Economic Commission for Europe

Inland Transport Committee

30 June 2011

Working Party on the Transport of Dangerous Goods

Joint Meeting of Experts on the Regulations annexed to the European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways (ADN) (ADN Safety Committee)

Nineteenth session
Geneva, 22–25 August 2011
Item 7 of the provisional agenda
Special authorizations, derogations and equivalents

Proposals for equivalents based on 1.5.3.1

Transmitted by the Government of the Netherlands

Introduction

1. Emission reduction is an important subject for inland navigation. Enormous progress has been made over the last 20 years in cleaning up truck engines. Inland navigation will have to make a serious effort in the years to come to keep track, focusing on the one hand on air quality parameters such as NOx and soot, and on the other hand on CO_2.

2. LNG is a clean fuel, that has been used in ferries and other sea-going vessels in Norway for over ten years. The use of LNG potentially reduces the emission of NOx by 80%, soot by 100%, and CO_2 by 20%, compared to a diesel engine running on gasoil.

3. Interest in the Netherlands in using LNG as a fuel for inland navigation has been growing over the last two years. Several companies are having systems developed to be able to use LNG as a fuel. In addition, several very large shippers are interested in using LNG for their inland navigation transport.

4. The Netherlands recognize and fully support these developments. The Netherlands believe LNG could be a break-through solution, working positively towards cleaner air, and at the same time further reducing CO_2 emissions from inland navigation.

Equivalents

5. For three vessels the developments are considered ready to be put into operation. The system is developed by DAMEN Shipyards (Bodewes Millingen) under supervision of Bureau Veritas. The vessel concerned is:

    - DRT – 1145 - Eco-Liner

6. LNG however has a flashpoint below 55 degrees Celsius and therefore the use of LNG as a fuel for inland navigation vessels is prohibited by ADN. In order to allow these vessels to use LNG as a fuel, a recommendation for an equivalent based on 1.5.3.1 ADN is needed.

7. Since the use of LNG is new in inland navigation, the Netherlands consider is too early at this stage to propose amendments to the regulations itself. The Netherlands prefer to gather experience with this new concept with a number of vessels, by using these recommendations. These experiences can be used for submitting a proposal to amend the regulations at a later stage.

8. In the annexes to this document the proposals for equivalents for the above mentioned vessels can be found, accompanied by the Hazard Identification Studies, carried out for the vessel by Bureau Veritas.

9. At the same time recommendations for three other vessels based on the Rhine Vessels Inspection Regulations are discussed within CCNR. Should the discussions within CCNR generate new information before the nineteenth session of this Working Party, the delegations will be informed accordingly.

Proposal

10. The Working Party is invited to discuss the proposals for equivalents annexed to this document and, if an agreement is reached, forward them to the Administrative Committee for adoption at its seventh session.

EUROPEAN COMMISSION, DIRECTORATE - GENERAL FOR ENERGY AND TRANSPORT

RECOMMENDATION TO THE COMMITTEE

REGARDING DEROGATIONS TO:
ANNEX ll of the DIRECTIVE 2006 / 87 / EC, Art.19 (2).

Recommendation Nr. .xxxx / 11
According to Annex ll of the Directive 2006 / 87 / EC Article 19 (2)

MTS "DRT - 1145 - EL"
(Motor Tank Ship "Damen River Tanker 1145 Eco Liner)

new building(s) in 2011 / 2012, with the official ID number 54314 and BV registernumber 20629A, to allow the derogations as specified in this recommendation from the Directives 2006 / 87 / EC and to accept application of equivalent arrangements as per IMO International Code on Safety for Gas-Fuelled Ships (IGF Code) and Bureau Veritas Rule Note NR 529 DTM R00 E Safety Rules for Gas-Fuelled Engine Installations in Ships of February 2007.

The Dutch delegation submitted this recommendation to the Joint Working Group of the EU Directive 2006/87/EG to inform and request for approval of the concept for a fully LNG propulsed vessel and allow the shipyard to proceed with the detailed engineering and construction of this type of vessel.

Introduction
Shipyard Bodewes Millingen has developed an alternative environmental friendly, sustainable driven Motor Tank Ship (ADN type C chemical tanker), known as "Damen River Tanker – 1145 – Eco Liner" (DRT 1145 EL).

Specification of the ship (as far as known):
LxBxD = 110,00 x 11,40 x 5,50 m
cargo tank capacity: 10 x 380 m^3
propulsion output: approx.2 x 600 kW
E-generating sets: approx.3 x 400 kW
E-driven bowthruster

Only one type of fuel will be available, i.e. LNG, stored onboard in dedicated pressure vessels under approx. 2 bar at minus 162 ^oC. After evaporation in the deck area, the LNG will supply the internal combustion engines for electricity generation as well as the gasboiler used for cargotank heating system. The engines are divided over two independent engine rooms whereas the gasboiler is located in PS or SB engine room.

The ship will be able to sail and navigate on one engine room with a relative speed of not less than 13 km/h and satisfactory manoeuvring capabilities and in compliance with the principles of hereunder mentioned IGF Code and Directive 2006/87/EC.

Hereafter a detailed description of the project is given.

Documents & Derogations

For the design of the vessel and the LNG propulsion system the following documents are applied:

- Directive 2006/87/EC as in force
- Directive 2008/68/EC (ADN) as in force
- Bureau Veritas Rules for the Classification of Inland Navigation Vessels NR 217 of April 2009
- IMO International Code on S afety for Gas-Fuelled Ships (IGF Code) under development (ref. MSC/.285(86) / BLG 15/6)
- Bureau Veritas Rule Note NR 529 DTM R00 E Safety Rules for Gas-Fuelled Engine Installations in Ships of February 2007.

Further to the application of LNG as the only fuel on board the vessel, full compliance with all regulations in force can not be achieved. Derogations from the requirements in Directives 2006/87/EC are found in the below listed items:

Derogations from Directive 2006/87/EC Articles:

> 8.01.3	Only IC engines may be installed using fuel with a flashpoint above 55^{o}C.
> 8.05.1	Location of LNG tanks on open deck.
> 8.05.6	EN standard for fuel filling connections and tank dearation arrangements
> 8.05.12	Tank openings for cleaning and inspection

In attachment 1 you will find a summary of the mentioned articles of the Directive 2006/87/EC and their relation to the IGF code.

Description of project
Damen River Tanker 1145
Ecoliner

Content

1. Introduction

In this part the design of the vessel is described in chapter 2, which focuses on the LNG storage and the design of the engine room. In chapter 3 the advantages of LNG are described and specific requirements for LNG propulsed vessels outside the technical design as mentioned in the previous chapter. Chapter 4 ends this part with a conclusion. An important part of the project is the risk analysis which can be found in attachment 2.

The recommendation is for this vessel only. Each new vessel will receive a new recommendation with relevant attachments like drawings and a risk analysis.

2. Design of vessel

The specific demands for LNG / NG propulsion will be focussed on the aft ship. Midship (cargo area) and fore ship will be 100% similar to a conventional tanker according ADN and EU regulations. Therefore this design can be easily adapted for other type of vessels. For LNG propulsed vessels no specific requirements are foreseen in case of berthing etc.. The design requirements from the Hazid are dealt with in the design. The class society will survey the vessel during its construction.

In attachment 3 the general arrangement of the Ecoliner can be seen.

2.1 LNG storage

Natural gas will be stored as Liquefied Natural Gas (LNG) in two cryogenic tanks with a temperature of about -162 °C and with a maximum pressure of about 2 bar (design pressure 6 bar). The tanks and LNG pipelines are provided with safety relief valves (setpoint 5 bar) discharging in a riser with its open end in a safe place and height above deck according IGF code. The tanks used are similar to the tanks used for road transport and are conform ADR and EN 13530. The inner tank is of stainless steel and the outer tank is made of ordinary steel. In the double wall a white powder called perlite protects the inner tank for heating by infrared radiation. The inner space between the two tanks is under vacuum so there is no heating by convection as well. The inner and outer tanks are connected in a way that heating through conduction is minimised.

Distance of the LNG/NG installation on open deck will not be less than 1m from the ship's sides and stern. The top of the tanks and the equipment will always be below the restricted air draft of the vessel.
No part of the LNG/NG system will enter the cargo area of the vessel.
The distance between the tanks and the accommodation openings are according ADN, see attachment 4.

The two tanks with their ancillaries are each forming redundant systems. The tanks are rigid mounted outside on the aft deck together with all the ancillaries as vaporizers etc. required to convert the LNG into NG with ambient temperature and low pressure. From

the cryogenic tanks the LNG is led to the vaporizers, after the vaporizers the NG will be led inside each independent P.S. and S.B. engine room. In case of an emergency in one of the engine rooms the NG will be directly shut off.

