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
General principles to prevent and reduce emissions **Tank design**	BAT for a proper design is to take into account at least the following: • the physico-chemical properties of the substance being stored • how the storage is operated, what level of instrumentation is needed, how many operators are required, and what their workload will be • how the operators are informed of deviations from normal process conditions (alarms) • how the storage is protected against deviations from normal process conditions (safety instructions, interlock systems, pressure relief devices, leak detection and containment, etc.) • what equipment has to be installed, largely taking account of past experiences of the product (construction materials, valve quality, etc.) • which maintenance and inspection plan needs to be implemented and how to ease the maintenance and inspection work (access, layout, etc.) • how to deal with emergency situations (distances to other tanks, facilities and to the boundary, fire protection, access	The LNG pipelines and ancillary equipment shall be designed as per EN1473 "Installation and equipment for LNG – design of off-shore installation". Pipes and piping components materials will be graded for cryogenic operations. Instrumentation will be included with at least double level of redundancy for the different systems and components. The LNG terminal Distribution and Control System (DCS) shall monitor, warn and correct any deviation from normal operation. An Emergency Shutdown shall be activated in case any operating parameter exceeds the safety margin. A dedicated non visible ground flare system will be included within the regasification plant and activated in such an emergency scenario. The FSU crew shall be made up of one (1x) FSU Master, one (1x) chief officer, another 2nd and 3rd chief officers, four (4x) able seamen, one (1x) chief engineer, another two (2x) engineers, four (4x) oilers, one (1x) machinist, one (1x) ETO electrician, one (1x) chief cook, one (1x) cook baker/kitchen assistant and three (3x) mess-men. Key process variables such as tank level, temperature and

Aspect of BAT	BAT	Status at Installation
	for emergency services such as the fire brigade, etc.). See Annex 8.19 for a typical checklist.	pressure shall be monitored from the DCS. Alarms shall be actuated if process variables diverts from a predefined range. An impoundment area will be designed with a volumetric holding capacity of 110% of the maximum liquid capacity of the pipelines. The spacing of the LNG tanks and impoundment areas shall comply with NFPA 59A “Standard for the production, storage and handling of LNG”. The bulk of the LNG shall be stored on a newly convert LNG Carrier the Armanda LNG Mediterrana. The Vessel is 283m long by 45 m wide and has 5No. Moss type storage tanks. It will be fully converted to a cold ironed vessel suitable as a floating storage unit permanently moored to the jetty, with a nominal 125,000m3 of storage. The FSU shall be immobilised before operations. In case of requiring a disconnection from the jetty for adverse weather the FSU shall moor to the storm mooring system. If required to leave the harbour this shall be done with tug assistance to anchorage in case of storm disconnection. The FSU electrical demands will be fulfilled via a ship to shore power connection The LNG ship to shore link with be via a hard arm due to the cryogenic nature and permanency of the process and the BOG ship to shore links will be via flexible hoses. There will be full redundancies on these ship-to-shore connections.

Aspect of BAT	BAT	Status at Installation
		The vessel will also have storm mooring points to allow it to be pulled off the jetty for the duration of an extreme storm event, at which time the hard arm and hoses will be disconnected. A small LNG pump suction drum shall be included in the regasification plant area. The design of this vessel is as per Pressure Equipment Directive 97/23EC and similar but more detailed check list as the one presented in Annex 8.19 was used for the design specification:  suction drum datasheet ENEM-JPA· The FSU shall meet applicable MARPOL and local requirements in relation to environmental management
General principles to prevent and reduce emissions **Inspection and maintenance**	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. 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.	Noted Scheduled routine inspections, external inspection and out-of-service will be arranged following best operating practices and OEM recommendations. Failure preventive maintenance will be carried out regularly on key components. A computer based Planned Maintenance System (PMS) agreed with the original equipment manufacturers supplying to the Project shall highlight maintenance to be carried out and shall keep a record of past

Aspect of BAT	BAT	Status at Installation
		maintenance works. In particular inspection of the FSU hull shall be carried out at 5 year intervals.
General principles to prevent and reduce emissions **Location and lay-out**	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. 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 considered, depending on the storage volume.	The LNG tanks are spherical type (BAT) located on the floating storage unit. The tank will operate in normal operating conditions at close to atmospheric pressure.
General principles to prevent and reduce emissions **Tank colour**	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.	Noted Insulation of LNG Tanks shall be designed so that it minimizes heat ingress. A colour coding shall be used for marking LNG lines in accordance with BS 381C "Specification for colours for identification, coding and special purposes" or RAL European color system.
General principles to prevent and reduce emissions	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	Noted Emissions will be prevented by implementing the designed principles described in section B.02.02.02

Aspect of BAT	BAT	Status at Installation
Emissions minimization principle in tank storage	certain time frame for implementation.	Boil Off Gas shall be managed on the FSU and sent to shore to be compressed, heated and used in the running of the power plants.
General principles to prevent and reduce emissions **Monitoring of VOC**	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. [1]	Not applicable. Emissions of VOCs are not expected under normal operating conditions. Boil-off gas generated in the LNG tanks will be recovered, conditioned and routed to the different power stations. Significant propane leaks from the propane loop system are not expected.
General principles to prevent and reduce emissions **Dedicating systems**	BAT is to apply dedicated systems; see Section 4.1.4.4. Dedicated systems are generally not applicable on sites where tanks are used for short to medium-term storage of different products.	Noted Dedicated systems will be designed for handling solely LNG. LNG transfer systems and regasification facility is designed for handling and treating LNG. These systems have been described in section B.02.20.01
Tank specific considerations **Open top tanks**	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. If emissions to air occur, BAT is to cover the tank by applying: • a floating cover, see Section 4.1.3.2 • a flexible or tent cover, see Section 4.1.3.3, or • a rigid cover, see Section 4.1.3.4.	Not considered for the proposed project.

