.1	mg/kg	TM30/PM15
Chromium <sup>#</sup>	16.6	19.1	19.5	20.7	14.9	13.3	9.8	20.6			<0.5	mg/kg	TM30/PM15
Cobalt <sup>#</sup>	1.8	2.6	2.6	3.0	2.3	1.8	1.1	2.8			<0.5	mg/kg	TM30/PM15
Copper <sup>#</sup>	12	14	15	16	12	10	9	14			<1	mg/kg	TM30/PM15
Lead <sup>#</sup>	<5	<5	<5	<5	13	<5	<5	<5			<5	mg/kg	TM30/PM15
Manganese <sup>#</sup>	79	72	68	66	57	50	54	77			<1	mg/kg	TM30/PM15
Mercury <sup>#</sup>	0.3	0.3	0.4	0.3	0.4	0.4	0.4	0.3			<0.1	mg/kg	TM30/PM15
Nickel <sup>#</sup>	16.9	22.0	34.3	23.8	17.1	13.7	10.5	22.2			<0.7	mg/kg	TM30/PM15
Selenium <sup>#</sup>	<1	<1	<1	<1	<1	<1	<1	4			<1	mg/kg	TM30/PM15
Thallium	<1	<1	<1	<1	<1	<1	<1	<1			<1	mg/kg	TM30/PM15
Tin	<1	<1	<1	<1	<1	<1	4	<1			<1	mg/kg	TM30/PM15
Vanadium	16	17	53	17	16	14	8	17			<1	mg/kg	TM30/PM15
Zinc <sup>#</sup>	41	57	52	58	43	31	29	51			<5	mg/kg	TM30/PM15
<b>PAH MS</b>													
Naphthalene <sup>#</sup>	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04			<0.04	mg/kg	TM4/PM8
Acenaphthylene	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03			<0.03	mg/kg	TM4/PM8
Acenaphthene <sup>#</sup>	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05			<0.05	mg/kg	TM4/PM8
Fluorene <sup>#</sup>	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04			<0.04	mg/kg	TM4/PM8
Phenanthrene <sup>#</sup>	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03			<0.03	mg/kg	TM4/PM8
Anthracene <sup>#</sup>	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04			<0.04	mg/kg	TM4/PM8
Fluoranthene <sup>#</sup>	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03			<0.03	mg/kg	TM4/PM8
Pyrene <sup>#</sup>	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03			<0.03	mg/kg	TM4/PM8
Benz(a)anthracene <sup>#</sup>	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06			<0.06	mg/kg	TM4/PM8
Chrysene <sup>#</sup>	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02			<0.02	mg/kg	TM4/PM8
Benzo(bk)fluoranthene <sup>#</sup>	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07			<0.07	mg/kg	TM4/PM8
Benzo(a)pyrene <sup>#</sup>	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04			<0.04	mg/kg	TM4/PM8
Indeno(123cd)pyrene <sup>#</sup>	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04			<0.04	mg/kg	TM4/PM8
Dibenzo(ah)anthracene <sup>#</sup>	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04			<0.04	mg/kg	TM4/PM8
Benzo(ghi)perylene <sup>#</sup>	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04			<0.04	mg/kg	TM4/PM8
PAH 16 Total	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6			<0.6	mg/kg	TM4/PM8
Benzo(b)fluoranthene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05			<0.05	mg/kg	TM4/PM8
Benzo(k)fluoranthene	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02			<0.02	mg/kg	TM4/PM8
PAH Surrogate % Recovery	108	119	103	113	106	102	105	109			<0	%	TM4/PM8
EPH >C8-C10 <sup>#</sup>	<5	<5	<5	<5	<5	<5	<5	<5			<5	mg/kg	TM5/PM8
EPH >C10-C20 <sup>#</sup>	408	63	<10	<10	<10	<10	76	<10			<10	mg/kg	TM5/PM8
EPH >C20-C30 <sup>#</sup>	331	41	<10	<10	<10	<10	42	<10			<10	mg/kg	TM5/PM8
EPH >C30-C40 <sup>#</sup>	<10	<10	<10	<10	<10	<10	23	<10			<10	mg/kg	TM5/PM8
EPH >C8-C40 <sup>#</sup>	739	104	<35	<35	<35	<35	141	<35			<35	mg/kg	TM5/PM8
Sulphate as SO4 (2:1 Ext) <sup>#</sup>	0.2052	0.1462	1.8795	0.1728	0.6094	0.8984	0.2526	1.5808			<0.0015	g/l	TM38/PM20

**Client Name:** Environ  
**Reference:** UK22-16873  
**Location:** DPS  
**Contact:** Michael Hazlehurst  
**JE Job No.:** 11/5009

**Solids:** V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

Client Name: Environ

SVOC Report : Solid

Reference: UK22-16873

Location: DPS

Contact: Michael Hazlehurst

JE Job No.: 11/5009

J E Sample No.	1-2	3-4	8-9	13-14	21-22						Please see attached notes for all abbreviations and acronyms		
Sample ID	BH-08	BH-08	SB-09	SB-10	SB-12								
Depth	1.8-2.0	2.8-3.0	1.3-1.5	2.3-2.5	0.8-1.0								
COC No / misc													
Containers	V	V	V	V	V								
Sample Date	27/06/2011	27/06/2011	27/06/2011	28/06/2011	28/06/2011								
Sample Type	Soil	Soil	Soil	Soil	Soil								
Batch Number	1	1	1	1	1								
Date of Receipt	01/07/2011	01/07/2011	01/07/2011	01/07/2011	01/07/2011						LOD	Units	Method No.
<b>SVOC MS</b>													
Phenols													
2-Chlorophenol	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
2-Methylphenol	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
2-Nitrophenol	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
2,4-Dichlorophenol	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
2,4-Dimethylphenol	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
2,4,5-Trichlorophenol	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
2,4,6-Trichlorophenol	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
4-Chloro-3-methylphenol	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
4-Methylphenol	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
4-Nitrophenol	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
Pentachlorophenol	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
Phenol	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
PAHs													
2-Chloronaphthalene	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
2-Methylnaphthalene	57	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
Phthalates													
Bis(2-ethylhexyl) phthalate	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
Butylbenzyl phthalate	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
Di-n-butyl phthalate	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
Di-n-Octyl phthalate	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
Diethyl phthalate	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
Dimethyl phthalate	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
Other SVOCs													
1,2-Dichlorobenzene	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
1,2,4-Trichlorobenzene	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
1,3-Dichlorobenzene	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
1,4-Dichlorobenzene	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
2-Nitroaniline	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
2,4-Dinitrotoluene	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
2,6-Dinitrotoluene	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
3-Nitroaniline	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
4-Bromophenylphenylether	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
4-Chloroaniline	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
4-Chlorophenylphenylether	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
4-Nitroaniline	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
Azobenzene	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
Bis(2-chloroethoxy)methane	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
Bis(2-chloroethyl)ether	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
Carbazole	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
Dibenzofuran	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
Hexachlorobenzene	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
Hexachlorobutadiene	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
Hexachlorocyclopentadiene	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
Hexachloroethane	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
Isophorone	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
N-nitrosodi-n-propylamine	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8
Nitrobenzene	<10	<10	<10	<10	<10						<10	ug/kg	TM16/PM8





## NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

### SOILS

Please note we are only MCERTS accredited for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary. If we are instructed to keep samples, a storage charge of £1 (1.5 Euros) per sample per month will be applied until we are asked to dispose of them.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected. Samples are dried at 35°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C

Asbestos screens where requested will be undertaken by a UKAS accredited laboratory.

### WATERS

Please note we are not a Drinking Water Inspectorate (DWI) Approved Laboratory. It is important that detection limits are carefully considered when requesting water analysis.

UKAS accreditation applies to surface water and groundwater and one other matrix which is analysis specific, any other liquids are outside our scope of accreditation

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples. All samples are treated as groundwaters and analysis performed on settled samples unless we are instructed otherwise.

### DEVIATING SAMPLES

Samples must be received in a condition appropriate to the requested analyses. All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. If this is not the case you will be informed and any analysis that may be compromised highlighted on your schedule/ report by the use of a symbol.

*The use of any of the following symbols indicates that the sample was deviating and the test result may be unreliable:*

\$	Sample temperature on receipt considered inappropriate for analysis requested.
^	Samples exceeding recommended holding times.
&	Samples received in inappropriate containers (e.g. volatile samples not submitted in VOC jars/vials).
~	No sampling date given, unable to confirm if samples are with acceptable holding times.

### SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130%. Results are not surrogate corrected.

### AQCs

Where AQC's fall outside UKAS/MCERTS criteria analysis is repeated if possible.

### NOTE

Data is only accredited when all the requirements of our Quality System have been met. In certain circumstances where the requirements have not been met, the laboratory may issue the data in its final report if it believes that the validity of the data has not been compromised but will remove the accreditation. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

## ABBREVIATIONS and ACRONYMS USED

#	UKAS accredited.
M	MCERTS accredited.
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
SS	Calibrated against a single substance.
*	Analysis subcontracted to a Jones Environmental approved laboratory.
W	Results expressed on as received basis.
+	Accreditation has been removed from this result see 'Note' on previous page.
++	Result outside calibration range, results should be considered as indicative only and are not accredited.
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
DR	Dilution required.

[illegible]



# Jones Environmental Laboratory

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No.4225

<b>Attention :</b>	Michael Hazlehurst
<b>Date :</b>	24th June, 2011
<b>Your reference :</b>	UK22-16873
<b>Our reference :</b>	Test Report 11/4615 Batch 3
<b>Location :</b>	DPS
<b>Date samples received :</b>	16th June, 2011
<b>Status :</b>	Final report
<b>Issue :</b>	1

Ten samples were received for analysis on 16th June, 2011, which was completed on 24th June 2011. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.

All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

**J W Farrell- Jones CChem FRSC**  
**Chartered Chemist**

# Jones Environmental Laboratory

**Client Name:** Environ

**Report :** Solid

**Reference:** UK22-16873

**Location:** DPS

**Solids:** V=60g VOC jar, J=250g glass jar, T=plastic tub

**Contact:** Michael Hazlehurst

**JE Job No.:** 11/4615

J E Sample No.	72-73	74-75	76-77	78-79	80-81	84-85					Please see attached notes for all abbreviations and acronyms		
Sample ID	DPS-BH05	DPS-BH05	DPS-BH06	DPS-BH06	DPS-BH07	DPS-BH08							
Depth	0-0.5	3.0-3.5	0-0.5	3.5-4.0	0-0.5	0-0.5							
COC No / misc													
Containers	V	V	V	V	V	V							
Sample Date	14/06/2011	14/06/2011	14/06/2011	14/06/2011	14/06/2011	14/06/2011							
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil							
Batch Number	3	3	3	3	3	3							
Date of Receipt	16/06/2011	16/06/2011	16/06/2011	16/06/2011	16/06/2011	16/06/2011					LOD	Units	Method No.
Antimony	<1	1	<1	<1	<1	<1					<1	mg/kg	TM30/PM15
Arsenic #	3.3	5.3	3.2	2.2	1.0	3.5					<0.5	mg/kg	TM30/PM15
Barium #	23	21	12	19	6	14					<1	mg/kg	TM30/PM15
Beryllium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5					<0.5	mg/kg	TM30/PM15
Cadmium #	0.4	0.3	0.3	0.4	0.4	0.4					<0.1	mg/kg	TM30/PM15
Chromium #	15.9	20.5	17.0	21.7	9.3	18.3					<0.5	mg/kg	TM30/PM15
Cobalt #	2.8	2.8	1.9	2.5	0.6	1.7					<0.5	mg/kg	TM30/PM15
Copper #	15	17	9	18	5	10					<1	mg/kg	TM30/PM15
Lead #	<5	<5	<5	<5	<5	5					<5	mg/kg	TM30/PM15
Manganese #	72	73	64	69	32	79					<1	mg/kg	TM30/PM15
Mercury #	0.4	0.3	0.4	0.4	0.4	0.3					<0.1	mg/kg	TM30/PM15
Nickel #	18.7	22.9	16.1	25.9	4.8	20.2					<0.7	mg/kg	TM30/PM15
Selenium #	<1	1	<1	2	<1	<1					<1	mg/kg	TM30/PM15
Thallium	<1	<1	<1	<1	<1	<1					<1	mg/kg	TM30/PM15
Tin	<1	<1	<1	<1	<1	<1					<1	mg/kg	TM30/PM15
Total Sulphate	2545	1973	1697	1343	915	1159					<50	mg/kg	TM50/PM15
Vanadium	18	23	16	20	10	31					<1	mg/kg	TM30/PM15
Zinc #	48	55	39	64	13	54					<5	mg/kg	TM30/PM15
<b>PAH MS</b>													
Naphthalene #	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04					<0.04	mg/kg	TM4/PM8
Acenaphthylene	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03					<0.03	mg/kg	TM4/PM8
Acenaphthene #	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05					<0.05	mg/kg	TM4/PM8
Fluorene #	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04					<0.04	mg/kg	TM4/PM8
Phenanthrene #	<0.03	<0.03	<0.03	<0.03	0.03	<0.03					<0.03	mg/kg	TM4/PM8
Anthracene #	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04					<0.04	mg/kg	TM4/PM8
Fluoranthene #	<0.03	<0.03	<0.03	<0.03	0.05	<0.03					<0.03	mg/kg	TM4/PM8
Pyrene #	<0.03	<0.03	<0.03	<0.03	0.05	<0.03					<0.03	mg/kg	TM4/PM8
Benz(a)anthracene #	<0.06	<0.06	<0.06	<0.06	0.09	<0.06					<0.06	mg/kg	TM4/PM8
Chrysene #	0.02	<0.02	<0.02	<0.02	0.10	<0.02					<0.02	mg/kg	TM4/PM8
Benzo(bk)fluoranthene #	<0.07	<0.07	<0.07	<0.07	0.18	<0.07					<0.07	mg/kg	TM4/PM8
Benzo(a)pyrene #	<0.04	<0.04	<0.04	<0.04	0.09	<0.04					<0.04	mg/kg	TM4/PM8
Indeno(123cd)pyrene #	<0.04	<0.04	<0.04	<0.04	0.11	<0.04					<0.04	mg/kg	TM4/PM8
Dibenzo(ah)anthracene #	<0.04	<0.04	<0.04	<0.04	0.09	<0.04					<0.04	mg/kg	TM4/PM8
Benzo(ghi)perylene #	<0.04	<0.04	<0.04	<0.04	0.11	<0.04					<0.04	mg/kg	TM4/PM8
PAH 16 Total	<0.6	<0.6	<0.6	<0.6	0.9	<0.6					<0.6	mg/kg	TM4/PM8
Benzo(b)fluoranthene	<0.05	<0.05	<0.05	<0.05	0.13	<0.05					<0.05	mg/kg	TM4/PM8
Benzo(k)fluoranthene	<0.02	<0.02	<0.02	<0.02	0.05	<0.02					<0.02	mg/kg	TM4/PM8
PAH Surrogate % Recovery	96	96	103	101	100	100					<0	%	TM4/PM8
VOC TICs	-	ND	-	-	-	-						None	TM15/PM10
SVOC TICs	-	ND	-	-	-	-							TM10/PM8

**Client Name:** Environ  
**Reference:** UK22-16873  
**Location:** DPS  
**Contact:** Michael Hazlehurst  
**JE Job No.:** 11/4615

**Solids:** V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

Client Name: Environ

SVOC Report : Solid

Reference: UK22-16873

Location: DPS

Contact: Michael Hazlehurst

JE Job No.: 11/4615

J E Sample No.	74-75										Please see attached notes for all abbreviations and acronyms		
Sample ID	DPS-BH05												
Depth	3.0-3.5												
COC No / misc													
Containers	V												
Sample Date	14/06/2011												
Sample Type	Soil												
Batch Number	3												
Date of Receipt	16/06/2011										LOD	Units	Method No.
<b>SVOC MS</b>													
Phenols													
2-Chlorophenol	<10										<10	ug/kg	TM16/PM8
2-Methylphenol	<10										<10	ug/kg	TM16/PM8
2-Nitrophenol	<10										<10	ug/kg	TM16/PM8
2,4-Dichlorophenol	<10										<10	ug/kg	TM16/PM8
2,4-Dimethylphenol	<10										<10	ug/kg	TM16/PM8
2,4,5-Trichlorophenol	<10										<10	ug/kg	TM16/PM8
2,4,6-Trichlorophenol	<10										<10	ug/kg	TM16/PM8
4-Chloro-3-methylphenol	<10										<10	ug/kg	TM16/PM8
4-Methylphenol	<10										<10	ug/kg	TM16/PM8
4-Nitrophenol	<10										<10	ug/kg	TM16/PM8
Pentachlorophenol	<10										<10	ug/kg	TM16/PM8
Phenol	<10										<10	ug/kg	TM16/PM8
PAHs													
2-Chloronaphthalene	<10										<10	ug/kg	TM16/PM8
2-Methylnaphthalene	<10										<10	ug/kg	TM16/PM8
Phthalates													
Bis(2-ethylhexyl) phthalate	<10										<10	ug/kg	TM16/PM8
Butylbenzyl phthalate	<10										<10	ug/kg	TM16/PM8
Di-n-butyl phthalate	<10										<10	ug/kg	TM16/PM8
Di-n-Octyl phthalate	<10										<10	ug/kg	TM16/PM8
Diethyl phthalate	<10										<10	ug/kg	TM16/PM8
Dimethyl phthalate	<10										<10	ug/kg	TM16/PM8
Other SVOCs													
1,2-Dichlorobenzene	<10										<10	ug/kg	TM16/PM8
1,2,4-Trichlorobenzene	<10										<10	ug/kg	TM16/PM8
1,3-Dichlorobenzene	<10										<10	ug/kg	TM16/PM8
1,4-Dichlorobenzene	<10										<10	ug/kg	TM16/PM8
2-Nitroaniline	<10										<10	ug/kg	TM16/PM8
2,4-Dinitrotoluene	<10										<10	ug/kg	TM16/PM8
2,6-Dinitrotoluene	<10										<10	ug/kg	TM16/PM8
3-Nitroaniline	<10										<10	ug/kg	TM16/PM8
4-Bromophenylphenylether	<10										<10	ug/kg	TM16/PM8
4-Chloroaniline	<10										<10	ug/kg	TM16/PM8
4-Chlorophenylphenylether	<10										<10	ug/kg	TM16/PM8
4-Nitroaniline	<10										<10	ug/kg	TM16/PM8
Azobenzene	<10										<10	ug/kg	TM16/PM8
Bis(2-chloroethoxy)methane	<10										<10	ug/kg	TM16/PM8
Bis(2-chloroethyl)ether	<10										<10	ug/kg	TM16/PM8
Carbazole	<10										<10	ug/kg	TM16/PM8
Dibenzofuran	<10										<10	ug/kg	TM16/PM8
Hexachlorobenzene	<10										<10	ug/kg	TM16/PM8
Hexachlorobutadiene	<10										<10	ug/kg	TM16/PM8
Hexachlorocyclopentadiene	<10										<10	ug/kg	TM16/PM8
Hexachloroethane	<10										<10	ug/kg	TM16/PM8
Isophorone	<10										<10	ug/kg	TM16/PM8
N-nitrosodi-n-propylamine	<10										<10	ug/kg	TM16/PM8
Nitrobenzene	<10										<10	ug/kg	TM16/PM8



**Client Name:** Environ  
**Reference:** UK22-16873  
**Location:** DPS  
**Contact:** Michael Hazlehurst  
**JE Job No.:** 11/4615

**VOC Report :       Solid**

Please see attached notes for all abbreviations and acronyms

[illegible]

## NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

### SOILS

Please note we are only MCERTS accredited for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary. If we are instructed to keep samples, a storage charge of £1 (1.5 Euros) per sample per month will be applied until we are asked to dispose of them.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected. Samples are dried at 35°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C

Asbestos screens where requested will be undertaken by a UKAS accredited laboratory.

### WATERS

Please note we are not a Drinking Water Inspectorate (DWI) Approved Laboratory. It is important that detection limits are carefully considered when requesting water analysis.

UKAS accreditation applies to surface water and groundwater and one other matrix which is analysis specific, any other liquids are outside our scope of accreditation

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples. All samples are treated as groundwaters and analysis performed on settled samples unless we are instructed otherwise.

### DEVIATING SAMPLES

Samples must be received in a condition appropriate to the requested analyses. All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. If this is not the case you will be informed and any analysis that may be compromised highlighted on your schedule/ report by the use of a symbol.

*The use of any of the following symbols indicates that the sample was deviating and the test result may be unreliable:*

\$	Sample temperature on receipt considered inappropriate for analysis requested.
^	Samples exceeding recommended holding times.
&	Samples received in inappropriate containers (e.g. volatile samples not submitted in VOC jars/vials).
~	No sampling date given, unable to confirm if samples are with acceptable holding times.

### SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130%. Results are not surrogate corrected.

### AQCs

Where AQC's fall outside UKAS/MCERTS criteria analysis is repeated if possible.

### NOTE

Data is only accredited when all the requirements of our Quality System have been met. In certain circumstances where the requirements have not been met, the laboratory may issue the data in its final report if it believes that the validity of the data has not been compromised but will remove the accreditation. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

## ABBREVIATIONS and ACRONYMS USED

#	UKAS accredited.
M	MCERTS accredited.
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
SS	Calibrated against a single substance.
*	Analysis subcontracted to a Jones Environmental approved laboratory.
W	Results expressed on as received basis.
+	Accreditation has been removed from this result see 'Note' on previous page.
++	Result outside calibration range, results should be considered as indicative only and are not accredited.
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
DR	Dilution required.

[illegible]



# Jones Environmental Laboratory

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Deeside  
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No.4225

<b>Attention :</b>	Michael Hazlehurst
<b>Date :</b>	24th June, 2011
<b>Your reference :</b>	UK22-16873
<b>Our reference :</b>	Test Report 11/4615 Batch 2
<b>Location :</b>	DPS
<b>Date samples received :</b>	15th June, 2011
<b>Status :</b>	Final report
<b>Issue :</b>	1

Fourteen samples were received for analysis on 15th June, 2011, which was completed on 24th June 2011. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied. All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

**J W Farrell- Jones CChem FRSC**  
**Chartered Chemist**

# **Jones Environmental Laboratory**

**Client Name:** Environ

**Report : Solid**

**Reference:** UK22-16873

**Location:** DPS

**Solids:** V=60g VOC jar, J=250g glass jar, T=plastic tub

**Contact:** Michael Hazlehurst

**JE Job No.:** 11/4615

J E Sample No.	40-42	48-49	50-52	55-56	61-62	63-64	65-66	67-69	70-71		Please see attached notes for all abbreviations and acronyms		
Sample ID	DPS-LF01	DPS-LF02	DPS-LF03	DPS-SB07	DPS-SB08	DPS-BH04	DPS-BH04	DPS-BH03	DPS-BH03				
Depth	0-0.5	4.5-5.0	0.5-1.0	0.4	2.0-2.5	0.-0.5	3.0-3.5	0-0.5	2.5-3.0				
COC No / misc													
Containers	V B	V	V B	V	V	V	V	V B	V				
Sample Date	09/06/2011	09/06/2011	10/06/2011	13/06/2011	13/06/2011	13/06/2011	13/06/2011	13/06/2011	13/06/2011				
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil				
Batch Number	2	2	2	2	2	2	2	2	2				
Date of Receipt	15/06/2011	15/06/2011	15/06/2011	15/06/2011	15/06/2011	15/06/2011	15/06/2011	15/06/2011	15/06/2011		LOD	Units	Method No.
Antimony	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	mg/kg	TM30/PM15
Arsenic #	2.9	5.4	2.8	2.1	3.0	4.1	2.1	2.5	2.5		<0.5	mg/kg	TM30/PM15
Barium #	41	22	21	9	16	14	24	24	22		<1	mg/kg	TM30/PM15
Beryllium	<0.5	<0.5	<0.5	<0.5	<0.5	0.5	0.6	<0.5	0.7		<0.5	mg/kg	TM30/PM15
Cadmium #	0.4	0.3	0.3	0.4	0.4	0.6	0.4	0.3	0.3		<0.1	mg/kg	TM30/PM15
Chromium #	19.1	16.9	16.4	19.1	20.5	20.4	23.7	15.3	23.8		<0.5	mg/kg	TM30/PM15
Cobalt #	2.2	1.9	2.4	2.5	2.1	2.2	2.4	2.1	3.5		<0.5	mg/kg	TM30/PM15
Copper #	19	10	14	15	14	16	17	12	16		<1	mg/kg	TM30/PM15
Lead #	12	6	7	<5	<5	11	<5	9	5		<5	mg/kg	TM30/PM15
Manganese #	84	73	66	65	77	63	66	60	87		<1	mg/kg	TM30/PM15
Mercury #	0.3	0.5	0.4	0.4	0.4	0.4	0.5	0.4	0.4		<0.1	mg/kg	TM30/PM15
Nickel #	51.5	15.7	20.1	24.4	21.8	26.1	25.4	15.0	29.2		<0.7	mg/kg	TM30/PM15
Selenium #	<1	<1	<1	1	<1	<1	2	<1	<1		<1	mg/kg	TM30/PM15
Thallium	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	mg/kg	TM30/PM15
Tin	<1	<1	<1	1	2	2	<1	<1	1		<1	mg/kg	TM30/PM15
Total Sulphate	2911	1169	7110	1802	5607	1454	5144	5213	1795		<50	mg/kg	TM50/PM15
Vanadium	166	26	16	17	17	25	19	15	22		<1	mg/kg	TM30/PM15
Zinc #	92	44	49	53	48	59	64	52	59		<5	mg/kg	TM30/PM15
<b>PAH MS</b>													
Naphthalene #	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04		<0.04	mg/kg	TM4/PM8
Acenaphthylene	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03		<0.03	mg/kg	TM4/PM8
Acenaphthene #	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05		<0.05	mg/kg	TM4/PM8
Fluorene #	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04		<0.04	mg/kg	TM4/PM8
Phenanthrene #	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03		<0.03	mg/kg	TM4/PM8
Anthracene #	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04		<0.04	mg/kg	TM4/PM8
Fluoranthene #	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03		<0.03	mg/kg	TM4/PM8
Pyrene #	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03		<0.03	mg/kg	TM4/PM8
Benz(a)anthracene #	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06		<0.06	mg/kg	TM4/PM8
Chrysene #	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.04	<0.02	<0.02		<0.02	mg/kg	TM4/PM8
Benzo(bk)fluoranthene #	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07		<0.07	mg/kg	TM4/PM8
Benzo(a)pyrene #	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04		<0.04	mg/kg	TM4/PM8
Indeno(123cd)pyrene #	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04		<0.04	mg/kg	TM4/PM8
Dibenzo(ah)anthracene #	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04		<0.04	mg/kg	TM4/PM8
Benzo(ghi)perylene #	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04		<0.04	mg/kg	TM4/PM8
PAH 16 Total	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6		<0.6	mg/kg	TM4/PM8
Benzo(b)fluoranthene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05		<0.05	mg/kg	TM4/PM8
Benzo(k)fluoranthene	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02		<0.02	mg/kg	TM4/PM8
PAH Surrogate % Recovery	93	87	84	86	97	96	94	104	96		<0	%	TM4/PM8
VOC TICs	-	-	-	-	-	-	ND	-	-			None	TM15/PM10
SVOC TICs	-	-	-	-	-	-	ND	-	-				TM10/PM8

**Client Name:** Environ  
**Reference:** UK22-16873  
**Location:** DPS  
**Contact:** Michael Hazlehurst  
**JE Job No.:** 11/4615

**Solids:** V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

Client Name: Environ

SVOC Report : Solid

Reference: UK22-16873

Location: DPS

Contact: Michael Hazlehurst

JE Job No.: 11/4615

J E Sample No.	65-66										Please see attached notes for all abbreviations and acronyms		
Sample ID	DPS-BH04												
Depth	3.0-3.5												
COC No / misc													
Containers	V												
Sample Date	13/06/2011												
Sample Type	Soil												
Batch Number	2												
Date of Receipt	15/06/2011										LOD	Units	Method No.
<b>SVOC MS</b>													
Phenols													
2-Chlorophenol	<10										<10	ug/kg	TM16/PM8
2-Methylphenol	<10										<10	ug/kg	TM16/PM8
2-Nitrophenol	<10										<10	ug/kg	TM16/PM8
2,4-Dichlorophenol	<10										<10	ug/kg	TM16/PM8
2,4-Dimethylphenol	<10										<10	ug/kg	TM16/PM8
2,4,5-Trichlorophenol	<10										<10	ug/kg	TM16/PM8
2,4,6-Trichlorophenol	<10										<10	ug/kg	TM16/PM8
4-Chloro-3-methylphenol	<10										<10	ug/kg	TM16/PM8
4-Methylphenol	<10										<10	ug/kg	TM16/PM8
4-Nitrophenol	<10										<10	ug/kg	TM16/PM8
Pentachlorophenol	<10										<10	ug/kg	TM16/PM8
Phenol	<10										<10	ug/kg	TM16/PM8
PAHs													
2-Chloronaphthalene	<10										<10	ug/kg	TM16/PM8
2-Methylnaphthalene	<10										<10	ug/kg	TM16/PM8
Phthalates													
Bis(2-ethylhexyl) phthalate	<10										<10	ug/kg	TM16/PM8
Butylbenzyl phthalate	<10										<10	ug/kg	TM16/PM8
Di-n-butyl phthalate	<10										<10	ug/kg	TM16/PM8
Di-n-Octyl phthalate	<10										<10	ug/kg	TM16/PM8
Diethyl phthalate	<10										<10	ug/kg	TM16/PM8
Dimethyl phthalate	<10										<10	ug/kg	TM16/PM8
Other SVOCs													
1,2-Dichlorobenzene	<10										<10	ug/kg	TM16/PM8
1,2,4-Trichlorobenzene	<10										<10	ug/kg	TM16/PM8
1,3-Dichlorobenzene	<10										<10	ug/kg	TM16/PM8
1,4-Dichlorobenzene	<10										<10	ug/kg	TM16/PM8
2-Nitroaniline	<10										<10	ug/kg	TM16/PM8
2,4-Dinitrotoluene	<10										<10	ug/kg	TM16/PM8
2,6-Dinitrotoluene	<10										<10	ug/kg	TM16/PM8
3-Nitroaniline	<10										<10	ug/kg	TM16/PM8
4-Bromophenylphenylether	<10										<10	ug/kg	TM16/PM8
4-Chloroaniline	<10										<10	ug/kg	TM16/PM8
4-Chlorophenylphenylether	<10										<10	ug/kg	TM16/PM8
4-Nitroaniline	<10										<10	ug/kg	TM16/PM8
Azobenzene	<10										<10	ug/kg	TM16/PM8
Bis(2-chloroethoxy)methane	<10										<10	ug/kg	TM16/PM8
Bis(2-chloroethyl)ether	<10										<10	ug/kg	TM16/PM8
Carbazole	<10										<10	ug/kg	TM16/PM8
Dibenzofuran	<10										<10	ug/kg	TM16/PM8
Hexachlorobenzene	<10										<10	ug/kg	TM16/PM8
Hexachlorobutadiene	<10										<10	ug/kg	TM16/PM8
Hexachlorocyclopentadiene	<10										<10	ug/kg	TM16/PM8
Hexachloroethane	<10										<10	ug/kg	TM16/PM8
Isophorone	<10										<10	ug/kg	TM16/PM8
N-nitrosodi-n-propylamine	<10										<10	ug/kg	TM16/PM8
Nitrobenzene	<10										<10	ug/kg	TM16/PM8



**Client Name:** Environ  
**Reference:** UK22-16873  
**Location:** DPS  
**Contact:** Michael Hazlehurst  
**JE Job No.:** 11/4615

**VOC Report : Solid**

Please see attached notes for all abbreviations and acronyms

J E Sample No.	65-66										Please see attached notes for all abbreviations and acronyms		
Sample ID	DPS-BH04												
Depth	3.0-3.5												
COC No / misc													
Containers	V												
Sample Date	13/06/2011												
Sample Type	Soil												
Batch Number	2												
Date of Receipt	15/06/2011										LOD	Units	Method No.
VOC MS													
Dichlorodifluoromethane	<2										<2	ug/kg	TM15/PM10
Methyl Tertiary Butyl Ether <sup>#</sup>	<2										<2	ug/kg	TM15/PM10
Chloromethane <sup>#</sup>	<3										<3	ug/kg	TM15/PM10
Vinyl Chloride	<2										<2	ug/kg	TM15/PM10
Bromomethane	<1										<1	ug/kg	TM15/PM10
Chloroethane <sup>#</sup>	<2										<2	ug/kg	TM15/PM10
Trichlorofluoromethane <sup>#</sup>	<2										<2	ug/kg	TM15/PM10
1,1-Dichloroethene <sup>#</sup>	<6										<6	ug/kg	TM15/PM10
Dichloromethane <sup>#</sup>	<7										<7	ug/kg	TM15/PM10
trans-1-2-Dichloroethene <sup>#</sup>	<3										<3	ug/kg	TM15/PM10
1,1-Dichloroethane <sup>#</sup>	<3										<3	ug/kg	TM15/PM10
cis-1-2-Dichloroethene <sup>#</sup>	<3										<3	ug/kg	TM15/PM10
2,2-Dichloropropane	<4										<4	ug/kg	TM15/PM10
Bromochloromethane <sup>#</sup>	<3										<3	ug/kg	TM15/PM10
Chloroform <sup>#</sup>	<3										<3	ug/kg	TM15/PM10
1,1,1-Trichloroethane <sup>#</sup>	<3										<3	ug/kg	TM15/PM10
1,1-Dichloropropene <sup>#</sup>	<3										<3	ug/kg	TM15/PM10
Carbon tetrachloride <sup>#</sup>	<4										<4	ug/kg	TM15/PM10
1,2-Dichloroethane <sup>#</sup>	<4										<4	ug/kg	TM15/PM10
Benzene <sup>#</sup>	<3										<3	ug/kg	TM15/PM10
Trichloroethene <sup>#</sup>	<3										<3	ug/kg	TM15/PM10
1,2-Dichloropropane <sup>#</sup>	<6										<6	ug/kg	TM15/PM10
Dibromomethane <sup>#</sup>	<3										<3	ug/kg	TM15/PM10
Bromodichloromethane <sup>#</sup>	<3										<3	ug/kg	TM15/PM10
cis-1-3-Dichloropropene	<4										<4	ug/kg	TM15/PM10
Toluene <sup>#</sup>	<3										<3	ug/kg	TM15/PM10
trans-1-3-Dichloropropene <sup>#</sup>	<3										<3	ug/kg	TM15/PM10
1,1,2-Trichloroethane <sup>#</sup>	<3										<3	ug/kg	TM15/PM10
Tetrachloroethene <sup>#</sup>	<3										<3	ug/kg	TM15/PM10
1,3-Dichloropropane <sup>#</sup>	<3										<3	ug/kg	TM15/PM10
Dibromochloromethane <sup>#</sup>	<3										<3	ug/kg	TM15/PM10
1,2-Dibromoethane <sup>#</sup>	<3										<3	ug/kg	TM15/PM10
Chlorobenzene <sup>#</sup>	<3										<3	ug/kg	TM15/PM10
1,1,1,2-Tetrachloroethane	<3										<3	ug/kg	TM15/PM10
Ethylbenzene <sup>#</sup>	<3										<3	ug/kg	TM15/PM10
p/m-Xylene <sup>#</sup>	<6										<6	ug/kg	TM15/PM10
o-Xylene <sup>#</sup>	<3										<3	ug/kg	TM15/PM10
Styrene <sup>#</sup>	<3										<3	ug/kg	TM15/PM10
Bromoform <sup>#</sup>	<3										<3	ug/kg	TM15/PM10
Isopropylbenzene <sup>#</sup>	<3										<3	ug/kg	TM15/PM10
1,1,2,2-Tetrachloroethane <sup>#</sup>	<3										<3	ug/kg	TM15/PM10
Bromobenzene	<2										<2	ug/kg	TM15/PM10
1,2,3-Trichloropropane <sup>#</sup>	<4										<4	ug/kg	TM15/PM10
Propylbenzene <sup>#</sup>	<4										<4	ug/kg	TM15/PM10
2-Chlorotoluene	<3										<3	ug/kg	TM15/PM10
1,3,5-Trimethylbenzene <sup>#</sup>	<3										<3	ug/kg	TM15/PM10
4-Chlorotoluene	<3										<3	ug/kg	TM15/PM10
tert-Butylbenzene <sup>#</sup>	<5										<5	ug/kg	TM15/PM10
1,2,4-Trimethylbenzene <sup>#</sup>	<6										<6	ug/kg	TM15/PM10
sec-Butylbenzene <sup>#</sup>	<4										<4	ug/kg	TM15/PM10
4-Isopropyltoluene <sup>#</sup>	<4										<4	ug/kg	TM15/PM10
1,3-Dichlorobenzene <sup>#</sup>	<4										<4	ug/kg	TM15/PM10
1,4-Dichlorobenzene <sup>#</sup>	<4										<4	ug/kg	TM15/PM10
n-Butylbenzene <sup>#</sup>	<4										<4	ug/kg	TM15/PM10
1,2-Dichlorobenzene <sup>#</sup>	<4										<4	ug/kg	TM15/PM10
1,2-Dibromo-3-chloropropane <sup>#</sup>	<4										<4	ug/kg	TM15/PM10
1,2,4-Trichlorobenzene <sup>#</sup>	<7										<7	ug/kg	TM15/PM10
Hexachlorobutadiene	<4										<4	ug/kg	TM15/PM10
Naphthalene	<27										<27	ug/kg	TM15/PM10
1,2,3-Trichlorobenzene <sup>#</sup>	<7										<7	ug/kg	TM15/PM10

## NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

### SOILS

Please note we are only MCERTS accredited for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary. If we are instructed to keep samples, a storage charge of £1 (1.5 Euros) per sample per month will be applied until we are asked to dispose of them.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected. Samples are dried at 35°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C

Asbestos screens where requested will be undertaken by a UKAS accredited laboratory.