Lay out of the engine rooms will be as far as possible complying with:

- Directive 2006/87/EC as in force
- Directive 2008/68/EC (ADN) as in force
- Bureau Veritas Rules for the Classification of Inland Navigation Vessels NR 217 of April 2009
- IMO International Code on Safety for Gas-Fuelled Ships (IGF Code) under development (ref. MSC/.285(86) / BLG 15/6)
- Bureau Veritas Rule Note NR 529 DTM R00 E Safety Rules for Gas-Fuelled Engine Installations in Ships of February 2007.

Each independent LNG tank and LNG-NG system will supply the installations of one engine room whereas back-up provisions of serving the other engine room are provided. Therefore a manifold will be provided from which each engine room is supplied through a remote closable main valve (ESD - Emergency Shutdown Valve), also located on open deck. In case of emergency either ESD valve can be closed remotely or automatically when required.

The evaporators, necessary to evaporate the LNG into NG, are also located on open deck, close to the tanks. Each main supply line to an engine room will have it's own independent evaporator.

On the deck of the aft ship a stainless steel drip tray is made to avoid damage to the deck in case of leakage of LNG. The drip tray can store the contents of one full tank and is in accordance with the IGF code.

In case of fire or pressure built up a water spray installation is installed acc to IGF code (attachment 5). The water spray installation is also used for diluting and evaporising the NG in case of blow-off.

In case of a calamity alarms are installed in the wheelhouse in compliance with the IGF Code (attachment 6).

2.2 Engine rooms

PS and SB engine room will be separated from each other by a longitudinal bulkhead which is watertight as well as gastight and has an A60 fire integrity. In this bulkhead a emergency escape watertight, A-60 isolated, self closing with open-close monitoring, door is provided.

The engine-generator sets and main switchboards will be located in both engine rooms. The installation in either engine room can run independently from the other.

All NG supply piping running within each engine room up to the engines and heater will be enclosed in a gastight enclosure (double wall piping). This gastight enclosure (acc IGF with ESD; attachment 7) Both engine rooms will be equipped with mechanical under-pressure ventilation with a capacity of not less than 30 air changes per hour and a fixed gas detection system. The fans will be of the non-sparking type, their motors being of the required safety execution. The outlet of these ventilation systems will be located in a safe area.

As, gas-safe certified engines in this output range and burning units are not (yet) available, the lack of this certification will be covered by the emergency shut down (ESD) protection of the engine rooms in compliance with the a.m. IGF Code and BV Rule Note. ESD will shut down one entire engine room except for some emergency lights, emergency equipment and Eex equipment as described in the IGF Code.

Heat recovery from the cooling water and the exhaust gases will be used for the cargo tank heating and domestic heating. The propulsion arrangement will be with electrical driven multi propeller (2 x) azimuth drives with one electrical bow thruster.
Electric power generation will be according the gas - electrical system. For redundancy and international regulation requirements 2 x independent engine rooms will be installed. Design of the Engine Room will be according the E.S.D. (emergency shut down) machinery space lay out.

In case of a fire in the engine room the LNG flow will be closed. The fire in the engine room can therefore be dealt with as on board a conventional vessel.
Attachment 8 shows the lay-out of the engine rooms.

Power management system
The design of the electrical generating system in combination with a power management system is such that each two of the four (about 50% of the required electrical power) generator sets are located in a separate compartment. In case of fire or flooding of one compartment the operation of the other electrical generating system is not affected.
The power management system is designed such that the generating power (generator sets at work) will be in balance with the required power consumers.
It complies with the IGF guidelines and the rules of Bureau Veritas for redundant electrical power generation and it also complies with the EU Directives for emergency propulsion. See attachment 9

Alarms in the wheelhouse will be according table 1 from the IGF code, see attachment 6.

3. Use of LNG

3.1 Advantages & use

The main motives to use LNG as fuel in inland navigation are the advantages for the environment:

- Fuel consumption reduction, using the higher efficiency of the electrical driven aft – propellers in combination with the power management system.
  - For redundancy less power/engines need to be installed leading to less emission and less fuel consumption.
  - Further more it opens the route to fully gas electric propulsion enabling the use of much cleaner engines then presently possible, fixed rotations per minute.
  - Heat recovery is applied, again leading to less fuel / emission consumption.
- Emission reduction natural gas in regard to gas oil about (equal installed kW.):
  - CO2 24 %
  - NOx 84 %
  - SO2 100 %
  - Particles95 %

  LNG fuelled ships comply at least with Euro 5 (more severe then current CCR regulations)

In case of leakage of LNG all liquid will flow in the drip tray where it will evaporize within hours according to experts working at the risk analysis. An exact time can not be given as this depends on several factors. LNG can also flow into water where it will evaporise and won't cause further damage to hull or to the water (except for temporarily freezing).
More information can be found on the LNG information sheet from the supplier (attachment 10).

3.2 Specific requirements

Upon request the LNG supplier sent a bunker procedure to instruct crew how to deal with the specific requirements for bunkering LNG. The procedure can be found in attachment 11.

All crew members will need training on how to handle the LNG propulsion system (including bunkering) and what to do in case of accidents. The training will be developed with the LNG supplier, tank- and system manufacturer. Final scheme will need approval of local authorities. The training will be mentioned in the ships manual.

For all crew members personal protection equipment in relation to LNG (UN 1972) will be required.

3.3 Inspection & evaluation

The vessel will be built under class and when in service will be surveyed every 2, 5 years according normal survey scheme.

The LNG system will be visually inspected every year by a class surveyor.
As a precaution the pressure relief valves will be replaced on a yearly basis. The rupture discs on the tank (indicating that the vacuum is decreasing) will be replaced during class renewal, e.g. every five years.
The LNG system will be evaluated every year by owner, ship yard and class society when in service and a report will be send to the EU and ADN commission.

4. Conclusion

This project is based on a fundament of an existing guideline, the IGF code. Developed is a complete new design for an Inland Waterway Vessel fitted for the use of a new fuel in this market, and in the same time meeting the requests for a cleaner environment.
By choosing proven technology and careful engineering and outfitting the design is fitted for purpose and of at least equal safety as a convention propulsed vessel. The design also leads to significant fuel reduction and lower emission.
This project is developed by intensive cooperation between the shipbuilding Industries, the transportation sector and the Authorities in order to find a way to fill in the requirements as close as possible to existing regulations.

List of Attachments

Nr.	Description	Manufacturer	Document Nr.
1	Relation between IGF Code and EU Directive 2006/87		
2	Risk Analysis		
3	General Arrangement	Bodewes	000-000
4	LNG storage in relation to safe zones of accommodation	Bodewes	000-003/a/b
5	Sprinkler installation		675-000
6	Monitoring of Gas supply systems acc IGF Code		
7	LNG-NG Diagram with gastight enclosure		321-000
8	Layout engine room and ventilation		200-000
9	Power Management	Bodewes	400-000
10	Safety sheet LNG		
11	General Bunker procedure		

end

European Commission
Directorate-General for Energy and Transport

RECOMMENDATION TO THE COMMITTEE
REGARDING DEROGATIONS TO:
DIRECTIVE 2008 / 68 / EC, Article 6

Recommendation Nr. xxxx / 11
According to Annex ll of the Directive 2008 / 68 / EC, Article 6

MTS "DRT - 1145 - EL"
(Motor Tank Ship "Damen River Tanker 1145 Eco Liner)

new building(s) in 2011 / 2012, with the official ID number 54314 and BV registernumber 20629A, to allow the derogations as specified in this recommendation from the Directives 2008 / 68 / EC and to accept application of equivalent arrangements as per IMO International Code on Safety for Gas-Fuelled Ships (IGF Code) and Bureau Veritas Rule Note NR 529 DTM R00 E Safety Rules for Gas-Fuelled Engine Installations in Ships of February 2007.

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The ship will be able to sail and navigate on one engine room with a relative speed of not less than 13 km/h and satisfactory manoeuvring capabilities and in compliance with the principles of hereunder mentioned IGF Code and Directive 2006/87/EC
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Further to the application of LNG as the only fuel on board the vessel, full compliance with all regulations in force can not be achieved. Derogations from the requirements in Directives 2008/68/EC are found in the below listed items:

Derogations from Directive 2008/68/EC Articles:

> 9.3.2.31.1 Only IC engines running on fuel with a flashpoint of more than 55^{o}C are allowed.
> 9.3.2.32.2 Airpipe arrangements of fuel tanks.
> 9.3.2.41.2 The installation in the engineroom of heating appliances fuelled with liquid fuel with flashpoint above 55^{o}C.
> 9.3.2.42.1 Boilers which are used for heating the cargo shall be fuelled with a liquid having a flashpoint of more than 55^{o}C.

In attachment 1 you will find a summary of the mentioned articles of the Directive 2008/68/EC and their relation to the IGF code.

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Damen River Tanker 1145
Ecoliner

Content

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the cryogenic tanks the LNG is led to the vaporizers, after the vaporizers the NG will be led inside each independent P.S. and S.B. engine room. In case of an emergency in one of the engine rooms the NG will be directly shut off.

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In case of a calamity alarms are installed in the wheelhouse in compliance with the IGF Code (attachment 6).

