Control of Major Accident Hazards Assessment Report

ENEMALTA DELIMARA POWER STATION

COMAH Assessment Report

ENEMALTA Safety Report
ENEMALTA Safety Management System
ENEMALTA Emergency Response Plan

October 2016
Control of Major Accident Hazards Assessment Report

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ENEMALTA Safety Report
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ENEMALTA Emergency Response Plan

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Abbreviations

ALARP  As Low As Reasonably Practicable (ALARA: As Low As Reasonably Achievable)
BLEVE  Boiling Liquid Expanding Vapour Explosion
BOG    Boil-Off Gas
CCGT   Combined Cycle Gas Turbine
CLP    Classification, Labelling, Packaging (Regulations)
COMAH  Control of Major Accident Hazards (Authority)
CPD    Civil Protection Department (Malta)
D3PP (PS)  Delimara 3 Power Plant (Power Station)
D4PP (PS)  Delimara 4 Power Plant (Power Station)
EGM    ElectroGas Malta Ltd
ENE    ENEMALTA
ERA    Environment & Resources Authority (Malta) former MEPA
ERP    Emergency Response Plan
ESD    Emergency Shutdown
FBR    Full Bore Rupture
FP     Flash Point
FSU    Floating Storage Unit
GRS    Gas Receiving Station
HAZID  Hazard Identification study
HAZOP  Hazard & Operability study
HC     Hydrocarbons
HCV    Hydrocarbons Vapours
HMB    Heat and Material Balances
HSE (UK)  Health & Safety Executive (UK)
HSE    Health Safety & Environment
IEP    Internal Emergency Plan
IR     Individual Risk
LA(s)  Loading Arm(s)
LFL    Lower Flammability Limit (LEL: Lower Explosive Limit)
LNG    Liquefied Natural Gas
LNGC   LNG Carrier
LOC    Loss of Containment
LOPA   Layer of Protection Analysis
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tr>
<td>LSIR</td>
<td>Location Specific Individual Risk</td>
</tr>
<tr>
<td>LUP</td>
<td>Land Use Planning</td>
</tr>
<tr>
<td>MAPP</td>
<td>Major Accident Prevention Policy</td>
</tr>
<tr>
<td>MEPA</td>
<td>Malta Environment &amp; Planning Authority</td>
</tr>
<tr>
<td>(M)SDS</td>
<td>(Material) Safety Data Sheet</td>
</tr>
<tr>
<td>MW</td>
<td>Molecular Weight</td>
</tr>
<tr>
<td>NBP</td>
<td>Normal Boiling Point</td>
</tr>
<tr>
<td>NG</td>
<td>Natural Gas</td>
</tr>
<tr>
<td>NVCC</td>
<td>Non Visible Combustion Chamber</td>
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<td>OGP</td>
<td>International Association of Oil &amp; Gas Producers</td>
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<td>OHSA</td>
<td>Occupational Health and Safety Authority (Malta)</td>
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<td>ReGasification Unit</td>
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<tr>
<td>RPT</td>
<td>Rapid Phase Transition</td>
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<tr>
<td>SCL</td>
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<tr>
<td>SMS</td>
<td>Safety Management System</td>
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<tr>
<td>TNO</td>
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<td>UFL</td>
<td>Upper Flammability Limit (UEL: Upper Explosive Limit)</td>
</tr>
<tr>
<td>(U)VCE</td>
<td>(Unconfined) Vapour Cloud Explosion</td>
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<tr>
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<td>Worst Case Scenario</td>
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1. Introduction

1.1 Project Background

The Delimara Power Station was established in 1991, and is currently the main provider of electricity generation in the Maltese Islands. Throughout the years, Enemalta (so called ENE in the document) has been instrumental in pioneering the usage of new technology to reach its corporate objectives together with offering better products and the best service to its customers.

The scope of Enemalta Delimara Power Station (DPS) Safety Report (SR) includes all the facilities, considering several phases of operation, according to the planning for the conversion of the facilities for combustion of natural gas as the principal source of energy. The loading, unloading, storage and transfer operation in the power plant, both for gas oil and fuel oil, as it happens in the current situation, but also the use of Diesel Oil only in the power plant and storage of both HFO and gasoil fuels, as it will happen in the future, is studied in the Enemalta SR.

In view of the construction and operation of ElectroGas Malta project which includes a Floating Storage Unit (FSU) for the storage of Liquefied Natural Gas (LNG), a Regasification Unit and the construction of the new D4 PS, there is also a provision of the conversion of Delimara Power Station-DPS3 to operate on Natural Gas (NG). D3PG will be the operators of the D3 engines based power plant, once they are converted to NG. The presence of hazardous substances in the facilities operated by D3PG will be always below the minimum thresholds established by the Seveso III Directive.

The handling of natural gas has been considered out of scope of ENEMALTA DPS SR, both for the current and the future situation, being the NG facilities not owned nor operated by Enemalta, even if the pipelines cross the Enemalta site. The natural gas handling is covered by ElectroGas Safety Report [1], as prepared and submitted by the owner of the pipelines. The presence of new natural gas pipelines within the facilities is expected to introduce an additional risk of gas leakage and gas fire and, more important, the possibility for a domino effect to happen within the facilities. This domino effect is considered as external domino effect and is assessed in the Coordinated Safety Report [30].

Prior to the commencement of conversion of DPS3, Enemalta will remain responsible for operating all eight diesel engines, steam turbine and auxiliary systems of DPS3. Following the complete transfer of operations of DPS3 to D3PG, Enemalta will no longer be responsible for operating the DPS3 eight diesel engines, steam turbine and auxiliary systems. The transfer of DPS3’s operations is to take place in two phases, each phase coinciding with the conversion phases of the plant to operate on NG. The first phase will see the conversion of the first four diesel engines to operate on both NG and gasoil. Up to completion of this first phase, Enemalta will continue to operate engines 1, 2, 3 and 4. Following completion of the first phase, D3PG will have the capability to operate the converted engines on NG and gasoil. Simultaneously Enemalta will stop operating engines 1, 2, 3 and 4, and allow said engines to be converted to run on NG. Therefore, upon completion of the first phase, Enemalta will no longer operate any of the eight DPS3 engines.
Due to the total amount of Dangerous Substances stored and handled in all facilities of Enemalta Delimara Station, Enemalta is an “upper tier” establishment as defined by the Control of Major Accident Hazards (COMAH) Regulations LN 179/2015 that implement in Malta the Seveso III Directive 2012/18/EU of the European Parliament and of the Council of 4 July 2012 “On the control of major-accident hazards involving dangerous substances”.

Maltese COMAH Competent Authority\(^2\) launched a project for the assessment of the updated Enemalta’s Reports (Deliverables), namely ENE Safety Report (ENE SR), Safety Management System (ENE SMS) and Emergency Response Plan (ENE ERP), according to the provisions of Seveso III Directive. GAP ANALYSIS S.A. has undertaken the task of performing the Assessment of Enemalta Reports (ENE SR, ERP and SMS) and of developing the COMAH Assessment Report on behalf of COMAH Authority.

A consistent and systematic approach has been adopted, aligned with practices used by the European Competent Authorities (CAs) and Third Parties, controlling major accident hazard risks in the EU Member States (Maltese Proposed COMAH Framework and LUP Policy, Health & Safety Executive UK, RIVM, etc.), aiming at providing advice to improve further the safety of the project and enhance human and environmental protection. Compliance with regulatory requirements (SEVESO III - COMAH) has been verified in terms of completeness and adequacy of safety related documentation, according to EC Guidelines on the preparation of SEVESO SRs and on Inspections of COMAH sites, and according to Hazard Identification Checklists and SMS Evaluation Checklists adopted by UNECE.

The present ENEMALTA DPS COMAH Assessment Report summarises findings, conclusions and recommendations derived during the assessment of the final versions of ENEMALTA DPS Safety Report, the ENEMALTA DPS Safety Management System and the ENEMALTA DPS Emergency Response Plan as submitted to COMAH CA and supplemented by relevant supporting studies, reports and information.

1.2 Study Scope

The purpose of the present Assessment Report titled “ENEMALTA DPS COMAH Assessment Report” is to provide technical support to Maltese COMAH Authority in order to verify compliance with regulatory requirements (SEVESO III Directive) as mainly related to Art.10 (Safety Report) of the Directive and particularly on:

par. 1 (a) “... demonstrating that a MAPP and SMS for implementing it have been put into effect in accordance with the information set out in Annex III of the Directive”

par. 1 (b) “... demonstrating that major-accident hazards and possible major-accident scenarios have been identified and that the necessary measures have been taken to prevent such accidents and to limit their consequences for human health and the environment”

par. 1 (c) “... demonstrating that adequate safety and reliability have been taken into account in the design, construction, operation and maintenance of the installation, storage facility, equipment and infrastructures connected with its operation which are linked to major-accident hazards inside the establishment”

\(^2\) The Competent Authority is set up jointly by the Occupational Health and Safety Authority (OHSA) together with the Environment and Resources Authority (ERA), the Planning Authority (PA) (former Malta Environment and Planning Authority (MEPA)) and the Civil Protection Department (CPD) of the Ministry for Home Affairs and National Security.
par. 1 (d) “… demonstrating that internal emergency plans have been drawn up and supplying information to enable external emergency plan to be drawn up”
par. 1 (e) “… providing sufficient information to the competent authority to enable decisions to be made regarding the siting of new activities or developments around existing establishments”.