Aspect of BAT	BAT	Status at Installation
	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. To prevent deposition that would call for an additional cleaning step, BAT is to mix the stored substance (e.g. slurry), see Section 4.1.5.1.	
Tank specific considerations **External floating roof tank**	External floating roof tanks are used for the storage of, e.g. crude oil; see Section 3.1.2. 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.	Not considered in the proposed project

Aspect of BAT	BAT	Status at Installation
	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. Additional measures to reduce emissions are (see Section 4.1.3.9.2): • applying a float in the slotted guide pole • applying a sleeve over the slotted guide pole, and/or • applying 'socks' over the roof legs. A dome can be BAT for adverse weather conditions, such as high winds, rain or snowfall. See Section 4.1.3.5. 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.	
Tank specific considerations **Fixed roof tanks**	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. 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. [2] For other substances, BAT is to apply a vapour treatment installation, or to install an internal floating roof (see	Fixed roof tanks are not considered in the proposed project. The LNG shall be stored in the FSU Moss type tanks.

Aspect of BAT	BAT	Status at Installation
	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 ºC) of 1 kPa and the tank has a volume of ≥ 50 m^3. In Germany, the condition for when to apply these BAT is when the substance has a vapour pressure (at 20 ºC) of 1.3 kPa and the tank has a volume of ≥ 300 m^3. For tanks < 50 m^3, BAT is to apply a pressure relief valve set at the highest possible value consistent with the tank design criteria. 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. 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,	

Aspect of BAT	BAT	Status at Installation
	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. 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^3 equipped with only primary seals and 97.6 % refers to a tank of 10263 m^3 equipped with primary and secondary seals. 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.	
Tank specific considerations **Atmospheric horizontal tanks**	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. Horizontal tanks are different to vertical tanks, e.g. since they can inherently operate under higher pressures.	Noted Small atmospheric horizontal drums are considered for the storage of fuel oil. The volatility of diesel is so low that they won't require anyvapour balancing system, vapour holding tank or vapour treatment asno vapour will boil off in the

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	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. [3] For other substances, BAT is to do all, or a combination, of the following techniques, depending on the substances stored: • apply pressure vacuum relief valves; see Section 4.1.3.11 • up rate to 56 mbar; see Section 4.1.3.11 • apply vapour balancing; see Section 4.1.3.13 • apply a vapour holding tank, see Section 4.1.3.14, or • apply vapour treatment; see Section 4.1.3.15. The selection of the vapour treatment technology has to be decided on a case-by-case basis.	tank. Diesel tanks will includepressure/vacuum relief valves for overpressure and vacuum protection.
Tank specific considerations **Pressurised storage**	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. 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. The selection of the vapour treatment technology has to be	Pressurized vertical cylinders will be used for storing nitrogen and propane. These won't require drainage system as they are stored in gas phase. An LNG onshore suction tank will be used as LNG buffer for the LNG system. This tank shall include a vapour balancing system (BAT) so that the boil off gas generated in the LNG suction drum as a result of heat leakage shall be recovered and consumed in the power plants.

Aspect of BAT	BAT	Status at Installation
	decided on a case-by-case basis.	
Tank specific considerations **Lifter roof tanks**	For emissions to air, BAT is to (see Sections 3.1.9 and 4.1.3.14): • apply a flexible diaphragm tank equipped with pressure/vacuum relief valves, or • apply a lifter roof tank equipped with pressure/vacuum relief valves and connected to a vapour treatment installation. The selection of the vapour treatment technology has to be decided on a case-by-case basis.	Lifter roof tanks are not considered in the proposed project
Tank specific considerations **Refrigerated tanks**	There are no significant emissions from normal operation, see Section 3.1.10.	There will be no significant emissions under normal operating conditions. All Boil Off Gas (BOG) shall be managed, recovered and used in the running of the power plants. Flaring of BOG won't be conducted at normal operating conditions and only under emergency situation (emergency shut-down). This is a safety measure to de-pressurize the gas systems. An ESD event shall be activated in case of fuel spill, gas release detection, fire and force majeure event.
Tank specific considerations **Underground and mounded tanks**	Underground and mounded tanks are used especially for flammable products, see Sections 3.1.11 and 3.1.8 respectively. For the storage of volatile substances which are toxic (T),	Underground and mounded tanks are not considered in the proposed project.

Aspect of BAT	BAT	Status at Installation
	very toxic (T+), or CMR categories 1 and 2 in an underground or mounded tank, BAT is to apply a vapour treatment installation.[4] For other substances, BAT is to do all, or a combination, of the following techniques, depending on the substances stored: • apply pressure vacuum relief valves; see Section 4.1.3.11 • apply vapour balancing; see Section 4.1.3.13 • apply a vapour holding tank, see Section 4.1.3.14, or • apply vapour treatment; see Section 4.1.3.15. The selection of the vapour treatment technology has to be decided on a case-by-case basis.	
Preventing incidents and (major) accidents **Safety and risk management**	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 Directive can also cause emissions from incidents and	Noted The proposed development will put in place a health and safety management system based on the conclusions from the detailed risk assessment. A full safety report will be developed for the project in accordance with the Seveso II Directive which will meet the requirements of an upper tier Seveso site BAT recommendations will be strictly followed.