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3. Use of LNG

3.1 Advantages & use

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  LNG fuelled ships comply at least with Euro 5 (more severe then current CCR regulations)

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3.2 Specific requirements

Upon request the LNG supplier sent a bunker procedure to instruct crew how to deal with the specific requirements for bunkering LNG. The procedure can be found in attachment 11.

All crew members will need training on how to handle the LNG propulsion system (including bunkering) and what to do in case of accidents. The training will be developed with the LNG supplier, tank- and system manufacturer. Final scheme will need approval of local authorities. The training will be mentioned in the ships manual.

For all crew members personal protection equipment in relation to LNG (UN 1972) will be required.

3.3 Inspection & evaluation

The vessel will be built under class and when in service will be surveyed every 2, 5 years according normal survey scheme.

The LNG system will be visually inspected every year by a class surveyor.
As a precaution the pressure relief valves will be replaced on a yearly basis. The rupture discs on the tank (indicating that the vacuum is decreasing) will be replaced during class renewal, e.g. every five years.
The LNG system will be evaluated every year by owner, ship yard and class society when in service and a report will be send to the EU and ADN commission.

4. Conclusion

This project is based on a fundament of an existing guideline, the IGF code. Developed is a complete new design for an Inland Waterway Vessel fitted for the use of a new fuel in this market, and in the same time meeting the requests for a cleaner environment.
By choosing proven technology and careful engineering and outfitting the design is fitted for purpose and of at least equal safety as a convention propulsed vessel. The design also leads to significant fuel reduction and lower emission.
This project is developed by intensive cooperation between the shipbuilding Industries, the transportation sector and the Authorities in order to find a way to fill in the requirements as close as possible to existing regulations.

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10	Safety sheet LNG		
11	General Bunker procedure		

end

Attachment 1; Relation IGF Code and EU Directive 2006/87

Attachement, Division IGF code with regard to European regulations, Code 2006 / 87 / EC

Para graph	Description, Annex II, Chapter 8, Engine Design	Complies Yes	Complies No	Remark Bodewes Millingen	I.G.F. code	Brief description I.G.F. code. Resolution MSC.285(86) (adopted on 1 June 2009) Interim Guidelines on Safety for Natural Gas-Fuelled Engine Installations in Ships Code based on E.S.D. engine rooms	Action by
Article 8.01, General							
1.	Engines and their ancillaries shall be designed, built and installed in accordance with best practice.		yes / no	Design and lay out of the engine room, tanks, systems etc. will be as far as possible and practical based on the I.G.F. Code Interim Guidelines on Safety for Natural Gas-Fuelled Engine Installations in Ships Resolution MSC.285(86) (adopted on 1 June 2009)	Preamble 1 Preamble 2 Preamble 3 2.6 2.6.1 2.6.1.1.	These Interim Guidelines have been developed to provide an international standard for ships, other than vessels covered by the IGC Code (International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk), with natural gas-fuelled engine installations The goal of these Interim Guidelines is to provide criteria for the arrangement and installation of machinery for propulsion and auxiliary purposes, using natural gas as fuel, which will have an equivalent level of integrity in terms of safety, reliability and dependability as that which can be achieved with a new and comparable conventional oil-fuelled main and auxiliary machinery. To achieve this goal, the functional requirements described in the relevant parts of these Interim Guidelines System configuration Alternative system configurations Two alternative system configurations may be accepted:	
				According information obtained from several suppliers by Bodewes Shipyards: No gas safe certified engines of any make / brand available up till now	2.6.1.1.1	Gas safe machinery spaces: Arrangements in machinery spaces are such that the spaces are considered gas safe under all conditions, normal as well as abnormal conditions, i.e. inherently gas safe.	
				Engine Room will be equipped and outfiited according the E.S.D. (emergency shutdown) principle as stated in the I.G.F. code; non certified (non-safe) equipment automatically to be switched off. Execution of the engine rooms will be double and redundant, 100% indepedent from each other, as reported by Art.8.02, paragraph 5 herein beneath, see also attachment	2.6.1.1.2	ESD-protected machinery spaces: Arrangements in machinery spaces are such that the spaces are considered non-hazardous under normal conditions, but under certain abnormal conditions may have the potential to become hazardous. In the event of abnormal conditions involving gas hazards, emergency shutdown (ESD) of non-safe equipment (ignition sources) and machinery is to be automatically executed while equipment or machinery in use or active during these conditions are to be of a certified safe type	
2.	Installations requiring regular inspection, particularly steam boilers, other pressure vessels and their accessories, and lifts, shall meet the regulations applying in one of the Member States of the Community.		no / yes	Inspection L.N.G. storage tank, not possible as reported by Art.8.05, paragraph 1, herein beneath			
3.	Only internal-combustion engines burning fuels having a flashpoint of more than 55 °C may be installed		no	L.N.G. Flashpoint -180°C, see attachment	Preamble 4 Preamble 5 Preamble 6	The Interim Guidelines address the safety of ships utilizing natural gas as fuel. Natural gas (dry) is defined as gas without condensation at common operating pressures and temperatures where the predominant component is methane with some ethane and small amounts of heavier hydrocarbons (mainly propane and butane). The gas composition can vary depending on the source of natural gas and the processing of the gas.	Notified bodies
Article 8.02, Safety equipment							
1.	Engines shall be installed and fitted in such a way as to be adequately accessible for operation and maintenance and shall not endanger the persons assigned to those tasks. It shall be possible to make	yes		Crew requires special instructions	chapter 8 8.1.1	Operational and training requirements The whole operational crew of a gas-fuelled cargo and a passenger ship should have necessary training in gas-related safety, operation and maintenance prior to the commencement of work on board	

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	them secure against unintentional starting.				8.2.1	Training in general The training on gas-fuelled ships is divided into the following categories: .1 category A: Basic training for the basic safety crew; .2 category B: Supplementary training for deck officers; and .3 category C: Supplementary training for engineer officers	
					8.3.1	A special maintenance manual should be prepared for the gas supply system on board.	
2.	Main engines, auxiliaries, boilers and pressure vessels, and their accessories, shall be fitted with safety devices.	yes		Gas supply systems as mentioned Art.8.05, paragraph 7 herein beneath Electronic safety devices based on the I.G.F. code Chapter 5, table 1			
3.	In case of emergency, it shall also be possible to shut down the motors driving the blower and suction fans from outside the space in which they are located, and from outside the engine room.	yes			Chapter 5, Table 1	Table 1, Monitoring of gas supply system to engines See attached copy of Table 1	
4.	Where necessary, connections of pipes which carry fuel oil, lubricating oil, and oils used in power transmission systems, control and activating systems and heating systems shall be screened or otherwise suitably protected to avoid oil spray or leakages onto hot surfaces, into machinery air intakes, or other sources of ignition. The number of connections in such piping systems shall be kept to a minimum.	yes					
	The number of connections in such piping systems shall be kept to a minimum.		no / yes	Pipelines to be carried out according I.G.F. code	Chapter 7 7.3	Manufacture, workmanship and testing Gas piping systems etc. etc.	
5.	External high pressure fuel delivery pipes of diesel engines, between the high pressure fuel pumps and fuel injectors, shall be protected with a jacketed piping system capable of containing fuel from a high pressure pipe failure. The jacketed piping system shall include a means for collection of leakages and arrangements shall be provided for an alarm to be given of a fuel pipe failure, except that an alarm is not required for engines with no more than two cylinders. Jacketed piping systems need not be applied to engines on open decks operating windlasses and capstans.		yes / no	The type of engines installed are no diesel engines and are not provided with high pressure fuel pumps. Engines will be engines without self-ignation (Otto type engine) and are provided with sparking plugs. Delivery pipes of the N.G. (Natural Gas; vapourized L.N.G.) system through the Engine Room are no high pressure lines. Maximum pressure about 6 bar, normal working pressure about 2 bars. According the I.G.F. code E.S.D double engine room gas containing lines through the engine room can be single piping, see also attached drawing,	2.6.3	ESD-protected machinery spaces	
					2.6.3.1	Gas supply piping within machinery spaces may be accepted without a gastight external enclosure on the following conditions:	
					.1	Engines for generating propulsion power and electric power should be located in two or more machinery spaces not having any common boundaries unless it can be documented that the common boundary can withstand an explosion in one of the rooms. **H170**Distribution of engines between the different machinery spaces should be such that in the case of shutdown of fuel supply to any one machinery space it is possible to maintain at least 40% of the propulsion power plus normal electrical power supply for sea-going services. Incinerators, inert gas generators or other oil fired boilers should not be located within an ESD-protected machinery space.	
					.2	The gas machinery, tank and valve installation spaces should contain only a minimum of such necessary equipment, components and systems as are required to ensure that any piece of equipment in each individual space maintains its principal function	
					.3	Pressure in gas supply lines within machinery spaces should be less than 10 bar, e.g., this concept can only be used for low pressure systems.	
					.4	A gas detection system arranged to automatically shutdown the gas supply (also oil fuel supply if dual fuel) and disconnect all non-explosion protected equipment or installations should be fitted, as outlined in 5.5 and 5.6.)	
				Fuel storage will be 2x similar L.N.G. tanks = 2x all required ancillaries as vapourizers etc. etc., see also attached drawing	2.6.3.2	For single fuel installations (gas only), the fuel storage should be divided between two or more tanks of approximately equal size. The tanks should be located in separate compartments	