### WATERS

Please note we are not a Drinking Water Inspectorate (DWI) Approved Laboratory. It is important that detection limits are carefully considered when requesting water analysis.

UKAS accreditation applies to surface water and groundwater and one other matrix which is analysis specific, any other liquids are outside our scope of accreditation

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples. All samples are treated as groundwaters and analysis performed on settled samples unless we are instructed otherwise.

### DEVIATING SAMPLES

Samples must be received in a condition appropriate to the requested analyses. All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. If this is not the case you will be informed and any analysis that may be compromised highlighted on your schedule/ report by the use of a symbol.

*The use of any of the following symbols indicates that the sample was deviating and the test result may be unreliable:*

\$	Sample temperature on receipt considered inappropriate for analysis requested.
^	Samples exceeding recommended holding times.
&	Samples received in inappropriate containers (e.g. volatile samples not submitted in VOC jars/vials).
~	No sampling date given, unable to confirm if samples are with acceptable holding times.

### SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130%. Results are not surrogate corrected.

### AQCs

Where AQC's fall outside UKAS/MCERTS criteria analysis is repeated if possible.

### NOTE

Data is only accredited when all the requirements of our Quality System have been met. In certain circumstances where the requirements have not been met, the laboratory may issue the data in its final report if it believes that the validity of the data has not been compromised but will remove the accreditation. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

## ABBREVIATIONS and ACRONYMS USED

#	UKAS accredited.
M	MCERTS accredited.
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
SS	Calibrated against a single substance.
*	Analysis subcontracted to a Jones Environmental approved laboratory.
W	Results expressed on as received basis.
+	Accreditation has been removed from this result see 'Note' on previous page.
++	Result outside calibration range, results should be considered as indicative only and are not accredited.
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
DR	Dilution required.

[illegible]



## Jones Environmental Laboratory

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No.4225

<b>Attention :</b>	Michael Hazlehurst
<b>Date :</b>	24th June, 2011
<b>Your reference :</b>	UK22-16873
<b>Our reference :</b>	Test Report 11/4615 Batch 1
<b>Location :</b>	DPS
<b>Date samples received :</b>	13th June, 2011
<b>Status :</b>	Final report
<b>Issue :</b>	1

Sixteen samples were received for analysis on 13th June, 2011, which was completed on 24th June 2011. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.

All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

**J W Farrell- Jones CChem FRSC**  
**Chartered Chemist**

# **Jones Environmental Laboratory**

**Client Name:** Environ

**Report : Solid**

**Reference:** UK22-16873

**Location:** DPS

**Solids:** V=60g VOC jar, J=250g glass jar, T=plastic tub

**Contact:** Michael Hazlehurst

**JE Job No.:** 11/4615

J E Sample No.	1-3	6-7	8-9	10-12	13-14	15-17	20-22	23-24	25-27	30-32	Please see attached notes for all abbreviations and acronyms		
Sample ID	DPS-BH01	DPS-BH02	DPS-BH02	DPS-SB01	DPS-SB01	DPS-SB02	DPS-SB03	DPS-SB03	DPS-SB04	DPS-SB05			
Depth	0.5	0.5	3.0-3.5	0-0.5	2.5-3.0	0-0.5	0.5-1.0	2.0-2.5	0.5-1.0	0.5-1.0			
COC No / misc													
Containers	V B	V	V	V B	V	V B	V B	V	V B	V B			
Sample Date	08/06/2011	08/06/2011	08/06/2011	08/06/2011	08/06/2011	08/06/2011	08/06/2011	08/06/2011	08/06/2011	08/06/2011			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Batch Number	1	1	1	1	1	1	1	1	1	1			
Date of Receipt	13/06/2011	13/06/2011	13/06/2011	13/06/2011	13/06/2011	13/06/2011	13/06/2011	13/06/2011	13/06/2011	13/06/2011	LOD	Units	Method No.
Antimony	<1	<1	-	<1	<1	<1	<1	<1	<1	<1	<1	mg/kg	TM30/PM15
Arsenic #	1.4	3.0	-	1.2	2.4	2.3	1.9	2.4	2.0	2.4	<0.5	mg/kg	TM30/PM15
Barium #	18	24	-	14	15	35	24	22	9	14	<1	mg/kg	TM30/PM15
Beryllium	<0.5	<0.5	-	<0.5	<0.5	<0.5	<0.5	0.5	<0.5	<0.5	<0.5	mg/kg	TM30/PM15
Cadmium #	0.2	0.3	-	0.2	0.4	0.3	0.4	0.4	0.5	0.3	<0.1	mg/kg	TM30/PM15
Chromium #	10.5	14.8	-	7.8	20.0	20.0	19.8	22.6	19.2	15.9	<0.5	mg/kg	TM30/PM15
Cobalt #	1.3	2.0	-	0.9	2.6	2.6	2.0	2.4	1.0	2.2	<0.5	mg/kg	TM30/PM15
Copper #	10	15	-	12	16	17	18	21	8	12	<1	mg/kg	TM30/PM15
Lead #	<5	<5	-	<5	<5	<5	<5	<5	<5	<5	<5	mg/kg	TM30/PM15
Manganese #	42	67	-	40	70	71	56	62	61	68	<1	mg/kg	TM30/PM15
Mercury #	0.4	0.4	-	0.4	0.3	0.4	0.5	0.3	0.4	0.4	<0.1	mg/kg	TM30/PM15
Nickel #	12.6	15.1	-	6.6	23.2	21.8	24.7	28.4	10.7	18.5	<0.7	mg/kg	TM30/PM15
Selenium #	<1	<1	-	<1	1	<1	2	2	<1	<1	<1	mg/kg	TM30/PM15
Thallium	<1	<1	-	<1	<1	<1	<1	<1	<1	<1	<1	mg/kg	TM30/PM15
Tin	<1	<1	-	<1	<1	<1	<1	<1	<1	<1	<1	mg/kg	TM30/PM15
Total Sulphate	2992	3340	-	2248	4721	4916	2190	2333	1186	5384	<50	mg/kg	TM50/PM15
Vanadium	11	15	-	13	17	18	20	22	11	14	<1	mg/kg	TM30/PM15
Zinc #	31	49	-	17	56	55	53	62	30	41	<5	mg/kg	TM30/PM15
<b>PAH MS</b>													
Naphthalene #	<0.04	<0.04	-	<0.40	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	mg/kg	TM4/PM8
Acenaphthylene	<0.03	<0.03	-	<0.30	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	mg/kg	TM4/PM8
Acenaphthene #	<0.05	<0.05	-	<0.50	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	mg/kg	TM4/PM8
Fluorene #	<0.04	<0.04	-	<0.40	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	mg/kg	TM4/PM8
Phenanthrene #	<0.03	<0.03	-	<0.30	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	mg/kg	TM4/PM8
Anthracene #	<0.04	<0.04	-	<0.40	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	mg/kg	TM4/PM8
Fluoranthene #	<0.03	<0.03	-	<0.30	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	mg/kg	TM4/PM8
Pyrene #	<0.03	<0.03	-	<0.30	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	mg/kg	TM4/PM8
Benz(a)anthracene #	<0.06	<0.06	-	<0.60	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	mg/kg	TM4/PM8
Chrysene #	<0.02	<0.02	-	<0.20	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	mg/kg	TM4/PM8
Benzo(bk)fluoranthene #	<0.07	<0.07	-	<0.70	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	mg/kg	TM4/PM8
Benzo(a)pyrene #	<0.04	<0.04	-	<0.40	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	mg/kg	TM4/PM8
Indeno(123cd)pyrene #	<0.04	<0.04	-	<0.40	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	mg/kg	TM4/PM8
Dibenzo(ah)anthracene #	<0.04	<0.04	-	<0.40	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	mg/kg	TM4/PM8
Benzo(ghi)perylene #	<0.04	<0.04	-	<0.40	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	mg/kg	TM4/PM8
PAH 16 Total	<0.6	<0.6	-	<6.0	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	mg/kg	TM4/PM8
Benzo(b)fluoranthene	<0.05	<0.05	-	<0.50	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	mg/kg	TM4/PM8
Benzo(k)fluoranthene	<0.02	<0.02	-	<0.20	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	mg/kg	TM4/PM8
PAH Surrogate % Recovery	93	98	-	101	109	106	100	112	118	124	<0	%	TM4/PM8
VOC TICs	-	-	-	-	-	-	ND	-	ND	ND		None	TM15/PM10
SVOC TICs	-	-	-	-	-	-	See Attached	-	See Attached	See Attached			TM10/PM8

**Client Name:** Environ  
**Reference:** UK22-16873  
**Location:** DPS  
**Contact:** Michael Hazlehurst  
**JE Job No.:** 11/4615

**Solids:** V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

# **Jones Environmental Laboratory**

**Client Name:** Environ  
**Reference:** UK22-16873  
**Location:** DPS  
**Contact:** Michael Hazlehurst  
**JE Job No.:** 11/4615

**Report : Solid**

**Solids:** V=60g VOC jar, J=250g glass jar, T=plastic tub

J E Sample No.	33-34	35-37									Please see attached notes for all abbreviations and acronyms		
Sample ID	DPS-SB05	DPS-SB06											
Depth	2.5-3.0	0-0.5											
COC No / misc													
Containers	V	V B											
Sample Date	08/06/2011	08/06/2011											
Sample Type	Soil	Soil											
Batch Number	1	1											
Date of Receipt	13/06/2011	13/06/2011									LOD	Units	Method No.
Antimony	<1	1									<1	mg/kg	TM30/PM15
Arsenic #	4.0	6.1									<0.5	mg/kg	TM30/PM15
Barium #	30	14									<1	mg/kg	TM30/PM15
Beryllium	0.5	<0.5									<0.5	mg/kg	TM30/PM15
Cadmium #	0.3	0.5									<0.1	mg/kg	TM30/PM15
Chromium #	17.1	17.8									<0.5	mg/kg	TM30/PM15
Cobalt #	3.0	3.0									<0.5	mg/kg	TM30/PM15
Copper #	13	17									<1	mg/kg	TM30/PM15
Lead #	<5	<5									<5	mg/kg	TM30/PM15
Manganese #	95	82									<1	mg/kg	TM30/PM15
Mercury #	0.4	0.3									<0.1	mg/kg	TM30/PM15
Nickel #	18.5	24.1									<0.7	mg/kg	TM30/PM15
Selenium #	<1	2									<1	mg/kg	TM30/PM15
Thallium	<1	<1									<1	mg/kg	TM30/PM15
Tin	<1	<1									<1	mg/kg	TM30/PM15
Total Sulphate	1937	4505									<50	mg/kg	TM50/PM15
Vanadium	21	19									<1	mg/kg	TM30/PM15
Zinc #	41	55									<5	mg/kg	TM30/PM15
<b>PAH MS</b>													
Naphthalene #	<0.04	<0.04									<0.04	mg/kg	TM4/PM8
Acenaphthylene	<0.03	<0.03									<0.03	mg/kg	TM4/PM8
Acenaphthene #	<0.05	<0.05									<0.05	mg/kg	TM4/PM8
Fluorene #	<0.04	<0.04									<0.04	mg/kg	TM4/PM8
Phenanthrene #	<0.03	0.03									<0.03	mg/kg	TM4/PM8
Anthracene #	<0.04	<0.04									<0.04	mg/kg	TM4/PM8
Fluoranthene #	<0.03	0.05									<0.03	mg/kg	TM4/PM8
Pyrene #	<0.03	0.05									<0.03	mg/kg	TM4/PM8
Benz(a)anthracene #	<0.06	0.07									<0.06	mg/kg	TM4/PM8
Chrysene #	<0.02	0.07									<0.02	mg/kg	TM4/PM8
Benzo(bk)fluoranthene #	<0.07	0.17									<0.07	mg/kg	TM4/PM8
Benzo(a)pyrene #	<0.04	0.07									<0.04	mg/kg	TM4/PM8
Indeno(123cd)pyrene #	<0.04	0.06									<0.04	mg/kg	TM4/PM8
Dibenzo(ah)anthracene #	<0.04	0.06									<0.04	mg/kg	TM4/PM8
Benzo(ghi)perylene #	<0.04	0.09									<0.04	mg/kg	TM4/PM8
PAH 16 Total	<0.6	0.7									<0.6	mg/kg	TM4/PM8
Benzo(b)fluoranthene	<0.05	0.12									<0.05	mg/kg	TM4/PM8
Benzo(k)fluoranthene	<0.02	0.05									<0.02	mg/kg	TM4/PM8
PAH Surrogate % Recovery	121	117									<0	%	TM4/PM8
VOC TICs	-	-										None	TM15/PM10
SVOC TICs	-	-											TM10/PM8



**Client Name:** Environ  
**Reference:** UK22-16873  
**Location:** DPS  
**Contact:** Michael Hazlehurst  
**JE Job No.:** 11/4615

**Solids:** V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

6 of 13

# Jones Environmental Laboratory

**Client Name:** Environ  
**Reference:** UK22-16873  
**Location:** DPS  
**Contact:** Michael Hazlehurst  
**JE Job No.:** 11/4615

**VOC Report :** Solid

J E Sample No.	20-22	25-27	30-32								Please see attached notes for all abbreviations and acronyms		
Sample ID	DPS-SB03	DPS-SB04	DPS-SB05										
Depth	0.5-1.0	0.5-1.0	0.5-1.0										
COC No / misc													
Containers	V B	V B	V B										
Sample Date	08/06/2011	08/06/2011	08/06/2011										
Sample Type	Soil	Soil	Soil										
Batch Number	1	1	1										
Date of Receipt	13/06/2011	13/06/2011	13/06/2011								LOD	Units	Method No.
<b>VOC MS</b>													
Dichlorodifluoromethane	<2	<2	<2								<2	ug/kg	TM15/PM10
Methyl Tertiary Butyl Ether <sup>#</sup>	<2	<2	<2								<2	ug/kg	TM15/PM10
Chloromethane <sup>#</sup>	<3	<3	<3								<3	ug/kg	TM15/PM10
Vinyl Chloride	<2	<2	<2								<2	ug/kg	TM15/PM10
Bromomethane	<1	<1	<1								<1	ug/kg	TM15/PM10
Chloroethane <sup>#</sup>	<2	<2	<2								<2	ug/kg	TM15/PM10
Trichlorofluoromethane <sup>#</sup>	<2	<2	<2								<2	ug/kg	TM15/PM10
1,1-Dichloroethene <sup>#</sup>	<6	<6	<6								<6	ug/kg	TM15/PM10
Dichloromethane <sup>#</sup>	<7	<7	<7								<7	ug/kg	TM15/PM10
trans-1-2-Dichloroethene <sup>#</sup>	<3	<3	<3								<3	ug/kg	TM15/PM10
1,1-Dichloroethane <sup>#</sup>	<3	<3	<3								<3	ug/kg	TM15/PM10
cis-1-2-Dichloroethene <sup>#</sup>	<3	<3	<3								<3	ug/kg	TM15/PM10
2,2-Dichloropropane	<4	<4	<4								<4	ug/kg	TM15/PM10
Bromochloromethane <sup>#</sup>	<3	<3	<3								<3	ug/kg	TM15/PM10
Chloroform <sup>#</sup>	<3	<3	<3								<3	ug/kg	TM15/PM10
1,1,1-Trichloroethane <sup>#</sup>	<3	<3	<3								<3	ug/kg	TM15/PM10
1,1-Dichloropropene <sup>#</sup>	<3	<3	<3								<3	ug/kg	TM15/PM10
Carbon tetrachloride <sup>#</sup>	<4	<4	<4								<4	ug/kg	TM15/PM10
1,2-Dichloroethane <sup>#</sup>	<4	<4	<4								<4	ug/kg	TM15/PM10
Benzene <sup>#</sup>	<3	<3	<3								<3	ug/kg	TM15/PM10
Trichloroethene <sup>#</sup>	<3	<3	<3								<3	ug/kg	TM15/PM10
1,2-Dichloropropane <sup>#</sup>	<6	<6	<6								<6	ug/kg	TM15/PM10
Dibromomethane <sup>#</sup>	<3	<3	<3								<3	ug/kg	TM15/PM10
Bromodichloromethane <sup>#</sup>	<3	<3	<3								<3	ug/kg	TM15/PM10
cis-1-3-Dichloropropene	<4	<4	<4								<4	ug/kg	TM15/PM10
Toluene <sup>#</sup>	<3	<3	<3								<3	ug/kg	TM15/PM10
trans-1-3-Dichloropropene <sup>#</sup>	<3	<3	<3								<3	ug/kg	TM15/PM10
1,1,2-Trichloroethane <sup>#</sup>	<3	<3	<3								<3	ug/kg	TM15/PM10
Tetrachloroethene <sup>#</sup>	<3	<3	<3								<3	ug/kg	TM15/PM10
1,3-Dichloropropane <sup>#</sup>	<3	<3	<3								<3	ug/kg	TM15/PM10
Dibromochloromethane <sup>#</sup>	<3	<3	<3								<3	ug/kg	TM15/PM10
1,2-Dibromoethane <sup>#</sup>	<3	<3	<3								<3	ug/kg	TM15/PM10
Chlorobenzene <sup>#</sup>	<3	<3	<3								<3	ug/kg	TM15/PM10
1,1,1,2-Tetrachloroethane	<3	<3	<3								<3	ug/kg	TM15/PM10
Ethylbenzene <sup>#</sup>	18	<3	14								<3	ug/kg	TM15/PM10
p/m-Xylene <sup>#</sup>	<6	<6	<6								<6	ug/kg	TM15/PM10
o-Xylene <sup>#</sup>	<3	<3	<3								<3	ug/kg	TM15/PM10
Styrene <sup>#</sup>	<3	<3	<3								<3	ug/kg	TM15/PM10
Bromoform <sup>#</sup>	<3	<3	<3								<3	ug/kg	TM15/PM10
Isopropylbenzene <sup>#</sup>	<3	<3	<3								<3	ug/kg	TM15/PM10
1,1,2,2-Tetrachloroethane <sup>#</sup>	<3	<3	<3								<3	ug/kg	TM15/PM10
Bromobenzene	<2	<2	<2								<2	ug/kg	TM15/PM10
1,2,3-Trichloropropane <sup>#</sup>	<4	<4	<4								<4	ug/kg	TM15/PM10
Propylbenzene <sup>#</sup>	<4	<4	<4								<4	ug/kg	TM15/PM10
2-Chlorotoluene	<3	<3	<3								<3	ug/kg	TM15/PM10
1,3,5-Trimethylbenzene <sup>#</sup>	<3	<3	<3								<3	ug/kg	TM15/PM10
4-Chlorotoluene	<3	<3	<3								<3	ug/kg	TM15/PM10
tert-Butylbenzene <sup>#</sup>	<5	<5	<5								<5	ug/kg	TM15/PM10
1,2,4-Trimethylbenzene <sup>#</sup>	<6	<6	<6								<6	ug/kg	TM15/PM10
sec-Butylbenzene <sup>#</sup>	<4	<4	<4								<4	ug/kg	TM15/PM10
4-Isopropyltoluene <sup>#</sup>	<4	<4	<4								<4	ug/kg	TM15/PM10
1,3-Dichlorobenzene <sup>#</sup>	<4	<4	<4								<4	ug/kg	TM15/PM10
1,4-Dichlorobenzene <sup>#</sup>	<4	<4	<4								<4	ug/kg	TM15/PM10
n-Butylbenzene <sup>#</sup>	<4	<4	<4								<4	ug/kg	TM15/PM10
1,2-Dichlorobenzene <sup>#</sup>	<4	<4	<4								<4	ug/kg	TM15/PM10
1,2-Dibromo-3-chloropropane <sup>#</sup>	<4	<4	<4								<4	ug/kg	TM15/PM10
1,2,4-Trichlorobenzene <sup>#</sup>	<7	<7	<7								<7	ug/kg	TM15/PM10
Hexachlorobutadiene	<4	<4	<4								<4	ug/kg	TM15/PM10
Naphthalene	<27	<27	<27								<27	ug/kg	TM15/PM10
1,2,3-Trichlorobenzene <sup>#</sup>	<7	<7	<7								<7	ug/kg	TM15/PM10

**Jones Environmental Laboratory**

### SVOCs - Tentatively Identified Compounds (TICs)

<b>Job number:</b>	11/4615
<b>Sample number:</b>	22
<b>Sample identity:</b>	DPS-SB03
<b>Sample depth:</b>	0.5-1.0
<b>Sample Type:</b>	Soil
<b>Units:</b>	ug/kg

**Method**      **TM16/PM8**

**note: Only samples with TICs (if requested) are reported. If TICs were requested but no compounds found they are not reported.**

Tentative Compound Identification (>80% match)	Retention Time (minutes)	Concentration
Benzenesulfonamide, N-ethyl-2-methyl-	9.57	138
Cyclic octaatomic sulfur	11.16	209

**SVOCs - Tentatively Identified Compounds (TICs)**

**Job number:** 11/4615  
**Sample number:** 27  
**Sample identity:** DPS-SB04  
**Sample depth:** 0.5-1.0  
**Sample Type:** Soil  
**Units:** ug/kg

**Method** TM16/PM8

**note:** Only samples with TICs (if requested) are reported. If TICs were requested but no compounds found they are not reported.

Tentative Compound Identification (>80% match)	Retention Time (minutes)	Concentration
Dodecane, 2,6,11-trimethyl-	8.83	200
Pentadecane	9.05	198
Benzenesulfonamide, N-ethyl-2-methyl-	9.56	490
Hexadecane	9.63	284
Methoxyacetic acid, 4-tetradecyl ester	9.91	325
Heptadecane	10.16	305
Octadecane	10.63	241
Hexadecane, 2,6,10,14-tetramethyl-	10.69	538
Nonadecane	11.06	408
Eicosane	11.46	202
Heneicosane	11.84	152

**Jones Environmental Laboratory**

### SVOCs - Tentatively Identified Compounds (TICs)

<b>Job number:</b>	11/4615
<b>Sample number:</b>	32
<b>Sample identity:</b>	DPS-SB05
<b>Sample depth:</b>	0.5-1.0
<b>Sample Type:</b>	Soil
<b>Units:</b>	ug/kg

**Method**      **TM16/PM8**

**note: Only samples with TICs (if requested) are reported. If TICs were requested but no compounds found they are not reported.**

Tentative Compound Identification (>80% match)	Retention Time (minutes)	Concentration
Phenol, 2,4-bis(1,1-dimethylethyl)-	9.01	142
Benzenesulfonamide, N-ethyl-2-methyl-	9.56	615
Benzenesulfonamide, N-ethyl-4-methyl-	9.88	295
9-Octadecenamide, (Z)-	13.86	1308

## NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

### SOILS

Please note we are only MCERTS accredited for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary. If we are instructed to keep samples, a storage charge of £1 (1.5 Euros) per sample per month will be applied until we are asked to dispose of them.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected. Samples are dried at 35°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C

Asbestos screens where requested will be undertaken by a UKAS accredited laboratory.

### WATERS

Please note we are not a Drinking Water Inspectorate (DWI) Approved Laboratory. It is important that detection limits are carefully considered when requesting water analysis.

UKAS accreditation applies to surface water and groundwater and one other matrix which is analysis specific, any other liquids are outside our scope of accreditation

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples. All samples are treated as groundwaters and analysis performed on settled samples unless we are instructed otherwise.

### DEVIATING SAMPLES

Samples must be received in a condition appropriate to the requested analyses. All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. If this is not the case you will be informed and any analysis that may be compromised highlighted on your schedule/ report by the use of a symbol.

*The use of any of the following symbols indicates that the sample was deviating and the test result may be unreliable:*

\$	Sample temperature on receipt considered inappropriate for analysis requested.
^	Samples exceeding recommended holding times.
&	Samples received in inappropriate containers (e.g. volatile samples not submitted in VOC jars/vials).
~	No sampling date given, unable to confirm if samples are with acceptable holding times.

### SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130%. Results are not surrogate corrected.

### AQCs

Where AQC's fall outside UKAS/MCERTS criteria analysis is repeated if possible.

### NOTE

Data is only accredited when all the requirements of our Quality System have been met. In certain circumstances where the requirements have not been met, the laboratory may issue the data in its final report if it believes that the validity of the data has not been compromised but will remove the accreditation. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

## ABBREVIATIONS and ACRONYMS USED

#	UKAS accredited.
M	MCERTS accredited.
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
SS	Calibrated against a single substance.
*	Analysis subcontracted to a Jones Environmental approved laboratory.
W	Results expressed on as received basis.
+	Accreditation has been removed from this result see 'Note' on previous page.
++	Result outside calibration range, results should be considered as indicative only and are not accredited.
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
DR	Dilution required.



[illegible]

## **Annex E: ENVIRON Generic Assessment Criteria**

ANALYTE	ENVIRON GAC (Commercial)	UNIT
<b>Metals</b>		
Antimony	7,550	mg/kg
Arsenic	635	mg/kg
Barium	22,100	mg/kg
Beryllium	417	mg/kg
Cadmium	230	mg/kg
Chromium	35	mg/kg
Cobalt	NC	mg/kg
Copper	71,700	mg/kg
Lead	750	mg/kg
Manganese	NC	mg/kg
Mercury	4.3	mg/kg
Nickel	1,790	mg/kg
Selenium	13,000	mg/kg
Thallium	NC	mg/kg
Tin	NC	mg/kg
Total Sulphate	N/A	mg/kg
Vanadium	3,160	mg/kg
Zinc	665,000	mg/kg

ANALYTE	ENVIRON GAC (Commercial)	UNIT
<b>PAHs</b>		
Naphthalene	75	mg/kg
Acenaphthylene	162	mg/kg
Acenaphthene	56.7	mg/kg
Fluorene	160	mg/kg
Phenanthrene	21,900	mg/kg
Anthracene	522,000	mg/kg
Fluoranthene	22,600	mg/kg
Pyrene	54,300	mg/kg
Benz(a)anthracene	91	mg/kg
Chrysene	140.0	mg/kg
Benzo(bk)fluoranthene	102	mg/kg
Benzo(a)pyrene	14	mg/kg
Indeno(123cd)pyrene	61.0	mg/kg
Dibenzo(ah)anthracene	13	mg/kg
Benzo(ghi)perylene	658	mg/kg
PAH 16 Total	NC	mg/kg
Benzo(b)fluoranthene	102	mg/kg

ANALYTE	ENVIRON GAC (Commercial)	UNIT
Benzo(k)fluoranthene	143	mg/kg
PAH Surrogate % Recovery	NC	%

ANALYTE	ENVIRON GAC (Commercial)	UNIT
<b>Hydrocarbons</b>		
EPH >C8-C10	NC	mg/kg
EPH >C10-C20	NC	mg/kg
EPH >C20-C30	NC	mg/kg
EPH >C30-C40	NC	mg/kg
EPH >C8-C40	5,000	mg/kg

ANALYTE	ENVIRON GAC (Commercial)	UNIT
<b>PCBs</b>		
PCB 28	NC	mg/kg
PCB 52	NC	mg/kg
PCB 101	NC	mg/kg

ANALYTE	ENVIRON GAC (Commercial)	UNIT
PCB 118	NC	mg/kg
PCB 138	NC	mg/kg
PCB 153	NC	mg/kg
PCB 180	NC	mg/kg
Total 7 PCBs	0.24	mg/kg

ANALYTE	ENVIRON GAC (Commercial)	UNIT
<b>Others</b>		
Asbestos Screen	NC	
pH	NC	pH units
Sulphide	NC	mg/kg
Sulphate as SO <sub>4</sub> (2:1 Ext)	NC	g/l

ANALYTE	ENVIRON GAC (Commercial)	UNIT
<b>SVOCs</b>		
2-Chlorophenol	3,590	mg/kg
2-Methylphenol	14,200	mg/kg
2-Nitrophenol	910	mg/kg
2,4-Dichlorophenol	3,530	mg/kg
2,4-Dimethylphenol	1,330	mg/kg
2,4,5-Trichlorophenol	2,300	mg/kg
2,4,6-Trichlorophenol	848	mg/kg
4-Chloro-3-methylphenol	8,333	mg/kg
4-Methylphenol	25,800	mg/kg
4-Nitrophenol	1,000	mg/kg
Pentachlorophenol	1,230	mg/kg
Phenol	3,200	mg/kg
2-Chloronaphthalene	113	mg/kg
2-Methylnaphthalene	7,148	mg/kg
Bis(2-ethyl-hexyl) phthalate	85,400	mg/kg
Butylbenzyl phthalate	942,000	mg/kg
Di-n-butyl phthalate	12.9	mg/kg

ANALYTE	ENVIRON GAC (Commercial)	UNIT
Di-n-Octyl phthalate	89,100	mg/kg
Diethyl phthalate	109	mg/kg
Dimethyl phthalate	275	mg/kg
1,2-Dichlorobenzene	562	mg/kg
1,2,4-Trichlorobenzene	123	mg/kg
1,3-Dichlorobenzene	177	mg/kg
1,4-Dichlorobenzene	221	mg/kg
2-Nitroaniline	651	mg/kg
2,4-Dinitrotoluene	3,750	mg/kg
2,6-Dinitrotoluene	1,860	mg/kg
3-Nitroaniline	200	mg/kg
4-Bromophenylphenylether	0.9	mg/kg
4-Chloroaniline	2,300	mg/kg
4-Chlorophenylphenylether	0.3	mg/kg
4-Nitroaniline	170	mg/kg
Azobenzene	151	mg/kg

ANALYTE	ENVIRON GAC (Commercial)	UNIT
<b>SVOCs (continued)</b>		
Bis(2-chloro-ethoxy)methane	1.3	mg/kg
Bis(2-chloro-ethyl)ether	0.2	mg/kg
Carbazole	897	mg/kg
Dibenzofuran	6,666	mg/kg
Hexachlorobenzene	0.1	mg/kg
Hexachlorobutadiene	17.6	mg/kg
Hexachlorocyclopentadiene	1	mg/kg
Hexachloroethane	8.1	mg/kg
Isophorone	887	mg/kg
N-nitrosodi-n-propylamine	1.9	mg/kg
Nitrobenzene	131	mg/kg

ANALYTE	ENVIRON GAC (Commercial)	UNIT
<b>VOCs</b>		

ANALYTE	ENVIRON GAC (Commercial)	UNIT
1,1,1,2-Tetrachloroethane	62.7	mg/kg
1,1,1-Trichloroethane	391	mg/kg
1,1,2,2-Tetrachloroethane	156	mg/kg
1,1,2-Trichloroethane	51.1	mg/kg
1,1-Dichloroethane	148	mg/kg
1,1-Dichloroethene	NC	mg/kg
1,1-Dichloropropene	12.8	mg/kg
1,2,3-Trichlorobenzene	56.8	mg/kg
1,2,3-Trichloropropane	3.14	mg/kg
1,2,4-Trichlorobenzene	123	mg/kg
1,2,4-Trimethylbenzene	NC	mg/kg
1,2-Dibromo-3-chloropropane	1.03	mg/kg
1,2-Dibromoethane	NC	mg/kg
1,2-Dichlorobenzene	562	mg/kg

ANALYTE	ENVIRON GAC (Commercial)	UNIT
1,2-Dichloroethane	0.35	mg/kg
1,2-Dichloropropane	1.72	mg/kg
<b>VOCs (continued)</b>		
1,3,5-Trimethylbenzene	1.28	mg/kg
1,3-Dichlorobenzene	17.7	mg/kg
1,3-Dichloropropane	12.8	mg/kg
1,4-Dichlorobenzene	221	mg/kg
2,2-Dichloropropane	20.4	mg/kg
2-Chlorotoluene	NC	mg/kg
4-Chlorotoluene	1.41	mg/kg
4-Isopropyltoluene	388	mg/kg
Benzene	15.8	mg/kg
Bromobenzene	NC	mg/kg
Bromochloromethane	1.10	mg/kg
Bromodichloromethane	1.10	mg/kg
Bromoform	417	mg/kg
Bromomethane	27.0	mg/kg
Carbon tetrachloride	1.74	mg/kg

ANALYTE	ENVIRON GAC (Commercial)	UNIT
Chlorobenzene	32.8	mg/kg
Chloroethane	567	mg/kg
Chloroform	57.3	mg/kg
Chloromethane	0.5	mg/kg
cis-1-2-Dichloroethene	7.74	mg/kg
cis-1-3-Dichloropropene	19.3	mg/kg
Dibromochloromethane	264	mg/kg
Dibromomethane	NC	mg/kg
Dichlorodifluoromethane	1,500	mg/kg
Dichloromethane	NC	mg/kg
Ethylbenzene	508	mg/kg
Hexachlorobutadiene	17.6	mg/kg
Isopropylbenzene	753	mg/kg
Methyl Tertiary Butyl Ether	NC	mg/kg
Naphthalene	75.0	mg/kg
n-Butylbenzene	430	mg/kg

ANALYTE	ENVIRON GAC (Commercial)	UNIT
o-Xylene	467	mg/kg
p/m-Xylene	564	mg/kg
<b>VOCs (continued)</b>		
Propylbenzene	399	mg/kg
sec-Butylbenzene	1,300	mg/kg
Styrene	607	mg/kg
tert-Butylbenzene	440	mg/kg
Tetrachloroethene	72.2	mg/kg
Toluene	835	mg/kg
trans-1-2- Dichloroethene	12.3	mg/kg
trans-1-3- Dichloropropene	12.8	mg/kg
Trichloroethene	6.61	mg/kg
Trichlorofluorometha ne	2,200	mg/kg
Vinyl Chloride	0.04	mg/kg

Note: GACS presented were applicable in August 2011.





## **Section 2 – Waste Management Plan**

Covering EP Conditions: 2.16.5.4



RVA GROUP

Decommissioning,  
decontamination,  
dismantling and demolition  
consulting engineers

## **Site Waste Management Plan**

**For the Enemalta Corporation**

**Delimara Power Station  
at Delimara, Malta**



## **Delimara Power Station, Delimara, Marsaxlokk**

## DOCUMENT ISSUE/AMENDMENT CERTIFICATE

Date	Author	Checker	Revision	Amendment
22/08/2011	M Taylor	I Wharton	000	Draft
04/09/2014	M Taylor	I Wharton	001	For Phase 1 Dismantling

**ENEMALTA CORPORATION**  
**DELIMARA POWER STATION, DELIMARA, MARSAXLOKK**

**WASTE MANAGEMENT PLAN**

**Contents**

Introduction .....	5
Terms of Reference .....	6
Waste and the Waste Hierarchy .....	7
Waste Types .....	8
Waste Segregation .....	8
Processing, Transportation, and Disposal (Recovery).....	8
Definitions .....	9
DPS Waste Totals.....	11
DPS Area Totals .....	17
APPENDIX A – DPS Area Plan .....	28

<b>Client:</b>	Enemalta Corporation
<b>Person Drafting this SWMP:</b>	Mark Taylor
<b>Site Location:</b>	Delimara Power Station, Delimara, Marsaxlokk, Malta
<b>Description of Proposed Works:</b>	Waste Estimates for Demolition, Dismantling, Clearance of Process Plant structures, Buildings, Equipment, and Foundation Removal at Delimara Power Station to Support the Station Outline Decommissioning Plan
<b>Estimated Cost of Project:</b>	N/A for this version

### **Introduction**

This Site Waste Management Plan (SWMP) applies to all demolition activities for the Delimara Power Station (DPS) but excludes the proposed new Gas Plant and Gas Reception Facility

DPS is situated in the south easterly part of the island and was first commissioned in 1992, and consists of the following units:

	Units	Commissioned
Phase 1	2 x 60MW Conventional Steam Boiler/Turbine units	1992
Phase 2a	2 x 37MW Open Cycle Gas Turbines	1994
Phase 2b	1 x 110MW Combined-Cycle Plant. 2 x 37MW Gas Turbines, 2 x Heat Recovery Steam Generators, 1 x 36MW Steam Turbine	1999
Phase 3	8 x Diesel Engines, 1 x 13MW Steam Turbine unit	Due 2012

The final total generation capacity of this station stands at 448MW.