The findings, conclusions and recommendations of the present ENEMALTA DPS COMAH Assessment Report provide:
- technical documentation for the definition of specific terms (before commissioning and after commissioning) for Licensing purposes, and
- technical guidance to COMAH Inspections which should be performed according to Art. 19 and 20 of the SEVESO III Directive, prior or following the start of operations.

All recommendations are developed based on the results of the assessment of ENE Safety Report, SMS and ERP, for the completeness, correctness, adequacy and credibility of their contents according to SEVESO III requirements.

ENE Deliverables that have been reviewed and fall under the scope of ENE COMAH Assessment Report are presented in Table 1.

Table 1: List of Reviewed ENE Deliverables

<table>
<thead>
<tr>
<th>Documents</th>
<th>Appendices to the documents</th>
<th>Reviewed</th>
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<tr>
<td>Safety Report</td>
<td>ENEMALTA_DPS_Safety Report_Final Issue (Rev. 03). Report number: 02-901-200560-15958</td>
<td>Annexure 1_PHA Report, Annexure 2_SDS, Annexure 3_Drawings, Annexure 4_Consequence Maps, Annexure 5_Calculations</td>
</tr>
<tr>
<td>Enemalta DPS Emergency Response Plan (ERP)</td>
<td>160728_Enemalta DPS_ERP_Final Issue (Review 4.1, July 28th 2016). Report number: 02-901-200560-16995</td>
<td>Annexure 1_Emergency Contact List, Annexure 2_Emergency procedures, Annexure 3_Material Resources, Annexure 4_Maps &amp; Drawings</td>
</tr>
<tr>
<td>Enemalta DPS Safety Management System (SMS)</td>
<td>160727_Enemalta DPS_SMS_Final Issue (Review 0.3, July 27th 2016). Report number: 02-901-200560-16210</td>
<td>Enemalta DPS SMS MP Procedures (Date: 14/1/2016 to 29/7/2016)</td>
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The above Deliverables make reference to supplementary data, reports and studies, plots and drawings, etc., which are not explicitly mentioned in Table 1. For assessment purposes, all safety related documentation included in that supplementary material has been considered during the review process. In all cases, where supplementary material has been reviewed, relevant references are included in the assessment performed and in the present ENEMALTA DPS COMAH Assessment Report.

The Documents reviewed refer to all facilities of Delimara Power Station (D1, D2A, D2B, D3). The documents related to the conversion of Delimara D3 PP are not included in the present Assessment Report, since Delimara D3 PP is not classified as an upper tier COMAH site.
1.3 Report Layout

The Sections of the ENEMALTA DPS COMAH Assessment Report are set out as follows:

- Section 1 provides description of Project background and the Scope of ENEMALTA DPS COMAH Assessment Report.
- Section 2 provides a brief Project Description.
- Section 3 presents the methods and tools applied for the assessment of ENEMALTA DPS Safety Report, Safety Management System and Emergency Response Plan. Section 3 describes also the Damage Thresholds and Risk Acceptance Criteria applied for the evaluation of the major accident scenarios included in Enemalta Consequence Analysis and Risk Assessment Reports and refers to the approach applied for the evaluation of risk analysis parameters and assumptions relevant to meteorological data, initiating events, selection of LOCs, incident types and Worst Case Scenarios (WCSs).
- Section 4 presents the review recommendations based on the results of the assessment of ENE Safety Reports, SMS and ERP. The proposed recommendations are divided in two categories according to their significance:
  - “General Recommendations” to be considered after commissioning, and
  - “Specific Requirements (or recommendations)” to be regarded as conditions, limitations or binding terms for issuing an operational permit before commissioning starts.

ENEMALTA DPS COMAH Assessment Report includes Annexes A and B, which constitute an integral part of ENEMALTA DPS COMAH Assessment Report.

- Annex A, includes the Assessment Checklists applied for addressing completeness, correctness and credibility evaluation of ENEMALTA SR, SMS and ERP contents. UNECE Sectoral Check Lists (SCLs) have been used as the basic guidance tool for the evaluation procedure and the development of SR, SMS and ERP Checklists.
2 Brief Project Description

2.1 Location of the New Establishments

Delimara Power Station (DPS) is located approximately 1 km south east of Marsaxlokk Village, at L-Inginier, on the Delimara Peninsula. This power station is built on partly reclaimed land and commenced operations in 1991. The site is bounded to the east by a road which runs between Tas Silg Fort and Fort Delimara, at an elevation of approximately 40 m above sea level. The western boundary of the site is delineated by Marsaxlokk Bay.

The location of the project is shown in Figure 1:

![Figure 1: Location of ENEMALTA Delimara Power Station](image)

2.2 Facilities Description

The main components in the Delimara Power Station are:

- **PHASE 1 (D1):** Two HFO steam units with boiler, steam turbine and generator, for baseload operations, 2 x 60 MW
- **PHASE 2a (D2A):** Two DO open cycle gas turbines and generator units at 37.5 MW, designed for peak load
- **PHASE 2b (D2B):** Two DO combined cycle gas turbines with heat recovery steam generators and a steam turbine for midrange duties, with a total capacity of 110 MW
- **PHASE 3 (D3):** Eight medium-speed diesel engines of the Wartsila Model 18V46, as well as a steam turbine generator of the Dresser-Rand model Frame 30 (Multi Stage Impulse Condensing), designed to combust heavy fuel oil as the main fuel and diesel fuel oil as a backup option.
The thermal power station of the plant is resumed in Table 2.

Table 2: Delimara Power Station Main Components

<table>
<thead>
<tr>
<th>Construction Phase</th>
<th>Source</th>
<th>Total Thermal Rating MWTH</th>
<th>Fuels</th>
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<tbody>
<tr>
<td>Phase 1</td>
<td>Steam Boilers (phase 1A and phase 1B)</td>
<td>332</td>
<td>Heavy Fuel oil (HFO)</td>
</tr>
<tr>
<td></td>
<td>CCGT1</td>
<td>121</td>
<td>Gasoil (DO)</td>
</tr>
<tr>
<td></td>
<td>CCGT2</td>
<td>121</td>
<td></td>
</tr>
<tr>
<td>Phase 2A</td>
<td>CCGT3A</td>
<td>121</td>
<td>Gasoil (DO)</td>
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<tr>
<td></td>
<td>CCGT3B</td>
<td>121</td>
<td></td>
</tr>
<tr>
<td>Phase 2B</td>
<td>Diesel engines 41 &amp; 42</td>
<td>77</td>
<td>HFO &amp; DO</td>
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<td>Diesel engines 43 &amp; 44</td>
<td>77</td>
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<tr>
<td></td>
<td>Diesel engines 45 &amp; 46</td>
<td>77</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Diesel engines 47 &amp; 48</td>
<td>77</td>
<td></td>
</tr>
</tbody>
</table>

The total nominal capacities of fuel storage are presented in Table 3.

Table 3: Total “Petroleum Products” Inventories

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>No. of Storage Tanks</th>
<th>Total Nominal Capacity, m³</th>
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<tr>
<td>Heavy Fuel Oil</td>
<td>3</td>
<td>56,710</td>
</tr>
<tr>
<td>Gasoil</td>
<td>4</td>
<td>33,884</td>
</tr>
</tbody>
</table>

The delivery and the handling of HFO and Diesel are the most important activities from the point of view of safety, as it is in those activities where the initiating event that could originate a major accident, can be identified. Details on the storage facilities together with prevention, detection and fire fighting systems of the establishment are presented in Chapter 3 of ENE SR.

These activities include all the steps from the delivery of the fuel at the quay until its final combustion in the boilers, diesel engines and gas turbines of the plant. HFO and diesel are delivered by sea tankers to the quay, which has been built for that purpose inside the station area. After the arrival of the fuel, a high pressure hose is used to unload the HFO and pump it through steel pipes to one of the three HFO storage tanks. In the case of diesel, the fuel is unloaded from the sea tanks by coupling an unloading arm at the quayside and transferred afterwards to one of the three diesel storage tanks located at the southern boundary by steel pipework. In the quay, in order to prevent leakage due to movements of ships or pressure failure of the piping system, there is a breakaway valve on HFO and Diesel Unloading Arm Lines.

Before the diesel is used in the gas turbines, the raw fuel receives a previous treatment by pumping it to centrifuges. As a result from this pre-treatment, traces of water are removed from the raw diesel and the purified diesel is stored in another storage tank (number 3). Afterwards, it is directly pumped from this tank to the gas turbine through a series of above ground steel pipework. Diesel is circulated to the combined cycle gas turbines using a series of three transfer pumps. To the open cycle gas turbines Diesel is also circulated, using another series of two transfer pumps. In the
case of HFO, prior to being transferred to the boilers at the phase 1, it is pretreated in the fuel oil pumping station by means of heat. Afterwards, two transfer pumps circulate HFO to the boilers in phase 1 using three screw pumps.

The locations of the individual facilities and the perimeter of the existing ENEMALTA DPS establishment are presented in Figure 2.

According to Figure 2, the facilities located within the perimeter of the existing establishment of ENEMALTA DPS include also some of the new facilities of ElectroGas (EGM) Malta Project, which involves the operation of a Floating Storage Unit (FSU), a Regasification Compound, a new CCGT Power Plant (D4), Delimara 3 Gas Reduction Station and the MV witchgear.