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6.	Insulation of engine parts shall meet the requirements of Article 3.04(3), second paragraph.	yes					
	Missing Fire Safety	yes		mising in Annex II, Chapter 8.02	Chapter 3	Fire safety etc. etc.	
					3.2	Tanks located above deck shielded with A60 insulation etc. etc.	
				Engine room lay out see attached drawing	3.2.5.	When more than one machinery space is required and these spaces are separated by a single bulkhead, the bulkhead should be class A-60.	
	Missing Waterspray	yes		mising in Annex II, Chapter 8.02	3.3.1	Fire main	
						The water spray system required below may be part of the fire main system provided that the required fire pump capacity and working pressure is sufficient to operation of both the required numbers of hydrants and hoses and the water spray system simultaneously.	
					3.3.1.2	When the storage tank is located on open deck, isolating valves should be fitted in the fire main in order to isolate damage sections of the main. Isolation of a section of fire main shall not deprive the fire line ahead of the isolated section of water.	
					3.3.2	Water spray system	
					3.3.2.1	A water spray system should be fitted for cooling and fire prevention and to cover exposed parts of gas storage tank located above deck.	
					3.3.2.2	The system should be designed to cover all areas as specified above with an application rate of 10 l/min/m2 for horizontal projected surfaces and 4 l/min/m2 for vertical surfaces.	
	Missing Fire extinguishers	yes		mising in Annex II, Chapter 8.02	3.3.3	Dry chemical powder fire-extinguishing system	
					3.3.3.1	In the bunkering station area a permanently installed dry chemical powder extinguishing system should cover all possible leak points. The capacity should be at least 3.5 kg/s for a minimum of 45 s discharges. The system should be arranged for easy manual release from a safe location outside the protected area.	
					3.3.3.2	One portable dry powder extinguisher of at least 5 kg capacity should be located near the bunkering station	
	Missing Fire detection	yes		mising in Annex II, Chapter 8.02	3.4	Fire detection and alarm system	
					3.4.1	Fire detection and alarm system	
					3.4.2.	Alarms and safety actions	
				Table 1, see also 8.02 paragraph 2 & 3 herein above	3.4.2.1	Required safety actions at fire detection in the machinery space containing gas-fuelled engines and tank room are given in table 1 of chapter V. In addition, the ventilation should stop automatically and fire dampers are to close.	
	Missing Control, monitorng and safety systems	yes		mising in Annex II, Chapter 8.02	Chapter 5	Control, monitorng and safety systems	
					5.1	General etc etc.	
					5.2	Gas tank monitoring etc etc.	
					5.4	Gas engine monitoring etc etc.	
					5.5	Gas detection etc etc.	
					5.5.1	Permanently installed gas detectors should be fitted in the tank room, in all ducts around gas pipes, in machinery spaces of the ESD-protected type, compressor rooms and other enclosed spaces containing gas piping or other gas equipment without ducting. In each ESD-protected machinery space, two independent gas detector systems should be required.	
				as described by 8.05 paragraph 7 herein beneath	5.6	Safety functions of gas supply systems	
Article 8.03, Power plant							
1.	It shall be possible to start, stop or reverse the ship's propulsion reliably and quickly.	yes					

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2.	The following shall be monitored by suitable devices which trigger an alarm once a critical level has been reached:	yes					
2a.	the temperature of the main-engine cooling water;	yes					
2b.	the lubricating-oil pressure for the main engines and transmissions;	yes					
2c.	the oil and air pressure of the main engine reversing units, reversible transmissions or propellers	yes					
3.	Where vessels have only one main engine, that engine shall not be shut down automatically except in order to protect against overspeed.	yes		double gas / electrical system with double independent / redundant engine room. Layout according R.O.S.R. and I.G.F. code			
4.	Where vessels have only one main engine, that engine may be equipped with an automatic device for the reduction of the engine speed only if an automatic reduction of the engine speed is indicated both optically and acoustically in the wheelhouse and the device for the reduction of the engine speed can be switched off from the helmsman's position.	yes					
5.	Shaft bushings shall be designed in such a way as to prevent the spread of water-polluting lubricants.	yes					
Article 8.04, Engine exhaust systemt							
					6.2.1.2	The exhaust system should be designed to withstand explosions of unburned mixture by means of: etc etc.	
1.	The exhaust gases shall be completely ducted out of the vessel.	yes					
2.	All suitable measures shall be taken to avoid ingress of the exhaust gases into the various compartments. Exhaust pipes passing through accommodation or the wheelhouse shall, within these, be covered by protective gas-tight sheathing. The gap between the exhaust pipe and this sheathing shall be open to the outside air.	yes					
3.	The exhaust pipes shall be arranged and protected in such a way that they cannot cause a fire.	yes					
4.	The exhaust pipes shall be suitably insulated or cooled in the engine rooms. Protection against physical contact may suffice outside the engine rooms.	yes					
Article 8.05, Fuel tanks, pipes and accessories							
1.	Liquid fuels shall be stored in steel tanks which are either an integral part of the hull or which are firmly attached to the hull. If so required by the design of the vessel, an equivalent material in terms of fire-resistance may be used. These requirements shall not apply to tanks having a capacity of no more than 12 litres that have been incorporated in auxiliaries during their manufacture. Fuel tanks shall not have common partitions with drinking-water tanks	yes / no	no / yes	Cryo Tanks according: Cryogenic tank constructed following the EN 13530 (TPED) code Approved according to the ADR and IMO – IMDG code. Note: Bodewes Millingen outer tank will be made of Grade A steel, stainless steel driptray covering all Cryo equipment as manifolds, vaporizer etc will be integrated in the vessels, see also attached drawing	2.8.1 7.2	The storage tank used for liquefied gas should be an independent tank designed in accordance with the IGC Code, chapter 4.1 Gas tanks Tests related to welding and tank testing should be in accordance with the IGC	Yard and Cryo tank supplier

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				Total design appraisal is done by Bureau Veritas. Piping, valves, etc. is fully SS appropriate for LNG cold temperatures			
	missing Pressure relief valves			Outlet pressure relief valve system and position according attached drawing	2.8.1.3 2.8.1.4	Pressure relief valves as required in the IGC Code chapter 8 should be fitted The outlet from the pressure relief valves should normally be located at least B/3 or 6 m, whichever is greater, above the weather deck and 6 m above the working area and gangways, where B is the greatest moulded breadth of the ship in metres. The outlets should normally be located at least 10 m from the nearest .1 air intake, air outlet or opening to accommodation, service and control spaces, or other gas safe spaces; and .2 exhaust outlet from machinery or from furnace installation.	
	missing storage on deck			As discussed during several meetings with I.V.W. and Bureau Veritas at I.V.W. office in Rotterdam, distance inner tank should be about 1 meter from vessels outer shell	2.8.3 2.8.3.1 2.8.3.2 2.8.3.3 2.8.3.4	Storage on open deck Both gases of the compressed and the liquefied type may be accepted stored on open deck. The storage tanks or tank batteries should be located at least B/5 from the ship's side. For ships other than passenger ships a tank location closer than B/5 but not less than 760 mm from the ship's side may be accepted. The gas storage tanks or tank batteries and equipment should be located to assure sufficient natural ventilation, so as to prevent accumulation of escaped gas. Tanks for liquid gas with a connection below the highest liquid level (see 2.8.1.2) should be fitted with drip trays below the tank which should be of sufficient capacity to contain the volume which could escape in the event of a pipe connection failure. The material of the drip tray should be stainless steel, and there should be efficient separation or isolation so that the hull or deck structures are not exposed to unacceptable cooling, in case of leakage of liquid gas.	
2.	Tanks and their pipework and other accessories shall be laid out and arranged in such a way that neither fuel nor fuel vapours may accidentally reach the inside of the vessel.	yes		L.N.G. tank lay out and tank system will be in compliance with the I.G.F. code, see also attached drawings	2.4 2.4.1 2.4.5	Arrangement of entrances and other openings Direct access through doors, gastight or otherwise, should generally not be permitted from a gas-safe space to a gas-dangerous space. Where such openings are necessary for operational reasons, an air lock which complies with the requirements of chapter 3.6 (2 to 7) of the IGC Code should be provided. If the access to an ESD-protected machinery space is from another enclosed space in the ship, the entrances should be arranged with self-closing doors. An audible and visual alarm should be provided at a permanent manned location. Alarm should be given if the door is open continuously for more than 1 min. As an alternative, an arrangement with two self-closing doors in series may be acceptable	
	Tank valves intended for fuel sampling or water drainage shall close automatically.	yes					
3.	No fuel tanks may be located forward of the collision bulkhead.	yes					
4.	Fuel tanks and their fittings shall not be located directly above engines or exhaust pipes.	yes					
5.	The filler orifices for fuel tanks shall be marked distinctly.	yes					
6.	The orifice for the fuel tank filler necks shall be on deck. The filler neck shall be fitted with a connection piece in accordance with European standard 12 827 etc. etc.		no	Standardisation still has to be done with the L.N.G. supplier in consultancy with the notified bodies			Yard, L.N.G. supplier, notified bodies