Phase 1 consists of 2 steam units each consisting of a boiler, a steam turbine and a generator with a capacity of 60 MW. The fuel is Heavy Fuel Oil (HFO). The plant runs

at base load. It is proposed that the Power Generating plant of Phase 1 is removed in the near future. The following is the list of the plant which will be removed:

1. 2no. Waagner Biro Steam Boilers rated at 260T/H steam flow fired by Heavy Fuel Oil
2. 2no. BHEL Steam Turbines/Generators rated at 60MW output with all auxiliary equipment found inside the Turbine Hall.
3. Phase 1 Chimney, (consisting of chimneys D1A and D1B 150m high with concrete wind shield).

The Turbine Hall structure and site service electrical systems (including the pipebridge between the Boilers and the Turbine Hall) are not included in the removal works. The values in brackets in the SWMP are those for the Phase 1 Power Generating plant which is proposed to be removed – these need to be subtracted from the none bracketed values once the work has been executed.

Phase 2a consists of 2 open cycle gas turbine / generator units each rated at 37.5 MW. The fuel is gas oil and the plant is used for peak loads. This plant may also be used for synchronous compensation.

Phase 2b consists of a combined cycle gas turbine block consisting of 2 gas turbines, 2 heat recovery steam generators and a steam turbine and associated generators with a total capacity of 110 MW. The fuel is gas oil and the plant is used for mid-range loads.

Phase 3 consist of 8 Wartsila 18V46 medium speed diesel engines capable of burning HFO and gas oil, and a 13MW steam turbine which is operated by steam generated by boilers which recover heat from the exhaust of the diesel engines. The power plant incorporates 8 Selective Catalytic Reduction units (SCR), and 4 de-sulphurisation units.

### **Terms of Reference**

The SWMP assumes that all decommissioning and decontamination work has been completed and that all chemicals and process material has been removed under the existing site operating and maintenance procedures.

On the section of the site that has been constructed on the made land to the west, foundation removal quantities include for the ground slabs and shallow foundations (up to 1m deep). This SWMP assumes that the quay structure remains.

Where foundations have been constructed onto the natural rock strata (to the east of the site) then the foundation removal quantities only include for the ground slabs and the top 0.5m of the foundations. This is standard industry practice unless there is a defined future use of the site that requires the full removal of the foundations. Any remaining buried structures will need to be documented and recorded.

### **Waste and the Waste Hierarchy**

Waste is defined in Article 1 (1) (a) of the Waste Framework Directive (2008/98/EC) and means.... "any substance or object ....which the holder discards or intends or is required to discard". All waste that falls within the scope of this definition will be recorded in the Site Waste Management Plan.

Waste is widely defined and includes excess unwanted materials, effluents, unwanted surplus substances arising from the application of any process and any substance or article which is broken, worn out, contaminated or otherwise damaged. Waste becomes controlled by legislation when it is discarded by the holder. Materials sold for re-use or re-cycling are still classified as waste and subject to all the statutory controls, including Duty of Care.

The European Commission Decision 2000/532/EC1 established a list of wastes. The list of waste has been used to determine what wastes are considered as hazardous waste. A substance or object has only been considered as waste if it conformed to the definition in regulation 4 of the Waste Regulations 2011 (L.N.184 of 2011).

All waste on DPS will be dealt with in accordance with the waste Duty of Care which is a legal requirement under regulation 12 of Waste Regulations 2011 (L.N.184 of 2011) and states that materials will be handled efficiently to minimise wastage and that all waste arising from the site will be managed appropriately.

The Waste Hierarchy has been applied when formulating this Site Waste Management Plan:

- Prevention
- Reuse



- Recycle
- Recovery
- Disposal

Where practical waste has been selected for reuse and recycling. Only when all other routes had been exhausted has waste been designated for landfill.

### **Waste Types**

The waste types that have been identified and documented in Table 1 for the Delimara Power Station are those which are expected to be produced during the demolition of the site. Table 2 further breaks these figures down into geographical areas (see Appendix A). This is to give greater knowledge and understanding of the site and to also allow for better detailed planning depending on demolition scheduling. Each identified waste has a European Waste Catalogue Code (EWC).

### **Waste Segregation**

The waste streams will be segregated along the lines of the waste item and not the code as some items share the same code but require different treatment/conditioning/disposal options. All waste will be segregated at the workplace or in a processing area and will then be stockpiled. Types of stockpiling can range from clearly labelled containers (bins, skips, buildings), to open fenced areas. The majority of any processing done on site will be solely to enable segregation and to aid transportation. The only exception to this will be materials to be re-cycled for use on site (see below). Therefore any treatment, conditioning, or recovery will be performed off-site either on Malta or abroad (see Table 1).

### **Processing, Transportation, and Disposal (Recovery)**

The concrete/brickwork will be re-cycled on site by utilising a mobile crushing machine to process it to an engineering grade fill, a typical example is crushed and sieved material of maximum size 75mm. This fill will be utilised to fill voids and hollows on the site.

All waste disposed off on Malta will be transported and disposed of by appropriate licensed entities as described in the Waste Regulations 2011 (L.N.184 of 2011). All waste to be shipped off the island will also follow the requirements of the regulations

but will either be shipped from existing ports or for bulk material directly from the Delimara quay.

### **Definitions**

“Waste Holder” means “the producer of the waste or the natural or legal person who is in possession of it”. It rests, in the first place, with the producer or holder of a substance or object to decide whether it is being discarded and is waste.

“Carrier” means the person who collects and carries out the transport.

“Consignment note” means a note that is to accompany the consignment of hazardous or non-hazardous waste.

“Disposal” means any operation which is not recovery even where the operation has as a secondary consequence the reclamation of substances or energy.

“Non Hazardous Waste” means all waste that does not display one or more of the hazardous properties listed in Schedule 3 of the Waste Regulations 2011 (L.N.184 of 2011). Examples can include paper, plastic, wood, domestic waste, metal and glass.

“Hazardous Waste” means waste which displays one or more of the hazardous properties listed in Schedule 3 of the Waste Regulations 2011 (L.N.184 of 2011).

“Inert” means material of an insoluble mineral nature i.e. glass, concrete, brick, stone, tiles, ceramics, glass fibre material, some soils.

“Recovery” means any operation the principal result of which is waste serving a useful purpose by replacing other materials which would otherwise have been used to fulfil a particular function, or waste being prepared to fulfil that function, in the plant or in the wider economy.

“Recycling” means any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes. It includes the reprocessing of organic material but does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations.

“Re-use” means any operation by which products or components that are not waste are used again for the same purpose for which they were conceived.

“Treatment” means recovery or disposal operations, including preparation prior to recovery or disposal.

“Waste Producer” means anyone whose activities produce waste (original waste producer) or anyone who carries out pre-processing, mixing or other operations resulting in a change in the nature or composition of this waste.



## DPS Waste Totals

TABLE 1													
Type of material	Materials						Schedule 2 Coding	Reuse, Re-manufacturing, Recycling and Energy Recovery					Disposal/Carrier
	EWC Code	Estimates		Inert	Hazardous	Non-Hazardous		On-site Reuse and Recycling		Off-site Reuse, Recycling or Recovery			Specify the type of landfill and disposal company
		m <sup>3</sup>	Tonnes					Specify the process	Quantity	Specify the process	Quantity	Location	Specify the waste license carrier.
<b>Soft Strip</b>													
Glass	17 02 02	19 (1)		Y		Y	R5			Re-cycle	19	Abroad	
Plasterboard	17 08 02	58				Y	D1 R5			Re-cycle	58	Abroad	Otherwise Landfill Malta (e.g. Ghallis)
Suspended Ceilings (alumin. tiles,etc.) & Floor Tiles	17 09 04	58				Y	D1 R5			Re-cycle	58	Abroad	Otherwise Landfill Malta (e.g. Ghallis)
Timber (incl. furniture)	17 02 01	403				Y	R3			Re-cycle	453	Abroad	
Paper and Cardboard	20 01 01	0				Y	R3			Re-cycle	0	Abroad	



TABLE 1													
Type of material	Materials						Schedule 2 Coding	Reuse, Re-manufacturing, Recycling and Energy Recovery					Disposal/Carrier
	EWC Code	Estimates		Inert	Hazardous	Non-Hazardous		On-site Reuse and Recycling		Off-site Reuse, Recycling or Recovery			Specify the type of landfill and disposal company
		m <sup>3</sup>	Tonnes					Specify the process	Quantity	Specify the process	Quantity	Location	Specify the waste license carrier.
Lights	20 01 21*	28 (2)			Y		R3 R4			Re-cycle	38	Abroad	
Waste Electrical & Electronic Equipment	16 02 14	23 (4)				Y	R4			Recovery	23	Abroad	
<b>Demolition Waste</b>													
Cable	17 04 11		166 (60)			Y	R4			Recovery	166	Abroad	
Cable – Oil Filled	17 04 10*		40		Y		R4 R9			Recovery & Re-cycle	40	Abroad	
Transformer Oils	13 03 10*		373 (68)		Y		R9			Re-use	373	Abroad	
Waste Oils	13 02 08* 13 07 01*		546 (23)		Y		R9			Re-cycle & Re-use	546	Abroad	



TABLE 1													
Type of material	Materials						Schedule 2 Coding	Reuse, Re-manufacturing, Recycling and Energy Recovery					Disposal/Carrier
	EWC Code	Estimates		Inert	Hazardous	Non-Hazardous		On-site Reuse and Recycling		Off-site Reuse, Recycling or Recovery			Specify the type of landfill and disposal company
		m <sup>3</sup>	Tonnes					Specify the process	Quantity	Specify the process	Quantity	Location	Specify the waste license carrier.
Batteries	16 06 01*	2055 No.			Y		R4 R6			Re-cycle	2055 No.	Abroad	
Insulation/Mineral wool	17 06 04	5614 (1600)				Y	R5 D1			Re-cycle	5614	Abroad	Otherwise Landfill Malta (e.g. Ghallis)
Calcium Silicate	17 06 03	50 (50)			Y		D1					Abroad	Otherwise Landfill Malta (e.g. Ghallis)
Ceramic Fibres	17 06 03*		0.8		Y		D1						Landfill Malta (e.g. Ghallis)
Refractory	16 11 06	30 (20)				Y	R5			Re-cycle	30	Abroad	
Ash and Coal Dust (Waste Hydrocarbon Solids)	10 01 04*	0			Y		D9						Abroad
Urea	16 10 02	0				Y	R3			Re-use	0	Abroad	



TABLE 1													
Type of material	Materials						Schedule 2 Coding	Reuse, Re-manufacturing, Recycling and Energy Recovery					Disposal/Carrier
	EWC Code	Estimates		Inert	Hazardous	Non-Hazardous		On-site Reuse and Recycling		Off-site Reuse, Recycling or Recovery			Specify the type of landfill and disposal company
		m <sup>3</sup>	Tonnes					Specify the process	Quantity	Specify the process	Quantity	Location	Specify the waste license carrier.
Plastics	17 02 03	20 (3)				Y	R5			Re-cycle	20	Abroad	
Fibreglass	10 11 03	0		Y		Y	D1						Landfill Malta (e.g. Ghallis)
Metal Cladding	17 04 05		280			Y	R4			Recovery	280	Abroad	
Foam insulation (CFC, HCFC, Propane)	17 06 03*	561			Y		D9						Abroad
Sand/Bitumen	17 03 01*	100			Y		D1						Landfill Malta (e.g. Ghallis)
Stone	17 01 02	800		Y		Y	R5			Recovery	800	Malta	
Concrete/Brick work	17 01 07	11102 (2900)		Y		Y	R5	Re-cycle (graded crush)	11102				



TABLE 1													
Type of material	Materials						Schedule 2 Coding	Reuse, Re-manufacturing, Recycling and Energy Recovery					Disposal/Carrier
	EWC Code	Estimates		Inert	Hazardous	Non-Hazardous		On-site Reuse and Recycling		Off-site Reuse, Recycling or Recovery			Specify the type of landfill and disposal company
		m <sup>3</sup>	Tonnes					Specify the process	Quantity	Specify the process	Quantity	Location	Specify the waste license carrier.
<b>Scrap Metal</b>													
Carbon Steel	17 04 05		18523 (4000)			Y	R4			Recovery	18523	Abroad	
Stainless Steel	17 04 05		27 (60)			Y	R4			Recovery	27	Abroad	
Copper	17 04 01		455 (160)			Y	R4			Recovery	385	Abroad	
Admiralty Brass	17 04 01		69 (69)			Y	R4			Recovery	92	Abroad	
Muntz Metal (Cu/Zn - 60/40)	17 04 01		40			Y	R4			Recovery	40	Abroad	
Aluminium	17 04 02		55 (38)			Y	R4			Recovery	22	Abroad	
Titanium	17 04 07		20			Y	R4			Recovery	20	Abroad	





TABLE 1													
Type of material	Materials						Schedule 2 Coding	Reuse, Re-manufacturing, Recycling and Energy Recovery					Disposal/Carrier
	EWC Code	Estimates		Inert	Hazardous	Non-Hazardous		On-site Reuse and Recycling		Off-site Reuse, Recycling or Recovery			Specify the type of landfill and disposal company
		m <sup>3</sup>	Tonnes					Specify the process	Quantity	Specify the process	Quantity	Location	Specify the waste license carrier.
High Nickel Alloys	17 04 07		3.4 (3)			Y	R4			Recovery	0.4	Abroad	
Foundations													
Concrete	17 01 01	17505		Y		Y	R5	Re-cycle (graded crush)	17505				
Steel	17 04 05		201			Y	R4			Recovery	201	Abroad	
Tarmac	17 03 01*	2652			Y		R3			Re-cycle	2652	Abroad	



## **DPS Area Totals**

<b>TABLE 2</b>					
Type of material	Materials				
	Estimates		Inert	Hazardous	Non-Hazardous
	m <sup>3</sup>	Tonnes			
<b>AREA 1</b>					
<b><i>Soft Strip</i></b>					
Glass	8		Y		Y
Plasterboard	25				Y
Suspended Ceilings & Floor Tiles	16				Y
Timber (incl furniture)	50				Y
Lights	6			Y	
Waste Electrical & Electronic Equipment	10				Y
<b><i>Demolition Waste</i></b>					
Cable		4			Y
Transformer Oils		0.2		Y	
Waste Oils		0.1		Y	
Insulation/Mineral wool	5				Y
Plastics	5				Y
Cladding		40			Y
Foam insulation (CFC, HCFC, propane)	120			Y	
Stone	540		Y		Y
Concrete/Brickwork/Porcelain	2240		Y		Y
<b><i>Scrap Metal</i></b>					
Carbon Steel		115			Y
<b><i>Foundations</i></b>					



TABLE 2					
Type of material	Materials				
	Estimates		Inert	Hazardous	Non-Hazardous
	m <sup>3</sup>	Tonnes			
Concrete	2552		Y		Y
Steel		40			Y
Tarmac	600			Y	
<b>AREA 2</b>					
<b>Soft Strip</b>					
Glass	4		Y		Y
Plasterboard	18				Y
Suspended Ceilings & Floor Tiles	32				Y
Timber (incl furniture)	80				Y
Lights	3			Y	
Waste Electrical & Electronic Equipment	2				Y
<b>Demolition Waste</b>					
Cable		35			Y
Cable Oil Filled		40		Y	
Transformer Oils		67		Y	
Waste Oils		0.25		Y	
Batteries	226 No.			Y	
Insulation/Mineral wool	44				Y
Plastics	2				Y
Cladding		36			Y
Foam insulation (CFC, HCFC, propane)	106			Y	
Stone	130		Y		Y


**TABLE 2**

Type of material	Materials				
	Estimates		Inert	Hazardous	Non-Hazardous
	m <sup>3</sup>	Tonnes			
Concrete/Brickwork/Porcelain	730		Y		Y
<b>Scrap Metal</b>					
Carbon Steel		1800			Y
Stainless Steel		10			Y
Copper		54			Y
<b>Foundations</b>					
Concrete	1100		Y		Y
Steel		18			Y
Tarmac	140			Y	
<b>AREA 3</b>					
<b>Soft Strip</b>					
Glass	4 (1)		Y		Y
Plasterboard	8				Y
Suspended Ceilings & Floor Tiles	6				Y
Timber (incl furniture)	80				Y
Lights	15 (2)			Y	
Waste Electrical & Electronic Equipment	8 (4)				Y
<b>Demolition Waste</b>					
Cable		60 (5)			Y
Transformer Oils		98 (68)		Y	
Waste Oils		23 (23)		Y	
Batteries	528 No.			Y	


**TABLE 2**

Type of material	Materials				
	Estimates		Inert	Hazardous	Non-Hazardous
	m <sup>3</sup>	Tonnes			
Insulation/Mineral wool	1800 (1600)				Y
Calcium Silicate	50 (50)			Y	
Refractory	20 (20)				Y
Plastics	5 (3)				Y
Cladding		70			Y
Foam insulation (CFC, HCFC, propane)	220			Y	
Stone	100		Y		Y
Concrete/Brickwork/Porcelain	3232 (2900)		Y		Y
<b>Scrap Metal</b>					
Carbon Steel		4900 (4000)			Y
Copper		180 (160)			Y
Admiralty. Brass		69 (69)			Y
Aluminum		40 (38)			Y
Stainless Steel		60 (60)			Y
High Nickel Alloy		3 (3)			Y
<b>Foundations</b>					
Concrete	5000		Y		Y
Steel		30			Y
Tarmac	550			Y	
<b>AREA 4</b>					
<b>Soft Strip</b>					
Glass	1		Y		Y


**TABLE 2**

Type of material	Materials				
	Estimates		Inert	Hazardous	Non-Hazardous
	m <sup>3</sup>	Tonnes			
Plasterboard	2				Y
Suspended Ceilings & Floor Tiles	1				Y
Timber (incl furniture)	25				Y
Lights	2			Y	
Waste Electrical & Electronic Equipment	1				Y
<b>Demolition Waste</b>					
Cable		20			Y
Transformer Oils		59		Y	
Waste Oils		36		Y	
Batteries	472 No.			Y	
Insulation/Mineral wool	350				Y
Ceramic Fibres		0.4		Y	
Refractory	10				Y
Plastics	4				Y
Cladding		17			Y
Foam insulation (CFC, HCFC, propane)	115			Y	
Concrete/Brickwork/Porcelain	300		Y		Y
<b>Scrap Metal</b>					
Carbon Steel		1992			Y
Stainless Steel		15			Y
Copper		50			Y
Muntz metal (Cu/Zn – 60/40)		40			Y


**TABLE 2**

Type of material	Materials				
	Estimates		Inert	Hazardous	Non-Hazardous
	m <sup>3</sup>	Tonnes			
Aluminum		3			Y
High Nickel Alloys		0.2			Y
<b>Foundations</b>					
Concrete	1053		Y		Y
Steel		10			Y
Tarmac	500			Y	
<b>AREA 5</b>					
<b>Soft Strip</b>					
Glass	1		Y		Y
Plasterboard	2				Y
Suspended Ceilings & Floor Tiles	1				Y
Timber (incl furniture)	50				Y
Lights	4			Y	
Waste Electrical & Electronic Equipment	1				Y
<b>Demolition Waste</b>					
Cable		40			Y
Transformer Oils		114		Y	
Waste Oils		60		Y	
Batteries	356 No.			Y	
Insulation/Mineral wool	3250				Y
Plastics	2				Y
Cladding		120			Y


**TABLE 2**

Type of material	Materials				
	Estimates		Inert	Hazardous	Non-Hazardous
	m <sup>3</sup>	Tonnes			
Concrete/Brickwork/Porcelain	1300		Y		Y
<b>Scrap Metal</b>					
Carbon Steel		6500			Y
Copper		123			Y
Titanium		20			Y
Aluminum		10			Y
<b>Foundations</b>					
Concrete	3230		Y		Y
Steel		50			Y
Tarmac	272			Y	
<b>AREA 6</b>					
<b>Soft Strip</b>					
Glass	0.5		Y		Y
Plasterboard	2				Y
Suspended Ceilings & Floor Tiles	1				Y
Timber (incl furniture)	10				Y
Lights	0.5			Y	
Waste Electrical & Electronic Equipment	0.5				Y
<b>Demolition Waste</b>					
Cable		4			Y
Transformer Oils		33		Y	
Waste Oils		17		Y	




**TABLE 2**

Type of material	Materials				
	Estimates		Inert	Hazardous	Non-Hazardous
	m <sup>3</sup>	Tonnes			
Batteries	149 No.			Y	
Insulation/Mineral wool	15				Y
Ceramic Fibres		0.4		Y	
Concrete/Brickwork/Porcelain	100		Y		Y
<b>Scrap Metal</b>					
Carbon Steel		530			Y
Copper		39			Y
High Nickel Alloys		0.2			Y
<b>Foundations</b>					
Concrete	470		Y		Y
Steel		7			Y
Tarmac	190			Y	
<b>AREA 7</b>					
<b>Soft Strip</b>					
Plasterboard	1				Y
Suspended Ceilings & Floor Tiles	1				Y
Timber (incl furniture)	5				Y
Lights	0.5			Y	
<b>Demolition Waste</b>					
Cable		1			Y
Transformer Oils		0.1		Y	
Waste Oils		0.5		Y	



TABLE 2					
Type of material	Materials				
	Estimates		Inert	Hazardous	Non-Hazardous
	m <sup>3</sup>	Tonnes			
Batteries	54 No.			Y	
Cladding		7			Y
Stone	30		Y		Y
Concrete/Brickwork/Porcelain	100		Y		Y
<b>Scrap Metal</b>					
Carbon Steel		216			Y
Copper		4			Y
<b>Foundations</b>					
Concrete	600		Y		Y
Steel		8			Y
Tarmac	220			Y	
<b>AREA 8</b>					
<b>Soft Strip</b>					
Timber (incl furniture)	10				Y
Lights	0.5			Y	
Waste Electrical & Electronic Equipment	1				Y
<b>Demolition Waste</b>					
Cable		1			Y
Transformer Oils		0.1		Y	
Waste Oils		8		Y	
Insulation/Mineral wool	150				Y
Plastics	2				Y



TABLE 2					
Type of material	Materials				
	Estimates		Inert	Hazardous	Non-Hazardous
	m <sup>3</sup>	Tonnes			
Concrete/Brickwork/Porcelain	500		Y		Y
<b>Scrap Metal</b>					
Carbon Steel		250			Y
Stainless Steel		2			Y
Copper		4			Y
Aluminium		2			Y
<b>Foundations</b>					
Concrete	400		Y		Y
Steel		5			Y
Tarmac	180			Y	
<b>AREA 9</b>					
<b>Demolition Waste</b>					
Cable		0.5			Y
Waste Oils		400		Y	
Sand/bitumen	100			Y	
Concrete/Brickwork/Porcelain	200		Y		Y
<b>Scrap Metal</b>					
Carbon Steel		1000			Y
<b>Foundations</b>					
Concrete	200		Y		Y
Steel		3			Y
Tarmac	0			Y	

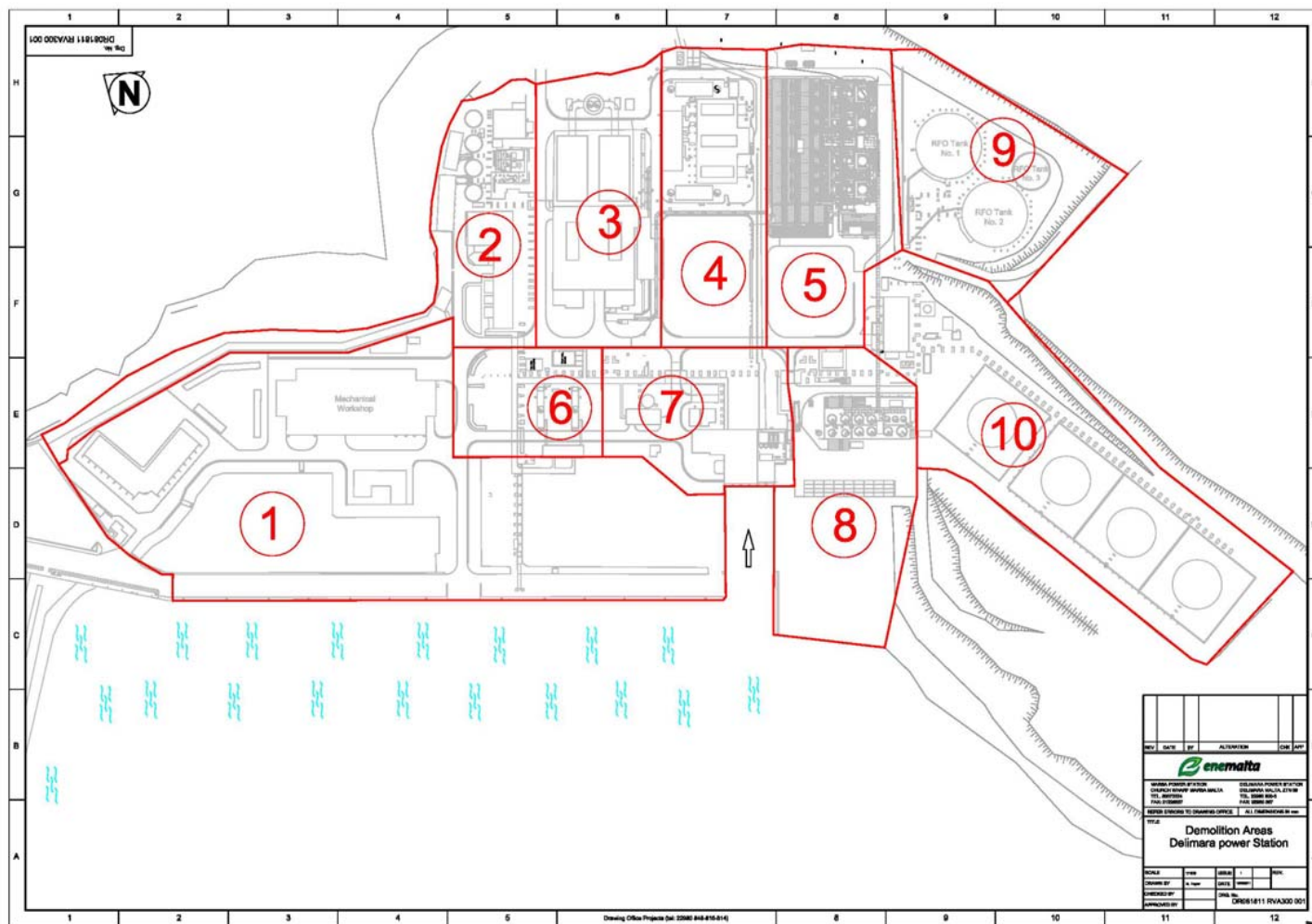


**TABLE 2**

Type of material	Materials				
	Estimates		Inert	Hazardous	Non-Hazardous
	m <sup>3</sup>	Tonnes			
<b>AREA 10</b>					
<b><i>Demolition Waste</i></b>					
Cable		0.5			Y
Transformer Oils		1.4		Y	
Waste Oils		1		Y	
Batteries	270 No.			Y	
Concrete/Brickwork/Porcelain	1600		Y		Y
<b><i>Scrap Metal</i></b>					
Carbon Steel		1220			Y
Copper		1			Y
<b><i>Foundations</i></b>					
Concrete	2900		Y		Y
Steel		30			Y



## APPENDIX A – DPS Area Plan



Project :	ENEMALTA Diesel Power Plant	2970	FM.311.001	0
Test Object :	Noise Measurement	Project No.	Index No.	Rev.
Date :	16.02.2011	Page	1 of 1	

**BWSC TEST****Acceptance criteria:**

The plant will be designed for a new plant contribution of max 45 dB (A) at power station boundary.

Engine units will be individually enclosed in an engine cell/noise enclosure to achieve max 85 dB (A) as room average in cells with engine stopped and neighbour engines running

Ing. Albert Farrugia  
Manager Projects - Electrical  
Enemalta Corporation

*[Signature]*  
21/11/12

21/11 - 2012 *[Signature]*  
Date/Signature - BWSC

Date/Signature - CLIENT

2970 Enemalta

**ON-SITE REPORT: PLANT NOISE PERFORMANCE**

Date: 20.11.2012

**Contents:**

Introduction .....	2
General description .....	2
Measuring instrument .....	2
Measurement Standards .....	3
Interior measurements .....	3
Exterior noise contribution .....	4
Stack contribution .....	5

**Attachments:**

Certificate of calibration: Sound calibrator  
Measurement report: Internal Noise Measurements: Corridor and loading bay  
Measurement report: Internal Noise Measurements: Engine noise enclosure  
Measurement report: External Noise Measurements  
Measurement report: Stack Noise Measurements

*Perf*

*D*

PROJECT : 2970 Enemalta  
 DATE : 19.11.2012  
 ISSUED BY : HSW APPROVED BY : LSE  
 SUBJECT : On-Site Report: Plant Noise Performance Tests

2070 0  
 PROJ. DOC.NO REV.

PAGE 2 OF 5

## TECHNICAL REPORT

### Noise Impact Evaluation

#### Introduction

*DELEMARIA*

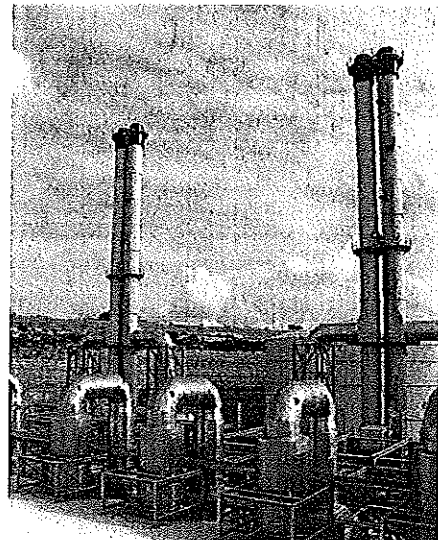
As part of the plant performance test for the new Dekelia Diesel engine power plant build and supplied to Enemalta by BWSC A/S, the internal and external noise impact has been measured and evaluated.

The measurement procedures used were presented to and subsequently approved by the Enemalta project group on 16.11.2012. Measurements were carried out between 16-17.11.2012 when appropriate plant load were available as prescribed in the measurement procedures.

#### General description

The new power plant comprises 8 Wärtsilä 18V46 diesel engine driven generators and one steam turbine driven by steam from 8 waste heat recovery boilers on the diesel exhaust gas system.

After the exhaust gas boilers, exhaust gas from two engines is combined and send through a bag-house filter. One ID-fan ensures the flow through the bag-house filter and the exhaust gas is emitted to the atmosphere through the stack 65 m above ground level. The power plant has four stacks grouped two by two.



#### Measuring instrument

All interior and exterior noise measurements were made with the following equipment:

Instrument	Manufacturer	Type	Serial No.
Sound Level Meter	Rion	NA-29E	10661133
Preamplifier	Rion	NH-17	25142
Microphone	Rion	UC-53	64468
Class 1 Acoustical Calibrator	Brüel & Kjær	4231	2229775

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2070 0  
PROJ. DOC.NO REV.

PAGE 3 OF 5

## TECHNICAL REPORT

The noise pressure recording instrument used, comply with the norm DIN EN 60651/ DIN EN 61672-1, class 1 and was calibrated with a calibrator prior to and after measurements.

The noise calibrator used comply with requirements as per IEC 60942 class 1.

Certificate of calibration is included as attachment.

### Measurement Standards

Measurements have generally been conducted in accordance with ISO: 1996 Determination of environmental noise levels 2007.

### Interior measurements

The configuration of the interior layout of the power house isolate each engine and generator in separate compartments which shall ensure a tolerable noise level for carrying out maintenance work on stopped engine units placed adjacent to other running engines.

The interior noise measurements cover the relevant work areas outside of engine compartments with running engines. The areas investigated are:

- 1) Power house loading bay.
- 2) Corridor along engine compartments towards the northern side of the power house.
- 3) One engine compartment with a stopped engine while both neighboring engines are operated at full load.

During the measurements all doors, gates and hatches were kept closed.

#### Loading bay and corridor

The measurement reports with all readings as well as the calculated room averages are included as attachments to this report.

The noise level at both the loading bay and the corridor was found to be well below the target value of 85 dB(A).

Loading bay noise level	74.9 dB(A)
Corridor noise level	78.6 dB(A)

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15

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2070 0  
 PROJ. DOC.NO REV.

PAGE 4 OF 5

## TECHNICAL REPORT

### Engine noise enclosure

The noise measurements were made in the compartment for engine unit 42 with all other engines operating at full load.

The measurement report with all noise readings and the calculated mean value is included as attachment to this report.

The measured noise level inside the engine noise enclosure was found to be well below the target value of 85 dB(A)

Engine noise enclosure noise level	77.1 dB(A)
------------------------------------	------------

### Exterior noise contribution

The external noise measurements were performed at two receptor location to the east of the power plant. The locations are marked on the aerial photograph shown in the figure to the right.

For both locations, the microphone was placed at the western road side at a height of 1.5 meter.

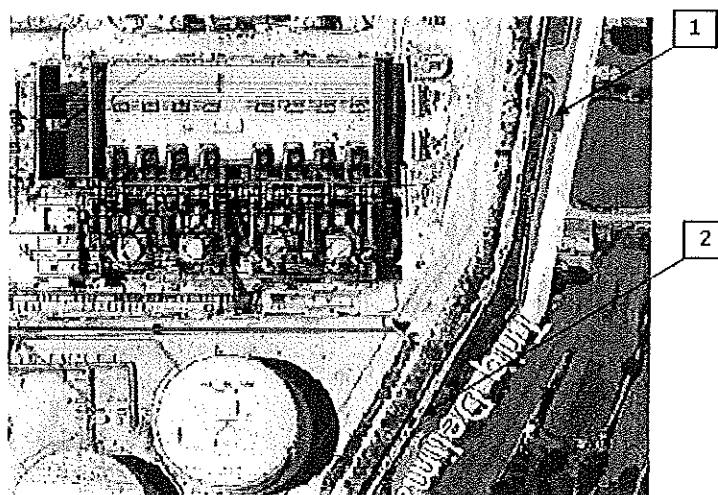


Figure 1: External noise receptor locations.

The measurement report with all noise readings and the calculations is included as attachment to this report.

It was found that the measured noise levels with and without contribution from the new power plant were too close to accurately determine the distinct contribution from the power plant alone.

Nevertheless the power plant noise contribution at the two noise receptor points can be indicated with tolerances as:

Receptor point 1	44.7 dB(A) +/- 2.0 dB
Receptor point 2	45.0 dB(A) +/- 2.0 dB

*Be*

*AS*

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SUBJECT : On-Site Report: Plant Noise Performance Tests

2070 0  
PROJ. DOC.NO REV.

PAGE 5 OF 5

## TECHNICAL REPORT

The target value for the plant noise contribution at site boundary is 45 dB(A), which has hereby been verified.

### Stack contribution

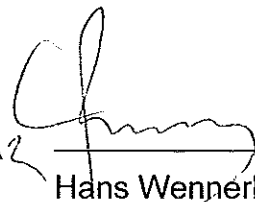
Noise measurements were carried out around the stack top in order to calculate an estimated noise impact at the site boundary.

Source determination from on-site measurements are subject to relatively large uncertainties, and measurement conditions on a platform around the stack top are not ideal. The measurement report with calculations is included as attachment to this report.

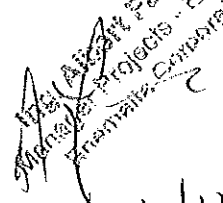
The results are:

Receptor point 1	38.8 dB(A) +/- 1.3 dB
Receptor point 2	40.6 dB(A) +/- 1.3 dB

The target value for the stack noise contribution is 40 dB(A), which has been achieved within the tolerances applicable for the method used.

20/11/2012   
Hans Wennerberg

M.Sc. Process Engineering

  
Mr. Albert Farrugia  
Manager Projects - Electrical  
Enemalta Corporation  
21/11/12

21/11-2012 - 

**2970 Enemalta**

**ON-SITE REPORT: PLANT NOISE PERFORMANCE**

Date: 20.11.2012

**Contents:**

Introduction .....	2
General description .....	2
Measuring instrument .....	2
Measurement Standards.....	3
Interior measurements .....	3
Exterior noise contribution.....	4
Stack contribution .....	5

**Attachments:**

Certificate of calibration: Sound calibrator  
Measurement report: Internal Noise Measurements: Corridor and loading bay  
Measurement report: Internal Noise Measurements: Engine noise enclosure  
Measurement report: External Noise Measurements  
Measurement report: Stack Noise Measurements

PROJECT : 2970 Enemalta  
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 SUBJECT : On-Site Report: Plant Noise Performance Tests

2070 0  
 PROJ. DOC.NO REV.