ElectroGas Malta project facilities which are located within the boundaries of ENEMALTA DPS are:
- the new CCGT D4 Power Plant,
- the converted Delimara D3 PP with the D3 Gas Reduction Station, and
- the new main NG pipeline that supplies Natural Gas to the Power Plants from the Compressor station of the Regasification Plant.

Figure 2: Locations of Individual Facilities and ENE DPS perimeter (designated areas of individual operators), Source: Drawing #3, Annex 3 of the Coordinated Safety Report [30].
3 Methodology

3.1 Methodological Framework

3.1.1 Legislation, Guidelines and Technical Framework

ENEMALTA COMAH Assessment Report has been based on the following instruments:

- UNECE convention on the transboundary effects of industrial accidents and EU Directive 96/82/EC (SEVESO II) by a consistent Checklist system
- Guidance on inspections as required by article 18 of the Council Directive 96/82/EC (Seveso II)
- Guidelines on a Major Accident Prevention Policy and Safety Management System, as required by Council Directive 96/82/EC (Seveso II)
- Guidance on the preparation of a safety report to meet the requirements of Directive 96/82/EC as amended by Directive 2003/105/EC (Seveso II)
- JRC, Implementing Art.12 of the Seveso II Directive: Overview of Roadmaps for Land-Use Planning In Selected Member States, 2008
- CCPS Guidelines for Developing Quantitative Safety Risk Criteria, 2009 (Center for Chemical Process Safety)
- An international comparison of four quantitative risk assessment approaches, RIVM Report 620552001, 2011
- Guide Dépôts de Liquides Inflammables, Groupe de Travail Dépôt de Liquides Inflammables (GTDLI), 2008
- Probabilistic accident assessment in the context of the French regulation, HAL Id: ineris-00973347 http://hal-ineris.ccsd.cnrs.fr/ineris-00973347
- International Association of Oil & Gas Producers OGP Process Release Frequencies – Risk Assessment Data Directory, March 2010
- UK HSE-Health and Safety Executive, Hydrocarbon Release Database (HCDR)-Phast database
- LIFE+ EU Project PROTEAS Seveso SMS Inspection Checklist
### Project Execution

The approach adopted for the Assessment of ENE Safety Report (including ERP and SMS) and the development of ENEMALTA COMAH Assessment Report includes the following steps:

- **Determination of requested technical and design data regarding safety documentation for the development of Safety Report, SMS and ERP for ENEMALTA facilities.**
- **Determination of a Checklist System based on UNECE Sectoral Checklists for the systematic and consistent assessment of the completeness, correctness and credibility of safety related data included in the ENEMALTA deliverables (See Section 3.2).**
- **Review, assessment, definition of supplementary data and re-evaluation of submitted versions of ENEMALTA Safety Report (3 revisions), SMS (3 revisions) and ERP (3 revisions), including HAZID and HAZOP Studies.**
- **Consultation with COMAH Authority and ENEMALTA representatives for clarifying the proposed risk analysis framework, review of recommendations on ENEMALTA SR, SMS, ERP, reaching common understanding on key COMAH requirements, agreement on process design parameters for safety critical equipment and verification that relevant good industrial practices and Standards are accepted, adopted and applied in all project phases.**
- **Review of the assumptions adopted for risk analysis purposes with special reference to the definition of Worst Case Scenarios (WCSs) of major accident hazards and of software simulation parameters for consequence assessment regarding thermal radiation and overpressure effects.**
- **Validation of consequence assessment results and Risk Assessment results.**
- **Development of Location Specific Individual Risk (LSIR) for the WCSs using the EFFECTS 9.0.26/TNO software. The model parameters have been based on the design and operation data as provided by ENEMALTA Safety Report Developers.**
- **Recommendations for further elaboration of ENEMALTA Safety Report Consequence Assessment and Risk Assessment (e.g. definition of damage criteria, list of supplementary Scenarios FBR - of vessels and pipelines, Domino Effects Criteria, etc.).**
- **Analysis of risk parameters to verify the sensitivity of the outputs of the consequence assessment models and of scenarios frequencies per case.**
- **Delivery of complete sets of Assessment Checklists, Sections 1-6 for ENEMALTA DPS SR, SMS and ERP, for the intermediate versions and the reviewed final version of the Deliverables (see Table 1).**
- **Development of the ENEMALTA COMAH Assessment Report with recommendations based on the results of the Assessment Checklists and the supplementary information provided by the operators via the recommendation action tracking lists developed during the assessment process.**
3.2 Evaluation Checklists

UNECE Sectoral Checklists (UNECE-SCLs) have been applied to support the assessment and present the assessment findings for ENEMALTA DPS Safety Report including SMS and ERP. The findings and recommendations can also facilitate effective COMAH inspections after commissioning of operations.

UNECE SCLs are divided in 6 sections, as follows:

1. SCL description of the environment and site
2. SCL main activities and products for single installations
3. SCL dangerous substances
4. SCL identification of hazards, risk assessment and preventive measures
5. SCL limitation of consequences and mitigation
6. SCL Major Accident Prevention Policy (MAPP) & Safety Management System (SMS)

The system of checklist is presented in electronic worksheets which allow an easy switch between the checklists, guidance text, references, and progress tracking. All questions are organized in three categories, so-called “3-Cs”:

- Under “Complete” questions will verify the presence of the required, essential information that a safety report should contain; and
- Under “Correct” and “Credible” will go questions that would be used to verify the ones in complete (to cross-check them).

The different SCLs give an overview on all safety performances, expressed by the simple yes/limited/no evaluation system. Detailed description of findings and comments are summarized for each element of every SCL.

For the assessment of ENEMALTA Safety Report and Safety Management System, the actual UNECE Checklists have been applied. Regarding the assessment of Internal Emergency Plan, the UNECE Checklist (Section-5) has been further elaborated including in each specific thematic area supplementary relevant provisions, as applied for COMAH sites based on “Guidance on inspections as required by article 18 of the Council Directive 96/82/EC (Seveso II)” and on EU Program LIFE+ PROTEAS Seveso SMS Inspection Checklist.

The detailed description of the evaluation findings: references to provisions and procedures, identified gaps and comments, according to completeness, correctness and credibility assessment of the information provided by ENEMALTA were presented to the COMAH CA according to UNECE SCLs format.

The overall conclusions based on the evaluation findings and the review recommendations per each SCLs Section 1-6 are presented in Section 4 of the present report.
3.3 Risk Acceptance Criteria

3.3.1 HSE UK LUP Policy - PADHI System

Land Use Planning Policy (New Version 2015) (Revised MEPA, Land Use Planning Policy 2004) as proposed by Maltese COMAH Authority is in line with the widely accepted LUP practice proposed by HSE in UK (PADHI system [15]). According to the PADHI System, a proposed development in the vicinity of major hazard establishments is classified into one of four “Sensitivity Levels”. The main factors that determine these levels are the number of persons at the development, their sensitivity (vulnerable populations, such as children) and the intensity of the development. With these two factors known, a simple decision matrix is used to give a clear "Advise Against" (AA) or "Don't Advise Against" (DAA) response, as presented in Table 4.

Table 4: Decision Matrix for LUP (HSE UK)

<table>
<thead>
<tr>
<th>Location Risk of fatality (per year)</th>
<th>Development in Inner Zone</th>
<th>Development in Middle Zone</th>
<th>Development in Outer Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 x 10^{-5}</td>
<td>1 x 10^{-6}</td>
<td>3 x 10^{-7}</td>
<td></td>
</tr>
<tr>
<td>Level 1 e.g. Factories</td>
<td>DAA</td>
<td>DAA</td>
<td>DAA</td>
</tr>
<tr>
<td>Level 2 e.g. Houses</td>
<td>AA</td>
<td>DAA</td>
<td>DAA</td>
</tr>
<tr>
<td>Level 3 e.g. Vulnerable members of society (schools, old people's homes)</td>
<td>AA</td>
<td>AA</td>
<td>DAA</td>
</tr>
<tr>
<td>Level 4 e.g. Football ground/Large hospital</td>
<td>AA</td>
<td>AA</td>
<td>AA</td>
</tr>
</tbody>
</table>

The three contours in Figure 3 represent levels of individual risk of
- 10 chances per million (cpm) or 10^{-5} /yr,
- 1 cpm or 10^{-6} /yr, and
- 0.3 cpm or 3x10^{-7} per year
respectively of receiving a dangerous dose or defined level of harm. The contours form three zones, with the outer contour defining the Consultation Distance (CD) around major hazard sites.

![Figure 3: Graphical presentation of Risk contours zones around a hazardous installation](image-url)
3.3.2 Evaluation of Risk Control – The French Approach

According to the French legal framework with reference to COMAH sites, the Evaluation of the risk control approach as specified in Appendix II of the Circular of 29 September 2005, allows the Prefect to assess the major accident risk control policy undertaken by the operator of a SEVESO site.

A Risk Matrix (risk assessment grid) is officially established in France, according to “probability” and “seriousness” combinations, outlining three accidental risk areas. Risk Acceptance Criteria thus involve the probability of accident scenarios and the severity of their consequences (parameter defined by the combination of consequence threshold value and affected persons).