Aspect of BAT	BAT	Status at Installation
	accidents. Applying a similar, maybe less detailed, safety management system is the first step in preventing and limiting these. BAT in preventing incidents and accidents is to apply a safety management system as described in Section 4.1.6.1.	
Preventing incidents and (major) accidents **Operational procedures and training**	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.	Noted An Operation and Maintenance training programme shall be prepared for the Operations and Maintenance personnel. The FSU will be operated by the same party that is carrying out the conversion from LNGC to FSU and thus will have the relevant expertise and specialists for the Operational phase. Refer to section B2.9 for additional details.
Preventing incidents and (major) accidents **Leakage due to corrosion and/or erosion**	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: • selecting construction material that is resistant to the product stored • applying proper construction methods • preventing rainwater or groundwater entering the tank and if necessary, removing water that has accumulated in the tank • applying rainwater management to bund drainage • applying preventive maintenance, and • where applicable, adding corrosion inhibitors, or applying	Noted Corrosion shall be contained or prevented by: 1. Selection of appropriate materials for the different applications. (BAT) a. Seawater pipelines are made of fibreglass and the seawater condenser internal tubes are made of titanium. b. LNG pipelines are made of cryogenic stainless steel. c. Natural gas pipelines are made of stainless steel

Aspect of BAT	BAT	Status at Installation
	cathodic protection on the inside of the tank. Additionally for an underground tank, BAT is to apply to the outside of the tank: • a corrosion-resistant coating • plating, and/or • a cathodic protection system. 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: • stress relieving by post-weld heat treatment, see Section 4.1.6.1.4, and • applying a risk based inspection as described in Section 4.1.2.2.1.	d. Demin water pipelines are made of carbon steel. e. High pressure steam pipelines are made of stainless steel 2. Inclusion of corrosion allowance in the design of pipelines and tanks. The corrosion allowance is defined as an amount of material in a pipe or vessel that is available for corrosion without affecting the pressure containing integrity. 3. A cathodic protection for the FSU and Jetty will be included (BAT). The cathodic protection system will be sacrificial anode type. 4. Corrosion inhibitors will be dosed to the water glycol loop. (BAT). This chemical compound is nitrite based for mild steel protection. This chemical will be already supplied with the glycol and so there won't be need to dose it on site.  MSDS C2053.pdf Details of the use of this corrosion inhibitor is included in section B2.3 Raw Materials, table 2.3.1 and the MSDS is included the Appendix A 5. Corrosion resistant coating/painting will be applied

Aspect of BAT	BAT	Status at Installation
		to the different pipelines and tanks. 6. Preventive maintenance shall be programmed. (BAT) Rainwater ingress into tanks is prevented in atmospheric tanks by using gooseneck vents of hooded breather vents. In pressurized tanks ingress of rain is not possible as they are completely sealed. There is not liquefied ammonia tanks on sites and SCC is not expected.
Preventing incidents and (major) accidents **Operational procedures and instrumentation to prevent overfill**	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: • high level or high pressure instrumentation with alarm settings and/or auto closing of valves is installed • proper operating instructions are applied to prevent overfill during a tank filling operation, and • sufficient ullage is available to receive a batch filling. 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 applied has to be decided for every single tank. See Section 4.1.6.1.6.	Noted All on shore tanks will be equipped with drain, high and low level indicators with visual and audible alarms, switches and interlocks with the distributed control system for a correct system operation. Fuel oil tanks will include an electronic overfill protection which will shut the filling valve to prevent overfilling. Level indicators with high level alarm,pressure measurement instrumentation and temperature transmitters at different tank level shall be installed in the FSU tanks. The ship-to-ship transfer shall be conducted in accordance to the transfer manual attached.

Aspect of BAT	BAT	Status at Installation
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Preventing incidents and (major) accidents **Instrumentation and automation to detect leakage**	The four different basic techniques that can be used to detect leaks are: • release prevention barrier system • inventory checks • acoustic emission method • soil vapour monitoring. 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.	LNG leak detection devices will be strategically placed on the gas plant (including equipment enclosures) and on the LNG transfer line to detect possible leaks which could occur in the facility. The arrangement of detectors will provide redundancy and to prevent false and spurious alarms. A voting arrangement for the detectors will be used. This voting function evaluates from multiple detectors the measurement of a given variable preventing spurious measurement caused by instruments malfunction. The leak detection system will operate continuously even during plant shutdown to detect any LNG spillage or gas leakage in the gas plant facilities. All detection devices will be protected from accidental damage and weather proof. EN1473:2007 "Installation and equipment for liquefied natural gas. Design of onshore installations" recommends the spilled LNG to be detected by low temperature sensors, for example, resistance type devices or fibre optic systems. The FSU includes gas detection system which shall be certified by the classification society
Preventing incidents and (major) accidents **Risk-based approach to emissions to soil**	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	Noted Negligible risk of soil pollution is expected by adopting the following measure: a thickness of the tank bottom of at least 5 mm, together with a leak detection system in combination with an