PAGE 2 OF 5

## TECHNICAL REPORT

### Noise Impact Evaluation

#### Introduction

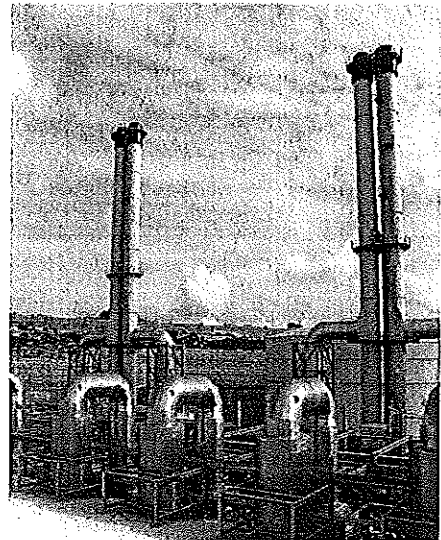
As part of the plant performance test for the new <sup>DEUMARA</sup> Dekelia Diesel engine power plant build and supplied to Enemalta by BWSC A/S, the internal and external noise impact has been measured and evaluated.

The measurement procedures used were presented to and subsequently approved by the Enemalta project group on 16.11.2012. Measurements were carried out between 16-17.11.2012 when appropriate plant load were available as prescribed in the measurement procedures.

#### General description

The new power plant comprises 8 Wärtsilä 18V46 diesel engine driven generators and one steam turbine driven by steam from 8 waste heat recovery boilers on the diesel exhaust gas system.

After the exhaust gas boilers, exhaust gas from two engines is combined and send through a bag-house filter. One ID-fan ensures the flow through the bag-house filter and the exhaust gas is emitted to the atmosphere through the stack 65 m above ground level. The power plant has four stacks grouped two by two.



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All interior and exterior noise measurements were made with the following equipment:

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31

17

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SUBJECT : On-Site Report: Plant Noise Performance Tests

2070 0  
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PAGE 3 OF 5

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- 1) Power house loading bay.
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- 3) One engine compartment with a stopped engine while both neighboring engines are operated at full load.

During the measurements all doors, gates and hatches were kept closed.

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The measurement reports with all readings as well as the calculated room averages are included as attachments to this report.

The noise level at both the loading bay and the corridor was found to be well below the target value of 85 dB(A).

Loading bay noise level	74.9 dB(A)
Corridor noise level	78.6 dB(A)

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2070 0  
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PAGE 4 OF 5

## TECHNICAL REPORT

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The measured noise level inside the engine noise enclosure was found to be well below the target value of 85 dB(A)

Engine noise enclosure noise level	77.1 dB(A)
------------------------------------	------------

### Exterior noise contribution

The external noise measurements were performed at two receptor location to the east of the power plant. The locations are marked on the aerial photograph shown in the figure to the right.

For both locations, the microphone was placed at the western road side at a height of 1.5 meter.

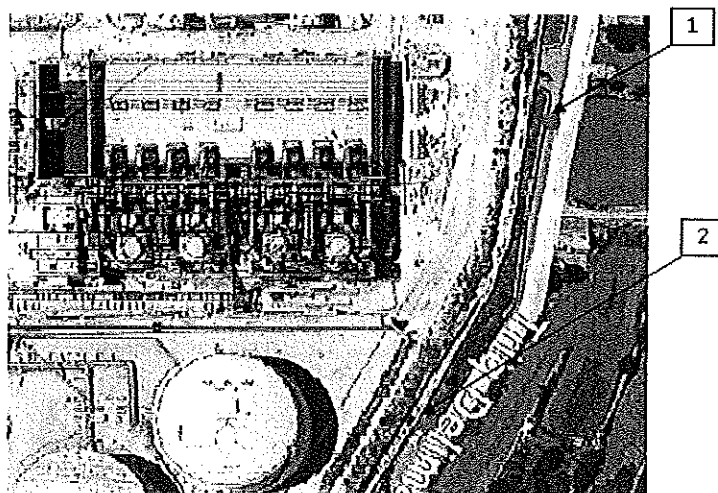


Figure 1: External noise receptor locations.

The measurement report with all noise readings and the calculations is included as attachment to this report.

It was found that the measured noise levels with and without contribution from the new power plant were too close to accurately determine the distinct contribution from the power plant alone.

Nevertheless the power plant noise contribution at the two noise receptor points can be indicated with tolerances as:

Receptor point 1	44.7 dB(A) +/- 2.0 dB
Receptor point 2	45.0 dB(A) +/- 2.0 dB

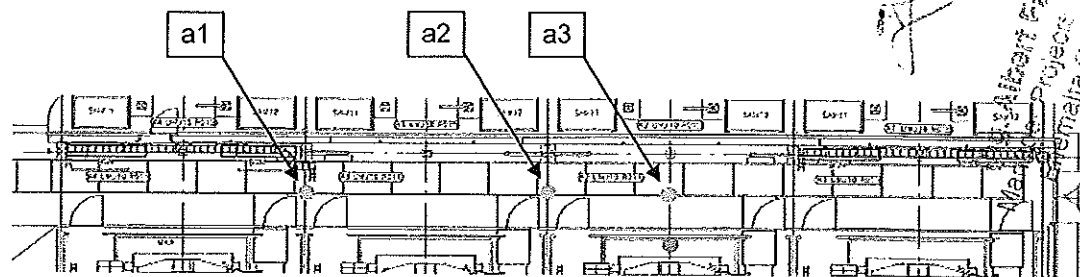
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a: Power house corridor outside noise enclosures with all nearby engines running at full load.

d: Loading bay with gates and doors closed and all nearby engines at full load.

Corridor



Engine unit #:

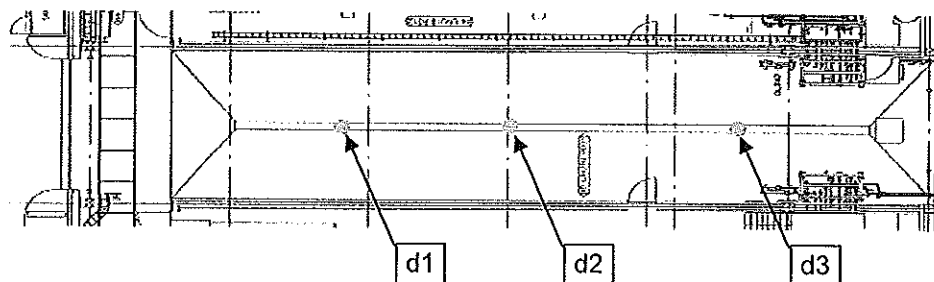
44 (45')

43 (46')

42 (47')

41 (48')

Loading bay:



No	Pos.	Time	$L_{WA,eq}$ [dB(A)]	Comments
1	a1	17:47	79.6	
2	a1		79.4	
3	a2		79.5	
4	a2		79.6	
5	a3		77.3	
6	a3		77.3	
7	d1		74.1	
8	d1		74.5	Banging noise from steam pipes
9	d2		75.2	do
10	d2		74.5	do
11	d3		74.7	do
12	d3		75.2	do
13	d3		75.0	do
14	d2		75.6	do
15	d1		74.9	
16	a1		78.5	
17	a2		78.2	
18	a3		77.0	



**Measurement summary and results**


Calculated mean noise levels for measurements in loading bay and power house corridor:

Loc.	Mean $L_{wA,eq}$ dB(A)	Area average
a1	79.2	78.6 dB(A) in the corridor.
a2	79.1	
a3	77.2	
d1	74.5	74.9 dB(A) in the loading bay.
d2	75.1	
d3	75.0	

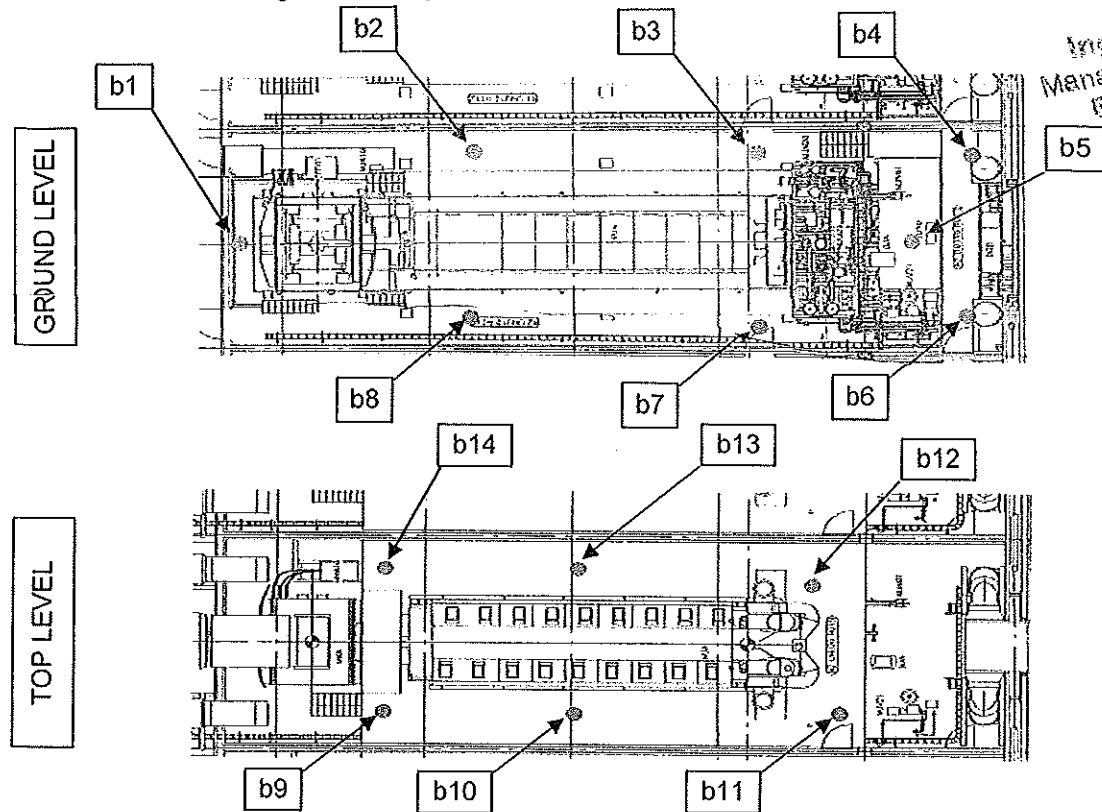
1. The noise levels found inside the power house building, outside of noise enclosures with running engines, were found to be well below the design target of 85 dB(A).
2. Most significant noise sources were identified as knocking sounds from steam pipes, and the air pressure difference between engine compartments and the power house corridor reducing compression of the door seals for optimal noise blocking.

**Test Result Acceptance**

---

  
21/11/12  
Ing. Albert Farrugia  
Manager Projects - Electrical  
Enemalta Corporation

b: Engine noise enclosure: Engines running in both neighboring compartments.



Ing. Albert Farrin  
Manager Projects -  
Enemalta Corporat

No	Pos.	Time	$L_{WA,eq}$ [dB(A)]	Comments
1	b1	19:46	72.9	
2	b2		72.9	
3	b3		72.4	
4	b4		78.8	
5	b4		78.4	
6	b5		80.5	
7	b5		80.6	
8	b6		81.5	
9	b6		81.7	
10	b7		80.3	
11	b7		80.0	
12	b8		70.8	
13	b8		70.8	
14	b9		68.2	
15	b9		68.4	
16	b10		71.9	
17	b10		71.7	
18	b11		79.7	
19	b11		79.7	
20	b12		78.8	
21	b12		79.1	
22	b13		72.9	
23	b13		72.6	
24	b14		68.6	
25	b14		68.7	

# Measurement summary and results

Noise enclosure noise levels:

Loc	Mean $L_{WA,eq}$ dB(A)	Area average
b1	72.9	77.1 dB(A) inside engine enclosure
b2	72.9	
b3	72.4	
b4	78.6	
b5	80.6	
b6	81.6	
b7	80.2	
b8	70.8	
b9	68.3	
b10	71.8	
b11	79.7	
b12	79.0	
b13	72.8	
b14	68.7	

Ing. Albert M. Micallef  
Manager Proj.  
Enemalta Corporation

1. The noise level measured inside an engine noise enclosure with all other engines running at full load, including inside both neighboring compartments were found to be well below the design target of 85 dB(A).
2. Most significant noise sources were identified as knocking sounds from steam pipes, and the fact that the air pressure difference between neighboring engine compartments prevents ideal compression of the door seals for optimal noise blocking.

#### Test Result Acceptance

---

Measurement/receptor

c: External noise contribution: DE-power plant running at full load.

Delimara boiler plant in operation.

d: External background noise: DE-power plant shut down.

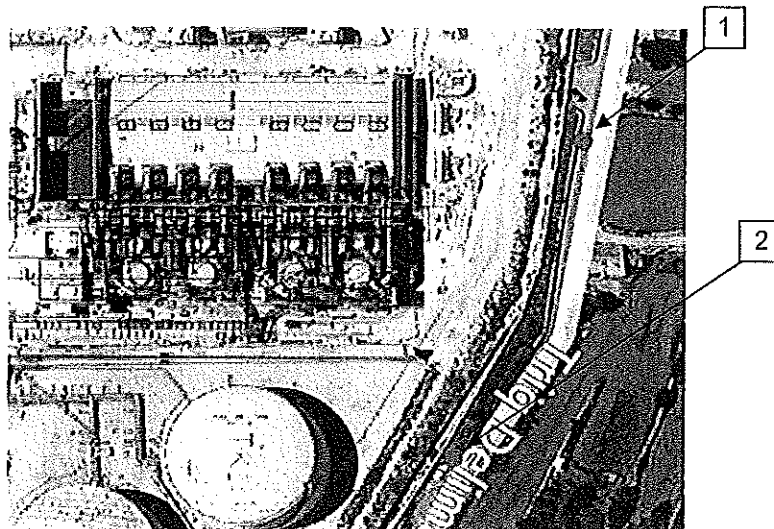
Delimara boiler plant in operation.

Note:

All doors and gates on the power plants must be closed.

Intermittent noise generating activities must be avoided during the noise measurements

Ing. Albert Farrugia  
Manager Projects - Electrical  
Enemalta Corporation

Receptor locations:**OPERATIONAL MEASUREMENT**

No	Pos.	Time	Read. [dB(A)]	Comments
1	c1	16-Nov	48.7	Quiet evening. Few crickets in the field across the road.
2	c1	~18:30	49.3	A very light breeze. One dog barking noticeably.
3	c1		48.5	
4	c1		48.7	
5	c1		48.7	
<b>Mean value</b>			<b>48.8</b>	<b>dB(A): Power plant + background noise</b>
6	c2	16-Nov	47.7	
7	c2		48.4	
8	c2		48.5	
9	c2		48.6	
10	c2		48.1	
<b>Mean value</b>			<b>48.3</b>	<b>dB(A): Power plant + background noise</b>

**BACKGROUND DETERMINATION #1**

No	Pos.	Time	Read. [dB(A)]	Comments
11	d1	16-Nov	46.1	Extremely silent background noise level. No noticeable
12	d1	23:57	46.0	wind, no visible waves on the sea.
13	d1		46.0	
14	d1		47.7	
15	d1		45.9	
<b>Mean value</b>			<b>46.4</b>	<b>dB(A): Background noise</b>
16	d2	16-Nov	43.3	
17	d2		43.4	
18	d2		43.1	
19	d2		43.2	
20	d2		43.0	
21	d2		43.5	
<b>Mean value</b>			<b>43.2</b>	<b>dB(A): Background noise</b>

**BACKGROUND DETERMINATION #2**

No	Pos.	Time	Read. [dB(A)]	Comments
22	d1	17-Nov	46.5	Quiet night. Very light breeze
23	d1	23:35	46.5	One dog barking noticeably.
24	d1		46.5	
25	d1		46.5	
26	d1		47.2	
<b>Mean value</b>			<b>46.7</b>	<b>dB(A): Background noise</b>
27	d2	17-Nov	44.0	
28	d2		45.1	
29	d2		45.3	
30	d2		45.8	
31	d2		46.8	
32	d2		45.4	
<b>Mean value</b>			<b>45.5</b>	<b>dB(A): Background noise</b>

Ing. Albert Farrugia  
Manager Projects - Enemalta  
Enemalta Corporation

**Measurement description**

Background conditions experienced on 16.11.2012 changed noticeably between the time when power plant noise were measured in the evening and the later measurement of the background noise level alone.

Background noise levels experienced on 17.11.2012 are considered to be more representative of the conditions experienced during the plant noise measurements made on 16.11.2012.

**Measurement Summary and results**

Description	Ref. 1 $L_{WA,eq}$ [dB(A)]	Ref. 2 $L_{WA,eq}$ [dB(A)]
Operational measurement	48.8	48.3
Background determination #1	46.4	43.2
Background determination #2	46.7	45.5
Plant contribution based on BG #1	45.1	46.6
Plant contribution based on BG #2	44.7	45.0

**Tolerances and uncertainty**

The differential method can generally not be used unless the background noise level is 3 dB or more below the measured sound pressure level for the power plant.

The measuring of noise with an appropriate noise level sensor/recorder complying with accuracy class 1, means that the accuracy of the measured noise pressure is considered to be within +/- 1.0 dB.

Due to the small difference between the operational measurement and the background determination, the repeatability is estimated to +/- 1.0 dB(A). This figure is also supported by considering the differences between actual reference point measurements.

Determination of the power plant contribution by use of the differential method will under the given conditions have a tolerance of not less than +/- 2 dB.

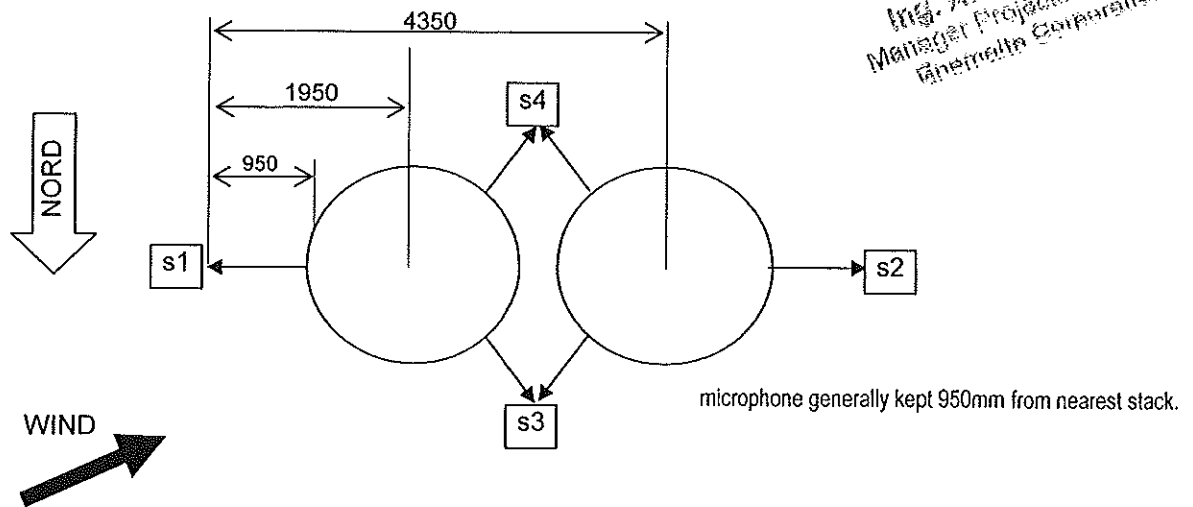
**Power Plant Noise Performance**

Based on the measurements conducted, and taking into account the tolerances involved when handling differential determination of noise measurements of similar magnitude, it is conclude that the power plant noise contribution at site boundary fulfill the design target of 45 dB(A)

**Remarks:**

Measurements were made with engines 5-8 in operation.  
Quite strong wind from East-North-East

Ing. Albert Farrugia  
Manager Projects - Electrical  
Enemalta Corporation



No	Pos.	Time	Read. [dB(A)]	Comments
1	s1	16-Nov	69.2	East
2	s1	~17:30	69.1	
3	s1		68.9	(67.9 dB(A) pointing away)
4	s2		70.3	West
5	s2		69.7	
6	s2		69.5	(70.1dB(A) pointing away)
7	s3		72.4	North
8	s3		72.2	
9	s3		72.0	(71.4 dB(A) pointing away)
10	s4		72.8	South
11	s4		72.9	
12	s4		71.9	(71.1 dB(A) pointing away)
				<b>General notes:</b>
				The wind was fairly strong
				A high pitch noise from a steam vent near the existing fuel treatment building was clearly audible, especial in measuring points s2, s3 and s4.

**Measurement summary:**

Loc.	Average	Max	Min
s1	69.1	69.2	69.1
s2	69.8	70.3	69.5
s3	71.0	72.4	72.0
s4	71.3	72.9	71.9

Uncertainties and tolerances

Accurate determination of noise power levels from sound pressure measurements requires a well defined and possibly controlled testing environment in order to reduce the number and magnitude of uncertainties.

The measurements that were made around the stack top do suffer from a number of uncertainties. The most influential factors to affect the measurements are:

- 1) **Wind:** Measurements were made with relatively strong wind from ENE.
- 2) **Background noise:** Noise from the power plant below, as well as from other sources – specifically steam drain near the fuel treatment building – was noticeable and will therefore influence the measurements.
- 3) **Measurement position:** The position of the microphone relatively to the stack opening was established with a tape measure using the platform railing as a reference. The actual position of the microphone may have varied during the measurements as it was handheld and mounted on an extension rod.
- 4) **Measurement accuracy:** The measuring of noise with an appropriate noise level sensor/recorder complying with accuracy class 1, means that the accuracy of the measured noise pressure is considered to be within +/- 1.0 dB.

Disturbances of type 1) and 2) are estimated to increase the measured noise pressure level of up to 2 dB which should be corrected before use, whereas the nature of 3) will introduce uncertainties in the measurements of approximately +/- 0.3 dB.

Ms. Albert Farrugia  
Manager Projects - Enemalta

Calculations:

Stack noise pressure level can be determined from:

$$L_{pA} = L_{WA} + 10 \cdot \log \left( \frac{A_1 + A_2}{A_1 \cdot A_2} \right), \text{ with } L_{WA} = L_{WA1} = L_{WA2}$$

From the measured noise pressure level and the surface area calculated for the measurement geometry:

$$A = 2d\pi^2 \left( \frac{D_R}{2} + \frac{2d}{\pi} \right) + \frac{D_R^2 \pi}{4} \quad \begin{array}{l} D_R : \text{Stack pipe diameter} \\ d : \text{Measurement distance from edge of stack pipe.} \end{array}$$

assuming that both stack pipes in the twin stack configuration emit noise of the same magnitude.

For the East and West points s1 and s2:

Using:	d1=	0.95 m for nearest stack pipe	A <sub>1</sub> =	33.2 m <sup>2</sup>
	d2=	3.35 m for distant stack pipe	A <sub>2</sub> =	210.3 m <sup>2</sup>

the stack noise power level for each stack pipe can be calculated for each measurement location, after correcting for the estimated background and wind disturbances of 1 dB:

L <sub>WA,S1</sub>	82.6 dB(A)
L <sub>WA,S2</sub>	83.4 dB(A)
L <sub>WA,S3</sub>	84.5 dB(A)
L <sub>WA,S4</sub>	84.9 dB(A)
L <sub>WA,avg</sub>	84.0 dB(A)

The noise level at the receptor points can then be calculated on the basis of the distance to the stack sources, ignoring the air-attenuation as:

$$L_{Ap} = L_{WA} - 11 - 20 \log(d)$$

The distances between stacks and reference points are approximately as listed:

Distance 'd'	Ref point 1	Ref. point 2
Stacks E	89	72 m
Stacks W	126	104 m

Result:

Total stack contribution at reference point 1:	38.8 dB(A)	+/- 1.3 dB
Total stack contribution at reference point 2:	40.6 dB(A)	+/- 1.3 dB

## **Report on 17<sup>th</sup> September incident on waste silo**

On the day of the incident the waste silo of the new plant needed to be emptied by discharging the FGD residue into the waste container. This unloading procedure had been carried out innumerable times before, and following general improvements made to the system its level of performance was deemed satisfactory.

Just before the said incident, BWSC had modified the residue transport system (transporting residue from the FGDs to the waste silo) to enable two concurrent discharges of residue into the waste silo from two separate FGDs. Before the modification mentioned, the waste silo had been receiving residue from just one FGD train until it emptied, so that the other FGDs were put on hold in a queuing system. This was leading to issues with the FGD bottom scraping system in those FGDs that were waiting to be emptied.

These modifications improved the residue transport system's performance in that whereas before the modification the system would frequently block, necessitating frequent resetting, following the modification the system performed to a satisfactory level. However, unbeknown to both BWSC and Enemalta at the time, a collateral effect of these modifications was that the pressure inside the waste silo was increased to almost double the original value due to the concurrent residue flow into the waste silo. This increase in pressure meant that dust leaks in the unloading mechanism which before were minimal or inexistent had now increased. Additionally, by virtue of the increased pressure, the rate at which dust was discharged from the waste silo into the container increased considerably.

When the dust in the waste transport container reaches a high level, a switch triggers the high level signal which automatically closes the waste discharge valve. As a backup, the operator also has the facility to manually stop the unloading cycle by pressing the emergency stop button which would automatically close all valves, thereby stopping the flow of dust.



On the day of the incident the normal procedure for waste discharge was being performed. However, on this occasion, the high level switch did not operate, and the operator was thus only alerted of the presence of a high level in the waste container that something had failed in the system when the dust started emerging from the container. The presence of such a high dust level consequently pushed the unloading nozzle off the container. The operator immediately pressed the emergency stop button, but due to the swiftness of the event, and the time needed for the unloading valve in the nozzle to close, a considerable amount of dust was emitted from the system. To make matters worse, it is being suspected that at the time of the incident, there was some 'roofing' of the waste in the waste silo, which collapsed at the time of the incident, thus resulting in a dust flow surge into the discharge bellow and into the waste container. The formation of this 'roof' was the result of the material being present in the waste silo for quite some time without being discharged into the waste containers (the waste silo is discharged in batches estimated to fill containers to the full to avoid multiple handling of containers, a process that is being developed as more experience on the system is gained).

The unloading procedure was thus stopped. Immediate steps were taken by Enemalta to clean up the dust that had deposited on the ground. The dust started to be shovelled into small heaps such that it could be easily picked up by industrial type vacuum cleaners. The waste material was loaded into the waste container directly from the vacuum cleaners themselves and the site was cleaned by late evening.

Following investigations by both BWSC and Enemalta into the incident, the following modifications were made to improved the system and avoid a repeat of such incidents:-

1. The waste silo vent filter was changed to one with three times the original flow capacity. This measure will limit the pressure into the waste silo during concurrent waste residue discharge into it.

2. The venting system of the waste container was modified to one where during waste discharge the displaced air in the container is no longer pushed back into the waste silo but is vented directly to atmosphere through a separate filter.
3. The discharge bellow has been modified such that it is now locked onto, rather than placed on, the waste container which permits a better seal between discharge bellow and container thus eliminating / minimising dust leaks to the atmosphere.
4. Instructions were given not to leave waste lying in the waste silo for an unnecessary period of time, if possible to empty the silos at the first opportunity and to avoid the accumulation of high levels of dust in the silo. This measure should avoid the roofing effect explained above.
5. Instructions were also given to change the use of the purge air system in the waste silo. This system is installed to unblock dust that may have 'roofed' in the waste silo. Originally the system was being used continuously thus further increasing the pressure in the silo, thereby exacerbating the already higher than normal pressure being experienced in the silo. The practice has now been changed such that this purge system is used only intermittently to shake the dust in the silo by opening and closing the purge air valve rather than leaving it open during discharge.
6. The container high level switch has since been repaired, tested and is now operational. However cannot be excluded that its fault on the day of the incident may be attributable to the greatly the increased dust flow rate through the nozzle.
7. The discharging bellow that had developed leaks is to be replaced by a new one. The cause of these leaks have been attributed to its excessive length resulting in it getting perforated after contacting with the steel wires of the lowering/raising mechanism. The new one will be of appropriate length thereby eliminating any contact.

8. The residue transport system pressure has now been reduced from 4.5 bar to 2 bar, resulting in a correspondingly reduced pressure in the waste silo. This reduction in pressure was made possible by incorporating improvements in the transfer fluidising air system in the FGD residue transportation lines with the introduction of check valves and the omission of one particular valve on each transport system.
9. The sequence for vibrators installed on the conical part of the waste silo were re-programmed to activate only during the unloading sequence and not before, thus eliminating any compacting effect this may have on the material. This could also have contributed to the 'roofing' of the dust in the waste silo.

An additional measure that is to be implemented in the waste silo residue unloading system is that the seals of the valves are to be changed to ones that are better able to contain the leaks of dust. Additionally BWSC are actively considering a complete change in valve type and to install ones identical to the valves presently installed in the FGD residue transport system with ceramic seats which have operated very effectively and without dust leakages.

The measures outlined above have already demonstrated their desired effect, and indications are that system performance has greatly improved since the day of the incident. However further testing needs to be done to confirm that the system performs to a satisfactory level.

---

## **Appendix VI**

### *CV and police conduct of Technically Competent Person*

## PERSONAL INFORMATION

David Griscti

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 +35679224233

 david.gixti@enemalta.com.mt

Sex Male | Date of birth 21/10/1979 | Nationality Maltese

## JOB APPLIED FOR

## WORK EXPERIENCE

30/07/2001–06/02/2015

## Engineer

Enemalta, Dellimara (Malta)

2001 - 2003 : Employed as electrical maintenance engineer at Marsa Power Station. During this period I was also involved in a small project on variable frequency drives.

2003 - 2013 : Employed as operations engineer at Marsa Power station turbines ,boilers and control room managing.

2013 - 2015 : Employed as operations engineer at Delimara D3 plant.

2015 onwards : Holding the position of Technical Manager of D3 operations

## EDUCATION AND TRAINING

1983 - 1990 : attended primary education at a local church school

1990 - 1995: Attended secondary school, at completion of which 10 O-level standard certificates were obtained in various science, cultural and language subjects

1995 - 1997: Attended sixth form school (post secondary) at completion of which Pure Maths and Physics advanced level certification was obtained. Other 4 subjects were also studied at intermediate level.

1997 - 2001: Studied electrical engineering on full time basis at the university of Malta at completion of which a Bachelors degree was obtained. Subjects of specialisation were Power and Control

2007 - 2013 : Read on part time basis a Master of Philosophy at the university of Malta in Electrical Engineering (MFQ level of 7). The abstract of this thesis is attached with this CV

2002 - 2014 : Attended various enemalta in-house training courses on First Aid, Fire fighting, Hazardous material handling, diesel engines operational training. Read also a distance learning course on power distribution protection. Done an introduction course on Visual Basic programming. Obtained boat handling license for navigation of up to 12km offshore

All relevant certificates of the education received and certificates obtained can be shown upon request

[Related document\(s\): Thesis Abstract CV.pdf](#)

## PERSONAL SKILLS

Mother tongue(s)

maltese

Other language(s)

english,italian

UNDERSTANDING		SPEAKING		WRITING
Listening	Reading	Spoken interaction	Spoken production	
B2	B2	B2	B2	B2

Levels: A1 and A2: Basic user - B1 and B2: Independent user - C1 and C2: Proficient user  
Common European Framework of Reference for Languages

Organisational / managerial skills	currently responsible of a staff composed of 52 operators, 8 generation officers (technical supervisors) and 4 engineers
Job-related skills	operating, managing and responsible of the whole activity on a power plant of 146MW
Computer skills	various Microsoft application software, programming in C and C++, Basic networking configurations
Other skills	enthusiast of internal combustion engines and work as auto and outboards mechanic/electrician during free time.

## ANNEXES

- 
- Thesis Abstract CV.pdf

## Thesis Abstract CV.pdf

### Abstract

The research presented in this dissertation deals with electric drives for propulsion. The first part of the thesis was more practically oriented in converting traditional displacement hull Maltese boats from using conventional internal combustion engine (ICE) outboards to the more efficient battery powered electric drives. Having obtained successful practical results in the electrification of low speed propulsion, the department decided to invest in research about high speed sea water applications. Naturally high speed crafts require high power to operate, thus the issue of efficient operation became even more important.

Over the last years, through the use of rare earth magnets and simplicity of construction, permanent magnet brushless dc motors (BLDC) prevailed over the conventional induction motor. The higher flux densities and lower copper losses present in BLDCs' made it possible to obtain higher power to size ratios and efficiencies when compared to other conventional motors. These permanent magnet motors require electronic commutation to operate, moreover high power BLDCs' operate at high speed and are generally constructed with a high pole number to minimize the current per pole. Electronic commutation is obtained either through the use of a mechanically coupled encoder or else through one of the sensorless schemes developed throughout the last years. Literature review shows that most of these sensorless schemes are based on the back emf signal produced by the motor.

The second and extensive part of this thesis focused on the design of adequate electronics required and on implementing a suitable algorithm based on back emf to operate a high pole number BLDC motor in its medium to high speed range with a single stage inverter. The proposed sensorless algorithm is based on synchronously sampling the terminal voltage of the concurrent unenergised phase without the use of any input filters to eliminate the superimposed switching frequency. An algorithm is then implemented to estimate the commutation instant from the sampled values in each

commutation interval. Validity of the presented algorithm during steady speeds and transients is shown through simulation and practical results. Finally, the operational restrictions encountered with the current setup and suggested future works are also discussed.



**PULIZIJA TA' MALTA**  
**MALTA POLICE**

**ČERTIFIKÁT TAL-KONDOTTA**  
***CERTIFICATE OF CONDUCT***

**Jien niddikjara illi, skond l-Ordinanza dwar ic-Certifikati tal-Kondotta (Kap. 77),**  
***I declare that, in terms of the Conduct Certificates Ordinance (Chap. 77),***

*I declare that, in terms of the Conduct Certificates Ordinance (Chap. 77),*

**isem u kunjom**  
***name and surname***

**DAVID GRISCTI**

**Nru. tal-Karta tal-Identita' 0512079M**

**Identity Card No**

bin/bint

**DENNIS**

imwieled/imwiela fi' 21/10/1979

**RIETA' MALTA**

son of/daughter of

born on the

2

u joqgħod/toqgħod  
and residing at

**21 MIRAGE, TRIQ L-ARTILLIERI, MARSASKALA MALTA**

huwa/hija persuna ta' kondotta tajba  
*is a person of good conduct*

Kwartieri Ġenerali tal-Pulizija  
Police H.Q  
Malta

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## **Appendix VII**

*Auxiliary boiler risk assessment report*

*Emergency response plan*



# *Risk Assessment*

## *Proposed Phase III Auxiliary Boiler at Delimara Power Station*

### *Technical Report*

DOCUMENT REF. NO: PRJ-ENV223

THIRD DRAFT

### *Publication Date*

08 June 2016



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## DOCUMENT APPROVAL

Approval Level	Name	Signature
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## ***Table of Contents***

<b>List of Figures .....</b>	<b>v</b>
<b>List of Tables .....</b>	<b>vi</b>
<b>1. Introduction .....</b>	<b>1</b>
<b>2. Background information.....</b>	<b>2</b>
<b>3. Assessment .....</b>	<b>4</b>
3.1 Purpose of assessment .....	4
3.2 Objective and approach.....	4
<b>4. Phase I.....</b>	<b>5</b>
4.1 Proposed laydown area .....	5
4.2 Description of auxiliary boiler.....	9
4.3 Identification of abnormal scenarios .....	16
4.3.1 Determination of scenarios' impact on surrounding plant and equipment .....	17
4.4 Opinion on risk.....	21
4.5 Recommendations.....	21
4.6 Conclusion.....	24
<b>5. Phase 2.....</b>	<b>25</b>
5.1 Introduction .....	25
5.2 Objective .....	25
5.3 Assessment Follow-up .....	25
5.4 Recommendation follow-up .....	26
5.5 Conclusions .....	29
<b>6. Appendix.....</b>	<b>30</b>



## List of Figures

Figure 1 - Plan view indicating the location of the various equipment indicated in Section 2 . 3	
Figure 2 - Proposed Auxiliary position .....	5
Figure 3- Photographic view points referred in figures 4 to 15.....	5
Figure 4 - Ground view from position 'A', service road around power station D3.....	6
Figure 5 - Ground view from position 'B' .....	6
Figure 6 - Ground view from position 'C', proposed location of gas pressure reduction station .....	6
Figure 7 - Ground view from position 'D' .....	6
Figure 8 - View from position 'E', proposed location of auxiliary boiler .....	6
Figure 9 – View from position 'F', steel staircase leading up to HFO storage tank farm.....	6
Figure 10 - View from position 'G', foam station.....	7
Figure 11 - View from position 'H', fuel pumping station.....	7
Figure 12 - View from position 'I', cliff face to the south .....	7
Figure 13 – View from position 'J' – pipe rack leading to D3.....	7
Figure 14 - View from position 'K' .....	7
Figure 15 - Pipeline rack supplying D3 .....	7
Figure 16 - Proposed site location from above.....	8
Figure 17 - Aerial view of site from steel staircase indicated in Figure 9 .....	8
Figure 18 - Front elevation.....	13
Figure 19 - Section AA.....	14
Figure 20 – Section BB .....	14
Figure 21 – Section CC .....	15
Figure 22 – Steam system configuration .....	15
Figure 23 – Fire wall details .....	30



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## *List of Tables*

Table 1 – Impact of scenarios on surrounding installations .....	17
Table 2 – Recommendations to minimise possibility of abnormal scenarios.....	21





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## ***1. Introduction***

This office has been requested to carry out an assessment to assess the suitability of the location proposed for the installation of the D3 auxiliary boiler and to identify risks arising during the operation of this boiler and to suggest mitigatory measures.