The Risk Matrix (see Table 5) is divided into 25 cells, corresponding to “probability” / “seriousness of the consequences” combinations (identical to those of the model in appendix V of the amended order of 10 May 2000: transposing the SEVESO II Directive into French Law) that the operator of the SEVESO site should use it as a model to position each potential accident (scenario) within the risk assessment. It is therefore used by superimposing it onto the table appearing in the risk assessment.

The “seriousness of the consequences” for the individuals corresponding with the interests targeted by article L. 511-1 of the environmental code (in France) and the “probability of accident (scenarios)” are assessed according to the scales defined by the order of 29 September 2005 (3) on the evaluation and consideration of the occurrence probability, kinetics, effect intensity and seriousness of the consequences of potential accidents in the risk assessments of permit holding classified installations (“A” to “E” for the probability) and “Moderate” to “Disastrous” for the seriousness of the consequences for individuals.

Detailed information on the application of the Risk Acceptability Matrix and Risk Acceptance Criteria based on the French approach is presented in Annex B of the present report. The general procedure for the implementation of the Risk Matrix is presented in Figure 1 of Annex B, while a brief description of key parameters of French methodological framework is presented below.

Specifically:

The scale used in France for the probability “A” to “E” is presented in Table 6, Section 3.3.3 (see also Annex B Table 4).

The scale used in France for the “seriousness of the consequences” is presented in Table 7, Section 3.3.3.

An assessment grid is therefore established (in France) according to “probability” and “seriousness” combinations, outlining three accidental risk areas (see Table 5):

- a high-risk area, represented by the word “NO”;

---

3 The law of 30 July 2003 (in France) relative to the prevention of technological and natural risks and damage reparation imposed the introduction of an estimation of probability, seriousness and kinetics in the risk assessments issued by the operators of permit holding installations. The Ministerial Order of 29 September 2005 completes this legislative requirement by determining regulatory thresholds to evaluate the intensity of the physical effects of hazardous phenomena, the seriousness of accidents and the probability of these phenomena and accidents.
- an intermediate risk area, represented by the acronym “MMR” (risk control measures), for which a continuous improvement approach is particularly relevant in order to attain, within economically acceptable conditions, a risk level as low as possible, taking into account current knowledge and practices as well as the vulnerability of the installation’s environment;

- a lesser risk area, which does not involve a “NO” or “MMR”. The gradation of “NO” or “MMR” cells into “rows” corresponds with an increasing risk, from row 1 to row 4 for “NO” cells and from row 1 to row 2 for “MMR” cells. This gradation corresponds with the priority given to risk reduction, focusing first and foremost on reducing the most significant risks (top rows).

### Table 5: Risk Acceptability Matrix - French Assessment Grid

| Seriousness of the consequences for individuals exposed to the risk (note 1) | PROBABILITY (ascending order from E to A) [note 1] |
|---|---|---|---|---|---|
| Disastrous | | | | | |
| Partial NO (new sites: note 2) / MMR row 2 (existing sites: note 3) | NO row 1 | NO row 2 | NO row 3 | NO row 4 |
| Catastrophic | | | | | |
| MMR row 1 | MMR row 2 (note 3) | NO row 1 | NO row 2 | NO row 3 |
| Significant | | | | | |
| MMR row 1 | MMR row 2 (note 3) | MMR row 1 | NO row 1 | NO row 2 |
| Serious | | | | | |
| MMR row 1 | MMR row 2 | MMR row 1 | NO row 1 |
| Moderate | | | | | |

**Note 1:** Probability and seriousness of the consequences are evaluated in accordance with the Ministerial Order relative to the evaluation and consideration of the occurrence probability, kinetics, effect intensity and seriousness of the consequences of potential accidents in the risk assessments of permit holding classified installations.

**Note 2:** The operator must implement additional technical measures to retain probability level E in case one of the risk control measures fails.

**Note 3:** In the case of an “AS” permit application: also check criterion C of section 3 of appendix I (of the order of 29 September 2005). (AS installations: this category corresponds with permit holding installations with public easement to control urban planning, including the so-called “upper tier” sites of the SEVESO II Directive)
3.3.3  Common Risk Matrix adopted for the preparation and evaluation of Delimara Safety Reports

For purposes of performing Risk Evaluation in the Safety Reports and the assessment of resulting risks in comparison with the measures and safeguards taken, a common Risk Matrix was developed and proposed by the evaluators. The common Risk Matrix was adopted by all Safety Report developers involved in ENE DPS SR and Electrogas Malta Project as approved by the COMAH Authority.

The common Risk Matrix was set as the basis for the evaluation of risks resulting from the analysis of major-accident hazards, the selection of worst case scenarios (WCSs), the evaluation of WCSs consequences, the estimation of WCSs frequency, the assessment of risk per WCS and the definition of risk reduction measures per WCS.

The results of Risk Evaluation have been considered into the assessment performed through UNECE Section-4 Checklists.

The adopted common Risk Matrix is in compliance with:

- The French legal framework for Evaluation of the risk control approach in Seveso establishments, as an appropriate practice for Delimara Safety Reports.
- The Threshold / End point values for the definition of Hazard Zones in consequence assessment as accepted by COMAH Malta Authorities for COMAH establishments, and
- Good Industrial Practices applied in EU countries.

The Societal Risk criteria on which the common Risk Matrix is based, are in line with the Societal Risk criteria adopted by HSE (UK) and in other countries. Societal Risk criteria adopted in the Netherlands are the most conservative compared with other national practices. The evaluation of Societal Risk in the individual Safety Reports is performed under the common Risk Matrix criteria, while the overall Societal Risk for all the establishments is performed in the assessment of the Coordinated Reports under the most conservative Dutch criteria (see Coordinated COMAH Assessment Report, Doc. No. P802-CA-001, 2016 [11])

The common Risk Matrix, presented in Table 6, has been developed as identical to the French Assessment Grid (Risk Acceptability Matrix officially established in France, analytically presented in Annex B).

The Risk Matrix outlines three accidental risk areas (red, yellow and green) identical to the three risk areas of the French Assessment Grid:

- **Red** for “high-risk area” represented by “NO”,
- **Yellow** for “intermediate risk area”, represented by “MMR” (risk control measures), and
- **Green** for “lesser risk area”, which does not involve a “NO” or “MMR”
Table 6: Common Risk Matrix adopted for the preparation and evaluation of Delimara Safety Reports

<table>
<thead>
<tr>
<th>Probability</th>
<th>Per year</th>
<th>1 Moderate</th>
<th>2 Serious/Medium</th>
<th>3 Major/Significant</th>
<th>4 Catastrophic</th>
<th>5 Disastrous/Extreme</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Likely</td>
<td>Greater than or equal to $10^{-2}$</td>
<td>Red</td>
<td>Red</td>
<td>Red</td>
<td>Red</td>
<td>Red</td>
</tr>
<tr>
<td>B Unlikely</td>
<td>Greater than or equal to $10^{-3}$ and less than $10^{-2}$</td>
<td>Yellow</td>
<td>Red</td>
<td>Red</td>
<td>Red</td>
<td>Red</td>
</tr>
<tr>
<td>C Very Unlikely</td>
<td>Greater than or equal to $10^{-4}$ and less than $10^{-3}$</td>
<td>Green</td>
<td>Yellow</td>
<td>Red</td>
<td>Red</td>
<td>Red</td>
</tr>
<tr>
<td>D Extremely Unlikely</td>
<td>Greater than or equal to $10^{-5}$ and less than $10^{-4}$</td>
<td>Green</td>
<td>Green</td>
<td>Yellow</td>
<td>Red</td>
<td>Red</td>
</tr>
<tr>
<td>E Remote</td>
<td>Less than $10^{-5}$</td>
<td>Green</td>
<td>Green</td>
<td>Green</td>
<td>Red</td>
<td>Red</td>
</tr>
</tbody>
</table>

Table 7: “Seriousness of Consequences” Scale

<table>
<thead>
<tr>
<th>Severity of Consequences</th>
<th>Significant Lethal Effect</th>
<th>First Lethal Effect</th>
<th>Irreversible Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme</td>
<td>PE&gt;10</td>
<td>PE&gt;100</td>
<td>PE&gt;1000</td>
</tr>
<tr>
<td>Catastrophic</td>
<td>1&lt;PE≤10</td>
<td>10&lt;PE≤100</td>
<td>100&lt;PE≤1000</td>
</tr>
<tr>
<td>Significant</td>
<td>PE≤1</td>
<td>1&lt;PE≤10</td>
<td>10&lt;PE≤100</td>
</tr>
<tr>
<td>Medium</td>
<td>0</td>
<td>PE≤1</td>
<td>1&lt;PE≤10</td>
</tr>
<tr>
<td>Moderate</td>
<td>No lethal effects outside the facility</td>
<td>PE≤1</td>
<td></td>
</tr>
</tbody>
</table>

Note: PE=Persons Exposed

The scale of “Seriousness of Consequences” presented in Table 7 is applied for Persons Exposed OUTSIDE the boundaries of the SEVESO establishment.

3.3.4 Damage Thresholds - Endpoint Values

The intensity of the effects (consequence) of dangerous phenomena resulting from WCSs is defined in comparison with reference values expressed in form of thresholds (threshold values /end point values) of toxic effects, effects of overpressure, thermal effects and effects linked to the impact of projectiles, for human and structures.