Aspect of BAT	BAT	Status at Installation
below tanks	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. 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.	external coating system and measures to prevent rainwater and groundwater ingress and tank bunding area (BAT). This is applicable to all tanks within the new facilities.
Preventing incidents and (major) accidents **Soil protection around tanks - containment**	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: • tank bunds around single wall tanks; see Section 4.1.6.1.11 • double wall tanks; see Section 4.1.6.1.13 • cup-tanks; see Section 4.1.6.1.14 • double wall tanks with monitored bottom discharge; see Section 4.1.6.1.15. 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. 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	Noted All chemical storage tanks within the extension facilities shall be located in leak-tight storage located in bunded containment areas (BAT). A separate containment shall preferably be used for each chemical, although the use of a common one will be allowed for tanks containing compatible products. The final arrangement will be decided in detailed engineering design stage. The containment shall have capacity equivalent of at least 110% of the tank it houses or, if a single containment houses several tanks, 110% of the largest tank it houses. The LNG moss tanks have a secondary barrier in case of small loss of containment. This secondary barrier is designed for containing possible leaks from the LNG Moss tanks and it is not designed for full containment of the tanks. The Moss tanks integrity has been assessed and

Aspect of BAT	BAT	Status at Installation
	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. Impervious barriers include: • a flexible membrane, such as HDPE • a clay mat • an asphalt surface • a concrete surface. 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. BAT for underground and mounded tanks containing products that can potentially cause soil pollution is to: • apply a double walled tank with leak detection, see Section 4.1.6.1.16, or • to apply a single walled tank with secondary containment and leak detection, see Section 4.1.6.1.17.	certified by BV certification society. The integrity of tanks shall be reassessed periodically every 5 years. For that activity each tank shall be emptied, inerted, attemperated and certified. The maximum stored volumes and associated bunded volumes are included in section B2.3 Raw Materials, tables: 2.3.2, 2.3.3 & 2.3.5
Preventing incidents and (major) accidents **Flammable areas and ignition sources**	See Section 4.1.6.2.1 together with ATEX Directive 1999/92/EC.	Hazardous zones will be assessed and the relevant ATEX rating of equipment within these zones shall be strictly adhered to.

Aspect of BAT	BAT	Status at Installation
Preventing incidents and (major) accidents **Fire protection**	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): • fire resistant claddings or coatings • firewalls (only for smaller tanks), and/or • water cooling systems	Flame arrestors and flame walls for small diesel tanks shall be included, both on the shore and on the FSU as required for the EDG fuel supply tanks.
Preventing incidents and (major) accidents **Fire-fighting equipment**	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.	The regas and jetty fire-fighting system shall be fully compliant with NFP regulations. The FSU will have an independent firefighting system, complete with own firefighting water storage tanks. There will be a dedicated ship to shore fight fighting link for refilling the FSU tanks as necessary. Typical small diesel tank flame arrestor details are attached herein (this information is confidential):  ENEM-JPA-E2-00-DR-ME-00087.pdf
Preventing incidents and (major) accidents **Containment of contaminated extinguishant**	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.	Full containment will be applied for onshore LNG suction tanks, chemicals, transformer oils and diesel tanks. LNG FSU tanks will have a secondary barrier designed for holding maximum envisaged potential leakage from tanks. These bunded areas will be fully isolated from water drains (BAT). Sprinkled water and fire-fighting high expansion

Aspect of BAT	BAT	Status at Installation
	For toxic, carcinogenic or other hazardous substances, BAT is to apply full containment.	foams shall be contained in the bunded areas. An authorized carrier will dispose it when there is risk of contamination. The bunds around all the transformers will contain the potentially oil contaminated firefighting water and the firefighting foam will be contained in the LNG suction drum and pipeline bund, further details are in section B2.3 tables 2.3.3 and 2.3.5

1.2 Storage of packaged dangerous substances

Aspect of BAT	BAT	Status at Installation
Safety and risk management	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 and maintain an up-to-date list of substances. However, companies storing dangerous substances not falling under	Due to the large amount of LNG stored and handled (> 200 tonnes), ElectroGas' new plant is an "upper tier" establishment as defined by the Control of Major Accident Hazards (COMAH) Regulations that implement the Seveso III Directive (2012/18/EU). The Directive has been transposed into Maltese law through the Control of Major Accident Hazards (COMAH) Regulations – LN 179 of 2015. As required by these regulations, a Major Accident

Aspect of BAT	BAT	Status at Installation
	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. BAT in preventing incidents and accidents is to apply a safety management system as described in Sections 4.1.6.1. 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	Prevention Policy (MAPP) and a Safety Management System (SMS) will be implemented. A Safety Report has been drawn up, including the Description of the Environment, the Description of the Installations, the Hazard Identification (including HAZID and HAZOP reviews), the Consequence Analysis (scenarios' effect distances), the Risk Assessment (scenarios' likelihood and severity) and the Safety of the Installations (prevention, mitigation and detection/protection measures). An Internal Emergency Plan has also been drawn up, including the General Data (description of the environment and installations), the Alert and Evacuation procedures, the Detection, ESD and Fire Fighting Systems, the Emergency Response Scenarios and the Training and Drills.
Training and responsibility	BAT is to appoint a person or persons who is or are responsible for the operation of the store. 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.	EGM and each operator (FSU, LNG Terminal and CCGT) will appoint a HSE manager for developing Safety Management Policies. The HSE Manager shall implement all necessary changes and updates to the Internal Emergency Plan. He will be responsible for all safety related information and training.