---

## 2. Background information

The D3 Power Station at Delimara is being converted from firing on diesel and heavy fuel oil (HFO) to fire on a combination of natural gas and diesel. The existing power station consists of eight engines that are capable of firing on both HFO and diesel.

As per proposed changes, D3 will start at the outlet from the Gas Pressure Reduction Station (GPRS) feeding natural gas to the engines, and at the inlet to the diesel pumps located within the Fuel Oil Pump House.

The eight existing engines, numbered 1 to 8, will be converted as follows:

- » Engines 1 to 4 will fire on natural gas only and
- » Engines 5 to 8 will be dual fuel engines firing on either natural gas or diesel as required.

D3 will not store any natural gas as this will be supplied from a further new development known as D4. D4 will store liquefied natural gas (LNG) in offshore storage tanks before re-gassing it and piping under pressure (approximately 40 bar) to a gas reduction station where it will be reduced in pressure (approximately 8 bar) to feed D3.

Diesel will continue to be supplied to D3 from the main diesel storage tanks operated by Enemalta. The diesel 'day tank' will be operated by D3.

An auxiliary boiler will be provided to generate steam for heating purposes (to maintain heat on standby engines) if steam cannot be supplied by operational engines on D3 or from D2.

Details are shown in Figure 1.

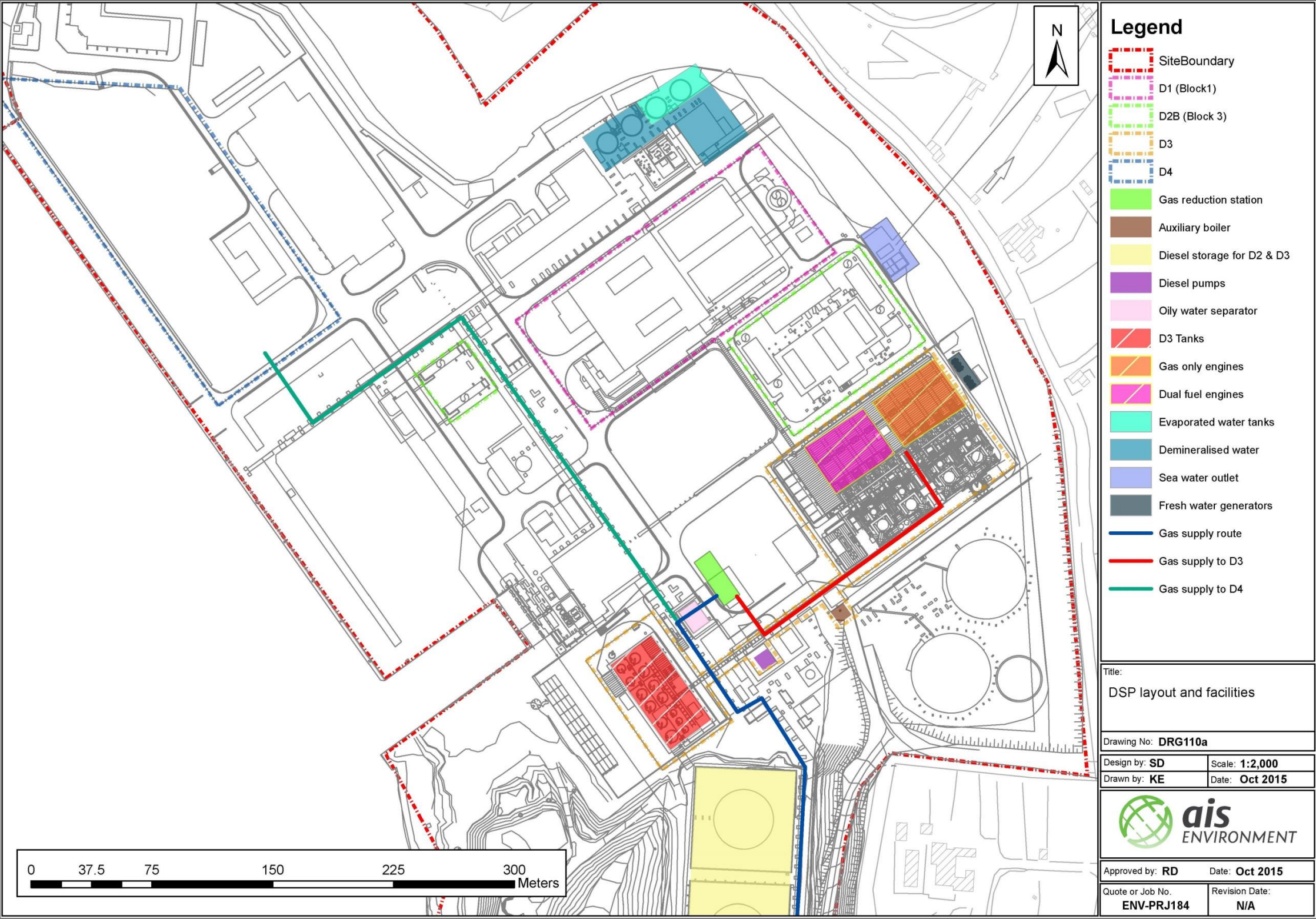


Figure 1 - Plan view indicating the location of the various equipment indicated in Section 2



### 3. Assessment

#### 3.1 Purpose of assessment

The brief received by this office was twofold:

- » To assess the suitability of the location proposed for the installation of the D3 auxiliary boiler and to suggest mitigatory measures to manage residual risks.
- » To identify risks arising during the operation of this boiler and to suggest mitigatory measures to manage residual risks.

#### 3.2 Objective and approach

The objectives of this exercise is to reduce the risk from hazards associated from the auxiliary boiler to as low as reasonably practicable (ALARP).

The brief listed under Section 3.1 were addressed independently in two phases:

##### » Phase I

##### *Objective*

To assess the suitability of the location proposed for the installation of the D3 auxiliary boiler and to suggest mitigatory measures to manage residual risks.

##### *Approach*

- a. Description of proposed laydown area.
- b. Description of auxiliary boiler.
- c. Identification of abnormal scenarios.
- d. Determination of plant and equipment that could be impacted by the abnormal operation/scenarios identified in 'b'.
- e. Provide opinion of risk and recommendations to mitigate residual risks.

##### » Phase II

##### *Objective*

To identify risks arising during the operation of this boiler and to suggest mitigatory measures to manage residual risks

##### *Approach*

In order to be able to effectively carry out this part of the assessment, the detailed design would be required. This will be reported in another document since this is still work in progress.



## 4. Phase I

### 4.1 Proposed laydown area

The area allocated to the installation of the proposed auxiliary boiler is indicated on the site plan shown in Figure 1. This area measures approximately 150 square metres and is located to the east of the existing fuel oil pump house and the foam tanks and to the west of the staircase leading up to the HFO tank farm. To the south of the site is the existing cliff face with a number of supply pipelines passing at high level from the tank farms located behind the site. To the north of the site are located a number of supply pipelines at high level leading into D3 behind which the gas reduction pressure station will be constructed. These are supported on steel lattice columns. The D3 natural gas supply line will also be installed on this existing pipe rack at high level. The area is indicated in the yellow dotted square in Figure 2, below.

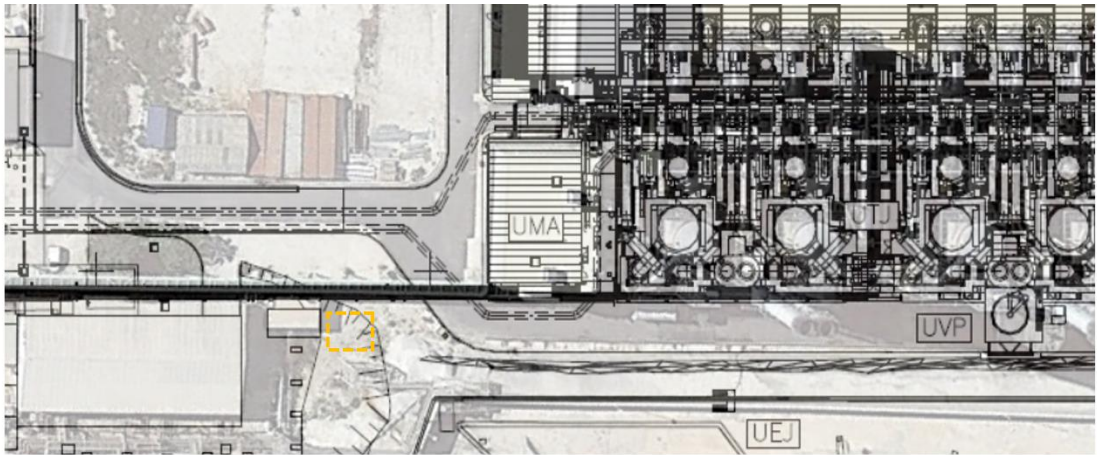


Figure 2 - Proposed Auxiliary position

A photographic description of the area is shown in Figures 4 – 17.

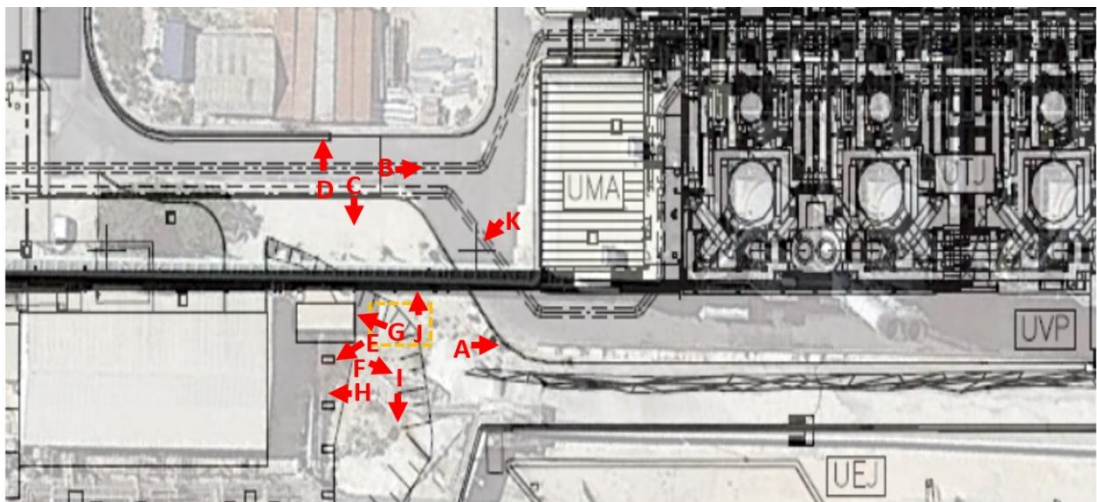


Figure 3- Photographic view points referred in figures 4 to 15



Figure 4 - Ground view from position 'A', service road around power station D3



Figure 5 - Ground view from position 'B'



Figure 6 - Ground view from position 'C', proposed location of gas pressure reduction station



Figure 7 - Ground view from position 'D'



Figure 8 - View from position 'E', proposed location of auxiliary boiler



Figure 9 - View from position 'F', steel staircase leading up to HFO storage tank farm





Figure 10 - View from position 'G', foam station



Figure 11 - View from position 'H', fuel pumping station



Figure 12 - View from position 'I', cliff face to the south

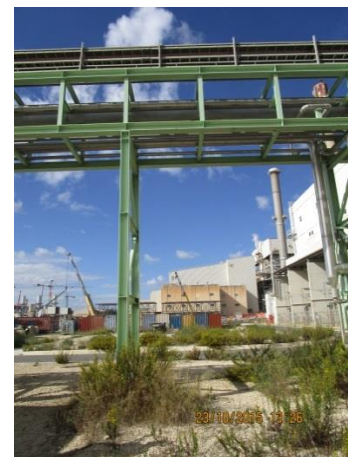


Figure 13 - View from position 'J' - pipe rack leading to D3



Figure 14 - View from position 'K'



Figure 15 - Pipeline rack supplying D3



*Figure 16 - Proposed site location from above*



*Figure 17 - Aerial view of site from steel staircase indicated in Figure 9*





## 4.2 Description of auxiliary boiler

As per document IFB No. : 0754-154HW0150525, Part Two, Technical Section, the proposed auxiliary boiler is a single flame three-pass steam boiler having the following technical data:

1.8.1	<b>Boiler type:</b>	
1.8.2	<b>Technical parameters of boiler</b>	
	Rated output	5 t/h
	Superheated steam outlet pressure:	0.8 MPa(g)
	Superheated steam outlet temperature:	180 °C
	Water supply temperature:	105°C
	Intake air temperature	25°C
	Exhaust fume temperature	220°C
	Exhaust fume loss	8.8%
	Incomplete combustion loss	0%
	Radiation loss	0.8%
	Calculated efficiency of boiler:	90.4%
	Guaranteed efficiency of boiler:	90%
	Continuous blow down rate of boiler:	1%
	Maximum air leak ratio:	0%
	Way of ventilation of boiler:	Forced blowing
	Preheated steam temperature difference	+10~-5 °C
	Time of boiler operating at 10% load	3-5 minutes
	Time extending from cold start to full-load operation of boiler	0.5 h
	Type and layout of combustor	Integrated with blower, hung on boiler door
	Furnace pressure	830Pa
	Volumetric heat load of boiler	1160KW/m <sup>3</sup>
	Cross section heat load	28.4KW/m <sup>2</sup>
	Total heating area of furnace	110m <sup>2</sup>
	Furnace operating pressure	830Pa
	Minimum operating load of boiler	20%
	Range of load fluctuation	20%-110% B-MCR
	Combustor oil pressure	-0.05-0.6MPa
	Oil consumption (max/min	305Kg/h
	Fundamental dimension of furnace (dept × width × height)	3.7*0.9*0.9m
	Furnace volume	2.35m <sup>3</sup>
	Boiler water shall be as required in EN standard	YES
1.8.3	Furnace shutdown protection	YES
1.8.4	Gross weight of boiler	N/A
	Boiler body weight	8.19t
	Weight of boiler platform and staircase	N/A



	Chimney weight	0.8t
	Water tank weight	0.5t
	Oil tank weight	0.5t
	Maximum weight of piece to be hoisted in installation	20t
	Maximum weight of piece for overhaul	12t
1.8.4.1	<b>Boiler case</b>	
	Material	P265GH/HII, P235GH-TC1
	Design pressure	1.3MPa
	Design temperature	195°C
	Wall thickness	14mm
	Inside diameter	2400mm
	Length of straight section of cylinder	4700mm
	Number of cyclone separators	N/A
1.8.4.2	<b>Furnace</b>	
	Wall thickness	20mm
	Inside diameter	900mm
	Length of straight section of cylinder	3700mm

#### 1.8.4.3 Superheater

Item	Quantity	Material	Specification
Superheater	1	16Mo3+NT/EN10273/10222-2 (1.5415)	Heat capacity; 26KW Stamp pressure: 1.0MPa

#### 1.8.4.4 Economizer

Type:

Item	Quantity	Material	Specification
Economizer tube	N/A	N/A	N/A



#### 1.8.4.5 Safety valve – material cast steel and not cast iron.

Description	Type	Discharge amount	Quantity	Popping pressure	Blowdown pressure
Boiler safety valve	DN40 PN16	5t/h	2	1.3MPa	0.8MPa
Deaeration tank safety valve	DN50 PN16	0.75t/h	1	0.05MPa	0.02MPa

#### 1.8.4.6 Valves

Description	Type	Quantity	Remarks
Steam valve	DN100 PN16	1	automatic
Feed water valve	DN32 PN16	1	
Blow down valve	DN25 PN16	1	automatic
Blow down valve	DN25 PN16	1	manul
Desalting valve	DN20 PN25	1	automatic

1.8.4.7	<b>Chimney</b>	
	Material	N/A
	Height:	N/A
	Inside diameter	N/A
	Wall thickness	N/A
1.8.4.8	<b>Combustor</b>	
	Combustion media	Light oil
	Quantity	1
	Type	WM-L30/3-A
	Light oil pressure	-0.05-0.6MPa
	Fuel oil volume	0.305 t/h
	Way of atomization	Mechanical atomization



1.8.4.9	<b>Water level gauge</b>	
	Type	Reflection class
	Working pressure	1.0MPa
	Operating temperature	184°C
	Center distance	300mm
1.8.5	<b>Blower</b>	
	Blowing rate	4400m <sup>3</sup> /h
	Air pressure	3500Pa
	Motor power/voltage	14.2KW/400V
1.8.6	<b>Induced draught fan (if any)</b>	N/A
	Blowing rate	m <sup>3</sup> /h
	Air pressure	Pa
	Motor power/voltage	KW/V
1.8.7	<b>Feed pump</b>	
	Flow rate	5.7m <sup>3</sup> /h
	Lift	1.1MPa
	Motor power/voltage	3KW/400V
1.8.8	<b>Deareator (if any)</b>	
	Flow rate	5t/h
	Working pressure (gauge pressure)	0.02-0.03MPa
	Temperature	105°C
	Deaerator water tank (if any)	Y
	Capacity	5t/h
	Working pressure (gauge pressure)	0.02-0.03MPa
	Temperature	105°C
1.8.9	Volume of feed tank	3m <sup>3</sup>
1.8.10	Volume of oil tank	3m <sup>3</sup>
1.8.11	<b>Oil pump</b>	Pressure atomization pump
	Flow rate	0.355m <sup>3</sup> /h
	Lift	1.8MPa
	Motor power/voltage	0kW/V
1.8.12	Volume of blowdown flasher	N/A
1.8.13	List of insulating materials	Mineral rock wool
1.8.14	Schedule of materials for heating surface (to be designed by the Tenderer)	Galvanized sheet cladding

1.8.1 5	Chemical dosing device	
	Dosing tank	0.75m <sup>3</sup> , material: PVC
	Steel anticorrosive device	
	Steel anticorrosive dosing pump (imported)	Quantity: Output: 6 L/h Lift: 2.5 MPa
	With screens, valves and all accessories	Yes
1.8.1 6	List of compressed air control valves consumers	Consumption of compressed air for instrumentation in 9Nm <sup>3</sup> /hr (Existing control air Compressors setpoint is 8 bar G , Dew point 3°C). Only used for automatic blow down valves and start up 2 to 3 seconds in 4 hours, approx. 5L per start up period.

Drawings covering the above installation are provided in Figures 18 to 22.

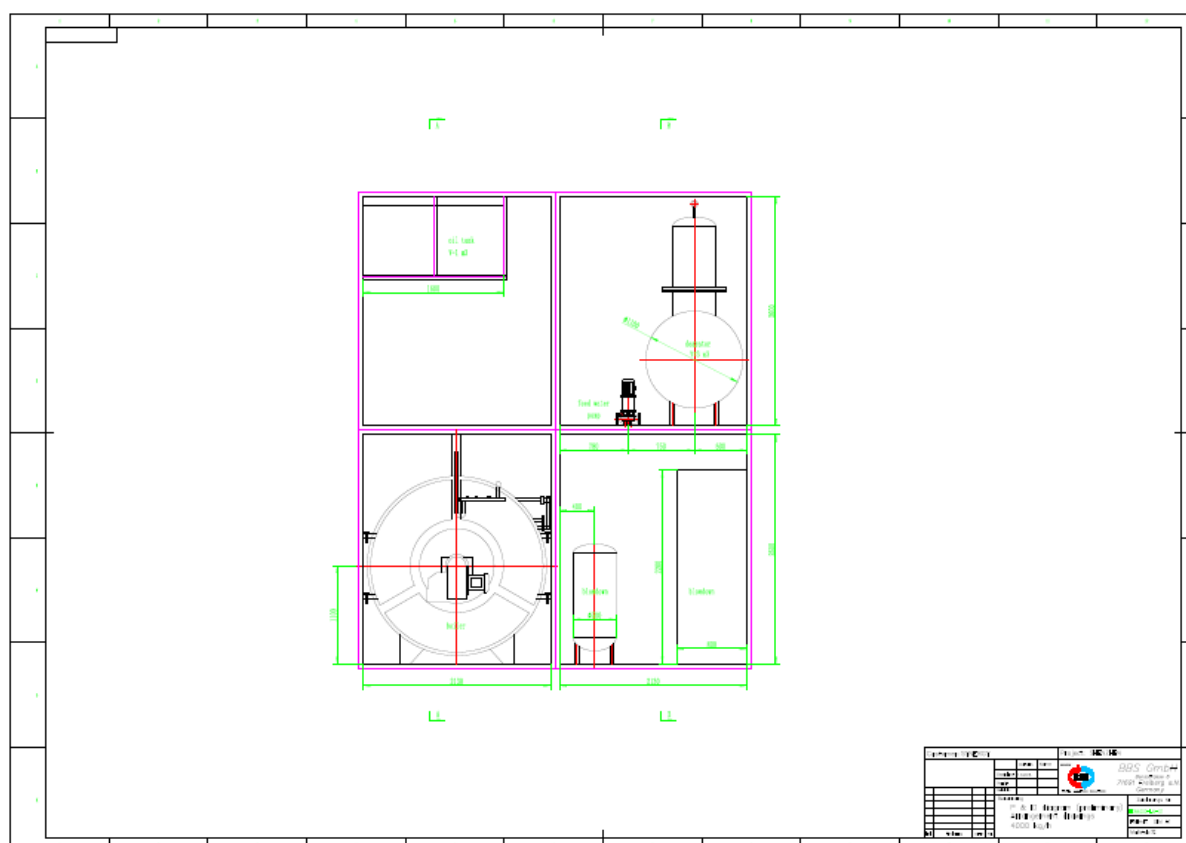


Figure 18 - Front elevation

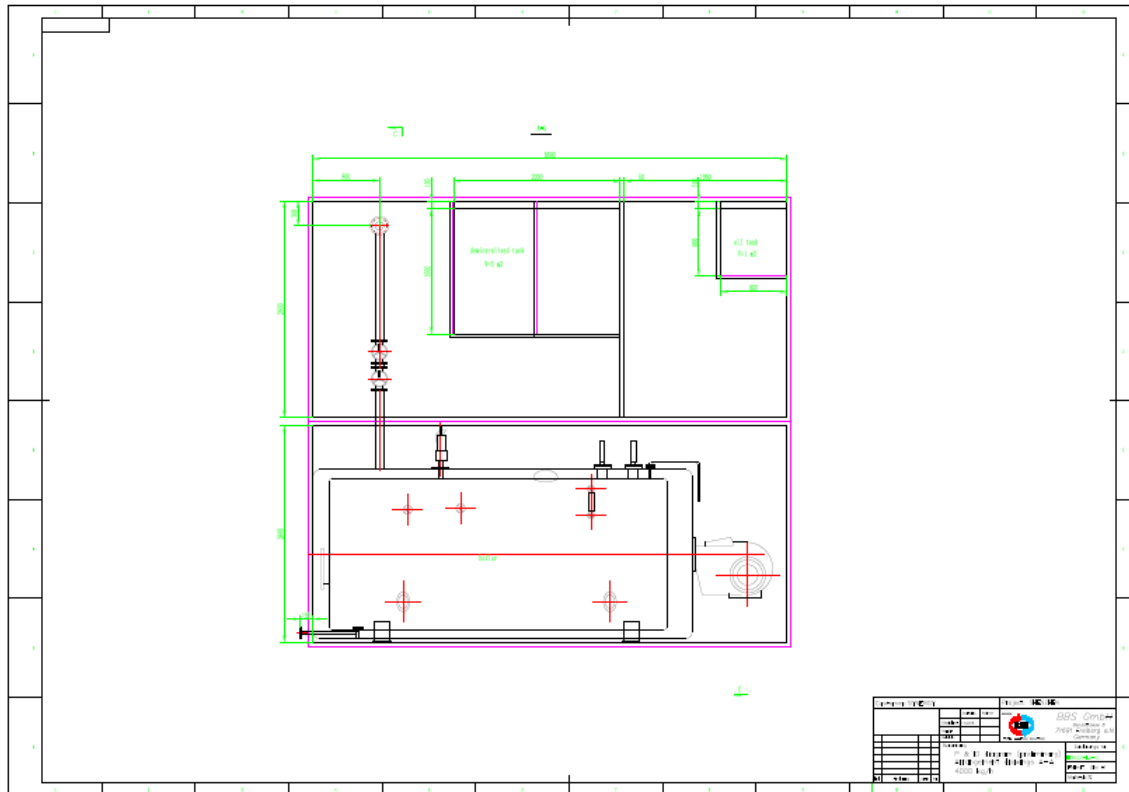


Figure 19 - Section AA

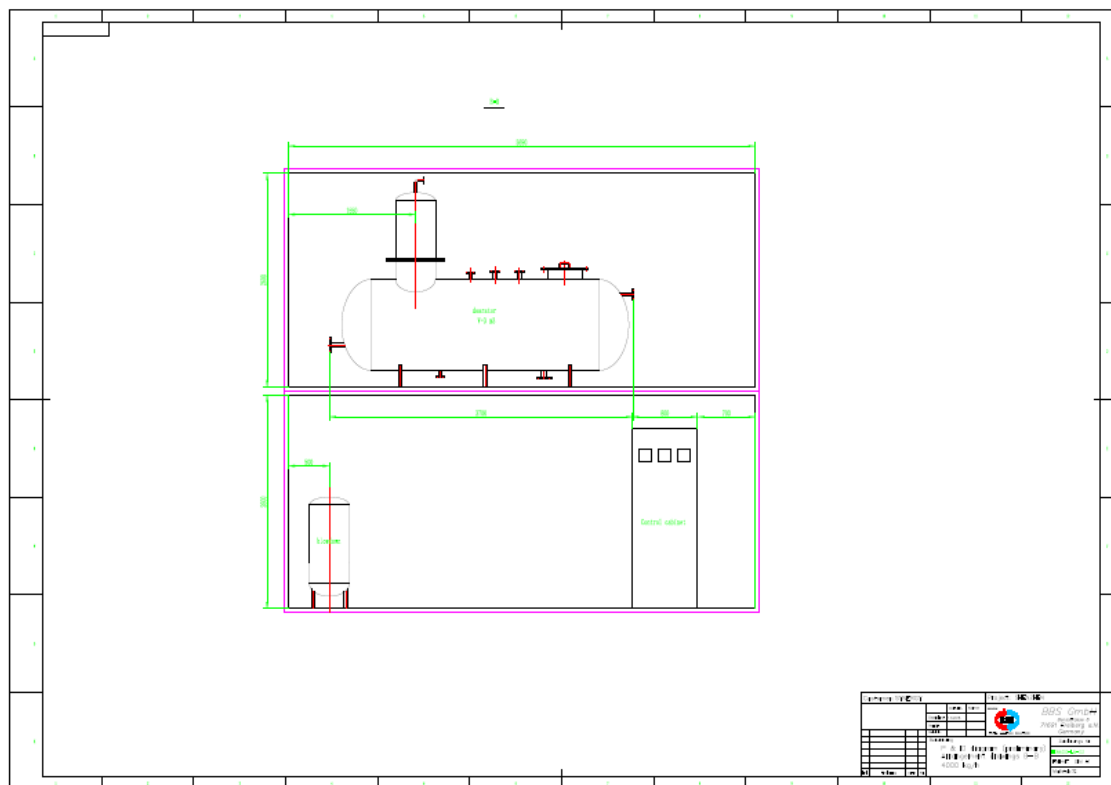


Figure 20 – Section BB

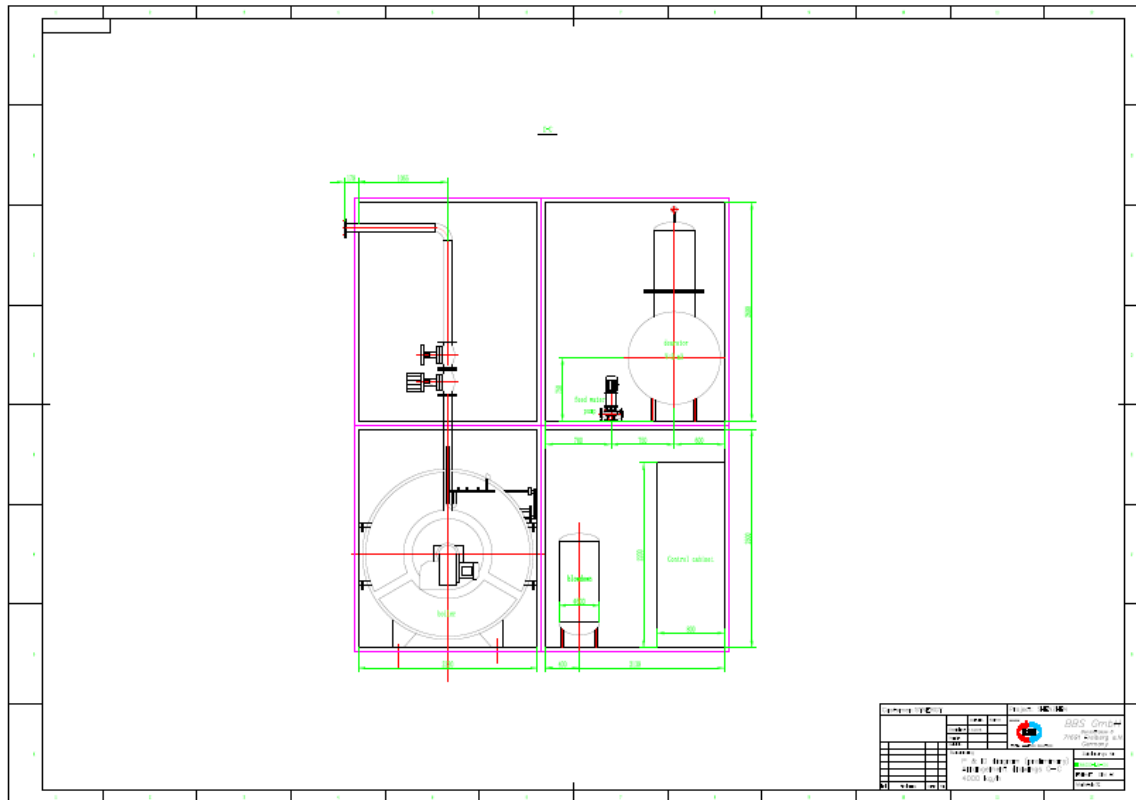


Figure 21 – Section CC

The configuration is a modular system contained in four 20 foot shipping containers arranged as shown in Figure 22.

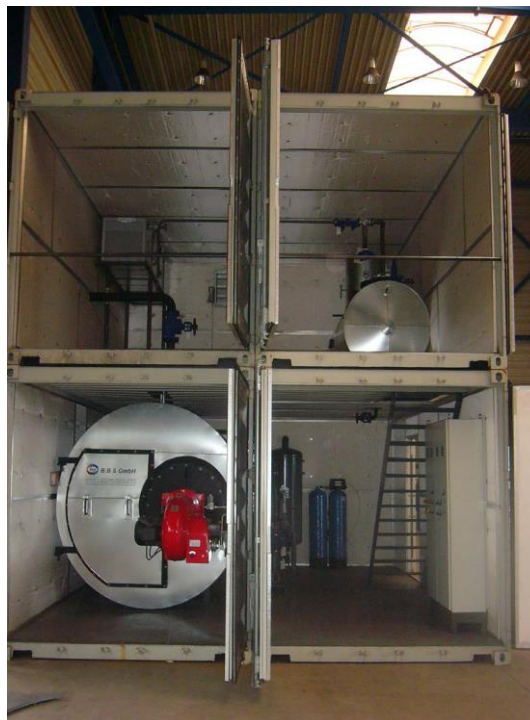


Figure 22 – Steam system configuration



### 4.3 Identification of abnormal scenarios

A variety of adverse situations have been identified:

- » Undetected fuel-rich mixtures, poor atomization of oil or improper purging resulting in a fuel/air explosion and/or flames exiting the chimney stack.
- » Undetected poor quality feed water resulting in tube failure due to corrosion.
- » Failure of safety relief valves resulting in overpressure with rupture of boiler shell.
- » Undetected low-water conditions due to failure of feed pumps and control valves resulting in overheating and weakening of boiler casing/ tubes.
- » Improper warm-up due to urgent steam requirements resulting in excessive metal fatigue and refractory material spalling.
- » Improper blowdown techniques leading to unacceptable level of water contaminants which may lead to a variety of metal failures.
- » Improper storage of the boiler plant resulting in undetected accelerated corrosion.
- » Failure by implosion of steam drum vent during cooling.
- » Undetected impact damage on tubing caused by tooling during routine cleaning.
- » Undetected flame impingement on the furnace wall and/or tubes.
- » Over stressing the boiler's production beyond its design limitations.
- » Introduction of water at a relatively low temperature resulting in thermal shock resulting in different parts of boiler expanding (or contracting) more rapidly than others.
- » Leakage from fuel tank and supply lines.
- » Ignition of inflammable gas/air clouds emitted by the nearby Gas Pressure Reduction Station.
- » Creation of a new hazardous zone that impinges over the auxiliary boiler location due to the introduction of different wet stock in the existing HFO tank farm once HFO is phased out.

From further assessment it was determined that not all scenarios listed above could have an adverse effect on surrounding plant and equipment. In fact, the scenarios of interest are those that could lead to an impact beyond the perimeter of the boiler installation. These are listed in Section 4.3.1.

Scenarios that only effect boiler efficiency and steam quality were not considered to be of concern as this does not have a direct impact on the surroundings.

The scenarios of concern are those that can result in a fire and/or explosion. Fires may occur due to the flame producing equipment forming an integral part of the boiler system. Fires evolving on site may ignite fuel supply lines and equipment located in the vicinity. On the other hand, explosions may occur if the pressure inside the boiler increases beyond the strength of the boiler shell, casing, tubes, etc. which could have deteriorated over time.





#### 4.3.1 Determination of scenarios' impact on surrounding plant and equipment

The scenarios listed previously have been assessed in view of their impact on surrounding plant, equipment, processes and activities if left undetected for a sufficiently long time.

Table 1 – Impact of scenarios on surrounding installations

No	Abnormal Scenario	Surrounding installations							Specific parameter which triggers action by D3PG.
		LNG Installation		Fuel pump house	Foam tanks	Boiler diesel storage tank and supply lines	HFO tank farm	Overhead pipe racks	
		LNG pipeline	Gas pressure reduction station						
1	Undetected fuel-rich mixtures, poor atomization of oil or improper purging resulting in fuel explosion and/or flames exiting the chimney stack.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Detect fuel-rich mixtures within burner and the automated response which normalises such mixture.



2	Undetected poor quality feed water resulting in tube failure due to corrosion.	No	No	No	No	No	No	No	n/a
3	Failure of safety relief valves resulting in overpressure with rupture of boiler shell.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Overpressure within boiler and response, or automated shutdown.
4	Undetected low-water conditions due to failure of feed pumps and control valves resulting in overheating and weakening of boiler casing/ tubes.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Feed pump operation Control Valves Low-water levels within the boiler
5	Improper warm-up due to urgent steam requirements resulting in excessive metal fatigue and refractory material spalling.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Rate of temperature rise to prevent thermal shock and uneven expansion. Insufficient de-aeration.
6	Improper blowdown techniques leading to unacceptable level of water contaminants which may lead to a variety of metal failures.	No	No	No	No	No	No	No	n/a



7	Improper storage resulting in undetected accelerated corrosion.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Visual Preventive maintenance
8	Failure of steam drum vent during cooling resulting in implosion.	No	No	No	No	No	No	No	n/a
9	Undetected impact damage to tubing caused by tooling during routine cleaning.	No	No	No	No	No	No	No	n/a
10	Undetected flame impingement on the furnace wall and/or tubes.	No	No	No	No	No	No	No	n/a
11	Over stressing the boiler's production beyond its design limitations.	No	No	No	No	No	No	No	n/a
12	Introduction of water at a relatively low temperature resulting in thermal shock resulting in different parts of boiler expanding (or contracting) more rapidly than others.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Water temperature at inlet



13	Leaks from diesel tanks and supply lines	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Leak detector
14	Ignition of inflammable gas/air clouds emitted by the nearby Gas Pressure Reduction Station.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Percentage LEL detection in locations where leaks are likely to occur from the GPRS which raises an alarm at D3PG
15	Creation of a new hazardous zone that impinges over the auxiliary boiler location due to the introduction of different wet stock in the existing HFO tank farm once HFO is phased out.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	To review situation when change occurs.