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	Such tanks shall be fitted with a breather pipe etc. etc.		no	For L.N.G. tanks no breather pipes will be fitted internal vapour return system, vapour will be liquefied again by the refill with LNG from the bunkers, see also article 8.05, paragraph 1 & 2, herein above			
				Blow off pipe however will be installed according I.G.F. regulations, see also attached drawing. See also 8.05, paragraph 1 herein above	2.8.1.3	Pressure relief valves as required in the IGC Code chapter 8 should be fitted	
	If tanks are interconnected, the cross-section of the connecting pipe shall be at least 1.25 etc. etc.		no	Interconnection pipes will be fitted after the L.N.G. vapourizers and have nothing to do with the L.N.G. filling system. Interconnection pipes only containing N.G. (natural gas).			
7.	Directly at tank outlets the pipework for the distribution of fuels shall be fitted with a shutoff device that can be operated from the deck.		no	Due to insulations between outer hull of the tank and the inner Cryo tank shutoff valves are not mounted direct at the inner Cryo tank	5.6	Safety functions of gas supply systems	
					5.6.1	Each gas storage tank should be provided with a tank valve capable of being remote operated and should be located as close to the tank outlet as possible.	
					5.6.2	The main gas supply line to each engine or set of engines should be equipped with a manually operated stop valve and an automatically operated "master gas fuel valve" coupled in series or a combined manually and automatically operated valve. The valves should be situated in the part of the piping that is outside machinery space containing gas-fuelled engines, and placed as near as possible to the installation for heating the gas, if fitted. The master gas-fuel valve should automatically cut off the gas supply as given in table 1.	
					5.6.2.1	The automatic master gas fuel valve should be operable from a reasonable number of places in the machinery space containing gas-fuelled engines, from a suitable location outside the space and from the bridge.	
					5.6.3	Each gas consuming equipment should be provided with a set of "double block and bleed" valves. These valves should be arranged as outlined in .1 or .2 (respectively shown as alternatives 1 and 2 in figure 1) so that when automatic shutdown is initiated as given in table 1, this will cause the two gas fuel valves that are in series to close automatically and the ventilation valve to open automatically and:	
					.1	two of these valves should be in series in the gas fuel pipe to the gas consuming equipment. The third valve should be in a pipe that vents to a safe location in the open air that portion of the gas fuel piping that is between the two valves in series; or	
					.2	the function of one of the valves in series and the ventilation valve can be incorporated into one valve body, so arranged that the flow to the gas utilization unit will be blocked and the ventilation opened.	
					5.6.3.1	The two block valves should be of the fail-to-close type, while the ventilation valve should be fail-to-open.	
					5.6.3.2	The double block and bleed valves should also be used for normal stop of the engine.	
					5.6.4	In cases where the master gas fuel valve is automatically shutdown, the complete gas supply branch downstream of the double block and bleed valve should be ventilated, if reverse flow from the engine to the pipe must be assumed.	
					5.6.5	There should be one manually operated shutdown valve in the gas supply line to each engine upstream of the double block and bleed valves to assure safe isolation during maintenance on the engine.	
					5.6.6	For one-engine installations and multi-engine installations, where a separate master valve is provided for each engine, the master gas fuel valve and the double block and bleed valve functions can be combined. Examples for the high-pressure system are shown in figures 1 and 2 (not attached)	

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					5.6.7	The total loss of ventilation in a machinery space for a single fuelled gas system should, additionally to what is given in table 1, lead to one of the following actions:	
					.1	For a gas electric propulsion system with more than one machinery space: Another engine should start. When the second engine is connected to bus-bar, the first engine should be shutdown automatically.	
					5.6.8	If the gas supply is shut off due to activation of an automatic valve, the gas supply should not be opened until the reason for the disconnection is ascertained and the necessary precautions taken. A readily visible notice giving instruction to this effect should be placed at the operating station for the shut-off valves in the gas supply lines.	
					5.6.9	If a gas leak leading to a gas supply shutdown occurs, the gas fuel supply should not be operated until the leak has been found and dealt with. Instructions to this effect should be placed in a prominent position in the machinery space.	
					5.6.10	A signboard should be permanently fitted in the machinery space containing gas-fuelled engines stating that heavy lifting, implying danger of damage to the gas pipes, should not be done when the engine(s) is running on gas.	
	This requirement shall not apply to tanks mounted directly on the engine.	n.a.					
8.	Fuel pipes, their connections, seals and fittings shall be made of materials that are able to withstand the mechanical chemical and thermal stresses to which they are likely to be subjected.	yes					
	The fuel pipes shall not be subject to any adverse influence of heat and it shall be possible to inspect them throughout their length		no	According 8.02, paragrapg 5 herein above and the I.G.F. code inside Engine Room double walled piping, pressure gas about maximum 6 bars. Inside piping can not be visual inspected, piping however provided with I.G.F. required alerts No double wall piping has to be used, See 8.02 paragraph 2 herein above	2.6.3.1	E.S.D.-protected machinery space Gas supply piping within machinery spaces may be accepted without a gastight external enclosure on the following conditions: See 8.02 paragraph 5 herein above	
9.	Fuel tanks shall be provided with a suitable capacity-gauging device.	yes					
	Capacity-gauging devices shall be legible right up to the maximum filling level.	yes					
	Glass gauges shall be effectively protected against impacts, shall be fitted with an automatic closing device at their base and their upper end shall be connected to the tanks above their maximum filling level.		no	no glass gauging will be used			
	The material used for glass gauges shall not deform under normal ambient temperatures.	n.a.					
	Sounding pipes shall not terminate in accommodation spaces.	yes					
	Sounding pipes terminating in an engine or boiler room shall be fitted with suitable self-closing devices.	n.a.					
10a.	Fuel tanks shall be safeguarded against fuel spills	yes /	no /	Fuel (L.N.G.) spill will be safeguarded by a stainless	2.8.3.4	Driptray as descriped herein above, Article 8.05, paragraph 1	

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	during bunkering by means of appropriate onboard technical devices which shall be entered in item 52 of the Community certificate.			steel driptray, driptray capacity enough for one L.N.G. storage tank. Driptray integrated in the vessels construction. Driptray covering: storage tanks, fill-manifold, vapourizers etc., see also attached drawings.	2.9.1.2	Drip trays should be fitted below liquid gas bunkering connections and where leakage may occur. The drip trays should be made of stainless steel, and should be drained over the ship's side by a pipe that preferably leads down near the sea. This pipe could be temporarily fitted for bunkering operations. The surrounding hull or deck structures should not be exposed to unacceptable cooling, in case of leakage of liquid gas.	
				Bunker / Fill manifolds at S.B.-, P.S. and at bunkering jib will be provided with remote controlled and automatic shutdown valves as stated in paragraph 11. Remote controls at site, from wheelhouse and from bunkering position (truck), see also attached drawing	2.9 2.9.1 2.9.1.3 2.9.2 2.9.2.2 2.9.2.5 2.9.2.6	Fuel bunkering system and distribution system outside machinery spaces Fuel bunkering station Control of the bunkering should be possible from a safe location in regard to bunkering operations. At this location tank pressure and tank level should be monitored. Overfill alarm and automatic shutdown should also be indicated at this location. Bunkering system A manually-operated stop valve and a remote operated shutdown valve in series, or a combined manually-operated and remote valve should be fitted in every bunkering line close to the shore connecting point. It should be possible to release the remote-operated valve in the control location for bunkering operations and or another safe location. Means should be provided for draining the liquid from the bunkering pipes at bunkering completion. Bunkering lines should be arranged for inerting and gas freeing. During operation of the vessel the bunkering pipes should be gas free	
10b.	If fuel is taken on from bunkering stations with their own technical devices to prevent fuel spills on board during bunkering, the equipment requirements in (a) and paragraph 11 shall no longer apply.	yes / no	no / yes	Bunkering is normally taken from L.N.G. trucks at dedicated bunkering spots. Bunkering from truck to vessel done by vessel's own bunkering jib, see also attached drawing.			
11.	If fuel tanks are fitted with an automatic shut-off device, the sensors shall stop fuelling when the tank is 97 % full; this equipment shall meet the 'failsafe' requirements. If the sensor activates an electrical contact, which can break the circuit provided by the bunkering station by a binary signal, it shall be possible to transmit the signal to the bunkering station by means of a watertight connection plug meeting the requirements of IEC publication 60309-1:1999 for 40 to 50 V DC, housing colour white, earthing contact position ten o'clock.	yes / no yes / no	no / yes no / yes		2.9.1.3	Control of the bunkering should be possible from a safe location in regard to bunkering operations. At this location tank pressure and tank level should be monitored. Overfill alarm and automatic shutdown should also be indicated at this location.	Electrician / L.N.G. tank supplier
12.	Fuel tanks shall be provided with openings having leak-proof closures that are intended to permit cleaning and inspection.		no	Tanks are not provided, due to the vacuum insulation, with hand- or manhole(s) or any other opening for cleaning purposes. For this "clean" type of fuel no provisions for cleaning purposes are required.			