Aspect of BAT	BAT	Status at Installation
Storage area	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.	Liquefied Natural Gas (LNG) is stored at the FSU in 5 independent insulated Moss type tanks, with a total storage capacity of 125 000 m^3.
Separation and segregation	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. 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.	The new EGM plant is partitioned into 3 main areas : the FSU at the jetty, the Regasification Plant and the CCGT. Distances between these areas are greater than 200 meters. From the Safety Report results, no domino effect is identified between the new plant facilities (from FSU to RGU & CCGT, or from RGU to FSU & CCGT), as these facilities are remote enough with comparison to the related safety distances. Furthermore, the Control Buildings are designed as fire resistant. From Hazard Identification, no incompatible combinations of substances have been identified.
Containment of leakage and contaminated extinguishant	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	At the FSU, the LNG tanks are within the double hull of the converted LNGC. The hold space is provided with gas detection, inert gas generator and leak cargo system (eductor system). At the Regasification Plant, an impounding basin is

Aspect of BAT	BAT	Status at Installation
	can only be decided on a case-by-case basis. 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.	installed, which will collect any possible LNG spills from the LNG pumps suction drum, the HP LNG and small scale pumps, the IFVs as well as the LNG pipeline from FSU. This impounding basin, designed in compliance with EN 1473, is provided with spill detection and high expansion foam generators.
Fire-fighting equipment	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.	At the FSU, the Fire Fighting Systems include hose lockers on the FSU deck and dry powder system (monitors) to protect the FSU manifolds, and CO_2 protection for compressor room and engine room. At the Jetty and the Regasification Plant, the Fire Fighting Systems consist of the fire water main network common both for onshore and jetty areas including fire fighting pumping station, outdoor hydrants and monitors, the standpipe and hose cabinets for the protection of buildings, the water spray systems for exposure protection of equipment, the water curtain system between the FSU and the jetty, and the high expansion foam system for the impounding basin and the NVCC KO drum pit. At the CCGT, sprinkler and spray deluge systems and clean agent systems are provided.

Aspect of BAT	BAT	Status at Installation
Preventing ignition	BAT is to prevent ignition at source as described in Section 4.1.7.6.1.	Hazardous areas have been identified in compliance with ATEX Directive (2014/34/EU). At the FSU: LNG tanks, Cargo hold space, Cargo tanks vents, Cargo domes, Cargo manifolds, Open deck area. At the onshore facilities; valve seals or flange gaskets, vents. Construction, installation and use of apparatus are strictly compatible with these areas in which an explosive atmosphere may occur.

1.3 Basins and lagoons

Aspect of BAT	BAT	Status at Installation
Basins and lagoons	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. 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: • a plastic cover; see Section 4.1.8.2	The project will include impounding basins for storm water and oil receptors. Emissions to air from these basins are not expected. BAT conclusions are not required

Aspect of BAT	BAT	Status at Installation
	• a floating cover; see Section 4.1.8.1, or • only small basins, a rigid cover; see Section 4.1.8.2. Additionally, where a rigid cover is used, a vapour treatment installation can be applied to achieve an extra 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. 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. 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.	

1.4 Atmospheric mined caverns

Aspect of BAT	BAT	Status at Installation
Emissions to air from normal operation	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 to this project
Emissions from incidents and	By their intrinsic nature, caverns are by far the safest way of storing large quantities of hydrocarbon products. BAT for	Not applicable to this project

Aspect of BAT	BAT	Status at Installation
(major) accidents	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. BAT, in preventing incidents and accidents, is to apply a safety management system as described in Section 4.1.6.1. BAT is to apply, and then regularly evaluate, a monitoring programme which at least includes the following (see Section 4.1.13.2): • monitoring of the hydraulic flow pattern around the caverns by means of groundwater measurements, piezometers and/or pressure cells, seepage water flowrate metering • assessment of cavern stability by seismic monitoring • water quality follow-up procedures by regular sampling and analysis • corrosion monitoring, including periodic casing evaluation. 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. For preventing seepage water entering the cavern, BAT is, apart from a proper design, to additionally apply cement	

Aspect of BAT	BAT	Status at Installation
	injection, see Section 4.1.13.6. 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. BAT is to apply automated overfill protection, see Section 4.1.13.8.	

1.5 Pressurised mined caverns

Aspect of BAT	BAT	Status at Installation
Emissions from incidents and (major) accidents	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. BAT, in preventing incidents and accidents, is to apply a safety management system as described in Section 4.1.6.1. BAT is to apply, and then regularly evaluate a monitoring programme which at least includes the following (see Section 4.1.14.2): • monitoring of the hydraulic flow pattern around the caverns by means of groundwater measurements, piezometers and/or pressure cells, seepage water flowrate	Not applicable to this project

Aspect of BAT	BAT	Status at Installation
	metering • assessment of cavern stability by seismic monitoring • water quality follow-up procedures by regular sampling and analysis • corrosion monitoring, including periodic casing evaluation. 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. For preventing seepage water entering the cavern, BAT is, apart from a proper design, to additionally apply cement injection, see Section 4.1.14.6 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. BAT is to apply automated overfill protection, see Section 4.1.14.8. BAT is to apply fail-safe valves in the event of a surface emergency event, see Section 4.1.14.4.	