#### 4.4 Opinion on risk

It is understood that the boiler system, fuel (diesel oil) storages and supply lines shall be constructed according to the prevailing EN standard or equivalent and shall meet the requirements of the European pressure equipment directive (PED) with the CE mark completed. The complete assembled delivery is to have a registered CE Declaration of conformity and to be fully compliant with the standards of the same CE certification. Individual components which are subject to CE marking are to be compliant in their own right.

Consequently, sufficient safety and control measures shall be integrated in its design to ensure full control on its operation and allow prompt interventions whenever process parameters are not within design conditions. The operators of the boiler need to ensure that an adequate maintenance regime is implemented to ensure continued effectiveness of the system and to ensure that only competent personnel are assigned to operate and maintain the equipment.

Provided that the above is implemented, the boiler will operate within its intended design parameters and therefore will only expose surrounding plant, equipment, processes and personnel to an acceptable level of risk.

It is however pertinent to note that as explained in Section 4.1, the area allocated for the installation of the boiler installation is surrounded by a variety of critical equipment supplying the D3 and D4 generation plants. In the event that an abnormal scenario is allowed to persist resulting in a fire and/or explosion, the extent of the damage would be difficult to quantify due to the potential domino effect and the actual extent of the fire/explosion.

In view of this latter scenario, a number of recommendations are given in Section 4.5.

#### 4.5 Recommendations

The following recommendations are intended to minimise the possibility of an abnormal scenario resulting in a fire and/or explosion and in the event that this is allowed to occur, to minimise the impact on surrounding plant, equipment and activities.

*Table 2 – Recommendations to minimise possibility of abnormal scenarios*

No.	Recommendation
1	A maintenance regime is to be implemented to ensure continued effectiveness of the boiler installation system and to ensure that only competent personnel are assigned to operate and maintain the said equipment.
2	Provision of sensory equipment to detect and display anomalies in the atomised fuel air mixture leaving the burner.
3	Double real time verification of the conductivity and other relevant water quality



	parameters at the demineralised water output side and the feed water input side.
4	Provision of electrical, mechanical sensory devices and combinations thereof to raise alarms at pre-determined pressure and temperature critical thresholds which trigger certified safety relief valves. Any steam vents or safety valves openings shall be located away from the operator levels and exhaust at a safe distance such that it would not affect anyone.
5	Provision of a failsafe open steam outlet valve with check valve to minimize possible occurrence of over pressures.
6	Provision of electrical, mechanical sensory devices and combinations thereof to raise alarms at pre-determined water levels which trigger automatic shutdowns.
7	Provision of microprocessor controlled start-up, to manufacturer's recommendations.
8	Provision of manufacturer's maintenance and storage instructions during cold/hot standby periods.
9	Provision of sensory equipment to detect and display anomalies in the feed water temperature.
10	Provision of an integrated bunded tank placed within an external bund having an electronic overfill prevention device and alarm, fire valve, contents gauge/level indicator and interstitial space monitoring.
11	Confirmation from the operator of the Gas Pressure Reduction Station that the boiler's location and stack do not constitute an unacceptable ignition source in relation to the hazard area classification detailed in their explosion protection document (ATEX Directive).
12	Liaison with the operators of the HFO tank farm to ensure that the location of equipment located close by, such as the boiler, do not constitute an ignition source to any new wet stock introduced once HFO is phased out.
13	*Provision of a rated sprinkler system within the boiler and ancillary enclosures.
14	* Provision of a fire rated boundary (min. 120mins) which separates the auxiliary boiler and its fuel supply from the adjacent foam station and the fuel pump house.
15	* Installation of perforated protective guards to allow for ventilation around the near sides of the existing elevated pipe racks and any new pipework connected to the boiler installation. This is intended to minimise the effect of projectiles on the pipework.
16	*Consider the installation of deflection plates or similar structures around the pipe



	rack pillars for the purpose of minimising the effects of a shockwave.
17	Boiler shall be oriented such that the pressure wave in the event of an explosion is directed into the open, and/or away from fixed structures.
18	The chimney stack height shall extend at least 3 m above the highest structure located within a 20m radius to allow for dispersion of exhaust gases.
19	Provision of sensory equipment which triggers the fuel cut off valve in situations where the temperature of exhaust gases passing through the chimney stack exceed normal expected temperatures.
20	A flame arrestor shall be installed on the chimney stack.
21	This risk assessment document shall be reviewed periodically to ensure its continued relevance in view of changes occurring around the boiler installations.

Note that actions marked with an '\*' may require the input of third party consultants with specific expertise.



#### **4.6 Conclusion**

Provided that the actions recommended under Section 4.5 are implemented, the location may be considered to be suitable for the installation of the auxiliary boiler and associated equipment.





## 5. Phase 2

### 5.1 Introduction

This report (issued on the 14 June 2016) addresses the developments that were carried out since the publication of the technical report covering the risk assessment on the suitability of the proposed location for the proposed phase III auxiliary boiler at the Delimara Power Station issued on the 3<sup>rd</sup> December 2015 (doc ref: PRJ-ENV223).

### 5.2 Objective

The objective of the second phase of this assessment is to identify hazards arising during the operation of this boiler and to suggest/confirm proposed mitigatory measures to manage residual risks once the detailed design has been completed.

### 5.3 Assessment Follow-up

The abnormal scenarios identified during the first phase of this assessment are reproduced below:

- » Undetected fuel-rich mixtures, poor atomization of oil or improper purging resulting in a fuel/air explosion and/or flames existing the chimney stack.
- » Undetected poor quality feed water resulting in tube failure due to corrosion.
- » Failure of safety relief valves resulting in overpressure with rupture of boiler shell.
- » Undetected low-water conditions due to failure of feed pumps and control valves resulting in overheating and weakening of boiler casing/ tubes.
- » Improper warm-up due to urgent steam requirements resulting in excessive metal fatigue and refractory material spalling.
- » Improper blowdown techniques leading to unacceptable level of water contaminants which may lead to a variety of metal failures.
- » Improper storage of the boiler plant resulting in undetected accelerated corrosion.
- » Failure by implosion of steam drum vent during cooling.
- » Undetected impact damage on tubing caused by tooling during routine cleaning.
- » Undetected flame impingement on the furnace wall and/or tubes.
- » Over stressing the boiler's production beyond its design limitations.
- » Introduction of water at a relatively low temperature resulting in thermal shock resulting in different parts of boiler expanding (or contracting) more rapidly than others.
- » Leakage from fuel tank and supply lines.
- » Ignition of inflammable gas/air clouds emitted by the nearby Gas Pressure Reduction Station.
- » Creation of a new hazardous zone that impinges over the auxiliary boiler location due to the introduction of different wet stock in the existing HFO tank farm once HFO is phased out.

As was stated in the previous version of this report (Phase I), not all scenarios listed above could have an adverse effect on surrounding plant and equipment. In fact, scenarios that



only affect boiler efficiency and steam quality were not considered to be of concern as this would not have a direct impact on the surroundings.

The scenarios of concern are those that can result in a fire and/or explosion and have an impact on surrounding equipment and processes. To address this matter, a number of recommendations were made. These are listed under Section 5.4 and the status of implementation noted.

#### 5.4 Recommendation follow-up

No	Recommendation	Boiler Supplier / SEPEM Feedback	Comments
1	A maintenance regime is to be implemented to ensure continued effectiveness of the boiler installation system and to ensure that only competent personnel are assigned to operate and maintain the said equipment.	This is to be provided by the boiler supplier.	Closed
2	Provision of sensory equipment to detect and display anomalies in the atomised fuel air mixture leaving the burner.	Boiler supplier confirmed that a flame sensor is to be offered to detect the combustion status.	Closed
3	Double real time verification of the conductivity and other relevant water quality parameters at the demineralised water output side and the feed water input side.	Boiler supplier confirmed that a measuring electrode fitted inside the boiler to measure conductivity of boiler water.	Closed
4	Provision of electrical, mechanical sensory devices and combinations thereof to raise alarms at pre-determined pressure and temperature critical thresholds which trigger certified safety relief valves. Any steam vents or safety valves openings shall be located away from the operator levels and exhaust at a safe distance such that it would not affect anyone.	Boiler supplier confirmed that a pressure and temperature protection chain is to be included.  SEPEM design team confirmed that steam venting and exhaust will be away from personnel to prevent injury.	Closed
5	Provision of a failsafe open steam outlet valve with check valve to	Boiler supplier confirmed that the steam relief	Closed



	minimize possible occurrence of over pressures.	valve is to vent as failed in the steam outlet.	
6	Provision of electrical, mechanical sensory devices and combinations thereof to raise alarms at pre-determined water levels which trigger automatic shutdowns.	Boiler supplier confirmed that a water level limiter and indicator is to be included.	Closed
7	Provision of microprocessor controlled start-up, to manufacturer's recommendations.	Boiler supplier confirmed that an automatic start-up /running /stopping programmer is to be included.	Closed
8	Provision of manufacturer's maintenance and storage instructions during cold/hot standby periods.	Boiler supplier confirmed that a maintenance and storage instructions are to be provided.	Closed
9	Provision of sensory equipment to detect and display anomalies in the feed water temperature.	Boiler supplier confirmed that a temperature indicator with relative pressure measurement is to be included.	Closed
10	Provision of an integrated bunded tank placed within an external bund having an electronic overflow prevention device and alarm, fire valve, contents gauge/level indicator and interstitial space monitoring.	Tank is to be included and placed inside one of the containers. No information is available on the provision of either an over-fill prevention device or a high level fuel indicator that interrupts fuel into the tank.	SEPEM have contacted the boiler supplier for clarification.
11	Confirmation from the operator of the Gas Pressure Reduction Station that the boiler's location and stack do not constitute an unacceptable ignition source in relation to the hazard area classification detailed in their explosion protection document	Boiler and stack are to be installed outside the hazardous area produced by D3.  Boiler supplier confirmed that the boiler is enclosed in a container having 120	SEPEM are to consult with D4 to confirm that the auxiliary boiler is located outside the hazardous zones produced by Gas Pressure Reduction



	(ATEX Directive).	minutes fire resistance. A spark arrestor is also to be installed at the end of the stack.	Station.
12	Liaison with the operators of the HFO tank farm to ensure that the location of equipment located close by, such as the boiler, do not constitute an ignition source to any new wet stock introduced once HFO is phased out.	Operators of HFO tank farm are to consider surrounding operations and equipment prior to storing a new product in lieu of the HFO.	SEPEM are to remain aware on any developments to the HFO tank farm once HFO is no longer stored in this location. This is to safeguard their investments and operations.
13	* Provision of a rated sprinkler system within the boiler and ancillary enclosures.	SEPEM to coordinate installation.	Closed
14	* Provision of a fire rated boundary (min. 120mins) which separates the auxiliary boiler and its fuel supply from the adjacent foam station and the fuel pump house.	Boiler and fuel tanks are situated in different containers. Container walls offer 120 minutes fire resistance.	Closed
15	* Installation of perforated protective guards to allow for ventilation around the near sides of the existing elevated pipe racks and any new pipework connected to the boiler installation. This is intended to minimise the effect of projectiles on the pipework.	Superseded by the fire wall recommended noted under item 14.	Fire wall is to be 8m high. This is higher than the containers (5.6m) and the top of the adjacent pipe racks (7m). Thus, any projectiles would be deviated by the wall. (Refer to Appendix)
16	* Consider the installation of deflection plates or similar structures around the pipe rack pillars for the purpose of minimising the effects of a shockwave.	See point 15.	Closed
17	Boiler shall be oriented such that the pressure wave in the event of an explosion is directed into the	Explosion door is included.	Boiler will be placed between the fire wall



	open, and/or away from fixed structures.		and cliff face.
18	The chimney stack height shall extend at least 3 m above the highest structure located within a 20 radius to allow for dispersion of exhaust gases.	Stack will be 15m high.	Closed
19	Provision of sensory equipment which triggers the fuel cut off valve in situations where the temperatures of exhaust gases passing through the chimney stack exceed normal expected temperatures.	Boiler supplier confirmed safety water level protection in safe temperature of exhaust will satisfy this need.	Closed
20	A flame arrestor shall be installed on the chimney stack.	Boiler supplier confirmed provision of a flame arrestor.	Closed
21	This risk assessment document shall be reviewed periodically to ensure its continued relevance in view of changes occurring around the boiler installations.	Noted	Closed

### 5.5 Conclusions

The majority of the recommendations put forward during phase 1 of this assignment have been integrated in the design and are expected to be implemented during either the boiler construction phase by the supplier or on site during the installation.

Clarification on recommendations 10 and 11 remain pending and are expected to be clarified by SEPEM in the near future.

Once all recommendations have been effectively implemented, the installation and operation of the auxiliary boiler is expected to expose the D3 plant and its surroundings to an acceptable level of risk.

6. Appendix

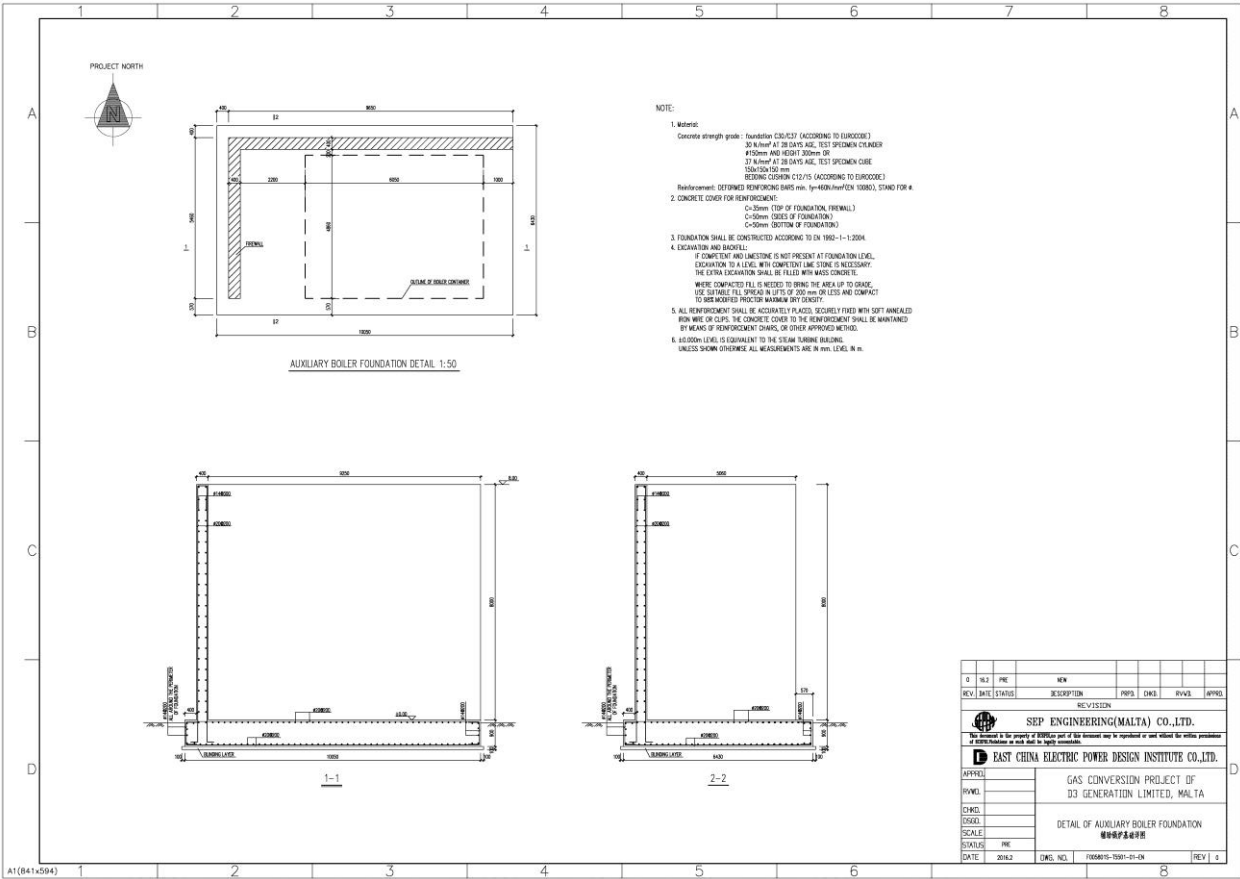


Figure 23 – Fire wall details

# D3PG DIESEL ENGINES PLANT

## EMERGENCY PLAN

Status:	Draft
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	Mr. Chen Zhichao
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## 1 REVISION LOG

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V1	14/012016	Draft Version for approval



## 2 CONTENTS

<b>1</b>	<b>REVISION LOG .....</b>	<b>2</b>
<b>2</b>	<b>CONTENTS .....</b>	<b>3</b>
<b>3</b>	<b>SCOPE AND AIM .....</b>	<b>5</b>
3.1	NOTES .....	5
<b>4</b>	<b>RESPONSIBILITIES .....</b>	<b>7</b>
4.1	CONTROL CENTRE .....	7
4.2	STANDBY CONTROL CENTRE .....	7
4.3	EMERGENCY CONTROLLER .....	7
4.3.1	<i>Nominated Personnel</i> .....	8
4.4	COMMUNICATIONS OFFICER .....	8
4.5	FORWARD CONTROL POINT.....	8
4.6	FORWARD CONTROLLER (EMERGENCY RESPONSE TEAM LEADER).....	8
4.6.1	<i>Nominated Personnel</i> .....	9
4.6.2	<i>Nominated Personnel</i> .....	9
4.7	RENDEZVOUS POINT (RVP) .....	9
4.8	TRAFFIC CONTROL.....	9
4.9	CASUALTY CLEARING AREA (CCA).....	9
4.10	ASSEMBLY POINT .....	10
4.11	ASSEMBLY POINTS – EMERGENCY RESPONSE TEAM .....	10
4.12	ASSEMBLY POINTS - NON ESSENTIAL PERSONNEL .....	10
4.13	ALERTING .....	10
4.14	COMAH SIREN .....	11
4.15	OPERATIONS PERSONNEL.....	11
4.16	ENEMALTA COMMUNICATIONS OFFICE.....	11
4.17	OTHER PERSONNEL / NON ESSENTIAL PERSONNEL.....	11
4.18	THIRD PARTY AND CONTRACTORS.....	11
4.19	VISITORS.....	11
4.20	CIVIL PROTECTION DEPARTMENT (CPD).....	11
4.21	TRANSPORT MALTA (TM).....	12
4.22	OCCUPATIONAL HEALTH & SAFETY AUTHORITY (OHSA).....	12
4.23	MALTA ENVIRONMENT & PLANNING AUTHORITY (MEPA) .....	12
4.24	ENVIRONMENTAL HEALTH DIRECTORATE.....	12
4.25	EMERGENCY SERVICES.....	12
<b>5</b>	<b>ACTIONS TO BE TAKEN .....</b>	<b>13</b>
5.1	EMERGENCY CONTROLLER .....	13
5.1.1	<i>General actions:</i> .....	13
5.1.2	<i>Specific actions</i> .....	13
5.2	COMMUNICATIONS OFFICER .....	16
5.2.1	<i>Fire</i> .....	16
5.2.2	<i>Injury inside plant</i> .....	17
5.2.3	<i>Fuel/Chemical Spill/Release</i> .....	17
5.3	EMERGENCY RESPONSE TEAM (ERT) .....	18
5.3.1	<i>Fire</i> .....	18
5.3.2	<i>Injury inside plant</i> .....	18
5.3.3	<i>Spill inside plant (See section 7.6)</i> .....	18
5.4	OPERATIONS PERSONNEL.....	19
5.4.1	<i>Generation Officers are to:</i> .....	19
5.4.2	<i>Enemalta:</i> .....	19
5.5	ENEMALTA SECURITY GUARDS .....	19
5.6	FIRST AIDERS.....	20
5.7	FOT PERSONNEL.....	20
5.8	D3 ADMINISTRATION BUILDING WING .....	20
5.9	STORES .....	21
5.10	GENERAL INSTRUCTIONS FOR NON-ESSENTIAL PERSONNEL .....	21

5.11	OTHER PERSONNEL.....	21
5.12	THIRD PARTY AND CONTRACTORS.....	22
5.13	VISITORS.....	22
<b>6</b>	<b>IMMEDIATE ACTION BY PERSONS AT SITE OF EMERGENCY .....</b>	<b>22</b>
6.1	FIRE ON PLANT .....	22
6.2	FIRE IN VEHICLE.....	22
6.3	FIRE IN ADMINISTRATION BLOCK.....	22
	INJURY INSIDE PLANT .....	23
6.4	DIESEL, LUBRICATING OILS, TRANSFORMER OILS SPILLS.....	23
6.4.1	Minor spills.....	23
6.4.2	Major spills.....	25
6.4.3	Spills in secondary containment (contained by bunds).....	27
6.5	CHEMICAL SPILLS .....	27
	<b>Confidential information</b>	
<b>7</b>	<b>MAJOR SYSTEM DISTURBANCE ON D3 PLANT .....</b>	<b>29</b>
7.1	ACTIONS IN THE EVENT OF MAJOR SYSTEM DISTURBANCE .....	29
7.1.1	D3 Shift Engineer and D3 Generation officers shall.....	29
7.2	DAMAGE TO PLANT WITH EXTENDED OUTAGE .....	29
<b>8</b>	<b>COMMUNICATIONS .....</b>	<b>29</b>
8.1	COMMUNICATION FACILITIES.....	29
<b>9</b>	<b>EMERGENCY ORGANISATION – COMMUNICATIONS FLOW.....</b>	<b>31</b>
<b>10</b>	<b>NOTIFICATIONS CHART.....</b>	<b>32</b>
<b>11</b>	<b>NOTIFICATIONS .....</b>	<b>33</b>
<b>12</b>	<b>MATERIAL RESOURCES (IN-HOUSE).....</b>	<b>35</b>
<b>13</b>	<b>REFERENCE DOCUMENTS.....</b>	<b>36</b>
<b>14</b>	<b>SITE LAYOUT .....</b>	<b>37</b>

## **3 SCOPE AND AIM**

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This Emergency Plan is intended to set up standard procedures in the event of emergencies, allocating responsibilities and the immediate action to be taken in the event of fire, injury, oil or chemical spill, in order to minimise the consequences of any incident. The plan will ensure that all efforts are co-ordinated through one point and to a common aim.

The main aims of this Emergency Plan are:

- Ensuring safety of personnel (plant personnel, public, response personnel)
- Avoiding or minimising damage to third party property
- Minimising or avoiding damage to plant
- Minimising or avoiding financial loss

### **3.1 Notes**

This plan is intended to be distributed to the Authorities including the Occupational Health & Safety Authority and the Civil Protection Department, as well as to our insurers.

In the event of any incident, compliance with this emergency plan from all persons involved and referred to in this document.

## Terms and Definitions

EP	Emergency Plan
D3PG	D3 Power Generation company Ltd.
MP	Maintenance Personnel
SOP	Standard Operating Procedure
H&S	Health and Safety
SDS	Safety Data Sheet
PPE	Personal Protective Equipment
CCR	Central Control Room
SO	Senior Operator
GO	Generation Officer
SCE	Shift Charge Engineer
CWP	Cooling Water Pump
ACSO	Assistant Chief Security Officer
PA	Personal Assistants
AM	Assistant Manager
ERT	Emergency Response Team
CPD	Civil Protection Department
TM	Transport Malta
OHSA	Occupational Health & Safety Authority
MEPA	Malta Environment & Planning Authority
AFM	Armed Forces of Malta
COMAH	Control of Major Accident Hazard
MDH	Mater Dei Hospital
CCA	Casualty Clearing Area
HFO	Heavy Fuel Oil

## **4 RESPONSIBILITIES**

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### **4.1 Control Centre**

The D3 **Control Centre** is to co-ordinate all emergency activities.

The DPS **Central Control Room** (CCR) is the place where currently D3 has its control centre. The D3 **Control Centre** is normally manned by 2 senior operators a GO and D3 shift engineer. All calls in case of an incident are to be routed to the **Control Centre** by radio, telephone, or runner. The Control Centre will immediately inform Enemalta in case of any emergency or incident that happened on D3

The D3 **Control Centre** is to make all calls to outside agencies. There is to be no delay in summoning Emergency Services, if necessary. D3 Control Centre will also inform Enemalta DPS Security Gate with all external agencies called

The D3 **Control Centre** is to be immediately informed of any incident.

**D3 Control Centre 22980850 and 22980784**

### **4.2 Standby Control Centre**

Should the main D3 control centre be endangered, a standby control centre will be set up as directed by the Emergency Controller. A probable stand-by control centre can be set up in D3 plant local control room

**D3 Plant local control room 22980121 or 22980120**

### **4.3 Emergency Controller**

The **Emergency Controller** has the overall responsibility for directing the company efforts during an emergency.

It is essential to realise that the Emergency Controller must act as a fixed reference point to co-ordinate the actions taken by different agencies.

#### **4.3.1 Nominated Personnel**

- Shift Charge Engineer D3 Power Plant
- D3 Control Centre GO

If the above are not available, the D3 senior operators at the Control Centre shall call the D3 plant GO on site to reach the Control Centre and assume these duties until the arrival of one of the nominees.

In extended emergencies, it is advisable that D3 Production and Technology Department management take over the role. The D3 Shift Engineer will then concentrate on the plant operations. It is important that the management attending informs the Emergency Controller upon handover, and gets all the relevant information.

#### **4.4 Communications Officer**

The Communications Officer, who is normally the D3 Control Centre GO, will assist the Emergency Controller with all communications and logging.

#### **4.5 Forward Control Point**

This to be set up as close as possible to the incident scene (with due regard to safety), such that a clear overview of the incident is possible. The forward control point must have continuous communication (radio / telephone / cell phone) with the control centre.

#### **4.6 Forward Controller (Emergency Response Team Leader)**

The Forward Controller is the Emergency Response Team Leader. This person is responsible for the action at the site of the incident and will concentrate on resolving the actual incident.

#### **4.6.1 Nominated Personnel**

- D3 Plant GO
- Senior member of emergency response team on D3 Plant

### **Emergency Response Team (ERT)**

The Emergency Response Team consists of shift personnel from the operations section working on D3 who have been specially trained in emergency response.

Upon arrival the rest of ERT members will coordinate actions with the Forward Controller.

In the case of spill response, Enemalta will be informed and also asked to assist.

#### **4.6.2 Nominated Personnel**

**Emergency Response Team (ERT)** will be composed from D3 operations staff and members list will be kept updated by the company on a yearly basis. This list will also be communicated to enemalta accordingly.

### **4.7 Rendezvous Point (RVP)**

The default Rendezvous Point for Emergency Services will be the DPS Main Gate. During an incident, this will be co-ordinated with CPD and Ambulance senior officers.

### **4.8 Traffic Control**

Controlling traffic is paramount. Enemalta Security can make use of the secondary gate (near the quayside) and also consider the emergency gate (at HFO tank farm).

### **4.9 Casualty clearing area (CCA)**

In the event of an accident with several injured, those injured will receive initial treatment on site prior to dispatch to hospital.

Depending upon the number of injured, the casualty clearing area would initially be located at the First Aid Room. If necessary, the D3 administration building wing can be used.

The Emergency Controller will inform Enemalta DPS Security guards of chosen location of the CCA. Then Enemalta DPS Security guards are to inform medical personnel and ambulances of chosen location of the CCA upon arrival.

#### **4.10 Assembly point**

The Assembly point is a designated gathering point to group personnel in specified areas. Assembly points are designated by signs. Operational personnel and ERT members are assigned to specific assembly points related to their duties.

In any case, should an assembly point become endangered, personnel are to proceed to the nearest assembly point, advising the Emergency Controller.

#### **4.11 Assembly Points – Emergency Response Team**

The on-site ERT shall meet at the Central Control Room (CCR) or as directed by the Emergency Controller.

#### **4.12 Assembly Points - Non Essential Personnel**

Assembly points for non essential personnel are as follows:

Area	Assembly Point	Location
Administration, Visitors, Third Party and Contractors	A	Main Gate
D 3 Fuel Tanks Operators	B	Weigh bridge room area

(\*) Operations staff will report to their area of duty, unless their area is endangered.

#### **4.13 Alerting**

The Emergency Controller will inform Enemalta and D3 staff of an alarm situation through radio/telephone/mobile means. At the discretion of the Emergency Controller and enemalta a fire alarm owned by Enemalta can also be sounded in case of very serious accidents.

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#### **4.14 COMAH Siren**

The large siren, fitted on the Central Control Room, is intended for warning the general public outside the Power Station of a major incident which may have off-site consequences and is Enemalta owned. This siren is ONLY to be sounded on the orders of Enemalta after being informed of any accident on D3 plant by Emergency Controller or the Civil Protection Incident Commander.

#### **4.15 Operations Personnel**

Operations personnel include all personnel in the D3 operations section not forming part of the ERT.

#### **4.16 Enemalta Communications Office**

The Enemalta Communications Office must coordinate communication with the Media during an emergency situation as per procedures set up in Section 8.

#### **4.17 Other Personnel / Non essential personnel**

Other personnel or non-essential personnel are those persons who are not essential to the running of the plant or who do not have specific duties during the emergency. These will normally be evacuated from the site during an emergency.

#### **4.18 Third Party and Contractors**

Third party and contractors working on site must be briefed on safety procedures before commencing works on D3 Plant.

#### **4.19 Visitors**

All visitors are to report to Assembly Point A near the DPS Main Gate and identify themselves to the Security Guards.

#### **4.20 Civil Protection Department (CPD)**

CPD is responsible for fire fighting and rescue operations, emergency planning and handling of major incidents. CPD is overall in charge at major incidents.

CPD can be contacted through the general emergency number 112

#### **4.21 Transport Malta (TM)**

Transport Malta is responsible for regulating safety and security issues along the shoreline and in ports. The Authority through the Vehicle Transit System (VTS) Control Room, must be informed of any issues that may endanger the port or port users, or affect the marine environment. Transport Malta has a leading role on marine pollution preparedness and response as per National Marine Pollution Contingency Plan (NMPCP).

#### **4.22 Occupational Health & Safety Authority (OHSA)**

OHSA is the Local Authority responsible for all Health & Safety matters including COMAH. OHSA must be alerted to any serious incident at COMAH sites and injuries to workers.

#### **4.23 Malta Environment & Planning Authority (MEPA)**

MEPA is responsible for general Environmental Issues. MEPA must be informed of any environmental incidents, including spills, air, marine or land pollution.

#### **4.24 Environmental Health Directorate**

The Environmental Health Directorate is responsible for public health. It is to be informed in case of air pollution or marine pollution, where the public health may be affected, e.g. swimming water quality.

#### **4.25 Emergency Services**

The Emergency Services include Civil Protection Department, Ambulance and Police. These can be contacted through the national emergency number 112. Additional resources may be called up through them to assist, for instance, Armed Forces of Malta (AFM), voluntary societies, etc.

## **5 ACTIONS TO BE TAKEN**

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This section describes the actions to be taken by the persons defined above.

### **5.1 Emergency Controller**

Upon being informed, he is to proceed to the Control Centre and take charge of the situation. He is to remain in the Control Centre throughout the emergency. He is to instruct other staff in the required actions.

#### **5.1.1 General actions:**

- Inform immediately Enemalta of the situation
- Contacts other agencies required (Police, pollution control, etc.)
- Acts as co-ordinator with other agencies, briefing them on arrival and arranging for their disposition.
- Ensures availability of resources and personnel during the emergency.
- Ensures that necessary action is taken to protect personnel and plant.
- Shuts down the plant involved, if necessary.
- Maintains normal operations of unaffected plant, as far as possible.

Above all, the Emergency Controller is to act as a fixed reference point for all responding agencies, and is to direct D3PG 's efforts towards a safe resolution of the incident.

#### **5.1.2 Specific actions**

##### **5.1.2.1 Fire**

- Ensures Enemalta have been advised and to attend DPS fire fighting systems
- Ensures DPS main gate security have been advised
- Ensures CPD have been called

**CPD / Police 112**

- Ensures evacuation of affected areas
- Directs ERT to required action

- Inform D3PG health safety and environment officer

#### **5.1.2.2 Injury**

- Ensure Enemalta and DPS main gate security are informed
- Ensures Nurse (when available), Ambulance, and CPD have been contacted

**Ambulance 112**

**CPD / Police 112**

- Directs ERT to required action
- Inform D3PG health safety and environment officer

#### **5.1.2.3 Spill inside plant**

- Inform Enemalta and DPS Main Gate Security
- Assesses situation
- Ensures further spillage is halted
- Directs ERT to required action
- Inform D3PG health safety and environment officer
- Contacts CPD

**Civil Protection Department 112**

- Advises MEPA/COMAH

**MEPA 9921 0404**

- In case of marine spills, advises Transport Malta

**TM (VTS) 2291 4491 / 2**

**TM (VTS) 2291 4491 / 2**

- Contacts pollution sub-contractor, if required

#### **5.1.2.4    *Chemical Spills***

- Ensure the Safety Data Sheet for the spilled material is available.

#### **5.1.2.5    *Bomb Threat***

Confidential information

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## **5.2 Communications Officer**

- Alerts members of the ERT and the Emergency Controller.
- Assists the Emergency Controller with communications, within and outside the plant.
- Logs all actions during an emergency.
- Non-emergency communications (e.g. press, general public etc) are to be handled through Enemalta.

### **5.2.1 Fire**

- Inform Enemalta to attend DPS fire fighting systems
- Alerts Emergency Controller and ERT
- Calls CPD immediately, informing operator of:
  - **E**xact location
  - **T**ype of incident
  - **H**azards on site
  - **A**ccess to accident location
  - **N**umber of casualties/size of accident
  - **E**mergency Services on site
- Alert DPS Security Guard of DPS Main Gate and advise them of expected actions.

### **5.2.2 Injury inside plant**

- Inform Enemalta
- Alerts Emergency Controller and ERT
- Calls Ambulance immediately, informing operator of:
  - **E**xact location
  - **T**ype of incident
  - **H**azards on site
  - **A**ccess to accident location
  - **N**umber of casualties/size of accident
  - **E**mergency Services on site
- Alerts DPS Main Security Guard House and advise them of expected actions.
- Contact D3PG HSE officer.

### **5.2.3 Fuel/Chemical Spill/Release**

- Inform Enemalta
- Alerts Emergency Controller and ERT
- Calls CPD immediately if a hazard to personnel exists.
- Emergency controller will alert outside agencies after assessment of situation.
- Inform MEPA of any significant spill.
- Alerts DPS Main Security Guard House and advise them of expected actions.
- Contact D3PG Health & Safety & Environment officer as soon as possible.

### **5.3 Emergency Response Team (ERT)**

The ERT will be alerted to an emergency situation by the Emergency Controller by mobile , radio or telephone.

- Upon receiving the call, members of the ERT are to rendezvous in the Control Centre.
- Members of the ERT engaged in critical operations are to ensure their plant is made safe and handed over before proceeding to the Control Centre.
- ERT members are to:
  - provide initial response to an incident
  - carry out actions as necessary to control the emergency, under the direction of the Emergency Controller
  - assist and provide backup to the Emergency Services when they arrive

#### **5.3.1 Fire**

- Collect protective clothing and equipment
- Proceed to scene of fire
- Attempt to control fire with available means
- Assist and provide backup to the Emergency Services when they arrive

#### **5.3.2 Injury inside plant**

- Collect protective clothing and equipment
- Proceed to casualty
- Assist casualty as required
- Assist Ambulance personnel

#### **5.3.3 Spill inside plant (See section 6.4)**

- Collect protective clothing and equipment
- Proceed to spill
- Ensure all pumping has stopped
- Ensure any drains are closed
- Attempt to isolate source
- Attempt to contain spill
- Proceed with recovery of spilled material



## **5.4 Operations Personnel**

- Proceed immediately to their assigned post of duty by a safe route.
- Where operators are assigned to an area of plant rather than a specific unit, operators will assemble near the panel of the closest unit.
- Report to their superior officer
- Remain available
- Carry out the following tasks, as instructed by D3 shift engineer or D3 generation officers:
  - Isolate any electrical supplies.
  - Isolate any valves that have been opened.
  - Isolate & make safe any hazardous equipment that might interfere with work.
- If their normal place of duty has been affected, they are to go to the nearest assembly point and report to the Emergency Controller.