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		Yes	No				
13.	Fuel tanks directly supplying the main engines and engines needed for safe operation of the vessel shall be fitted with a device emitting both visual and audible signals in the wheelhouse if their level of filling is not sufficient to ensure further safe operation.	yes					L.N.G. tank supplier

Attachment 1; Relation IGF Code and EU Directive 2008/68 (A.D.N.)

Attachment, Division IGF code with regard to European regulations, Code 2008 / 68 / EC
Regulations from United Nations 2011, ECE / TRANS / 220 (Vol.I) European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways (ADN), including the Annexed Regulations, applicable as from 1 January 2011)

LINK TO UN DOCUMENTATION http://www.unece.org/trans/danger/publi/adn/adn2011/11files_e.html

Part & Paragraph	Description	Complies Yes	Complies No	Remark Bodewes Millingen Design of Bodewes will be as:	I.G.F. code	Direct copy or summarization (etc. etc.) of the description I.G.F. code. Resolution MSC.285(86) (adopted on 1 June 2009) Interim Guidelines on Safety for Natural Gas-Fuelled Engine Installations in Ships Code based on E.S.D. engine rooms	Action by
Part 1	**General provisions**						
1.2.1.	Definitions						
This section contains all general or specific definitions:							
I							
IBC	(Intermediate Bulk Container): means a rigid, or flexible portable packaging, other than those specified in Chapter 6.1 of ADR that etc. etc. "use link top of this sheet, page 1 of 6"	yes / no		The design and lay out of the vessel is made in such a way that the L.N.G storage tanks are outside the cargo zone, see attachment To the opinion of Bodewes shipyards, the regulations of the A.D.N. does not apply to this part (aft ship) of the vessel	2.8.1	The storage tank used for liquefied gas should be an independent tank designed in accordance with the IGC Code, chapter 4.1	
				Cryo Tanks according: Cryogenic tank constructed following the EN 13530 (TPED) code Approved according to the ADR and IMO – IMDG code.	7.2	Gas tanks Tests related to welding and tank testing should be in accordance with the IGC Code, sections 4.10 and 4.11.	
				Piping, valves, etc… (including vaporizer systems) is fully SS, appropriate for LNG cold temperatures	2.8.3.4	Tanks for liquid gas with a connection below the highest liquid level (see 2.8.1.2) should be fitted with drip trays below the tank which should be of sufficient capacity to contain the volume which could escape in the event of a pipe connection failure. The material of the drip tray should be stainless steel, and there should be efficient separation or isolation so that the hull or deck structures are not exposed to unacceptable cooling, in case of leakage of liquid gas.	
					2.9.1.2	Drip trays should be fitted below liquid gas bunkering connections and where leakage may occur. The drip trays should be made of stainless steel, and should be drained over the ships side by a pipe that preferably leads down near the sea. This pipe could be temporarily fitted for bunkering operations. The surrounding hull or deck structures should not be exposed to unacceptable cooling, in case of leakage of liquid gas.	
1.1.3.	Exemptions						
1.1.3.6	Exemptions related to empty uncleaned packagings						
1.1.3.6.1	(a) In the event of the carriage of dangerous goods in packages, the provision of ADN other than those of 1.1.3.6.3. are not applicable when the gross mass of all the dangerous goods carried does not exceed 3.000 kg etc. etc. "use link top of this sheet, page 1 of 6"						
1.1.3.6.2	The carriage of exempted quantities according to 1.1.3.6.1 is, however, subject to the following conditions:	yes / no		L.N.G. will be used as fuel risk of blow off during laying up, see also 1.8.5 herein beneath			

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	a. The obligation to report in accordance with 1.8.5 remains applicable: b. Packages, except vehicles and containers etc. etc. "use link top of this sheet, page 1 of 6". c. The following documents shall be on board: – the transport documents etc. etc. "use link top of this sheet, page 1 of 6" d. The goods shall be stowed in the holds: "use link top of this sheet, page 1 of 6" e. Goods of different class shall be separated by a minimum horizontal distance of 3 m. etc. etc. "use link top of this sheet, page 1 of 6" f. For seagoing and inland navigation vessels etc. etc. "use link top of this sheet, page 1 of 6"	no yes n.a. yes yes n.a.		Is there any need to report the transport of L.N.G. each time See part 1, IBC herein above See part 1, IBC herein above			
1.8.5	Notifications of occurrences involving dangerous goods	yes					
1.8.5.3	An occurrence subject to report in accordance with 1.8.5. etc. etc. "use link top of this sheet, page 1 of 6"	yes / no		During lay up without any use of LNG by combustion engines there is always the risk of blow off, blow off prevention is covered by the I.G.F. code			
Part 2	**Classification**						
2.2.2.	Class 2 Gases	yes					
2.2.2.1.2.	The substances and articles of Class 2 are subdivided as follows: 3. Refrigerated liquefied gas: a gas which when packaged for carriage is made partially liquid because of its low temperature.	yes					
2.2.2.1.3.	Substances and articles (except aerosols) of Class 2 are assigned to one of the following groups according to their hazardous properties, as follows						
	F flammable;	yes					
Part 3	**Dangerous goods list, special provisions and exemptions related to limited and expected quantities**						
3.2	List of dangerous goods						
3.2.1	Table A, List of dangerous goods in numerical order						
Column 1	UN-nummer/Indentification number						
	UN 1972	yes					
Column 2	Name and description						
	Methane, refrigerated liquid or natural gas etc. etc. "use link top of this sheet, page 1 of 6"	yes					
Column 3a	Class						
	2, Class 2, gasses, see also 2.2.2. herein above	yes					
Column 3b	Classification code						

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	3F, see also 2.2.2.1.2 and 2.2.2.1.3 . herein above	yes					
Column 4	Packaging group						
	"void"	yes					
Column 5	Labels						
	2.1, see 5.2.2.2 and 5.3.1.1.7 herein beneath	yes					
Column 6	Special provisions						
	"void"	no / yes		The design and lay out of the vessel is made in such a way that the L.N.G storage tanks are outside the cargo zone, see drawing: Attachments To the opinion of Bodewes shipyards, the regulations of the ADN does not apply to this part (aft ship) of the vessel			
Column 7a	Limited and excepted quantities						
	LQ0, no exemptions according rules 3.4.2, see herein beneath	no		covered by the I.G.F. code			
Column 7b	Limited and excepted quantities						
	EO, ADNR not applicable if made according 3.4	no		covered by the I.G.F. code			
Column 8	Carriage permitted						
	"void" if column 8 is empty, the substance or article may only be carried in packages	yes					
Column 9	Equipment required						
	PP, EX, A, safety equipment	yes					
Column 10	Ventilation						
	VE01, according 7.1.6.12 see herein beneath	no			2.8.3.1	Both gases of the compressed and the liquefied type may be accepted stored on open deck.	
Column 11	Provision concerning loading, unloading and carriage						
	"void"	yes					
Column 12	Number of blue cones / lights						
	1, One blue cone always required	yes					
Column 13	Remarks						
	"void"	yes					
3.4	Dangerous goods packed in limited quantities	no / yes		covered by the I.G.F. code			
3.4.1.	This chapter provides the provisions applicable to the carriage of dangerous goods of certain classes packed in limited quantities etc. etc. "use link top of this sheet, page 1 of 6"	no		covered by the I.G.F. code			
Part 4	**Provisions concerning the use of packagings, tanks and bulk cargo transport units**						
4.1	General provisions						
4.1.1.	Packagings and tanks etc etc, "use link top of this sheet, page 1 of 6" according ADR, IMDG etc.	yes / no		See part 1, IBC herein above			
4.1.2.	The requirements etc etc. "use link top of this sheet, page 1 of 6" according ADR, IMDG etc.	yes / no		See part 1, IBC herein above			