For Delimara Safety Reports the Effects are defined according to the following Threshold/End Point Values (Table 8).
Table 8: Threshold/End Point values for Delimara Safety Reports (End Point Values in bold are proposed in the new Land Use Planning Policy (New Version 2015) (Revised MEPA, Land Use Planning Policy 2004))

<table>
<thead>
<tr>
<th>Effects</th>
<th>Significant Lethal Effects</th>
<th>First Lethal Effects</th>
<th>Irreversible</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hazard Zones: Threshold / End point values</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Domino Zone</td>
<td>Inner Zone (Very Serious Hazard)</td>
<td>Middle Zone (Serious Hazard)</td>
<td>Outer Zone (Significant Hazard)</td>
</tr>
<tr>
<td>99% fatality</td>
<td>50% fatality</td>
<td>1% fatality</td>
<td>No fatality</td>
</tr>
<tr>
<td><strong>Thermal Radiation</strong></td>
<td>37.5 kW/m²</td>
<td>15 kW/m²</td>
<td>5 kW/m²</td>
</tr>
<tr>
<td><strong>Thermal Dose</strong></td>
<td>1800 (to 2000) TDU (*)</td>
<td>500 (to 1000) TDU for short duration effects</td>
<td>3 kW/m²</td>
</tr>
<tr>
<td><strong>Overpressure</strong></td>
<td>700 mbar</td>
<td>300 (to 350) mbar</td>
<td>140 mbar</td>
</tr>
<tr>
<td><strong>Toxic</strong></td>
<td>LC50: Lethal concentration for 50% lethality</td>
<td>LC1: Lethal concentration for 1% lethality</td>
<td>IDLH</td>
</tr>
<tr>
<td><strong>Thermal Radiation</strong></td>
<td>Thermal Dose</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Thermal Dose</strong></td>
<td>1800 (to 2000) TDU (*)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Overpressure</strong></td>
<td>300 (to 350) mbar</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Toxic</strong></td>
<td>LC50: Lethal concentration for 50% lethality</td>
<td>LC5</td>
<td></td>
</tr>
</tbody>
</table>

The selected criteria for thermal radiation and for overpressure effects, as specified in Table 8, are considered a conservative approach.

Further Hazard Zones with Significant Lethal effects may also be defined according to the following Threshold/End Point Values (Table 9).

Table 9: Further Hazard Zones with Significant Lethal effects for Delimara Safety Reports

<table>
<thead>
<tr>
<th>Effects</th>
<th>Significant Lethal Effects</th>
<th>Significant Lethal Effects</th>
<th>Significant Lethal Effects</th>
<th>Lethal Effects</th>
<th>First Lethal Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hazard Zones: Threshold / End point values</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inner Zone (Very Serious Hazard)</td>
<td>50% fatality</td>
<td>40% fatality</td>
<td>5% fatality</td>
<td>3% fatality</td>
<td>Middle Zone (Serious Hazard)</td>
</tr>
<tr>
<td>50% fatality</td>
<td>15 kW/m²</td>
<td>13.4 kW/m²</td>
<td>9.3 kW/m²</td>
<td>7.3 kW/m²</td>
<td>1% fatality</td>
</tr>
<tr>
<td>Thermal Radiation</td>
<td>1800 (to 2000) TDU (*)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overpressure</td>
<td>300 (to 350) mbar</td>
<td>-</td>
<td>170-200 mbar</td>
<td>-</td>
<td>140 mbar</td>
</tr>
<tr>
<td>Toxic</td>
<td>LC50: Lethal concentration for 50% lethality</td>
<td>-</td>
<td>LC5</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

4 TDU: Thermal Dose Units in $((kW/m^2)^{4/3})$sec
Domino Effect Criteria

With special reference to Domino Effect Analysis, during the evaluation process additional criteria have been proposed by the evaluators and agreed upon with the project stakeholders for a detailed evaluation of possible domino effect, not only on the basis of the radiation or overpressure at which critical equipment is exposed, but also on the basis of the exposure duration. Specifically:

**VCE** may provoke catastrophic rupture of affected pressurized, elongated and small equipment with a probability higher than 80%, and of atmospheric equipment with a probability higher than 95%, at overpressure exceeding 700 mbar [application of Probit functions (Mingguang & Juncheng 2008, Cozzani et al. 2006) ref. Kardell & Loof 2014].

**Pool Fires and Jet Fires** with duration of more than 10 minutes may generate structural damage and loss of inventory of exposed pressurized equipment (of volume > 1 m$^3$) with a probability higher than 50%, and of atmospheric equipment with a probability higher than 85%, at heat radiation exceeding 37.5 kW/m$^2$ [application of Probit functions (Landucci et al. 2009, Antonioni et al. 2009, Cozzani et al. 2006) ref. Kardell & Loof 2014].

Additionally, it is considered that no domino effect to pressurized equipment can be realistically sustained from Pool Fires or Jet Fires with a duration of less than 10 minutes, for all phenomena engulfing pressurized equipment (of volume > 1 m$^3$) in flame, specifically for HFO/DO flames since heat emission level of HFO/DO flame is not expected to exceed a level of 50 kW/m$^2$.

The same circumstance can also apply to the atmospheric equipment (up to a volume of 28000 m$^3$) when engulfed in flame with the condition that the fraction of heat radiated to the atmospheric equipment is lower than the 30-50% of the heat emitted by the flame.

**For LNG / NG Pool Fires and Jet Fires** of short duration (30 seconds to 10 minutes) the heat radiation level of the flame is expected to be high e.g. 140 kW/m$^2$, so Domino zones of LNG and NG Pool Fires and Jet Fires, should be handled as following:

- For Pool Fires, the pool fire envelope (with pool centre at the location of release), and
- For Jet fires, the zone around the release location with distance equal to the jet fire frustum length.

The damage criteria applied for Domino effects to buildings and building elements for thermal and blast overpressure, are presented in the relevant Safety Reports.
### 3.4 Evaluation of Risk Assessment Parameters

#### 3.4.1 Meteorological Data

Meteorological data are necessary to perform the simulation of atmospheric dispersion of gas clouds and risk assessment calculations based on wind rose data and weather stability classes. Meteorological data can be expressed in terms of Pasquill classes. The Pasquill stability classes describe the amount of turbulence present in the atmosphere and range from “A” to “F” class. Stability class “A” corresponds to ‘unstable’ weather, with a high degree of atmospheric turbulence, as would be found on a bright sunny day. Stability class “D” describes ‘neutral’ conditions, corresponding to an overcast sky with moderate wind. A clear night with little wind would be considered to represent ‘stable’ conditions, denoted by stability class “F”.

Stability classes “D” and “F” are commonly used in Risk Assessment and QRA studies, as representative of the neutral and stable weather conditions in the site location.

The evaluators have developed Pasquill stability classes profile, as derived from the available meteo data of Delimara region. Meteorological data were obtained by Malta International Meteo Office (Benghajsa Station) and Enemalta Delimara Meteo Station. The data obtained from Benghajsa Meteo station, cover the area of the Freeport / Birzebbugia and refer to the period 2006 to 2012. The data obtained from Delimara Meteo Station cover the area of Delimara Peninsula and Marsaxlokk Bay and refer to the period 2010 to 2013. The meteo data include observations in terms of year, month, date, hour (24 hours), and on the wind direction and the wind speed (8760 records per year).

The analytical meteo data collected (in total 35,040 records from Delimara Meteo Station for a 4year period: 2010-2013 and 26,280 records from Benghajsa Meteo station for a 3year period: 2011-2013) were elaborated in the present study in order to produce the actual weather stability classes applicable in the region of Delimara station. To this end, the Pasquill- Gifford stability method was applied with the following inputs (recorded data):

- Horizontal wind speed
- Cloud cover
- Ceiling height, and
- Time of observation

Data on cloud cover of the examined region were obtained by Malta International Airport (data from Luqa Station for the years 2010 to 2013). Moreover, the solar elevation angle was recorded for 24hour observations in terms of year, month and date for Malta Longitude (35° 54') and Latitude (14° 31')

The meteorological data set contains probabilities for typical weather classes (Pasquill stability class, wind speed, day or night) occurring at the location of Delimara.

http://keisan.casio.com/exec/system/1224682331
The weather classes profile as developed by the evaluators is presented in Table 10 and Figure 4 below.

![Wind Rose for Weather Classes in Delimara Area](image)

Figure 4: Wind Rose for Weather Classes in Delimara Area

The obtained average frequency distributions of weather classes, regarding data obtained by Delimara Meteo Station for the years 2010-2013, are presented in Table 10 for 12 wind directions and 6 weather classes. Direction 346-015 corresponds to wind coming from the North and is indicatively presented with Wind Sector 0 (degrees). The average wind speed per weather class equals to the average wind speed of all observations in each class.