### **5.4.1 Generation Officers are to:**

- Conduct roll call as per daily work assignment.
- Ensure any members of the ERT are dispatched, and their duties delegated to others.
- Ensure normal operations continue, as far as possible.
- Report status to Emergency Controller.
- Where personnel are operating critical plant, they are to ensure that all machinery has been made safe and any transfer operations halted.
- Personnel not involved in the emergency operations are to remain accessible as they may be required by the Emergency Controller.

### **5.4.2 Enemalta:**

- In charge of the water fire systems and water makeup, to ensure that a continuous supply of water is available.

## **5.5 Enemalta Security Guards**

- To communicate with Head of Security/ACSO and advise of the situation.
- No vehicles except emergency vehicles are to enter the plant. The emergency vehicles are to be directed to the rendezvous point as indicated by the Emergency Controller.

- It may be helpful to assign someone with Enemalta identification at the roundabout leading to the power station, as it is easy for persons unfamiliar with the area to miss it.
- Maintain clear access, ensuring all gates are kept clear. If necessary police are to be called to assist.
- Responsible for assisting with roll call and identifying any missing personnel.
- To notify Emergency Controller of any missing persons.
- To take record of personnel entering and leaving site.
- In major incidents the security guards are to ask for reinforcements as required.

### **5.6 First Aiders**

- First Aiders are to assemble near clinic if safe, and report to Emergency Controller.
- In a serious incident, hospital staff will direct medical operations, D3PG first aiders will assist under the direction of MDH medical staff.
- Details of casualties are NOT to be passed to relatives or third parties. D3PG HSE officer will deal with this.

### **5.7 FOT Personnel**

- Stop any transfers safely
- Close valves including separator and bund drains
- Ensure that all machinery has been made safe
- Assemble at the weigh bridge room
- Report to the GOs

### **5.8 D3 Administration building wing**

- The administration block will only be evacuated if endangered.
- In emergencies which are not affecting this block, personnel are to remain at their usual offices and stand by for instructions from the Emergency Controller.
- Upon hazard notification, all personnel are to proceed to the assembly point, near the Security Guard House.
- DPS Main Gate Security guards will call CPD

- DPS Main Gate Security will inform Enemalta
- Escort any visitors to safety.
- Clerks/Personal Assistants (PAs) are to conduct roll call from time & attendance system, and security records to account for all personnel.
- No one is to re-enter the building until CPD have assured its safety.

## **5.9 Stores**

- Incidents in other areas of the plant are unlikely to endanger the stores.
- Personnel are to evacuate and collect at the assembly point outside the Workshop Main Door
- Stores personnel are to secure the stores if it is safe to do so.
- Call CPD on 112.
- No one is to re-enter the building until CPD have assured its safety.

## **5.10 General Instructions for non-essential personnel**

- Personnel not involved in the emergency operations are to remain accessible as they may be needed by the Emergency Controller. Under no circumstances are personnel to go home or otherwise leave the assembly point unless the Emergency Controller has been notified.
- If the assembly point is endangered, they are to collect at the nearest safe assembly point.

## **5.11 Other Personnel**

- Upon being notified, all personnel are to proceed to their assembly point. They are to remain at this place until instructed to move by the Emergency Controller.
- If the assembly points are endangered, an alternative place will be identified.

### **5.12 Third Party and Contractors**

- Contractors working on site are to be briefed on safety procedures by their Operator ( D3PG, Enemalta, D4) contact person.
- Contractors are to follow directions as indicated by the Operator.
- Make safe any work in progress
- Report to assembly point at the Assembly point A – DPS Main Gate
- Conduct roll call
- Report to roll-call officer

### **5.13 Visitors**

All visitors are to report to the Visitors' assembly point (Assembly point A – DPS Main Gate) and identify themselves to the roll-call officer.

## **6 IMMEDIATE ACTION BY PERSONS AT SITE OF EMERGENCY**

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### **6.1 Fire on Plant**

- Activate the manual call point nearest to the fire to sound the fire alarm.
- Evacuate
- Inform Control Centre:
  - What is involved
  - Any injuries
- Attempt to fight fire using available equipment, if it is safe to do so.

### **6.2 Fire in vehicle**

- Inform Control Centre of fire stating:
  - What is involved
  - Any injuries
- Attempt to fight fire using available equipment, if it is safe to do so.
- Move adjacent vehicles to a safe area if it is safe to do so.

### **6.3 Fire in Administration Block**

- Sound nearest fire alarm
- Evacuate

- Inform Central Control Room of fire stating:
  - What is involved
  - Any injuries
- Attempt to fight fire using available equipment, if it is safe to do so.

### **Injury inside plant**

- Check casualty and apply immediate First Aid
- Inform Control Centre of injury stating:
  - Name of casualty
  - Type of injury
- Assist casualty as necessary
- Unless injury is minor, all operations in the vicinity are to be suspended
- All machinery and plant is to be left as it was at time of accident until Health & Safety have cleared to resume operation. (Except as necessary to secure area)

## **6.4 Diesel, Lubricating oils, Transformer oils Spills**

These oils do not offer particularly high fire or injury potential; however, still all precautions should be taken. Most oils may be harmful after extended exposure so unnecessary exposure should be avoided.

Most of the oils used offer a fairly low fire risk because of their high flashpoint; however, when heated, they can ignite.

In any case seek appropriate guidance from the Safety Data Sheets (SDS) and site chemists.

### **6.4.1 Minor spills**

Minor spills are those less than 20 litres.

#### ***6.4.1.1 Action for minor spills on land***

The action for minor spills on land is as follows:

- Use appropriate PPE as necessary
- Isolate source
- Consider calling Emergency Services if assistance is deemed necessary.
- Contain spill as far as possible especially if it can go into the road or drains. Spill kit cabinets are available:

- In the container found on the Enemalta jetty
- Near D3 HFO Separator's Room
- In culverts where isolating valves are installed, these should be closed in a way as to reduce the flow to the interceptors
- In D3 plant, if a spill occurs next to the boiler trenches where normally blow down water flows through them, it is important to start boiler pit diaphragm pump to the oily water as to reduce the spill's flow rate to the sea water.
- Place warning signs if spill is in the road and can cause a hazard to traffic – if necessary advice Police to assist controlling traffic
- Recover spill using suitable means:
  - Bucket & shovel / dustpan work well on smooth floors
  - Absorbent pads which can each absorb (approx) 1 litre
  - Sand or other oil absorbing particulates
- Recovered oil and absorbent materials to be dealt with as "hazardous waste".

#### **6.4.1.2 Action for minor spills into the sea**

- Inform Enemalta
- Shut down all transfer operations
- Use appropriate PPE as necessary
- Isolate source
- Inform Control Centre of spill stating:
  - Type of spill material
  - Approximate quantity
  - Whether source has been isolated
- Contain with booms (PU/PVC booms are preferred as they are reusable, whereas absorbent booms are quick to deploy but cannot be re-used after contamination)
- Contact chemists to assist with identification and dealing with material, if needed
- Recover spill using suitable means:
  - Pumping from pit / sump
  - Using skimmers (various types)
  - Absorbent pads which can each absorb (approx) 1 litre
  - Sand or other oil absorbing particulates
- Recovered oil and absorbent materials to be dealt with as "hazardous waste".

#### **6.4.1.3    *Action for minor spills in tank area***

- Wear appropriate PPE as necessary
- Isolate source
- Inform Control Centre stating:
  - Type of fuel
  - Approximate quantity
  - Whether source has been isolated
- Ensure all drains are closed
- Attempt to limit spread of fuel by available equipment.
- Recover spill using suitable means:
  - Pumping from pit / sump
  - Using skimmers (various types)
  - Absorbent pads which can each absorb (approx) 1 litre
  - Sand or other oil absorbing particulates
- Recovered oil and absorbent materials to be dealt with as “hazardous waste

#### **6.4.2    Major spills**

Major spills are considered over 20 litres.

##### **6.4.2.1    *Action for major spills on land***

The action for major spills on land is as follows:

- Assess spill potential
- Call Emergency Services
- Consider calling spill recovery contractor if necessary
- Wear appropriate PPE as necessary
- Isolate source
- Contain spill as far as possible, especially if it can go into the road or drains
- Place warning signs if spill is in the road and can cause a hazard to traffic - if necessary advice Police to assist controlling traffic
- Recover spill using suitable means:
  - Suitable pump

- Bucket & shovel / dustpan work well on smooth floors
  - Absorbent pads which can each absorb (approx) 1 litre
  - Sand or other oil absorbing particulates
- Recovered oil and absorbent materials to be dealt with as “hazardous waste”.
- Inform MEPA
  - Inform D3PG HSE officer

#### **6.4.2.2 Action for major spills into the sea**

- Inform Enemalta
- Shut down all transfer operations
- Wear appropriate PPE as necessary
- Isolate source
- Inform Control Centre of spill stating:
  - Type of spill material
  - Approximate quantity
  - Whether source has been isolated
- Set up forward control point to maintain contact with Control Centre
- Consider calling Emergency Services if assistance necessary.
- Inform OHSA with the spillage quantity
- Contain with booms (PU/PVC booms are preferred as they are reusable, whereas absorbent booms are quick to deploy but cannot be re-used after contamination)
- Inform MEPA
- Contact Enemalta chemists to assist with identification and dealing with material, if needed
- Recover spill using suitable means:
  - Pumping from pit / sump
  - Using skimmers (various types)
  - Absorbent pads which can each absorb (approx) 1 litre
  - Sand or other oil absorbing particulates

Recovered oil and absorbent materials are to be dealt with as “hazardous waste”.



### **6.4.3 Spills in secondary containment (contained by bunds)**

Where environmental control measures have been implemented (reservoirs, bunding or other secondary containment) spill control will be much easier and consequences to the environment should be minimal. However bear in mind that any oil in the secondary containment MUST be removed as soon as possible.

When removing the spill from secondary containment:

- Wear appropriate PPE as necessary
- Isolate source
- Verify secondary containment is intact (check especially any drain valves are present)
- Oil should be removed by pumping as far as possible.

## **6.5 Chemical Spills**

The principles for oil spills generally apply, that is:

- Isolate source
- Contain spill
- Collect spill
- Dispose of in appropriate manner

However, the following points are also to be observed:

- Whereas the difference between a major and minor oil spill is defined whether the volume of oil spilt is 20 litres or more, for chemicals, this volume is set to 5 litres. Therefore:
  - Major chemical spills are considered over 5 litres
  - Minor chemical spills are considered under 5 litres
- Do not try to handle unknown chemicals – make sure you have the right information from the right SDS
- Get advice from Enemalta chemists
- Greater precautions may be needed as there are several hazardous chemicals on site.
- Always operate from upwind if gases, airborne vapours or dust is present
- Use chemical absorbent pads, since oil absorbents may not work with chemicals.

## **6.6 Bomb threat**

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## **7 MAJOR SYSTEM DISTURBANCE ON D3 PLANT**

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A Major System Disturbance is an occurrence which affects output from the plant thus disturbing Enemalta operations.

### **7.1 Actions in the event of Major System Disturbance**

#### **7.1.1 D3 Shift Engineer and D3 Generation officers shall**

- Inform immediately Enemalta
- Inform D3PG management and owners
- Take necessary actions on plant to re-stabilize plant

### **7.2 Damage to Plant with extended Outage**

Should the disturbance be caused by a machine or critical structure, where the fault is such that the machine will remain out of service for weeks or months, D3 management will raise issue with Enemalta and insurers.

## **8 COMMUNICATIONS**

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In all cases, outside help is to be contacted only by the Emergency Controller. Emergency Services and other outside assistance is only to be contacted directly by onsite personnel if communication with the Central Control Room is lost.

Even if 112 have been called directly from the accident site, the Central Control MUST be informed in order to provide the first reaction as well as contact the necessary agencies.

Good communications are the keystone to good management. Their importance is even greater during an emergency.

The chart in Section 9 Emergency Organisation – Communications Flow indicates how the organisation should work.

### **8.1 Communication facilities**

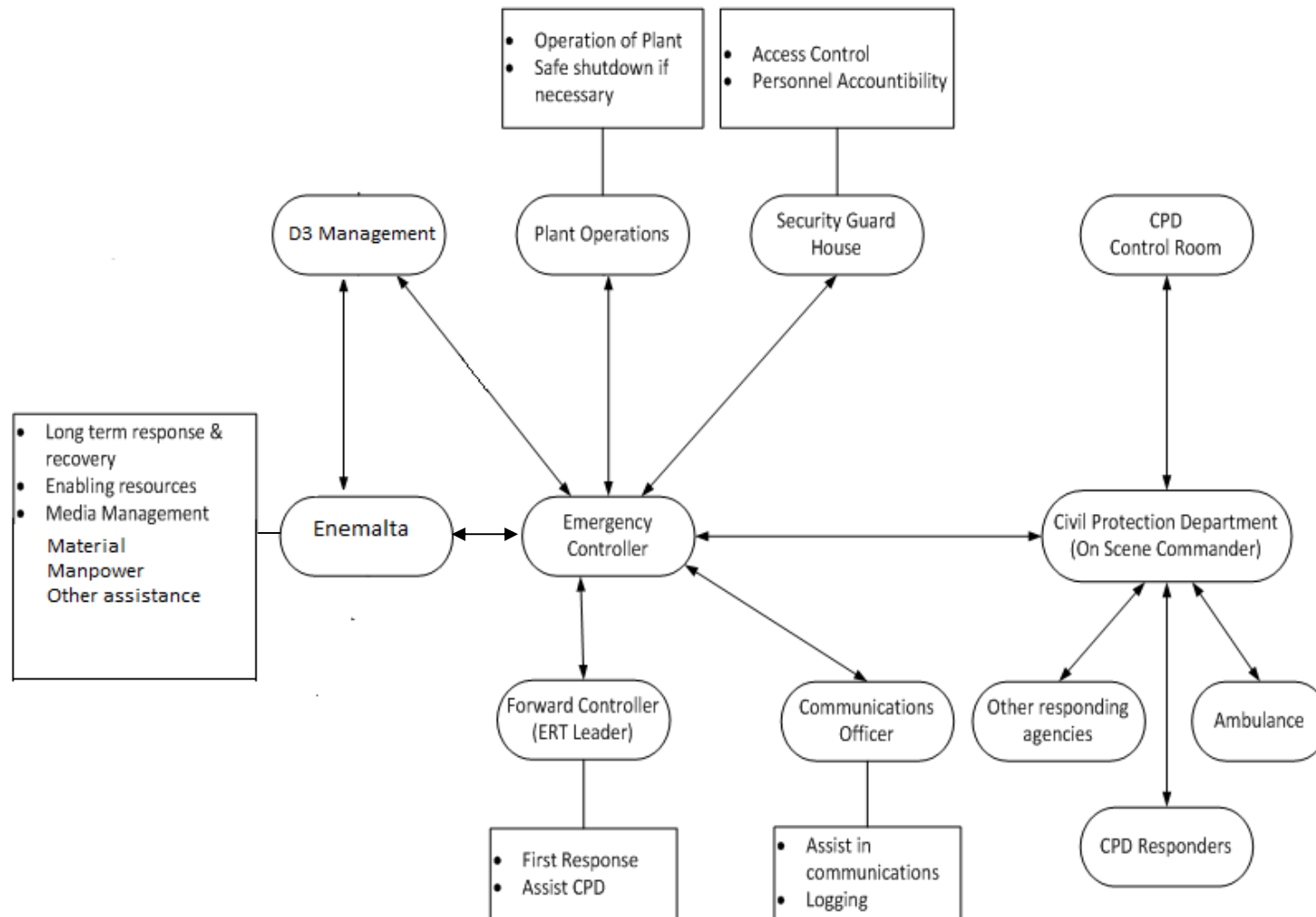
The main communication facilities are:

- Telephone

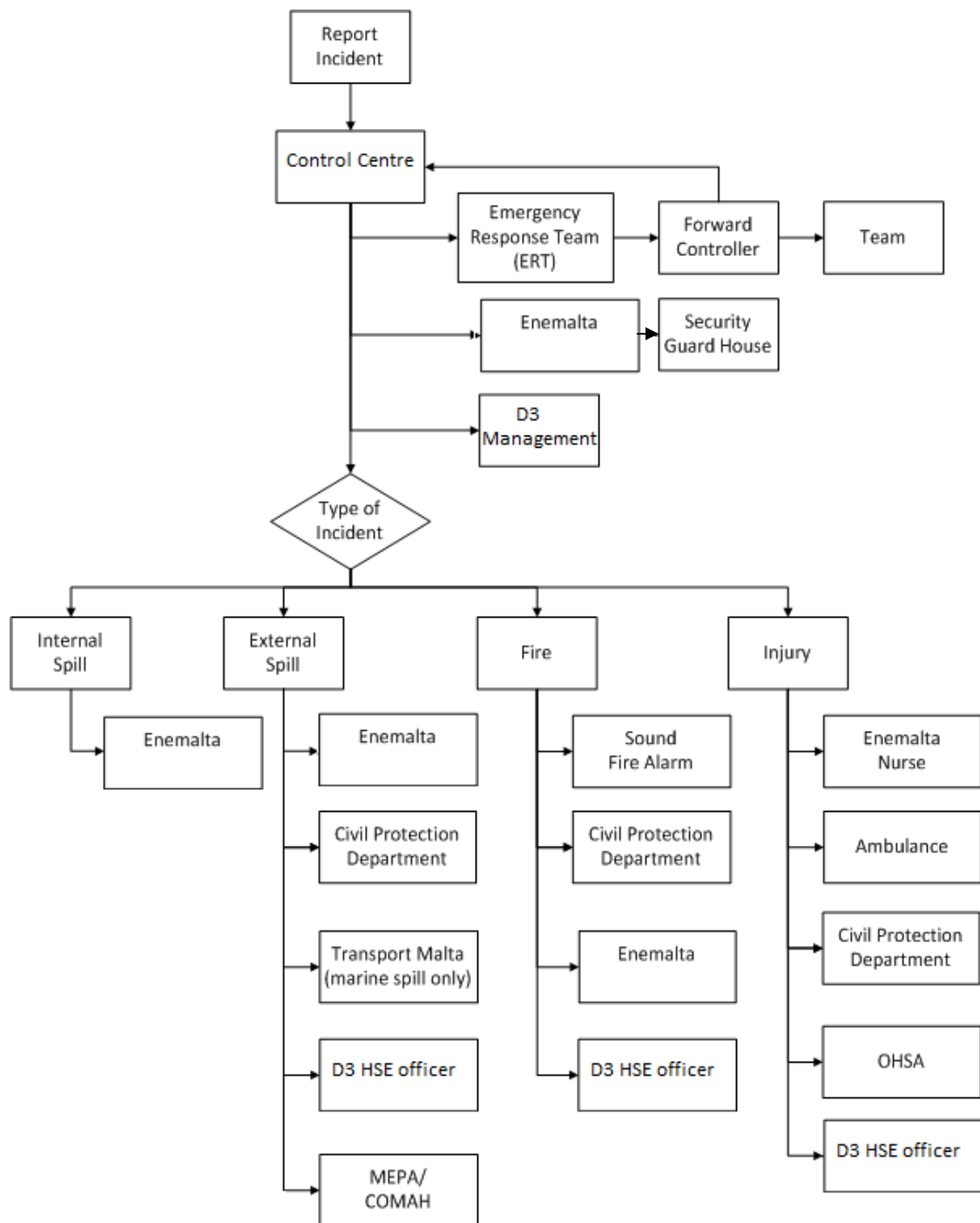
- Portable Radio
- Security/Fire Section radio
- Mobile phone

It is important to realise that we are placing too much reliance on mobile phones. In an emergency, especially one which is affecting the national power grid, the mobile phone network is likely to fail. Even if the electricity supply is stable, the mobile phone networks are liable to become congested due to extraordinary traffic. The use of alternative means especially private radio is essential in such cases.

## 9 EMERGENCY ORGANISATION – COMMUNICATIONS FLOW



## 10 NOTIFICATIONS CHART



## 11 NOTIFICATIONS

The document **Emergency Telephone Directory** contains a list of useful telephone numbers in case of emergencies.

### Notes:

- ALL incidents MUST be reported
- Any significant incident must be reported as a priority. These include:
  - Injuries requiring hospitalisation
  - Incidents with significant financial consequences
  - Incidents with significant environmental consequences
- Minor incidents must still be reported, however report may be done during normal working hours of the department concerned.

	Fire	Injury	Spill
<b>D3PG</b>			
D3 HSE officer	✓	✓	✓
D3 Management	✓	✓	✓
Enemalta	✓	✓	✓
Nurse		✓	
<b>Government Agencies</b>			
Occupational Health & Safety Authority		✓	<sup>1</sup> ✓
Police		✓	
Environmental Health Directorate	<sup>2</sup> ✓		
Malta Environmental & Planning Authority (MEPA)			<sup>3</sup> ✓

- When contacting CPD or Ambulance through the emergency number 112, this call is received at Police HQ
- These notifications are intended as the first calls to be made during an emergency. However, post emergency reports are still required according to procedures and/or legislation.

<sup>1</sup> To be advised of any fire or spill which can affect the sea

<sup>2</sup> To be advised if the sea may be affected (for bathing quality) or serious air pollution

<sup>3</sup> To be advised if the sea may be affected (for bathing quality) or serious air pollution

- The form to be used for the post emergency reports is called the **Incident/Exercise Report Form**, currently available on the Enemalta Portal at the location below:

[Documents/Environmental Management System \(EMS\)/EMS Forms/ Incident/Exercise Report Form](#)



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## 12 MATERIAL RESOURCES (IN-HOUSE)

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The table below lists the main stockpiles of equipment which may be useful in an emergency:

Item	Location
Spill Control Material	Container at FO Unloading (found on the jetty)
Spill Control Material	Oil Spill cabinet near D3 HFO Separator's Room
Spill Control Material	Fire Store – under Control Room Fire Store – CW Pumphouse (FFI)
Spill Control Material	Enemalta General Store
Fire fighting foam	Store near Enemalta CW Pump House
Extinguishers / Hoses / Other Equipment	Fire Store – under Enemalta Control Room Fire Store – CW Pumphouse (FFI)

## **13 REFERENCE DOCUMENTS**

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Emergency Telephone Directory

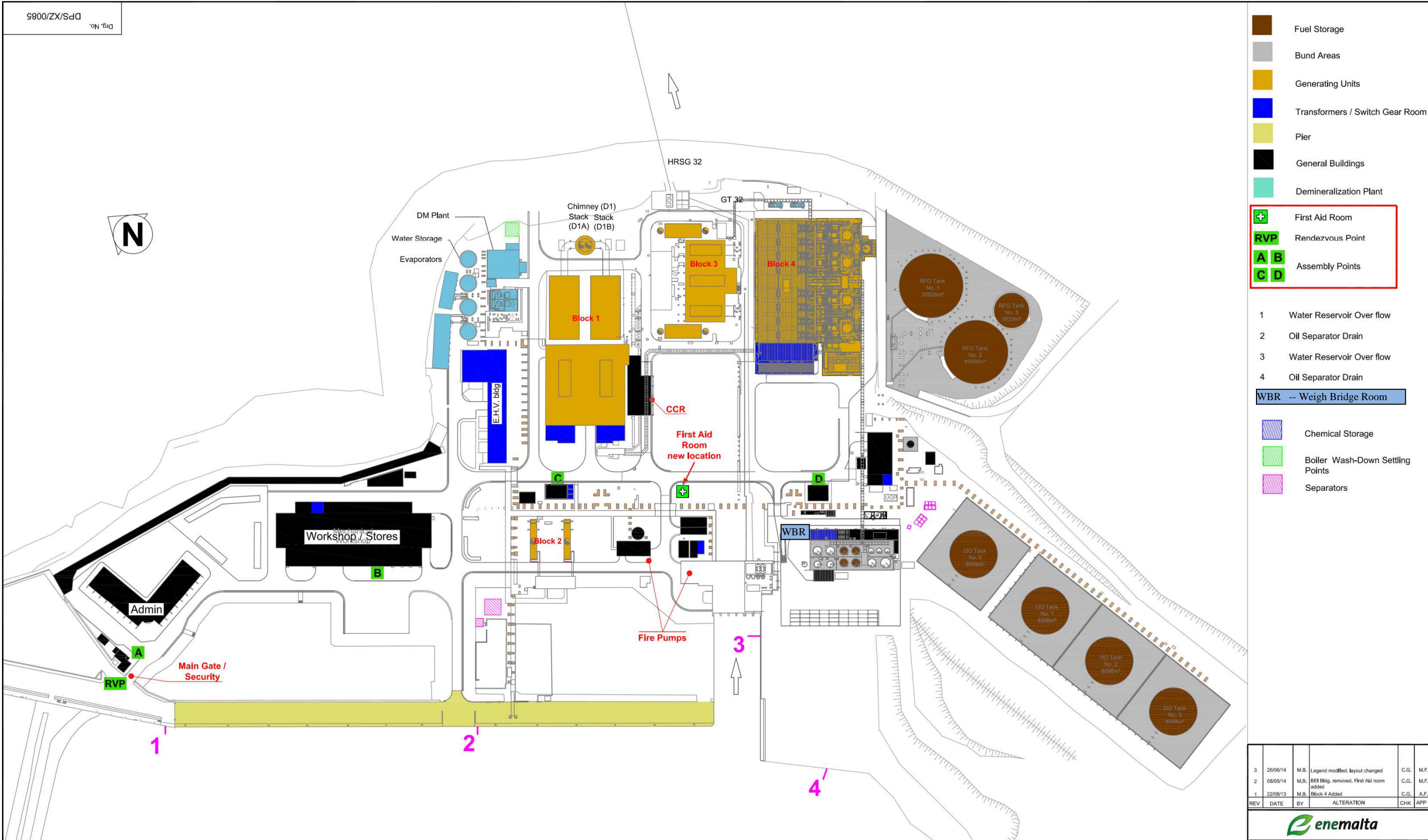
Incident/Exercise Report Form

Generation Incident Report

Public Relations Procedure – Emergency Plan

SOP-SEC-08-11 - Security Standard Operating Procedure

14 SITE LAYOUT



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## **Appendix VIII**

*Replies to MEPA comments*

**Form A**

Section	Duly made?	MEPA Comments 18 September 2015	Applicant's replies 23 October 2015	Duly made?	MEPA Comments 01 December 2015	Applicant's replies 21/01/16	Duly made?	MEPA comments 11 February 2016	Applicant's replies 01 April 2016	MEPA comments 5 April 2016
A1.1	✓	Noted	-	✓	-	-	✓	-		-
A1.2	✓	Noted	-	✓	-	-	✓	-		-
A1.3	✓	Noted	-	✓	-	-	✓	-		-
A1.4	✗	See sections 3.5 and 3.6	Included.	✓	Noted		✓	Kindly ensure that section is updated in the event that development consent is required for the new boiler	Noted	-
A2.1	✓	Noted	-	✓	-	-	✓	-		-
A2.2	✓	Noted	-	✓	-	-	✓	-		-
A3.1	✓	Noted	-	✓	-	-	✓	-		-
A3.5	✗	Kindly provide copies of Memorandum and articles of association for D3PG and amend table in section 1.4 accordingly	Included in Appendix III.	✓	Noted		✓	-		-
A3.6	✗	Kindly provide copies of Memorandum and articles of association, copy of certificate of incorporation/ registration for SEP (Malta) Holding Ltd. Kindly also amend table in section 1.4 accordingly	Included in Appendix III.	✗	Kindly provide copies of Memorandum and articles of association, copy of certificate of incorporation/ registration for SEP (Malta) Holding Ltd.	Included	✓	-		-

Form C

Section	MEPA Comments 18 September 2015– based on submissions on 15 September 2015	Applicant’s replies 23 October 2015	MEPA Comments 01 December 2015	Applicant’s replies 21/01/16	MEPA Comments 11 February 2016	Applicant’s replies 01 April 2016	Duly made ?	MEPA comments 5 April 2016	Applicant’s replies 23 May 2016	ERA comments 31 May 2016	Applicant’s replies 14 June 2016	Duly Made ?	ERAccomments 15 Jun 2016
		<p>MEPA still awaits confirmation on the following items which are also addressed in certain sections below:</p> <p>details:</p> <p>(1) Confirmation of the location of the auxiliary boiler</p> <p>(2) Updates on the atmospheric emissions, and</p> <p>(3) Detailed drawings of the plant which shall either replace certain submitted documents or be included in</p>	<p>Information pertaining to all three pending matters is included in the relevant sections as indicated in the replies and also in the report which we are still submitting in track changes for ease of reference.</p>	<p>Noted</p>		✓	-	-	-	-	-	✓	-

		specific sections below.											
C1.1	<p>Kindly compile the table in section C 1.1 of the form to include the propose activity and directly associated activities (including waste management, chemical storage etc). You may also wish to include reference to section C 1 of the application document.</p> <p>Regarding the introduction of section 1.1, kindly confirm whether the 0.0044 kg/s pilot fuel to be utilised in engines 5 to 8 will be required throughout their operation or only during start-up. Kindly also explain the reason behind similar</p>	<p>Section C 1.1. compiled.</p> <p>Yes the pilot fuel flow mentioned is confirmed for engines 5 to 8. Pilot fuel amounts to a 1% of the total fuel required to operate DF engines. The flow rate of 20L/hr (0.0044kg/s) is much lower than the current</p>	<p>Noted</p> <p>Noted</p>	<p>Updated letter submitted on Tuesday 22<sup>nd</sup> December 2015. We await reply from MEPA.</p>	-	-	✓	-	-	-	-	✓	-

	emissions quoted in table 1 for all 8 engines in spite of the use of the pilot fuel.	3,000L/hr flow rate that is being adopted for the HFO system to produce the same amount of energy.											
	Post abatement emission figures provided in section 1.1.2.2 (table 1) shall be further discussed with the operator in view of request by D3PG dated 18 <sup>th</sup> September 2015.	The reasons behind similar emissions quoted in Table 1 for all 8 engines in spite of the pilot fuel is described in Section 1.1.2.6.	Noted. MEPA awaits update to letter dated 18 <sup>th</sup> September 2015 which are required following meetings with the operator. Once submitted the emission limit values to be set for the converted plant will need to be further discussed.	Refer to site layout plan in Figure 3 (DRG 151a). Descriptions of instances when gas will be required to be released have also been included in the text.	MEPA has taken note of the proposal and justification.								
	Kindly include details on provisions in place in terms of the pressure of the gas being supplied and the conversion to the pressure required by D3 engines	Noted.	Submissions have been noted. MEPA awaits submission and details of all pressure release valves together with information on instances where the release of gas will be required. Kindly confirm whether	Yes, release of gas from such valves has been taken into account in safety studies.	Noted.								
	Kindly amend table 1 in	More detail has been			-								







	<p>boiler and its specifications.</p> <p>Regarding the statement “...Enemalta will need to determine the necessity of additional boilers for the generation of evaporated water for the site...” in section 1.1.2.7, kindly note that the issue will need to be discussed with Enemalta and a position included in both operators’ applications.</p> <p>The last paragraph of section 1.1.2.7 shall be amended to include synergies with Enemalta in terms of dosing of the</p>	<p>position will be reviewed in the context of the whole installation.</p> <p>Noted and included in Section 1.1.2.4.</p> <p>Noted and included.</p> <p>The boilers at D2 are exhaust gas boilers used</p>	<p>Kindly note that section 1.4.2 (referred to in the text of section 1.1.2.7) does not include reference to the location of the steam boiler in Figure 9.</p> <p>Kindly confirm whether the updates mean that while the four dual fuel engines are running on gasoil, the D2 gas boilers will also be in operation</p> <p>Noted. Kindly confirm whether there will be any periodic</p>		<p>IPPC permit, and as may be amended prior to issue of the permit.</p>								
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	sea water with chemicals together with the monitoring that will be carried out at by Enemalta at the Hofra Iz-Zghira outlet.	<p>to recover heat from the gas turbines' exhaust. They will remain on standby in case there is a limited gas supply. The boilers at D1, which are currently operating on HFO will be decommissioned once D4 is in operation.</p> <p>Dosing of sea water will continue to take place by Enemalta. It is the responsibility of Enemalta to supply the operators of D3 with good quality sea water that limits fouling and mechanical damage to the plant.</p>	checking of the chemical parameters within such intake water by D3PG. The same applies for the sea water outlets. Kindly confirm whether D3PG will be monitoring discharges ( as per current IPPC permit) prior to connection to the common discharge point regulated by Enemalta.										
C1.2	Regarding the 5 <sup>th</sup> paragraph of section 1.2,	Risk assessment is currently	Kindly confirm whether the issue of	Perit Edwin Mintoff is liaising with	Noted. – This will be confirmed	No planning consent is	✓	Noted. Confirmation from the	-	-	-	✓	-

	<p>confirmation on any development consent required for the additional semi-closed structure and the foundation of the boiler will need to be assessed</p> <p>Kindly provide information as to how the start-up and shutdown periods shall be maintained in accordance with “<i>COMMISSION IMPLEMENTING DECISION concerning the determination of start-up and shut-down periods for the purposes of Directive 2010/75/EU of the European Parliament and of the Council on industrial emissions</i>”.</p>	<p>being performed for the proposed location of the boiler. The footprint is expected to take approximately 70m<sup>2</sup> and the maximum height is expected to be about 12m (for the chimney stack).</p> <p>Included in the Section 2.2.3</p>	<p>planning consent has been discussed with the MEPA planning directorate.</p> <p>Noted. Further queries may arise once the MEPA Air Unit is consulted. Kindly provide details on start-ups and shutdowns in the context of the dual fuel engines switching from the use of NG to Gasoil. Kindly also explain whether and how the auxiliary boiler will be used in such instances.</p>	<p>the relevant authorities on this matter.</p> <p>Included in Section 2.2.2.</p>	<p>during consultation period with statutory consultees</p> <p>Noted</p>	<p>required for the auxiliary boiler due to Article 85 (2) (f) of Act VII of 2016: Development Planning Act, 2016.</p> <p>70. (1) Subject to the provisions of this article and to the following provisions of this Part of the Act, and subject to articles 55 and 85(2)(n), no development shall be carried out except with development permission. (2) For the purposes of this article, and, unless the</p>		<p>Planning Authority will be requested as part of the Regulatory Consultation.</p>						
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						context otherwise requires, for all other purposes in this Act, "develop ment" means the carrying out of building, engineeri ng, quarrying, mining or other operations for the constructi on, demolitio n or alterations in, on, over, or under any land or the sea, the placing of advertise ments or the making of any material change in use of land or building and sea, other than: (f) the							
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						placing of plant and machiner y required for the operation of a use already covered by developm ent permissio n on land within the perimeter of the site covered by the same permissio n of the use being operated.								
C1.3	1. Kindly link structures/ areas mentioned in table 2 to a correspond ing drawing showing their location. Kindly include a table within the drawing listing these structures	Noted and included in Section 1.3	1. Note d	Previous map has been revised to include emissions from PRVs. Please refer to DRG 113b in Section 1.3.	1. –		✓	-	-	-	-	-	✓	-

	<p>2. Kindly confirm that the thermal rating being quoted in the first line of table 2 is the projected thermal rating. Kindly also explain why the UTM coordinates are slightly different from those quoted in the IPPC permit. For the DF engines kindly explain why “... (backup LFO)...” is quoted in the table rather than Gasoil or diesel.</p>	<p>Yes, the thermal rating is the projected thermal rating. UTM coordinates have been updated accordingly. The term backup LFO has been replaced as suggested.</p>	<p>2. Noted</p>	<p>Updated letter submitted on Tuesday 22<sup>nd</sup> December 2015.</p>	<p>2. –</p>								
	<p>3. Items listed in the 6<sup>th</sup> row shall be included in the</p>	<p>Included in Section C1.1 of Form.</p>	<p>3. Noted</p>		<p>3. –</p>								



	associated activities in section C1.1 of the form and												
	4. values quoted in row 8 shall be further discussed with the operator in view of request by D3PG dated 18 <sup>th</sup> September 2015	Noted.	4. MEPA awaits update to letter dated 18 <sup>th</sup> September 2015 which are required following meetings with the operator. Once submitted the emission limit values to be set for the converted plant will need to be further discussed.		4. MEPA has taken note of the proposal and justification.								
	5. Regarding row 12, kindly indicate whether D3PG shall have	At D3's outfall pit, a temperature monitoring probe is present to monitor the	5. Further discussions may need to be held so as to ensure		5. –								