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4.1.4.	Only packaging and tanks which meet the requirements of part 6 of ADR or RID may be used	yes / no		See part 1, IBC herein above			
Part 5	**Consignment procedures**						
5.2	Marking and labelling	yes					
5.2.1	Marking of packages	yes					
	Note: "use link top of this sheet, page 1 of 6", see part 6 ADR	yes / no		See part 1, IBC herein above			
5.2.2.2.	Provision for labels	yes					
5.3	Placarding and marking of containers MEGC's MEMU's Tank containers, portable tanks, vehicles and wagon's	yes					
5.3.1.7.	Specification for placards	yes					
	etc. etc. "use link top of this sheet, page 1 of 6"	yes					
Part 6	**Requirements for the construction and testing of packagings (including IBC's and large packagings), tanks and bulk cargo transport units**						
6.1.2	Portable tanks may also meet the requirements of chapter 6.7 or if appropriate chapter 6.9 of the IMDG code	yes / no		See part 1, IBC herein above			
Part 7	**Requirements concerning loading, carriage, unloading and handling of cargo**						
7.1.6.12	Ventilation						
VE01	Holds containing these substances shall be ventilated with the ventilators operating at full power etc etc. "use link top of this sheet, page 1 of 6"	no		L.N.G. tanks are stored outside, L.N.G. systems in the engine room are covered by the I.G.F. code according E.S.D. machinery spaces	2.10	Ventilation system etc etc.	
					2.10.1.3	Any loss of the required ventilating capacity should give an audible and visual alarm at a permanently manned location.	
					2.10.3	Machinery spaces containing gas-fuelled engines etc. etc.	
					2.10.3.2	ESD-protected machinery spaces should have ventilation with a capacity of at least 30 air changes per hour. The ventilation system should ensure a good air circulation in all spaces, and in particular ensure that any formation of gas pockets in the room are detected. As an alternative, arrangements whereby under normal operation the machinery spaces is ventilated with at least 15 air changes an hour is acceptable provided that, if gas is detected in the machinery space, the number of air changes will automatically be increased to 30 an hour.	
7.2.4.1.	The carriage of packages in the cargo area is prohibited etc etc. "use link top of this sheet, page 1 of 6"	yes / no		The design and lay out of the vessel is made in such a way that the L.N.G storage tanks are outside the cargo zone, see attachment. To the opinion of Bodewes shipyards, the regulations of the A.D.N. does not apply to this part (aft ship) of the vessel			
Part 8	**Provisions for vessel crew, equipment, operation and documentation**						
8.1.2.1	Documents etc. etc. "use link top of this sheet, page 1 of 6"	yes / no		Covered by the I.G.F. code The design and lay out of the vessel is made in such a way that the L.N.G storage tanks are outside the cargo zone, see attachment .	chapter 8 8.1.1	Operational and training requirements The whole operational crew of a gas-fuelled cargo and a passenger ship should have necessary training in gas-related safety, operation and maintenance prior to the commencement of work on board	

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				To the opinion of Bodewes shipyards, the regulations of the A.D.N. does not apply to this part (aft ship) of the vessel	8.2.1 8.3.1	Training in general The training on gas-fuelled ships is divided into the following categories: .1 category A: Basic training for the basic safety crew; .2 category B: Supplementary training for deck officers; and .3 category C: Supplementary training for engineer officers A special maintenance manual should be prepared for the gas supply system on board.	
Part 9	**Rules for construction**						
Chapter 9.1	Rules for construction of dry cargo vessels						
	Provisions of 9.1.0.0 to 9.1.0.79 apply to dry cargo vessels	yes / no		The design and lay out of the vessel is made in such a way that the L.N.G storage tanks are outside the cargo zone, see attachment. To the opinion of Bodewes shipyards, the regulations of the A.D.N. for Motor tank vessels of type N, C or G does not apply to this part (aft ship) of the vessel but the regulations of a dry cargo vessel apply to this vessel			
9.1.0.31	Engines						
9.1.0.31.1 9.1.0.41.2	Only internal combustion engines running on fuel having a flashpoint above 55° C are allowed Heating, cooking and refrigerating appliances shall be fuelled with liquid fuels, liquid gas or solid fuels. The installation in the engine room or other separate space of heating appliances fuelled with liquid fuel having a flashpoint above 55° C is however, permitted	no		L.N.G. Flashpoint -180°C	Preamble 4 Preamble 5 Preamble 6	The Interim Guidelines address the safety of ships utilizing natural gas as fuel. Natural gas (dry) is defined as gas without condensation at common operating pressures and temperatures where the predominant component is methane with some ethane and small amounts of heavier hydrocarbons (mainly propane and butane). The gas composition can vary depending on the source of natural gas and the processing of the gas.	
9.1.0.91	Holds						
9.1.0.91.1	The vessel shall be built as a double-hull vessel with double-hull spaces and double bottom within the protected area	no		Zone is above the E.S.D. protected engine room, see attachments. Each engine room (2 x redundant engine room) is comparable with double shell and double bottom			
9.1.0.91.2	The distance between the sides of the vessel and the longitudinal bulkheads of the hold shall be not less than 0,80m. Etc. etc. "use link top of this sheet, page 1 of 6"	yes / no		As discussed during several meetings with I.V.W. and Bureau Veritas at I.V.W. office in Rotterdam, distance inner tank should be about 1 meter from vessels outer shell	2.8.3.2	The storage tanks or tank batteries should be located at least B/5 from the ships side. For ships other than passenger ships a tank location closer than B/5 but not less than 760 mm from the ships side may be accepted.	
9.1.0.91.3	The depth of the double bottom shall be at least 0,50m etc. etc. "use link top of this sheet, page 1 of 6"	no		Zone is above the E.S.D. protected engine room, see attachments. Each engine room (2 x redundant engine room) is comparable with double shell and double bottom			

Attachment 2; Risk analysis for Damen River tanker 1145 – Eco Liner

For the Ecoliner a Hazid study and a Root cause analysis were performed.
The purposes of the studies is to confirm the risks present to the specific system and ensure that safety systems have been considered and will be implemented in the design according the preventive measures mentioned in the hazid.

In the Hazid (table 2) all possible hazards for this LNG propulled vessel are identified and checked for their potential effects to the vessel, crew and environment. The study was performed on several days with people with different experience related to LNG systems. In table 1 dates and participants can be found.

Table 1: List of participants

Name	Company	Role	11/04/11	21/04/11	16/05/11	19/05/11	24/05/11
Jan Huis	Bureau Veritas	Principal Surveyor Machinery & Safety	X	X	X	X	X
Frank Kersbergen	Bureau Veritas	Manager Statutory Affairs		X			X
Liesbeth den Haan	Bureau Veritas	Manager Inland Navigation		X		X	X
Wim van Gemeren	Bureau Veritas	Senior surveyor			X		
Guy Jacobs	Bureau Veritas	Principal Surveyor at Head Office	X				
David Rodriguez-Codina	Bureau Veritas	Surveyor at Head Office	X				
Rob Schuurmans	Bodewes Millingen	Ship yard Director				X	
Willem Kroon	Bodewes Millingen	Ship yard Project manager	X		X	X	
Koert van der Ploeg	MAN Rollo	Technical Engineer	X		X		
Gertjan Boer	MAN Rollo	Sales Manager	X				
Jan van der Voort	MAN Rollo	Specialist Gas Engines			X		
Theo Baars	TOPEC	Sales Manager	X		X		
Walter Sterkenburg	TOPEC				X		
Ton Hoving	IVW – Dutch Authority	Senior Advisor			X		
Fabian van Damme	Dohmeyer	CEO				X	
Jan van Houwenhove	VRV – cryogene tanks	Sales Director Europe				X	

The Hazid is divided into two sections, the LNG-system on the aft deck and the engine rooms with their specific systems.
In the table of the Hazid we have the following columns:

- Cause; what leads to the hazard
- Hazard; what will happen
- Potential Effects; what can be the effect to vessel, crew, environment
- Preventive measures; what should be done to avoid the hazard
- Safeguards; when the hazard occurs what is done to minimize the effects

During the hazid only single failure was considered as is normal practice.
The preventive measures from the hazid will serve as recommendations of the design.

In the hazid study and root cause analysis you will find references to the questions asked by several delegations as mentioned in chapter 1 of the project description.

After the Hazid study a root cause analysis was done (table 3). All external events that might occur and has impact on the LNG system are listed. In the second column is the cause from the Hazid study related to the event. Also for each root cause preventive measures are mentioned and where applicable safeguards.