1.6 Salt leached caverns

Aspect of BAT	BAT	Status at Installation
Salt leached caverns	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. BAT, in preventing incidents and accidents, is to apply a safety management system as described in Section 4.1.6.1. BAT is to apply, and then regularly evaluate a monitoring programme which at least includes the following (see Section 4.1.15.2): • assessment of cavern stability by seismic monitoring • corrosion monitoring, including periodic casing evaluation • carrying out of regular sonar evaluations to monitor	Not applicable to this project

Aspect of BAT	BAT	Status at Installation
	eventual shape variations, particularly if undersaturated brine is used. 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.	

1.7 Floating storage

Aspect of BAT	BAT	Status at Installation
Floating storage	Floating storage is not BAT, see Section 3.1.18.	Floating storage was selected as the preferred LNG storage technology for this project during pre-conceptual design at development stage. The decision for choosing the FSU was based on safety and was analysed in the Quantitative Risk Assessment (QRA) prepared for this project. The QRA assessed three different options: 1. Onshore LNG tanks and regasification plant and a jetty designed for mooring the LNG visitor cargo and transferring the LNG to the LNG tanks. 2. A floating storage unit with an onshore regasification

Aspect of BAT	BAT	Status at Installation
		plant and a jetty as in option 1 but with higher capacity, designed for mooring the FSU and the visitor cargo. 3. A floating storage unit with regasification plant installed in the FSU and a jetty as in option 2. The QRA conclusions are included below. The QRA study is included in an appendix. Gas cloud extension drawings and individual risk curves for each option can be found within this study for the different options.  QRA EIA.pdf *The Quantitative Risk Assessment (QRA) included in the EIS indicated that the offshore LNG terminal (FSU) was preferable to an on-shore LNG terminal because the offshore facility would be located further from the CCGT power plant and the heavy fuel oil (HFO) storage tanks. In the event of a major gas leak the ignition points in the CCGT could trigger a fire, which would damage the CCGT and possibly DPS 3. Although the track record of LNG storage facilities indicates that such accidents are highly unlikely (see Section 4.3 of the EIS), it is advisable for the distance between the power plant and the storage facility to be ‘safe’, especially in cases where room for multiple power stations is*

Aspect of BAT	BAT	Status at Installation
		unavailable. The 'safe distance' would allow the re-gas system to be used to contribute to the cooling requirements of the power plant, whilst at the same time prevent serious accidents, no matter how unlikely their occurrence may be. *On the basis of the risk assessment exercise, the QRA identified an area offshore within which the unloading hoses connecting the supply carrier with the LNG storage facility could be located. Following discussions with the Ports and Yachting Directorate (PYD) of Transport Malta, a suitable location for the offshore LNG terminal and jetty was identified.* *The conclusions of the QRA, with regard to the safety of the LNG terminal, are summarised below:* *1) Individual risk curve: The QRA identified that no incompatibility was identified between the projected terminal and the LNG terminal (or consequences which may affect people, the environment and neighbouring facilities), however the offshore LNG terminal would provide the softest in terms of impacts. In the event of liquid or gas release, effects would be: fire (pool, jet or flash fire); gas cloud generation or unconfined vapour*

Aspect of BAT	BAT	Status at Installation
		cloud explosion (UVCE), however these scenarios can be isolated in the event of an accident, through the closure of emergency shut-down valves; 2) *Gas cloud extension: the QRA studied the spread of a gas cloud in case of a major gas leak at the CCGT and HFO tanks. On the basis of this assessment the QRA identified the location of potential leak points within the development, namely the loading hoses and the re-gas unit, as well as where these should be located should a leak occur. The QRA identified a location wherein the flammable part of the gas cloud would not encounter any ignition points which would be located in the new CCGT and/or the existing DPS 3, 2A and 2B. The QRA indicates that a gas release would not cause a domino effect on the HFO tank. The QRA also identified that as natural gas is lighter than air, when the LNG transforms to NG it would diffuse and rise progressively, therefore avoiding the inlets located on the eastern side of the peninsula, and avoiding potential human health risks.* *The conclusions of this QRA assessment indicated that the offshore LNG floating-storage option was considered, on balance, the safer option with reference to both human life and security of supply, and was therefore seen as the preferred option.*

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
Inspection and maintenance	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.	Scheduled preventive maintenance and regular inspections will be carried out in the key mechanical, electrical and instrumentation and control equipment with the objective of minimizing unscheduled maintenance and maximizing plant availability. A computer based Planned Maintenance System (PMS) will coordinate maintenance activities to be performed, following the different equipment manufacturer's recommendations regarding the number and type of inspections, spare parts planning and other major factors affecting the component life and proper operation of the equipment.
Leak detection and repair programme	For large storage facilities, according to the properties of the products stored, BAT is to apply a leak detection and repair 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.	Noted LNG leak detection, propane gas detection and fire gas detection will be included. (BAT)
Emissions minimisation	BAT is to abate emissions from tank storage, transfer and handling that have a significant negative environmental	Noted

Aspect of BAT	BAT	Status at Installation
principle in tank storage	effect, as described in Section 4.1.3.1. This is applicable to large storage facilities, allowing a certain time frame for implementation.	Emissions to air won't take place from the LNG storage tank during LNG transfer operating conditions. In case of pressure surge in the LNG tanks, the auxiliary boilers will start burning the BOG in order to control the pressure and avoid any BOG release to atmosphere from the tank relief valves. In case of emergency disconnection from onshore, emergency release couplings will close safe in order to isolate the LNG and BOG systems offshore from onshore and limit the amount of release in such an event. For solids and liquid emissions generation, the attached waste management plant shall be in place in the FSU. Waste management Plan - OPS-MALT-ALM-ENV-PLN-0002_R0 (2).pdf
Safety and risk management	BAT in preventing incidents and accidents is to apply a safety management system as described in Section 4.1.6.1.	The proposed development will put in place a health and safety management system based on the conclusions from the detailed risk assessment. BAT recommendations will be strictly followed.
Operational procedures and training	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.	Noted