Table 10 (a & b): Stability classes break down per wind direction and average wind speed

<table>
<thead>
<tr>
<th>Wind Stability Classes</th>
<th>Wind Direction</th>
<th>B medium</th>
<th>D low</th>
<th>D medium</th>
<th>D high</th>
<th>F low</th>
<th>E medium</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>B medium</td>
<td>0,00</td>
<td>1,35%</td>
<td>0,20%</td>
<td>0,74%</td>
<td>0,03%</td>
<td>3,08%</td>
<td>0,20%</td>
<td>5,61%</td>
</tr>
<tr>
<td>D low</td>
<td>30,00</td>
<td>0,46%</td>
<td>0,01%</td>
<td>0,00%</td>
<td>0,00%</td>
<td>1,02%</td>
<td>0,00%</td>
<td>1,49%</td>
</tr>
<tr>
<td>D medium</td>
<td>60,00</td>
<td>0,34%</td>
<td>0,01%</td>
<td>0,00%</td>
<td>0,00%</td>
<td>0,75%</td>
<td>0,00%</td>
<td>1,10%</td>
</tr>
<tr>
<td>D high</td>
<td>90,00</td>
<td>2,62%</td>
<td>0,24%</td>
<td>1,25%</td>
<td>0,09%</td>
<td>1,49%</td>
<td>0,45%</td>
<td>6,14%</td>
</tr>
<tr>
<td>F low</td>
<td>120,00</td>
<td>5,05%</td>
<td>0,36%</td>
<td>3,31%</td>
<td>0,89%</td>
<td>1,88%</td>
<td>0,99%</td>
<td>12,48%</td>
</tr>
<tr>
<td>E medium</td>
<td>150,00</td>
<td>2,53%</td>
<td>0,16%</td>
<td>2,12%</td>
<td>0,68%</td>
<td>1,84%</td>
<td>0,54%</td>
<td>7,88%</td>
</tr>
<tr>
<td>Total stability</td>
<td>180,00</td>
<td>5,15%</td>
<td>0,46%</td>
<td>1,61%</td>
<td>0,23%</td>
<td>1,57%</td>
<td>0,50%</td>
<td>9,51%</td>
</tr>
<tr>
<td>contribution %</td>
<td>210,00</td>
<td>2,69%</td>
<td>0,31%</td>
<td>1,78%</td>
<td>0,37%</td>
<td>1,42%</td>
<td>0,39%</td>
<td>6,97%</td>
</tr>
<tr>
<td></td>
<td>240,00</td>
<td>0,97%</td>
<td>0,22%</td>
<td>1,37%</td>
<td>0,65%</td>
<td>1,47%</td>
<td>0,51%</td>
<td>5,18%</td>
</tr>
<tr>
<td></td>
<td>270,00</td>
<td>1,07%</td>
<td>0,15%</td>
<td>2,08%</td>
<td>0,80%</td>
<td>2,42%</td>
<td>0,55%</td>
<td>7,07%</td>
</tr>
<tr>
<td></td>
<td>300,00</td>
<td>2,60%</td>
<td>0,32%</td>
<td>5,81%</td>
<td>6,00%</td>
<td>4,80%</td>
<td>2,20%</td>
<td>21,72%</td>
</tr>
<tr>
<td></td>
<td>330,00</td>
<td>3,19%</td>
<td>0,42%</td>
<td>2,88%</td>
<td>1,39%</td>
<td>5,50%</td>
<td>0,00%</td>
<td>13,38%</td>
</tr>
<tr>
<td>Average Wind Speed per</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>stability class [m/sec]</td>
<td>0.00</td>
<td>28%</td>
<td>3%</td>
<td>24%</td>
<td>11%</td>
<td>28%</td>
<td>6%</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>30,00</td>
<td>2,2(B)</td>
<td>2,2(D)</td>
<td>4,4(D)</td>
<td>7,4(D)</td>
<td>0,9(F)</td>
<td>3,2(E)</td>
<td></td>
</tr>
</tbody>
</table>
In order to examine the possible changes of the derived stability classes through the years, the distribution of their occurrence was evaluated for the period 2010 to 2013, and is presented in Figure 5.

According to results of the present analysis based on data derived from Delimara Meteo Station, the following conclusions can be extracted:

- Three weather classes, namely F, D and B, are those with the highest occurrence in the 4 year period examined. Their mean average values are 28%, 24% and 28% respectively.
• There are no substantial variation in the contribution (occurrence) of the classes through the years 2010-2013.
• The average wind speeds in this period for the prevailing classes are F 0.9 m/s, D 4.3 m/s and B 2.2 m/s.
• D stability class has a total contribution of 38% (D_{medium} 24% with an average wind speed of 4.3 m/s, D_{high} 11% with 7.4 m/s and D_{low} 3% with 2.2 m/s). D stability class can thus be accurately represented by an overall average wind speed of 5 m/s (D5).
• F stability class has a total contribution of 28% with an average wind speed of 0.9 m/s. F stability class can thus be realistically represented by an overall average wind speed of 2 m/s (F2).

It is acceptable practice in QRA studies to consider the stability classes A to D to be represented overall by D stability class, and the stability classes E and F to be represented overall by F class. In such case, the observed meteo data can be represented overall by a 66% contribution of D class with an average wind speed of 4 m/s (D4) and by a 34% contribution of F class with an average wind speed of 1.3 m/s (F1.3).

The Stability classes’ profile, as presented in Table 10, has been adopted by ENEMALTA DPS Safety Report Developers for consequence and risk assessment.

3.4.2 Initiating Events

Initiating events of the WCSs in the SR have been drawn from the deviations and accident causes examined in the HAZID and HAZOP studies. The list of initiating events has been assessed following the logic of Fault Tree Analysis (FTA) for all possible LOCs and the immediate causes of major accidents examined in Hazard Analyses of similar facilities and safety critical equipment.

All types of hazards have been considered for the possible WCSs related to HFO and DO, such as mechanical, process, external and natural hazards. The causes and safeguards of every hazard per top event (LOC) are detailed in the FTA and Event Tree analysis of the ENE SR.

The initiating events examined in the SR, have been assessed for all possible causes of equipment failure or equipment overriding, such as:
• Temperature and Pressure deviations from normal
• Flow and Level deviations from normal
• Composition deviations from normal
• Operational or procedural failure
• Corrosion / Erosion of material
• External load / Mechanical force / Vibrations / Crushes
• Natural causes (extreme weather, seismic activity, flooding, lightning, etc.)
• Third Party Interference (unauthorized interventions, collision, terrorism, vandalism, etc.)
• Domino effects from nearby equipment
• Other (equipment or line specific).
The causes examined per case depend on the type and material of safety critical equipment, the operating conditions, the location of equipment or line within the facilities, etc. Details on the causes examined per equipment or line, as well as of the safeguards provided, are presented in the HAZID and HAZOP studies and the Fault Tree and Event Tree Analyses of ENE Safety Report.

The assessment of the causes and safeguards examined in the SR produced a list of comments and recommendations that have been discussed and integrated in the final version of the studies.

Recommendations and considerations on the causes and safeguards are presented in Section 4 of the present ENEMALTA DPS COMAH Assessment Report.

### 3.4.3 **Loss of Containment (LOC) – Fault Trees and Event Trees**

A list of LOC top events has been developed in the Safety Report according to the type of release.

The types of LOCs examined have been verified per type of outflow model and equipment (source of release), as outlined in Table 11.

#### Table 11: Type of LOC per type of release and equipment

<table>
<thead>
<tr>
<th>Type of LOC</th>
<th>Outflow model</th>
<th>Type of Equipment (source of release)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catastrophic Rupture of equipment</td>
<td>Instantaneous release of Maximum Inventory</td>
<td>HFO storage, buffer and service Tanks DO Raw and treated tanks and DO D3 Service tanks</td>
</tr>
<tr>
<td>Instantaneous release</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full Bore Rupture (FBR) of Pipelines, Hoses Pumps (discharge lines) Semi continuous release</td>
<td>Semi continuous release of maximum inventory at operating conditions (Release duration depending on the control and blocking systems and detection available)</td>
<td>HFO &amp; DO Pipelines, HFO Unloading Hose, DO Unloading Arm</td>
</tr>
<tr>
<td>Partial rupture of Pipeline (Hole 2”) Pumps (discharge lines) Continuous release</td>
<td>Continuous release for 30 mins or until equipment is empty</td>
<td>HFO Pipelines, Hoses</td>
</tr>
<tr>
<td>Small hole in equipment, Pumps (discharge lines) Continuous release</td>
<td>Continuous release until equipment is empty</td>
<td>Pipelines, Hose, Arm</td>
</tr>
</tbody>
</table>

The list of LOCs has been assessed for completeness according to the potential release conditions of HFO and DO respectively and in line with the operating conditions of the safety critical equipment considered. The list of critical equipment and their normal operating conditions has been assessed for this purpose.
For the LOCs, Fault Trees and Event Trees are referred to the Safety Report. The list of causes examined per LOC has been assessed as related to the outputs of the HAZOP/HAZID studies and as compared with past accidents in similar facilities.

As a result of the above assessment, an initial list of comments and recommendations was developed and submitted to Safety Report developers. These mainly refer to the additional scenarios on FBR in HFO and DO Tanks. The Safety Report developers in communication with the COMAH CA and the evaluators have reviewed, discussed and agreed upon a set of supplementary material to be submitted in the revised versions of the Safety Report and accompanying documentation. The comments and recommendations made, as well as reference to the supplementary material provided along with the final version of the Safety Report, have been incorporated in the assessment.

3.4.4 Incident Types, WCSs and Consequence Zones

The phenomena examined with reference to the identified Worst Case Scenarios (WCSs) related to HFO and DO in ENE Safety Report Consequence and Risk Assessment, are:

- Pool Fires
- Flash Fires
- Vapour Cloud Explosions (VCEs), and
- Environmental Spillage.