	<p>its of emissions monitoring point prior to connection to the main outflow discharging into the Hofra Iz-Zghira outlet</p> <p>6. Kindly also clarify whether any other operator will be storing any waste, raw material or chemicals on behalf of D3PG</p>	<p>aforementioned temperature criterion. No other readings are taken at this outfall pit.</p> <p>This is not the case. Except for fuel storage – NG is stored at D4 and DO is stored by Enemalta.</p>	<p>that any exceedances of ELVs set by the Authority registered by Enemalta at the final discharge point can be traced back to individual operators.</p> <p>6. Noted</p>		6. –								
C1.4 C1.4.1	<p>Submissions are noted. Kindly provide copies of the documents referenced in this section and reference such annexes in the text of this</p>	<p>Included in text and included a separate annex.</p>	<p>Noted.</p>	-	-	-	✓	-	-	-	-	✓	-

	<p>section.</p> <p>Kindly also make reference to the site report prepared by Enemalta including ground investigations carried out. Kindly provide information on how such a report will be extended for the “independent” D3PG plant and to the address the obligations under Regulations 9(3) and 16(2) of the Industrial Emissions (IPPC) Regulations and “<i>communication from Commission - European Commission Guidance concerning baseline reports under Article 22(2) of Directive 2010/75/EU on industrial emissions (2014/C 136/03)</i>”.</p>	Refer to Report Section 1.4.1	Noted	-	-								
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	<p>The land and groundwater risk assessment, the baseline report and the monitoring strategy (or timeframe for their submission) shall be submitted to the Authority prior to the commencement of the public consultation.</p> <p>Final versions of figures 8 – 15 shall be provided at the earliest prior to commencement of any consultation. Kindly ensure that these all contain a key, do not contain any “interpretation clouds”, and soft copies of each are provided with the correct referencing in the title of the attachment.</p>	<p>Refer to Report Section 1.4.1. This will be submitted in the improvement programme within a 6 month timeframe from the commissioning phase.</p> <p>These versions will be provided in the following submission, which is expected to occur towards the end of November.</p>	<p>Noted. Conditions in this regard will be included in the IPPC Permit.</p> <p>Noted. MEPA awaits such submissions</p>	<p>Noted.</p> <p>New drawings have been included in Section 1.4.3.</p>	-	-								
C1.4.2	Noted. Kindly amend to include information on	Included.	Noted	-	-	-	✓	-	-	-	-	-	✓	-

	the location of the site permanent office.												
C1.4.3	Final versions of figures 8 – 15 shall be provided at the earliest prior to commencement of any consultation. Kindly ensure that these all contain a key, do not contain any “interpretation clouds”, and soft copies of each are provided with the correct referencing in the title of the attachment.	These will be provided in the following submission.	MEPA awaits submissions. Waste management area A shall be included in “figure 9”	The original waste management area A has been removed in DRG 111c. The location which was previously referred to as waste management area C has been renamed to waste management area A. Chemical storage area and spare parts areas have been removed, because these will not be required by the operators of D3. Chemicals will be bought in real-time from a local contractor and maintenance will be subcontracted	Noted		✓	-	-			✓	-



						<p>regards to TP21, it is important to note that D3 GRS plant is owned by D4, so the TP21 should not fall within the remit of D3. D3 only connects to the GRS for gas supply and is not involved in the operation or control of the GRS.</p>		<p>2. TP14: With regards to the PPM equipment located on D3's oil interceptor, kindly clarify why the 15ppm threshold has been selected for re-routing of the water to the sludge system. Moreover, kindly explain what will happen to the oily water once rerouted to the sludge system. Kindly also note that the Emission limit value for hydrocarbons at the discharge point to sea is 5ppm. Kindly confirm whether treatment of the oil water through Enemalta's "additional polishing interceptor" will achieve the 5ppm limit value.</p>	<p>2. The 15ppm threshold has been selected since the previous 5ppm target was causing the system to block and function inefficiently. This was being caused by the dust and silt collected from the surroundings, which in no way are related to the operations of D3. The oily water currently enters the sludge system and is collected in storage tanks and used as a fuel source for D1. Once D1 will be decommissioned, the contents of the sludge tanks will be transferred to an appropriate waste facility by using authorised waste carriers.</p> <p>3. Noted.</p>	<p>2. Kindly provide further details on the process described whereby oily water currently enters the sludge system and is collected in storage tanks and used as a fuel source for D1.</p>	<p>2. Quantities of oily water generated will diminish once the plant is converted because HFO will no longer be used. Oil sludge will consist of occasional leaks from engines, lube oil separators. The oil sludge will be exported to an approved facility and not transferred to D1.</p>		<p>2. Noted</p>
							3. Comment			3. -			3. -

								regarding TP21 is noted.		4. During a meeting held between D4 and Enemalta on 27 May 2016 regarding the tie-in points it was agreed that TP 15 – 415V is to be renamed as 415V electrical connection and it shall not be specified as being an electrical supply to the D3 DM and evaporated water pumps. This was decided in view that the 415V from Enemalta serves different utilities for	4. Noted, tie-in point name changed as instructed.		4. Noted
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										the other two operators and would thus necessitate a different tie-in point number should it be specific to the utility.			
<b>C2 – Your proposed techniques</b>													
C2.1	<p>1. Reference to LN 337 of 2001 shall be replaced by reference to LN 184 of 2011 as amended.</p> <p>2. Timeframes for achievement of ISO 14001 will also be required prior to the commencement of the</p>	<p>Noted and amended.</p> <p>A two-year timeframe is being proposed. During the first year, the new operators will be adopting the ISO system that is currently being</p>	<p>1. LN 337 has been repealed by LN 184 which has then been amended through SL 504.37. Kindly amend text accordingly.</p> <p>2. MEPA will be discussing such timeframes with the operator since 2 years is deemed too long</p>	<p>Noted and amended.</p> <p>Noted, timeframes are being proposed to reduce to 16months. This timeframe will kick-off at the stage where D3PG takes full-control of the D3</p>	<p>Noted</p> <p>MEPA believes that 16 months is too long and will therefore require ISO certification within 12 months of commencement</p>	<p>Noted and agreed.</p>	✓	Noted	-			✓	

	consultation process for this variation.	employed by Enemalta. This ensures a sufficient adaptation period for training the personnel on how to adopt such a management system. Following this period, it is being proposed that the new operators will set up their own independent ISO system which will undergo the standardised auditing processes.		plant following conversion.	ement of operations								
C2.2 C2.2.1	1. Operation on gasoil for prolonged periods shall be limited to the timeframes stipulated within Regulation 13 of LN	Operation on gasoil is limited to emergency situations, and long periods (>120 hours) are not envisaged.  Should however this be the case, the re-installation and re-	1. Further queries may arise once the MEPA Air Unit is consulted. MEPA also awaits additional details on timeframes required for the reinstallation of the	Included	1. Noted		✓	-	-	-	-	✓	-

	<p>11 of 2013. In the event that longer periods are envisaged, kindly provide details on timeframes required for the re-installation and re-commissioning of the full SOx abatement system</p>	<p>commissioning of the full gasoil exhaust abatement system might be required to cater for prolonged gasoil operation. Despite being technically possible, this entails a number of logistical, operational and logistical considerations which are being discussed with the client.</p> <p>Noted and amended.</p>	<p>FGD should its use be required.</p>											
	<p>2. Kindly note that the 3<sup>rd</sup> paragraph of this section refers to a “section 0”. Kindly amend.</p>	<p>Additional details have been included, more will be provided at a later stage.</p>	<p>2. Noted</p>	<p>Emission values for the auxiliary steam boiler have been included.</p>	<p>2. –</p>									

	3. kindly provide additional details on the use of the auxiliary boiler and its specifications. MEPA may need to include specific conditions and ELVs for this part of the plant. Details on whether it will be constantly in use shall also be provided		3. Noted. MEPA awaits details of projected emission values for the steam boiler.		3. Noted								
C2.2.2	Kindly expand section to include reference to periods of start-up and shutdown, momentary	Included in Section C2.2.2.	Further queries may arise once the MEPA Air Unit is consulted. Kindly provide details on start-ups and	More details have been included	More detail on shut down in line with current permit condition	New details included in report	✓	Noted	-	-	-	✓	-

	stoppage, leakage or malfunction.		shutdowns in the context of the dual fuel engines switching from the use of NG to Gasoil. Kindly also explain whether and how the auxiliary boiler will be used in such instances.		is required (Table 2.2.1.3).								
C2.2.3	<p>1. Kindly provide an explanation of the process flow diagram submitted in this section and refer to the diagram within the text.</p> <p>2. Kindly include additional drawing or amend one of the current ones to show how</p>	<p>Included in Section C2.2.3.</p> <p>The process flow diagram that was submitted has been amended to include the evaporated water and DM system.</p>	<p>1. Noted</p> <p>2. Noted</p>		<p>1. –</p> <p>2. –</p>		✓	<p>1. –</p> <p>2. –</p>	<p>1. –</p> <p>2. –</p>	<p>1. –</p> <p>2. –</p>	<p>1. –</p> <p>2. –</p>	✓	<p>1. –</p> <p>2. –</p>

	evaporated water from the operations of D3PG will be rerouted to Enemalta's evaporated water storage tank.												
C2.2.4	Section not yet submitted	Refer to Appendix IV containing BAT documents for BREF Large Combustion Plants, Emissions from Storage and Industrial Cooling Systems.	Feedback will be provided once Conclusions submitted by all operators are reviewed.	Noted	<p><b>BAT comparison – LCP BREF</b></p> <p>Document is overall deemed duly made however, the following comment prevail: Regarding part 3, kindly include a note that should there be a requirement for operating the dual-fuel engines on diesel, BAT is still being utilised.</p> <p>Regarding the section on</p>	<p>This general note was included in the report.</p> <p>Noted.</p>	✓	<p>Kindly note that the statement should be included in the LCP bref and not the BAT comparison on Storage.</p>	Noted and amended as instructed.	-	-	✓	-

					<p>Dust and SO<sub>2</sub> emissions from gas fired combustion plants MEPA takes note of D3PG's letter dated 22<sup>nd</sup> December 2015 and notes proposal and justification</p> <p><b>BAT Comparison – Industrial cooling systems</b></p> <p>Noted.</p> <p><b>BAT Comparison – Emissions from Storage</b></p> <p>Noted.</p>								
C2.2.5	In reply to this question kindly provide a short explanation on the reasons behind the conversion of the plant to gas	In in Section C2.2.1	Noted	-	-	-	✓	-	-	-	-	✓	-
C2.3	1. Kindly include a drawing showing	Included in Section C2.3. Currently	1. Details shall be provided to MEPA and	The chemical store that was	1. Noted	1. -	✓	1. -	1. -	1. -	1. -	✓	1. -

	the location of storage of each of the chemicals.	the access to the chemical store is not limited to the operators of D3 only. It is intended that the arrangement of the area is modified to ensure that only the operators of D3 will have access to the store.	application amended accordingly .	mentioned in previous submissions will no longer be required. This implies that all the chemicals that are required by D3PG will be bought in real-time from a local contractor.									
	2. Kindly amend table showing : - which substances are stored in amounts greater than 1 tonne at any given time. - % capacity of secondary containment.	Noted and rectified.	2. Noted.		2. –	2. –		2. –	2. –	2. –	2. –		2. –
	3. Kindly	This is not	3. Noted		3. –	3. –		3. –	3. –	3. –	3. –		3. –



	also clarify whether any other operator will be storing any waste, raw material or chemicals on behalf of D3PG.	the case. Except for fuel storage – NG is stored at D4 and DO is stored by Enemalta.											
C2.4	<p>1. Kindly note that Methane is not an ozone depleting substance. Kindly amend section accordingly</p> <p>2. Kindly provide information as to whether the SF6 switch gear systems are hermetically sealed.</p> <p>3. Kindly</p>	<p>This has been rectified.</p> <p>Yes they are hermetically sealed.</p>	<p>1. Noted</p> <p>2. Noted</p>	<p>1. –</p> <p>2. –</p>	<p>1. –</p> <p>2. –</p>	<p>1. –</p> <p>2. –</p>	<p>✓</p>	<p>1. –</p> <p>2. –</p>	<p>1. –</p> <p>2. –</p>	<p>1. –</p> <p>2. –</p>	<p>1. –</p> <p>2. –</p>	<p>✓</p>	<p>1. –</p> <p>2. –</p>

	provide information as to whether other equipment containing ozone depleting substances is present on site or is planned to be installed (ex A/C equipment in site offices etc.	No new equipment containing ozone depleting substances is planned to be installed on site. The administrative offices are equipped with standard A/C equipment and facilities that will not change from the current IPPC permit.	3. Noted.	3. –	3. –	3. –		3. –	3. –	3. –	3. –		3. –
	4. A maintenance programme for all equipment shall be included in the IPPC permit	A preliminary maintenance programme has already been attached in Appendix II.	4. Noted.	4. –	4. –	4. –		4. –	4. –	4. –	4. –		4. –
C2.5	Noted.	Noted.	Noted.	Noted	Noted.	Noted	~	Noted.	-	-	-	~	Noted.

	Further queries may be raised following consultation with the COMAH Competent Authority in relation to the tanks` bunds` maintenance.		Further queries may be raised following consultation with the COMAH Competent Authority in relation to the tanks` bunds` maintenance.		Further queries may be raised following consultation with the COMAH Competent Authority in relation to the tanks` bunds` maintenance.			Further queries may be raised following consultation with the COMAH Competent Authority in relation to the tanks` bunds` maintenance.					Further queries may be raised following consultation with the COMAH Competent Authority in relation to the tanks` bunds` maintenance.
C2.6 C2.6.1	Noted	-	-	-	-	-	✓	-	-	-	-	✓	-
C2.6.2	Noted	-	-	-	-	-	✓	-	-	-	-	✓	-
CB2.7	Kindly confirm the source of the potable water	From the water mains.	Noted	-	-	-	✓	-	-	-	-	✓	-
C2.8	Noted.  Once submitted MEPA will provide feedback which includes the opinion of the COMAH competent Authority	Noted	Noted.  Once submitted MEPA will provide feedback which includes the opinion of the COMAH competent Authority		Noted.  Once submitted MEPA will provide feedback which includes the opinion of the COMAH competent Authority	Section C2.8 has been revised to include the boiler risk assessment and emergency response plan reports. These are attached in Appendix VII.	✘	ERP reviewed by CPD.  Kindly ensure that the boiler risk assessment is also submitted to OHSA for review.  With regards to the boiler Risk Assessment, kindly provide the following:  1. A timeframe for submission of Phase II of the risk assessment. .	Noted.  This will be submitted by the 1 <sup>st</sup> week of June 2016.	Noted		~	-  1. Noted kindly submit a copy to the

								<p>2. In section 4.3.1 kindly specify what is meant by the term “left undetected for a sufficiently long time”. Kindly also clarify the specific parameter which triggers action by D3PG.</p>	<p>June.</p> <p>2. The term ‘sufficiently long time’ is not the same for all scenarios. For example: the time required to result in weakening of boiler casings/tubes due to overheating caused by failure of feed pumps, etc. will be different from the time to result in rupture of the boiler shell due to failure of safety relief valves. The parameters which trigger action by D3PG are</p>	<p>2. The parameters which trigger action by D3PG as listed in attached document are to be cross referenced in the table listed in section 4.3.1.</p>	<p>This includes Phase II of the boiler risk assessment and a revised table in Section 4.3.1.</p> <p>Included.</p>		<p>COMAH CA</p> <p>2. –</p>
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								3. Kindly note that the operations of the boiler may have to be disclosed to Enemalta and EGM for inclusion in the coordinated safety studies.	being attached to Appendix VII. 3. Noted.	3. –			3. –
								4. With regards to the recommendations listed in section 4.5 of the RA, kindly indicate whether actions required by third parties, for example on points 10 and 11 have been discussed and concluded by all parties.	4. Risk assessment has been sent to all parties involved, including the boiler manufacturer. The boiler manufacturer has taken onboard all the recommendations listed.	4. Noted.			4. –
C2.9	Noted.	Noted	-	-	-	-	✓	-	-	-	-	✓	
C2.10	1. Kindly note that as a follow up to the current outline decom	Noted and will be implemented in the improvement programme. The report is expected	1. Noted		1. Noted	-	✓	-	-	-	-	✓	-

	<p>missioning plan, D3PG will be required to provide its own amendments so as to address the decommissioning of the plant itself and all ancillary structures within the remit of D3PG.</p>	<p>to be published within 2 years after the commissioning of the converted D3 engines. It is intended that D3PG will operate D3 for 18 years after which there will be discussions with Enemalta on how to proceed.</p>											
	<p>2. In this regard, kindly note that this will need to take into consideration the commission guidance referred</p>	<p>Noted.</p>	<p>2. —</p>		<p>2. Noted</p>								

	<p>to in section 1.4.1</p> <p>3. A timeframe for the submission of an outline decommissioning plan will need to be agreed upon prior to commencement of drafting of the permit.</p> <p>4. Kindly amend text in section 2.10 of the report accordingly</p>	<p>Two years into the commissioning of D3, the decommissioning plan should be submitted as part of the improvement programme of the IPPC permit.</p> <p>Implemented.</p>	<p>3. Noted</p> <p>4. Noted</p>		<p>3. Noted</p> <p>4. Noted</p>								
C2.11	<p>1. Kindly provide further information on arrangements in</p>	<p>The Power Purchase Agreement between D3PG and Enemalta states that Enemalta will be</p>	<p>1. Noted. Further queries may arise following submissions by other operators.</p>	<p>Noted.</p>	<p>1. Noted</p>		✓	-	-	-	-	✓	-

	place in terms of sea water dosing. This query arises in view that D3PG will be in charge of the sea water cooling pumps and thus co-ordination between entities needs to be further explained. This may also be briefly mentioned in section 1.3	responsible for the dosing of seawater to satisfy the conditions for operating the D3 plant. Enemalta commits that the dosage of chlorine dioxide to seawater at D3's outfall pit will not exceed 0.1ppm. On the other hand, D3PG will be in charge of the seawater pumping system.											
2.	A drawing showing all	Included in previous section.	2. Noted, see comments in earlier section.	Noted.	2. Noted								



	the tie in points with the other operators shall accompany the explanation in this section .												
	3. Reference to the discharge point monitoring and common sewerage connection shall also be included in this section .	This section has been amended accordingly.	3. Noted. See earlier comment on monitoring prior to connection with common discharge point to sea	Noted.	3. Noted	TP list and map amended in Section C1.4.3.		Comments made in previous section regarding the Tie-in points refer.	Noted (refer to previous section)	Kindly refer to comment on TP15 made in previous section.	Noted		
					4. As per meeting held on Tuesday 9 <sup>th</sup> February regarding tie in	With regards to TP21, it is important to note that D3 GRS plant is							

					points, all plans which show tie in points shall be amended and corresponding table included at the end of this document shall be confirmed / amended	owned by D4, so the TP21 should not fall within the remit of D3. D3 only connects to the GRS for gas supply and is not involved in the operation or control of the GRS.							
<b>B3 – Your Proposed emissions</b>													
C 3.1	Noted	-	-	-	-	-	✓	-	-	-	-	✓	-
C3.1.1,													
C3.1.2	Kindly provide a drawing showing the locations of areas A to C as quoted in section 3.1.2. in view that figure 16 does not show the waste storage area. Please include reference to this drawing in the text and in the form.	Included.	Noted	-	-	-	✓	-	-	-	-	✓	-
C3.1.3	For these wastes, give details on	The current waste contractors	Reference to figure 14 is not included in the	Reference and text have been	Referenc e to drawing	Referenc e to drawing	✓	Noted	-	-	-	✓	-

	<p>authorised disposal/recovery facilities proposed to be used for each waste. If any on-site recovery of waste is proposed, provide details.</p> <p>For each of these wastes, give details on off-site transportation, including registered waste carriers/brokers to be used.</p>	<p>might change in the future. Whoever will be given such a contract would need to be registered with MEPA as a waste carrier.</p>	<p>text. In this regard kindly amend text accordingly and confirm whether Enemalta will be responsible for maintenance of oil/water interceptors managing D3 oily water destined for discharge.</p> <p>Prior to commencement of consultation, D3PG will be required to disclose information and permit numbers of all waste contractors/ waste management sites commissioned for the management of the waste generated.</p>	<p>amended accordingly</p> <p>List of waste contractors, permit numbers and waste broker numbers were added in this section. These contractors are subject to change depending on the prices tendered by different companies.</p>	<p>to be included in text. Waste contractors shall be finalised before the date of the public hearing allowing enough time for MEPA to review and confirm permits in place</p>	<p>included in text.</p> <p>Waste contractors list will be confirmed prior to the date of public hearing.</p>							
C3.2	<p>Noted</p> <p>Kindly see comment to section 1.4.1 in relation to land and groundwater risk assessment</p>	Noted	Noted	-	-	-	✓	-	-	-	-	✓	-
C3.3 C3.3.1	Kindly provide a drawing showing the	Included. The cesspit that is	Kindly include Tie in point number in figure	Tie in point number included in	As per meeting held on	Noted	✓	-	-	-	-	✓	-

	sewer line connections	connected to the 'office' currently belongs to Enemalta.	15 Kindly confirm whether the "synconta 700 pump chambers" marked in green on figure 15 are the cess pits mentioned in the text in the last paragraph of section 3.3 which are used by D3PG.	DRG 116b.  Each synconta 700 pump chamber pumps the sewage contents of each of the two cesspits that are connected to Enemalta's main underground pit.	Tuesday 9 <sup>th</sup> February regarding tie in points, all plans which show tie in points shall be amended and corresponding table included at the end of this document shall be confirmed/ amended								
C3.3.2	Please note that during consultation, any amendments required to your application will be discussed with WSC in view that 3 operators will be using the same discharge connection to the sewer	Noted.	Please note that during consultation, any amendments required to your application will be discussed with WSC in view that 3 operators will be using the same discharge connection to the sewer	Noted	Noted.	-	✓	-	-	-	-	✓	-
C3.3.3	Kindly tick the appropriate box in the form and if required additional information	Done.	Noted	-	-	-	✓	-	-	-	-	✓	-

C3.3.4	Kindly tick the appropriate box in the form and if required additional information	Done.	Noted	-	-	-	✓	-	-	-	-	✓	-
C3.4	<p>1. Kindly amend Fig 19 to show how evaporated water from the operations of D3PG will be rerouted to Enemalt a's evaporated water storage tank.</p> <p>2. Kindly explain the reference to section 0</p> <p>3. Kindly include cross referencing to Fig. 20</p>	<p>Included in a separate drawing in Section 3.4</p> <p>Amended.</p> <p>A map has been included.</p>	<p>1. Noted. Kindly include reference to Figure 16 in the text.</p> <p>2. Noted</p> <p>3. Kindly include a drawing showing all discharge points listed</p>	<p>Included</p> <p>The discharge points shown in the previous table have</p>	<p>1. Noted</p> <p>2. –</p> <p>3. As per meeting held on Tuesday 9<sup>th</sup> February</p>	<p>Tie-in points table and map have been updated</p>	~	<p>Comments made in previous section regarding the Tie-in points refer</p>	<p>Noted (included in previous section)</p>	<p>Kindly refer to comment on TP15 made in previous section.</p>	<p>Noted</p>	✓	-

	<p>in section C3.5 to refer to the discharges to sea. Kindly also provide the geo-referenced co-ordinates of each discharge point to sea at Marsaxlokk Bay and treatment prior to discharge.</p>		<p>in table 11. You may wish to amend figure 17</p>	<p>been removed because these do not lie within the remit of D3PG, but of Enemalta. The D3PG tie-in points connected to such discharges have been referenced in text.</p>	<p>regarding tie in points, all plans which show tie in points shall be amended and corresponding table included at the end of this document shall be confirmed/ amended</p>	<p>in Section C1.4.3.</p> <p>With regards to TP21, it is important to note that D3 GRS plant is owned by D4, so the TP21 should not fall within the remit of D3. D3 only connects to the GRS for gas supply and is not involved in the operation or control of the GRS.</p>								
	<p>4. details on how D3PG's discharges shall be monitored prior to connection to</p>	<p>A temperature probe is the only monitoring equipment at D3's outfall which D3PG is responsible</p>	<p>4. Further discussions may need to be held so as to ensure that any exceedances of ELVs set by the Authority registered</p>	<p>Noted.</p>	<p>4. Noted</p>									



	<p>points mentioned in the drawing are not explained. Kindly amend drawing accordingly</p> <p>3. Details on any treatment prior to discharge shall also be provided in the text</p> <p>4. Kindly explain the reference to section 0</p>	<p>listed in the legend and are now also explained in detail in Section 1.4.3.</p> <p>Included in this Section.</p> <p>Amended.</p>	<p>3. Noted, kindly confirm whether Enemalta is responsible for the maintenance of oil/water interceptors catering for D3PGs oily water</p> <p>4. Noted</p>	<p>Included as in Section 3.1.3</p>	<p>3. Noted</p> <p>4. –</p>								
C3.6	<p>1. This section shall be accompanied by applicable drawing</p>	<p>Drawings will be provided once the exact geographical locations of the pressure-relief valves</p>	<p>1. Kindly submit a drawing showing all emission points to air or refer to any applicable drawing</p>	<p>Included, refer to DRG 113b in Section 1.3.</p>	<p>1. Kindly confirm if DRG113 b is another drawing other than 113c (figure 6).</p>	<p>Confirmed. DRG113 c is the revised version of DRG113 b. The latter was not</p>	✓	<p>Noted</p>	<p>-</p>	<p>-</p>	<p>-</p>	✓	<p>-</p>



	gs showin g all emissi on points to air.	for the gas supply will be determined. This information should be available in the following submission.	submitted in earlier sections. PRVs will need to be included once their location is confirmed.			included in the 4 <sup>th</sup> submissio n.							
	2. Kindly include details on emissi ons from auxilia ry boiler and provid e locatio n of the emissi on point on a drawin g. (Altho ugh the locatio n of the boiler has been provid ed in an earlier	Implemente d in Section 3.6.	2. Noted. see comments to 1 above	Included	2. –								

	section , kindly include the location of the emission point in the drawing mentioned in point 1 above.												
	3. Project ed emissi ons data and hours of operati on of the boiler shall be provid ed.	Implemente d.	3. Noted. Kindly note earlier comments on emission levels from the boiler. It is suggested that earlier sections make reference to Table 13 which contains emissions data from the boiler.		3. Noted								
	4. Any day tank vents and any	As explained above, once the location of all air emission	4. Noted, see comment 1 above		4. –								

	<p>pressur e release valves in the ammon ia dosing system shall be include d as emissi on points.</p> <p>5. Post abatem ent emissi on figures shall be further discuss ed with the operato r in view of request by D3PG dated 18<sup>th</sup> Septem ber 2015.</p>	<p>points are confirmed, a holistic map showing all the emission points will be provided.</p> <p>Noted.</p>	<p>5. MEPA awaits update to letter dated 18<sup>th</sup> September 2015 which are required following meetings with the operator. Once submitted the emission limit values to be set for the converted plant will need to be further discussed.</p>	<p>Updated justification letter has been sent.</p>	<p>5. MEPA has taken note of the proposal and justificati on.</p>								
C3.7	<p>Kindly refer to historical episodes related to the ammonia dosing system</p>	<p>According to Enemalta, no such episodes have</p>	<p>Noted.</p>		<p>Odour issues will be addressed through permit</p>	<p>Noted</p>	✓						

	<p>and corrective actions taken by Enemalta. Kindly provide information as to how such actions shall continue in the event of episodes of odour.</p> <p>Details can be requested from Enemalta.</p>	<p>occurred in the past. The complaints Enemalta was aware of during D3's operation are related to odours generated from VOCs. Enemalta has always disputed this as complaints were received from roads opposite to where one would expect the smell to travel.</p>			condition s								
C3.8	<p>1. Kindly include information on tests carried out during the land investigations carried out as part of the current permit and augmen</p>	<p>This section has been updated accordingly.</p> <p>Included in Appendix V.</p>	<p>1. Noted</p> <p>2. Noted</p>		<p>1. –</p> <p>2. –</p>		✓						

	<p>t this section with the findings from such a report limiting oneself to the areas of operation under the responsibility of D3PG.</p> <p>2. A copy of the report shall be cross referenced and provided</p>												
C3.9	<p>1. Kindly provide results of the latest noise monitoring carried out on site and a comparison with previous noise monitoring surveys. This must show whether there was</p>	<p>Included, report attached in Appendix V.</p>	<p>1. Noted. Noise monitoring will be required as part of the IPPC Permit and shall follow: standard ISO8297: 1994 and any revision thereof, and ISO37XX series or specifically ISO 96142:1996. Such a standard is</p>	<p>Included in text.</p>	<p>1. Noted</p>	-	✓	-	-	-	-	✓	-

	<p>a reduction/increase of noise at the closest sensitive receptors.</p> <p>2. Kindly also augment the section showing whether the conversion of the plant will lead to reduction/increase of noise at the closest sensitive receptors</p>	Included.	<p>more relevant to multi operator installations</p> <p>2. Noted</p>		2. –								
C3.10	Not Yet Provided	Included.	<p>1. Regarding monitoring of emissions to air, kindly provide details on any recalibration required following conversion and prior to operation on gas.</p>	<p>Additional details have been provided in this section.</p> <p>Noted.</p>	<p>1. Regarding monitoring of emissions to air, kindly provide details on any recalibration required following conversion and prior to operation on gas taking into</p>	<p>It is being proposed that following the conversion process, the QAL2 tests would need to be conducted, which will be followed by the AST</p>	✖	<p>1. As per email dated 2 March 2016 kindly note that both QAL2 and AST calibration tests would be required during the commissioning period (i.e. after the IPPC permit is issued). The submission of such certification will be included as a requirement in the permit.</p>	<p>1. Noted and will be implemented during the commissioning period</p>	1. Noted	-	✓	-

			2. Regarding emissions to the sea, further discussions may need to be held so as to ensure that any exceedances of ELVs set by the Authority registered by Enemalta at the final discharge point can be traced back to individual operators		consideration the new start-up and shutdown periods	tests whenever they are due.		2. –	2. –				
					2. Noted								
					3. MEPA now also notes that the gutter system surrounding D3 will be discharging into a settling pit which overflows into the Hofra –z- Zghira outfall. Kindly	Included in Section C3.10 in sea emissions	3. Noted. The gutter checks shall be included in the weekly inspection SOP which shall be provided to ERA prior to commencement of operations.	3. The gutter checks are already included in the existing weekly inspection SOPs.	3. Noted.				

					include information on control measures in place including monitoring regimes and maintenance coordinated between both operators.								
					4. Kindly also include details on monitoring regime to be applied to discharge point TP14	Included in Section C3.10 in sea emissions.		4. Noted					
C3.11	Not Yet Provided	Included as two flow diagrams.	Noted. Section may need to be revisited following updates and conclusion on pending items in earlier sections.	Noted.	Noted. Section may need to be revisited following updates and conclusion on pending items in earlier sections.	Noted	✓	-	-	-	-	✓	-
<b>C4 – Impact on the Environment</b>													
C4.1	Not Yet Provided	Included	Noted. Section may need to be revisited	Noted.	-	-	✓	-	-	-	-	✓	-



			following updates and conclusion on pending items in earlier sections.										
C4.2	Not Yet Provided	Included	Noted		-	-	✓	-	-	-	-	✓	-
<b>C5 – Environmental statements</b>													
C5.1	<p>1. In reply to this question, relevant excerpts from the original EIA shall be provided including a summary of conclusions.</p> <p>2. Regarding the D4 EOIA, kindly include reference to relevant PA numbers together with excerpts from sections</p>	<p>Included.</p> <p>Included.</p>	Noted. Section may need to be revisited following updates and conclusion on pending items in earlier sections.	Noted	-	-	✓	-	-	-	-	✓	-

	where D3 including its conversion was mentioned and discussed within the context of the construction of D4.												
<b>C6 – Statutory consultees</b>													
C6.1	Noted	-	-	-	-	-	✓	-	-	-	-	✓	-
C6.2	Noted	-	-	-	-	-	✓	-	-	-	-	✓	-
C6.3	Noted	-	-	-	-	-	✓	-	-	-	-	✓	-
<b>C7 – Planning Status</b>													
B7.1	Not Yet Provided	Included.	Noted. Section may need to be amended with new applications submitted until time of consultation.  MEPA will guide D3PG accordingly.	Noted.	Kindly confirm whether issues of development consent for the new boiler have been concluded	No planning consent is required due to Article 85 (2) (f) of Act VII of 2016: Development Planning Act, 2016.  70. (1) Subject to the provisions of this article and to the following provisions of this Part of the Act, and subject	✓	Noted. Confirmation from the Planning Authority will be requested as part of the Regulatory Consultation	Noted	-	-	✓	-

						<p>to articles 55 and 85(2)(n), no development shall be carried out except with development permission .</p> <p>(2) For the purposes of this article, and, unless the context otherwise requires, for all other purposes in this Act, "development" means the carrying out of building, engineering, quarrying, mining or other operations for the construction, demolition or alterations in, on, over, or under any land or the sea, the placing of advertisements or the making of any material change in use of land or building</p>							
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						and sea, other than: (f) the placing of plant and machinery required for the operation of a use already covered by developme nt permission on land within the perimeter of the site covered by the same permission of the use being operated.								
B8 – Technically competent person														
B8.1	Not Yet Provided	Will be provided.	Not Yet Provided	Included in Section 8.1 and Form C 8.1.	Include reference to Appendix VI in the form.	Referenc e included	✓	Noted	-	-	-	✓	-	
B8.2	Not Yet Provided	Will be provided.	Not Yet Provided	Included in Form C 8.2.	-	-	✓	-	-	-	-	✓	-	
B9 – Expenditure plan														
B9.1	Not Yet Provided	Will be provided.	Not Yet Provided	It is currently being discussed.	MEPA awaits submissio n	Included in Section C.9	✓	Noted	-	-	-	✓	-	

## Inspection Report

Installation: Delimara Power Station  
Location: Delimara Power Station – Enemalta Plc, Delimara, Marsaxlokk  
Date: 25 May 2016  
Present: *ERA*: Anthony Aquilina (Team Manager), Nathalie Ellul (EPO), Stefan Azzopardi (AEPO)  
*Enemalta*: Ing. Ismail D'Amato, Ing. Sylvana Debono, Johann Zammit  
*iAS*: James Schembri  
*AECOM*: Kate Aplin  
*IAS*: Ruth Debrincat, Sacha Dunlop

The site visit at the installation commenced at 09:30am with a meeting whereby the scope behind the inspection and areas which had to be visited were indicated.

The meeting was followed by a walk-through inspection where the various structures and generating plants operated by the various operators were explained in detail. This included the following areas:

- Jetty and Regas Area which will be operated by Electrogas Malta Ltd (EGM).;
- The area around the Enemalta Diesel oil and HFO tank farms;
- The diesel engines and associated waste management area which will be operated by D3PG;
- The cooling water intake and associated seawater pumps;
- The cooling water outfall and tie-in points which will be utilised by D3PG and EGM;
- The boiler blowdown settling pits operated by Enemalta;
- Area around DPS 1 and DPS 2;
- Areas where oil water interceptors are installed;
- Evaporators and DM plant which will be operated by Enemalta.
- CCGT areas which will be operated by EGM.

With regards to the cooling water outfall all operators were notified that in addition to the discontinuous monitoring currently required as part of the current IPPC permit (IP002/07/E), all operators will be required to install equipment for continuous monitoring of the effluent generated by the respective operator. The continuous monitoring equipment is to be ideally located at a point where the operator is in a position to ensure that only water from the respective generating plant is being monitored. ERA confirms that continuous monitoring is required for the following parameters: Flow, pH and temperature in line with the current permit conditions. On this matter, EGM are to provide feedback as to whether it is technically possible to install such equipment at the sampling manhole.

As part of the inspection, the movement of Enemalta's waste site was discussed and the current temporary waste sites were visited. Within the temporary hazardous waste area, a number of IBCs containing boiler blowdown effluent, waste oils from the conversion of the diesel engines and other hazardous material were observed. Some oil contamination from the cleaning of structures within the bunded area was noted. Enemalta was notified to ensure that any oil spillages are immediately cleared using appropriate absorbent material. Upon visual

inspection, it transpires that the containment volume of the waste area does not cater for 110% of the volume stored within the area. In view of this, Enemalta were requested to ensure that wastes are disposed of as quickly as possible.

Enemalta were requested to provide an indication of the timeframe by when the permanent waste site will be set-up, however, Enemalta indicated that this issue is still being discussed with Electrogas in view that Enemalta were not in agreement with the waste site being proposed by EGM. Following agreement on this matter, Enemalta would have to issue a tender for the construction of the waste site, therefore, an exact timeframe could not be provided. Nonetheless, ERA indicated that this issue had to be concluded prior to the determination of the IPPC permit.

The inspection was concluded at 1150am.