2.2 Considerations on transfer and handling techniques

Aspect of BAT	BAT	Status at Installation
Piping	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. Bolted flanges and gasket-sealed joints are an important source of fugitive emissions. BAT is to minimise the 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. BAT for bolted flange connections (see Section 4.2.2.2.) include: • fitting blind flanges to infrequently used fittings to prevent accidental opening • using end caps or plugs on open-ended lines and not valves • ensuring gaskets are selected appropriate to the process application • ensuring the gasket is installed correctly • ensuring the flange joint is assembled and loaded correctly • where toxic, carcinogenic or other hazardous substances are transferred, fitting high integrity gaskets, such as spiral wound, kammprofile or ring joints. Internal corrosion may be caused by the corrosive nature of	In compliance with BAT recommendations Piping will be designed in accordance with ASME B31.3 "Process piping standard" and European Pressure Equipment Directive 97/23/EC All LNG and natural gas pipework will be above ground. Welded inline valves and welded pipelines will be preferred and used whenever practical over flange connections with appropriate consideration for commissioning, isolation and maintenance. The number of flanges in pipe runs will be minimized and where required, qualified gaskets complying with EN 12308. When flanged connection is unavoidable (very limited cases), these will comply with BAT recommendations and international standard ASME 16.5 "pipe flanges and flanged fittings". Corrosion allowance will be considered for all the pipelines according to the operating lifetime and transferred fluid. Pipe materials will be selected according with the particular application. Cryogenic stainless steel will be used for LNG and boil-off gas transfer lines. Paint coatings will be applied to the pipelines for preventing external corrosion as per EN- 4628-3

Aspect of BAT	BAT	Status at Installation
	the product being transferred, see Section 4.2.3.1. BAT is to prevent corrosion by: • selecting construction material that is resistant to the product • applying proper construction methods • applying preventive maintenance, and • where applicable, applying an internal coating or adding corrosion inhibitors. To prevent the piping from external corrosion, BAT is to apply a one, two, or three layer coating system depending 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.	
Vapour treatment	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. For example, according to Dutch regulations, the emission of methanol is significant when over 500 kg/yr is emitted.	Noted BOG vapour management system between LNG cargo and FSU will be included. This system will include a BOG manifold hose connection and all the associated instruments for smooth control. BOG will flow from the FSU back to the LNG cargo tanks during offloading operation to control the build-up of BOG pressure in the tanks. BOG will also continue to be sent to shore during ship to ship transfers, where it will be compressed and used as fuel in the power plants.
Valves	BAT for valves include: • correct selection of the packing material and construction	Noted

Aspect of BAT	BAT	Status at Installation
	for the process application • with monitoring, focus on those valves most at risk (such as rising stem control valves in continual operation) • applying rotating control valves or variable speed pumps instead of rising stem control valves • where toxic, carcinogenic or other hazardous substances are involved, fit diaphragm, bellows, or double walled valves • route relief valves back into the transfer or storage system or to a vapour treatment system. See Sections 3.2.2.6 and 4.2.9.	Valves shall be selected according to the process application: 1. Valve packing materials and construction are selected for cryogenic LNG and natural gas applications accordingly. 2. Process variables will be monitored so wear/malfunction of valves can be detected. 3. Variable speed pumps are considered within the project for applications when a valve would have been under continual severe operation. 4. Double isolation philosophy is adopted in hazardous and high steam pressure lines. Belows are used in instrumentation in NG lines. 5. Emergency relief valves are routed to a high position for good dispersion. Lambda blowers will be used to prevent any flammable mixture. Relief valves are only operated under emergency situation and are not routed to any storage.
Pumps and compressors **Installation and maintenance of pumps and compressors**	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: • proper fixing of the pump or compressor unit to its base-plate or frame • having connecting pipe forces within producers' recommendations • proper design of suction pipework to minimise hydraulic imbalance	Noted The design will comply with BAT recommendations. LNG pumps are designed as per ISO 13709/API 610 "Centrifugal pumps for petroleum, petro-chemical and natural gas industry". This standard covers BAT recommendations. BOG compressors are designed as per API 618

Aspect of BAT	BAT	Status at Installation
	• alignment of shaft and casing within producers' recommendations • alignment of driver/pump or compressor coupling within producers' recommendations when fitted • correct level of balance of rotating parts • effective priming of pumps and compressors prior to start-up • operation of the pump and compressor within producers' recommended performance range (The optimum performance is achieved at its best efficiency point.) • the level of net positive suction head available should always be in excess of the pump or compressor • regular monitoring and maintenance of both rotating equipment and seal systems, combined with a repair or replacement programme.	"reciprocating compressors for petroleum, petro-chemical and natural gas industry".. This standard covers BAT recommendations.
Pumps and compressors **Sealing system in pumps**	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 bellow pumps. For more details see Sections 3.2.2.2, 3.2.4.1 and 4.2.9.	Noted Submerged, pot mounted LNG pumps will be included so as to prevent any liquid or gaseous leak.
Pumps and compressors **Sealing systems in compressors**	BAT for compressors transferring non-toxic gases is to apply gas lubricated mechanical seals.	BOG compressors are reciprocating type. Leak protection is provided by three proprietary non lubricated piston rings in series. Nitrogen will be used as buffer/purge gas. This is in