The above phenomena have been verified as sustainable per case i.e. per type of release related to the type of LOC. The selection of WCSs in the SR has been assessed and approved. The list of WCSs has been assessed following the logic of Event Trees, the deviations examined in the HAZOP and HAZID studies and an exhaustive list of causes for major accidents in similar facilities.

The Consequence Zones for each phenomenon and WCS are calculated in the SR. The EFFECTS/TNO software has been used for representative substances n-eicosane and n-pentadecane for HFO and DO respectively.

The assessment of Consequence Zones per WCS was performed based on the guidelines of CPR-14E TNO “Yellow Book” [6], CPR-16E “Green Book” [7] and the models of the EFFECTS/TNO 9.0.26 software.

For the phenomena identified and the WCSs examined in the SR, all the assumptions made in the evaluation of Consequence Zones were assessed. The type of models used, the parameters involved and the model inputs were scrutinised for representative WCSs of potential HFO and DO releases. An indicative list of models and parameters used for the assessment is presented below:

- Liquid / Gas release models (for FBR, medium and small holes in equipment and pipes)
  - representative substance involved in the release
  - type of release (instantaneous, continuous, semi-continuous)
- hole rounding
- release inventory – filling degree of equipment
- pressure at time of release (normal operating pressure)
- initial temperature at time of release
- release height
- release duration (2min, 10mins, 30mins or until equipment or line is empty, depending on the control and blocking systems and detection available per case)
- (main outputs) release rate and outflow duration, etc.

- Pool evaporation model on ground or water (including liquid pool formation before ignition)
  - representative substance involved in pool
  - type and duration of release (instantaneous, continuous, semi-continuous)
  - surface on which evaporation takes place (ground, water, relief, subsoil temperature)
  - mass flow rate (max per case) and pool temperature
  - type of pool growth (spreading or confined)
  - ambient conditions, wind speed
  - (main outputs) evaporation rate, extent of pool surface and duration, etc.

- Dense Gas Dispersion model (flammable cloud)
  - representative substance involved in the cloud
  - type and duration of release (instantaneous, continuous, semi-continuous)
  - type of dispersion (dense gas)
  - mass flow rate (max per case)
  - weather stability class and wind speed
  - ambient temperature, humidity and solar radiation
  - roughness length (depending on the relief and obstacles in the area the cloud is dispersed)
  - cloud threshold concentrations (LFL, 50%LFL, etc.)
  - time after release starts
  - (main outputs) explosive mass, dimensions and extent of flammable cloud (max explosive mass or cloud area), cloud concentration vs. downwind distance, etc.

- Pool Fire model
  - representative substance involved
  - pool size (confined, unconfined)
  - fraction combustion heat radiated e.g. 5%
  - mass flow rate (max per case)
  - temperature of the pool
  - ambient conditions, wind speed
  - CO₂ in atmosphere
  - release duration
  - (main outputs) pool fire size/diameter, flame dimensions, Surface Emissive Power (SEP), Fire duration, heat radiation levels and contours, etc.

- Explosion model (Multi Energy model)
- representative substance involved
- total mass in explosive range
- fraction of flammable cloud confined
- mass between UFL and LFL or below LFL
- ambient pressure
- offset between release location and cloud centre
- (main outputs) blast overpressure levels and contours, confined mass in explosive range

As a result of the above assessment, no recommendations are made. The general comments made, as well as reference to the material provided by the Safety Report developers, have been incorporated in the assessment.

3.4.5 *Domino Effects*

Domino effects are examined in case equipment is engulfed in fire e.g. pool fire sustained under nearby equipment for a sufficient time period, or ruptured due to explosion overpressure.

Escalation events are covered by Domino Effects and the WCSs examined as Catastrophic and Partial rupture of equipment. For instance, if the flame of a pool fire, caused by an early rupture of a tank (primary scenario), engulfs an adjacent tank in the same bund for a substantial time period, it can cause catastrophic or partial rupture of the engulfed tank resulting to a secondary pool fire depending on the amount of product involved (secondary scenario).

The Domino Effects criteria proposed by the evaluators (see Table 8, Section 3.3.4) have been applied by ENE SR developers.

The domino effects have been extensively examined for internal domino in individual SRs and for external domino in the Coordinated SR [30]. The results are presented in appropriate tables in the SRs.

All equipment identified as subject to domino effects, has been assessed according to the extent of consequence zones of primary WCSs and the Domino effects criteria adopted.

As a result of the above assessment, an initial list of comments and recommendations was developed and submitted to Safety Report developers. The SR developers in communication with the COMAH Authority and the evaluators have reviewed, discussed and agreed upon the material to be submitted in the revised versions of the SR and accompanying documentation. The comments and recommendations made, as well as the reference to the material provided by the Safety Report developers, have been incorporated in the assessment.
3.4.6 Event Frequencies – Ignition Probabilities

Event frequencies were assessed on the base of failure frequencies of equipment and pipelines involved. OGP database has been used as a measure to assess base failure frequencies assumed in the SR. The results have shown that frequency values used in SR are correctly estimated.

The WCSs frequencies in the ENE Safety Report are deduced from Event Trees tailor made to HFO and DO present in ENE facilities and the specific release conditions in the safety critical equipment, by applying the probabilities of ignition (direct or delayed). The frequencies of WCSs examined in the SR were verified by applying LOC frequencies and Ignition Probabilities per case in the Event Trees per LOC and type of release.

Direct ignition probability for HFO has been assumed flat (1%), as documented by Reference Data (BEVI/RIVM). The assumptions made for the ignition probabilities of HFO and DO at different operating conditions are acceptable, since they are well documented and in line with the methodology described in CPR-18E TNO “Purple Book” [8]. No actual ignition probabilities according to the type of land uses and occupancy of developments are necessary due to very low ignition probabilities of the substances involved.

As a result of the above assessment, no comments or recommendations were necessary.

3.4.7 Risk Assessment – Risk Evaluation

The risk associated with each WCS has been calculated in ENE Safety Report on the basis of the deduced WCS frequency and the calculated number of fatalities expected within the extent of the Consequence Zones per end point value.

For purposes of Risk Evaluation in the Safety Reports and the assessment of resulting risks in comparison with the measures and safeguards taken, the common Risk Matrix (Table 6) developed and proposed by the evaluators was adopted by ENE Safety Report developers. The common Risk Matrix has been used in the SR as a tool for Risk Evaluation according to Societal Risk criteria set for persons exposed OUTSIDE the boundaries of the SEVESO establishment (people external to the establishment).

In order to evaluate whether the risk of each WCS is at acceptable, tolerable or unacceptable level, the common Risk Matrix has been applied in the SR, in which each and every WCS has been ranked according to the level of its risk.

Risk Evaluation performed in the Safety Report has been assessed. According to the results, it is concluded that:

- None of the scenarios exhibits risk of “unacceptable” level;
- The vast majority of WCSs are within the “broadly acceptable” risk region, and
- A very limited number of WCSs, related to HFO releases from storage tanks, are within the intermediate risk area “tolerable if ALARP risk region” for which risk reduction measures have been implemented.

The results of Risk Evaluation have been considered into the assessment performed through UNECE Section-4 Checklists. Relevant comments and recommendations are presented in Section 4.4 of the present COMAH Assessment Report.
4 Review Recommendations

A. Safety Report

The evaluation results concerning the first four sections of Assessment Checklist (SCL-1 to SCL-4) are based on UNECE – SCLs format.

The overall conclusions regarding the data provided on

- 1. SCL description of the environment and site
- 2. SCL main activities and products for single installations
- 3. SCL dangerous substances
- 4. SCL identification of hazards, risk assessment and preventive measures

are as follows:

### 4.1 Description of the environment and site (SCL-1)

- **Description of the environment (SCL-1.1)**  
  The relevant contents of the Safety Report are complete, correct and credible according to the requirements of the COMAH Regulations LN 179/2015.

<table>
<thead>
<tr>
<th>General Recommendations to be considered after commissioning</th>
</tr>
</thead>
<tbody>
<tr>
<td>GR 1.1.1</td>
</tr>
<tr>
<td>GR 1.1.2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Specific Requirements (or recommendations) to be regarded as conditions, limitations or binding terms for issuing an operational permit before commissioning starts</th>
</tr>
</thead>
<tbody>
<tr>
<td>NONE</td>
</tr>
</tbody>
</table>

- **Description of the site (SCL-1.2)**  
  The relevant contents of the Safety Report are complete, correct and credible according to the requirements of the COMAH Regulations LN 179/2015.

<table>
<thead>
<tr>
<th>General Recommendations to be considered after commissioning</th>
</tr>
</thead>
<tbody>
<tr>
<td>GR 1.2.1</td>
</tr>
</tbody>
</table>
Specific Requirements (or recommendations) to be regarded as conditions, limitations or binding terms for issuing an operational permit before commissioning starts

NONE

4.2 Main activities and products for single installations (SCL-2)

The relevant contents of the Safety Report are complete, correct and credible according to the requirements of the COMAH Regulations LN 179/2015.

<table>
<thead>
<tr>
<th>General Recommendations to be considered after commissioning</th>
</tr>
</thead>
<tbody>
<tr>
<td>GR 2.1</td>
</tr>
<tr>
<td>o The COMAH Inspections planned for the facilities, according to reg. 16 of the COMAH Regulations LN 179/2015, should verify the available classification/certifications of equipment and the implementation of Explosive Atmospheres (ATEX) study (e.g. via Risk Based Inspections).</td>
</tr>
</tbody>
</table>

Specific Requirements (or recommendations) to be regarded as conditions, limitations or binding terms for issuing an operational permit before commissioning starts

SR 2.1

➤ In case any further modification in the piping and instrumentation of the facilities is deemed necessary before commissioning, which could have significant consequences for major-accident hazards in relation to the information provided in the P&IDs (Pipe& Instrumentation Diagrams) submitted along with the ENE Safety Report rev03 (9 Sept.2016), it should be notified in detail to the COMAH Authority in advance of that modification (according to reg. 9 of the COMAH Regulations LN 179/2015).

4.3 Dangerous substances (SCL-3)

The relevant contents of the Safety Report are complete, correct and credible according to the requirements of the COMAH Regulations LN 179/2015.

<table>
<thead>
<tr>
<th>General Recommendations to be considered after commissioning</th>
</tr>
</thead>
<tbody>
<tr>
<td>NONE</td>
</tr>
</tbody>
</table>

Specific Requirements (or recommendations) to be regarded as conditions, limitations or binding terms for issuing an operational permit before commissioning starts

NONE
4.4 Identification of hazards, risk assessment and preventive measures (SCL-4)

The relevant contents of the Safety Report are complete, correct and credible according to the requirements of the COMAH Regulations LN 179/2015.

<table>
<thead>
<tr>
<th>General Recommendations to be considered after commissioning</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GR 4.1</strong></td>
</tr>
<tr>
<td>o Any major updates (or further recommendations related to major-accident hazards) of Hazard &amp; Operability or Hazard Identification studies (HAZOP/HAZID) shall be submitted to the COMAH Authority and shall be available to the Inspections planned for the facilities, according to reg. 16 of the COMAH Regulations LN 179/2015 (Seveso Inspections).</td>
</tr>
<tr>
<td><strong>GR 4.2</strong></td>
</tr>
<tr>
<td>o An updated list of events experienced in comparable activities should be included in future versions of the Safety Report for further documenting the selection of worst case scenarios examined in the ENE Safety Report rev03 (9 Sept.2016).</td>
</tr>
<tr>
<td><strong>GR 4.3</strong></td>
</tr>
<tr>
<td>o In future revisions of ENE Safety Report, the potential consequences of Pool Fires in the area of the escape routes of the Regasification Unit, should be considered in the improvements proposed for the safeguards of Diesel Oil transfer pipelines.</td>
</tr>
<tr>
<td><strong>GR 4.4</strong></td>
</tr>
<tr>
<td>o Consistency of Consequence Zones between the Safety Report and the Coordinated Safety Report should always be verified in case of any future major updates.</td>
</tr>
<tr>
<td><strong>GR 4.5</strong></td>
</tr>
<tr>
<td>o All reviews of Emergency Response Plan and recommendations to be referred to in the updates of the Safety Report.</td>
</tr>
<tr>
<td><strong>GR 4.6</strong></td>
</tr>
<tr>
<td>o The COMAH Inspections planned for the facilities, according to reg. 16 of the COMAH Regulations LN 179/2015 (Seveso Inspections), should verify the implementation of measures and safeguards against Third Party Interference (security) and Natural hazards including any recommendations coming out of future revisions of environmental impact assessment.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Specific Requirements (or recommendations) to be regarded as conditions, limitations or binding terms for issuing an operational permit before commissioning starts</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SR 4.1</strong></td>
</tr>
<tr>
<td>NONE</td>
</tr>
</tbody>
</table>
B. Internal Emergency Plan

4.5 Limitation of consequences and mitigation measures (SCL-5)

5 - ENEMALTA DPS

The evaluation results concerning the section (SCL-5) are based on UNECE–SCLs Checklists.

In this section the contents of the Internal Emergency Plan are assessed. The overall conclusions regarding the data provided on (SCL-5) limitation of consequences and mitigation measures concerning the operations only of ENEMALTA within the perimeter of ENEMALTA DELIMARA POWER STATION, are as follows:

The relevant contents of the Safety Report are complete, correct and credible according to the requirements of the COMAH Regulations LN 179/2015.

<table>
<thead>
<tr>
<th>General Recommendations to be considered after commissioning</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GR 5.1</strong>&lt;br&gt;o In future revisions of the Emergency Response Plan, the development of a Fire Control &amp; Safety Plan should be considered for the installations or alternatively the updated lists with material resources (fire fighting, rescue, PPEs, first aid equipment, etc.) should be available to the COMAH CA Inspections planned for the facilities, according to reg. 16 of the COMAH Regulations LN 179/2015 (Seveso Inspections).</td>
</tr>
<tr>
<td><strong>GR 5.2</strong>&lt;br&gt;o The COMAH CA Inspections should verify that no additional detection equipment are required in the Enemalta DPS facilities for the prevention of internal explosions and impairment of critical DPS facilities considering the potential extent of Natural Gas flammable envelopes, as presented in the EGM Safety Report.</td>
</tr>
<tr>
<td><strong>GR 5.3</strong>&lt;br&gt;o The COMAH CA Inspections should confirm the operators' reaction time (detection to alert) after experience from emergency drills with reference to Natural Gas cloud and Jet Fires from EGM facilities.</td>
</tr>
<tr>
<td><strong>GR 5.4</strong>&lt;br&gt;o The COMAH CA Inspections should have available any internal audit and inspections report, including the recommendations action track-list of HAZOP/HAZID and ATEX studies.</td>
</tr>
<tr>
<td><strong>GR 5.5</strong>&lt;br&gt;o The COMAH CA Inspections should have available an updated Emergency Response Plan with material/resources lists and relevant documentation.</td>
</tr>
<tr>
<td><strong>GR 5.6</strong>&lt;br&gt;o The COMAH CA Inspections should have available the PPEs lists and assess their appropriateness and adequacy for major accident hazards including possible effects from Natural Gas release.</td>
</tr>
<tr>
<td><strong>GR 5.7</strong>&lt;br&gt;o Evacuation routes external to the establishment with alternatives to be further detailed in line with the relevant requirements of the External Emergency Plan.</td>
</tr>
</tbody>
</table>
GR 5.8  

- In future revisions of the Emergency Response Plan, the development of an appropriate Decision Support System with relevant databases should be considered (if necessary) for the operations of Emergency Control Centre.

GR 5.9  

- The COMAH CA Inspections should verify the implementation of procedures included in the ENE Emergency Response Plan with additional reference to the emergency rating applied.

GR 5.10  

- All future reviews of the company Safety Management System and recommendations to be referred to in the updates of the Emergency Response Plan as relevant.

Specific Requirements (or recommendations) to be regarded as conditions, limitations or binding terms for issuing an operational permit before commissioning starts

SR 5.1  

NONE

C. MAPP- Safety Management System

4.6 Major Accident Prevention Policy (MAPP) & Safety Management System (SMS) (SCL-6)

6 - ENE DPS

The evaluation results concerning the section (SCL-6) are based on UNECE – SCLs Checklists.

In this section the contents of the SMS are assessed. The overall conclusions regarding the data provided on (SCL-6) Major Accident Prevention Policy (MAPP) & Safety Management System (SMS) concerning only the operations of ENEMALTA within the perimeter of ENEMALTA DELIMARA POWER STATION, are as follows:

SR contents are overall complete, correct and credible.

<table>
<thead>
<tr>
<th>General Recommendations to be considered after commissioning</th>
</tr>
</thead>
</table>
| GR 6.1  

- In the updating of the Major Accident Prevention Policy, a number of predefined targets for major accidents should be addressed (in either quantitative or qualitative terms) in order to enable COMAH CA to assess compliance against the policy objectives and the continuous improvement indicators for the control of major accident hazards.

GR 6.2  

- The COMAH CA Inspections planned for the facilities, according to reg.16 of the COMAH Regulations LN 179/2015, should:
  - verify how the Major Accident Prevention Policy (MAPP) is communicated, how Management of Human Resources ensures that employees and third parties adhere to the MAPP, how MAPP is promoted;
  - verify training in the ENE Emergency Response Plan at regular basis (proposed
annually);
- confirm implementation of internal inspections and testing/monitoring of safety critical equipment/systems related to the control of major accident hazards;
- check documented Audits and verify follow-up of audit results;
- consider Key Performance Indicators.

**GR 6.3**

- ENE should confirm that the adopted Risk Assessment procedure within company’s Safety Management System entails adequate methodologies and satisfies Risk Assessment criteria at least equivalent to those used in the Safety Report. *(Risk Assessment methodology and criteria for the identification of major-accident hazards and the evaluation of major accident risks should always satisfy officially adopted criteria, sound scientific principles and good industrial practices as those used in the Safety Report).*

<table>
<thead>
<tr>
<th>Specific Requirements (or recommendations) to be regarded as conditions, limitations or binding terms for issuing an operational permit before commissioning starts</th>
</tr>
</thead>
<tbody>
<tr>
<td>NONE</td>
</tr>
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5 References

[9] DIPPR - Design Institute for Physical Properties, American Institute of Chemical Engineers (AIChE).


Annex A - Assessment Checklists UNECE Sectoral Check Lists (SCLs)

See attached Folder
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**ANNEX B - French Methodological Framework and Risk Acceptance Criteria**

See attached File