Aspect of BAT	BAT	Status at Installation
	BAT for compressors, transferring toxic gases is to applydouble seals with a liquid or gas barrier and to purge the process side of the containment seal with an inert buffer gas. In very high pressure services, BAT is to apply a triple tandem seal system. For more detail see Sections 3.2.3 and 4.2.9.13.	line with BAT recommendations
Sampling connections	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.	Needle valves will be used for NG sampling lines with a block valve. NG samples are used to determine gas composition and heating value for the fiscal metering.

Part 3: Storage of solids

Aspect of BAT	BAT	Status at Installation
Open storage	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. 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. 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. BAT for long-term open storage are one, or a proper combination, of the following techniques: • moistening the surface using durable dust-binding	Not applicable to this project

Aspect of BAT	BAT	Status at Installation
	substances, see Section 4.3.6.1 • covering the surface, e.g. with tarpaulins, see Section 4.3.4.4 • solidification of the surface, see Table 4.13 • grassing-over of the surface, see Table 4.13. BAT for short-term open storage are one, or a proper combination, of the following techniques: • moistening the surface using durable dust-binding substances, see Section 4.3.6.1 • moistening the surface with water, see Sections 4.3.6.1 • covering the surface, e.g. with tarpaulins, see Section 4.3.4.4. Additional measures to reduce dust emissions from both long and short-term open storage are: • placing longitudinal axis of the heap parallel with the prevailing wind • applying protective plantings, windbreak fences or upwind mounds to lower the wind velocity • 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 % • 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 • placing retaining walls close together.	

Aspect of BAT	BAT	Status at Installation
	See Table 4.13 for more details.	
Enclosed storage	BAT is to apply enclosed storage by using, for example, 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. 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. BAT for sheds is to apply proper designed ventilation and filtering systems and to keep the doors closed. See Section 4.3.4.2. BAT is to apply dust abatement and a BAT associated emission level of 1 – 10 mg/m3, 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. 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.	Not applicable to this project

Aspect of BAT	BAT	Status at Installation
Storage of packaged dangerous solids	For details regarding BAT for the storage of packaged dangerous solids, see Section 5.1.2.	Not applicable to this project
Preventing incidents and (major) accidents **Safety and risk management**	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, 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. BAT in preventing incidents and accidents is applying a safety management system as described in Section 4.1.7.1.	Not applicable to this project

Part 4: Transfer and handling of solids

Aspect of BAT	BAT	Status at Installation
General approaches to minimise dust from transfer and handling	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. 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. 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. 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. BAT for roads that are used by trucks and cars only, is	Not applicable to this Project

Aspect of BAT	BAT	Status at Installation
	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. 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. BAT is to clean roads that are fitted with hard surfaces according to Section 4.4.6.12. 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. 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. 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: • installing baffles inside fill pipes	

Aspect of BAT	BAT	Status at Installation
	• applying a loading head at the end of the pipe or tube to regulate the output speed • applying a cascade (e.g. cascade tube or hopper) • applying a minimum slope angle with, e.g. chutes. 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: • height adjustable fill pipes • height adjustable fill tubes, and • height adjustable cascade tubes. These techniques are BAT, except when loading/unloading non drift sensitive products, for which the free fall height is not that critical. Optimised discharged hoppers are available and described in Section 4.4.6.7	
Considerations on transfer techniques **Grabs**	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. BAT for new grabs, is to apply grabs with the following properties (see Section 4.4.5.1): • geometric shape and optimal load capacity • the grab volume is always higher than the volume that is	Not applicable to this Project

Aspect of BAT	BAT	Status at Installation
	given by the grab curve • the surface is smooth to avoid material adhering, and • a good closure capacity during permanent operation.	
Considerations on transfer techniques **Conveyors and transfer chutes**	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 generate detail designs for new and existing transfer points. For more details see Section 4.4.5.5. 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: • lateral wind protection, see Section 4.4.6.1 • spraying water and jet spraying at the transfer points, see Sections 4.4.6.8 and 4.4.6.9, and/or • belt cleaning, see Section 4.4.6.10. For highly drift sensitive products (S1 and S2) and moderately drift sensitive, not wettable products (S3) BAT for new situations, is to: o apply closed conveyors, or types where the belt itself or a second belt locks the material (see Section 4.4.5.2), such as: • pneumatic conveyors • trough chain conveyors	Not applicable to this Project

Aspect of BAT	BAT	Status at Installation
	• screw conveyors • tube belt conveyor • loop belt conveyor • double belt conveyor o or to apply enclosed conveyor belts without support pulleys (see Section 4.4.5.3), such as: • aerobelt conveyor • low friction conveyor • conveyor with diabolos. 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. 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. To reduce energy consumption for conveyor belts (see Section 4.4.5.2), BAT is to apply: • a good conveyor design, including idlers and idler spacing • an accurate installation tolerance, and • a belt with low rolling resistance. See Annex 8.4 for the disperseveness classes (S1 – S4) of solid bulk materials.	

Aspect of BAT	BAT	Status at Installation

[1] 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.

[2] 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.

[3] 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.

[4] 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.