Table 2: Hazid

1. LNG Tanks on Aft ship deck					
Nb	**Cause**	**Hazard**	**Potential Effects**	**Prevention measures**	**Safeguards**
1.1	Rupture of tank	Leakage of LNG	Damage to deck & construction Fire/Explosion Gas entering gas safe spaces	Protection of deck & ship construction by drip trays for 100% of one tank contents as stated in IGF Code Openings of gas safe spaces outside gas dangerous zones	Tanks are provided with a waterspray installation according IGF Code. Installation is used for dillution and evaporation of the NG and/or cooling the non ruptured tank For fire: ships fixed fire fighting installation
1.2	Overpressure in tank	Rupture of tank	Damage to deck & construction Fire/Explosion Gas entering gas safe spaces	Safety valves on tanks icw IGF Code (also designed for liquid discharge) Openings of gas safe spaces outside gas dangerous zones	See 1.1
1.3	Rupture & external leakage of piping system on open deck	Release of LNG or NG	Damage to deck & construction Fire/Explosion Gas entering gas safe spaces	Protection of deck & ship construction by drip tray Openings of gas safe spaces outside gas dangerous zones	Close ESD valve on tanks to stop LNG/NG release See 1.1
1.4	Internal leakage of piping system	uncontrolled flow of LNG	loss of control	Number of shut off valves in series	Gas shut off by ESD valves

Nb	Cause	Hazard	Potential Effects	Prevention measures	Safeguards
1.5	Heat build-up in tank	Pressure increase in tank & tank liquid full	Tank rupture	See 1.2	See 1.1
1.6	Tank liquid full	Pressure increase in tank	Tank rupture	See 1.2	See 1.1
1.7	Tank overboard	Release of LNG	Environmental pollution	Approved fixation on ship structure	ESD on board for piping
2. Engine room					
Nb	**Cause**	**Hazard**	**Potential Effects**	**Prevention measures**	**Safeguards**
2.1.	Rupture or leakage of inner pipe	Gas release into double wall of pipe		Piping is designed, inspected and tested icw IGF Code	Gas detection which will lead to automatic ESD of the concerned supply line
2.2	Rupture or leakage of complete piping system including gas train and single walled combustion air parts of engine	Gas release into engine room	Fire & explosion Danger for human health	Piping is designed, inspected and tested icw IGF Code	Gas detection which will lead to automatic ESD Ventilation increase further to gas detection. Possible switch off of only in case of fire

Nb	Cause	Hazard	Potential Effects	Prevention measures	Safeguards
2.3	Backfire of engine caused by incorrect air-fuel mixture, leaking inlet valve or incorrect ignition timing May occur in particular during starting of engine.	Flame from inlet system Scattered parts from inlet system caused by pressure wave Flame in gas train	Damage to inlet system engine or engine room & operators	Design of inlet system such that it can withstand pressure wave Flame arrestor in gas train Appropriate starting procedure with flushing of inlet and exhaust system prior to switching on ignition Appropriate flush procedure of gas piping with natural gas to prevent high air concentration which may result in potential combustible mixture in gas piping. Flushing at first start-up or after service work (when piping has been disassembled)	System to detect backfire and shut-down engine immediately to prevent new backfires
2.4	Explosion in exhaust system caused by unburnt gas	Rupture of exhaust gas system	Fire/explosion in engine room Danger to human health	Design of exhaust system such that it can withstand pressure wave Flame arrestor in exhaust silencer	

Nb	Cause	Hazard	Potential Effects	Prevention measures	Safeguards
2.5	Severe engine damage	Gas release into engine room	Fire/explosion in engine room Danger to human health	Use of class approved main components (engine block, crankshaft, connecting rods)	Appropriate generating set monitoring and control Gas detection which will lead to automatic or manual ESD Ventilation increase further to gas detention. Possible switch off only in case of fire
2.6	Failure or leaking of double valve block with stalled engine	Gas in inlet system engine and/or crank case via closed crankcase ventilation (CCV) system. Gas in engine room	Backfire during starting (see 2.3) Fire/explosion, Danger of human health	Appropriate CCV (closed crankcase ventilation) design Sufficient engine room ventilation Gas detection which will lead to ESD Appropriate starting procedure with flushing of inlet and exhaust system prior to switching on ignition	CCV as standard on top of engine. Natural gas has lower density than air. Natural gas will never reach crankcase. Closed main adjusting screw which serves as a 2nd barrier. Leakage test of double valve block after normal shut-down. Alarm in case of leakage valve.

Nb	Cause	Hazard	Potential Effects	Prevention measures	Safeguards
2.7	Gas in crankcase via CCV system with running engine	Explosive mixture in crankcase	Fire/explosion, Danger to human health		During operation crankcase is permanently vented into inlet system (near air filter) via under pressure or piston blow-by. Natural gas will never accumulate in crankcase
2.8	Gas temperature out of range at inlet gas train (<+10°C or >+40°C)	Incorrect air-fuel mixture Ice in intake system engine Failure of gas train	Gas in engine room	Selection of a proper evaporation system (including cold start)	Gas detection will lead to shut down ESD valve Ventilation increase further to gas detection
2.9	Liquid phase gas at inlet gas train/engine	Pressure built-up when both double valve block and main adjusting screw are closed Failure of gas-piping resulting in release of gas in engine room See 2.9	Fire & Explosion	Selection of a proper evaporation system (including cold start)	Gas detection will lead to shut down ESD valve Ventilation increase further to gas detention Possible shut off in case of fire

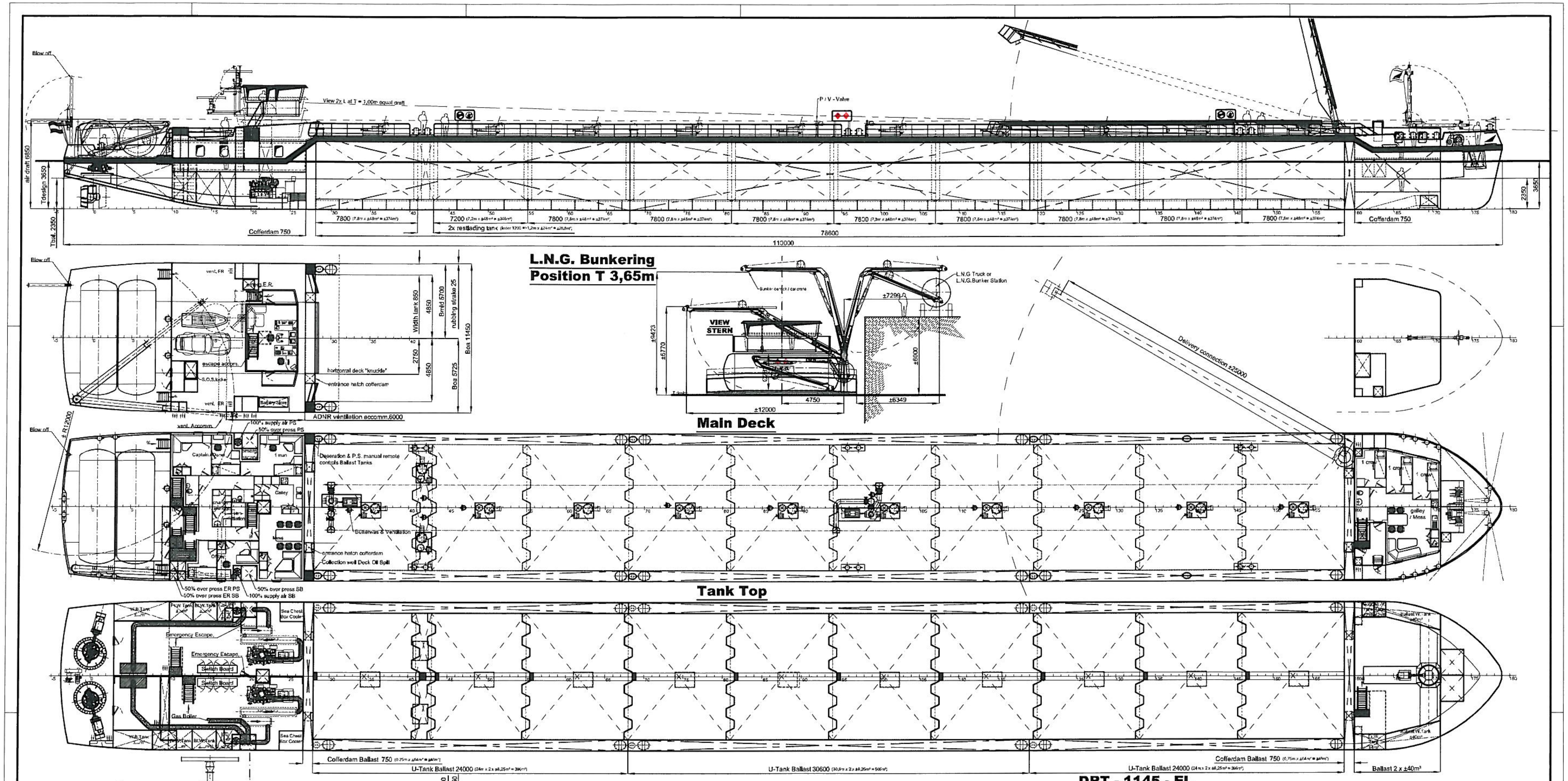
Nb	Cause	Hazard	Potential Effects	Prevention measures	Safeguards
2.10	Gas pressure out of range (<10 mbar or >50 mbar) upstream of gas train	Failure of components gas train (high gas pressure) Gas leakage into engine room when gas train parts fail	Bad engine performance Fire & Explosion		Over pressure safety valve in gas supply line upstream of gas train Gas detection will lead to shut down ESD valve Ventilation increase further to gas detention Possible shut down
2.11	Gas in cooling system when cylinder head gasket fails	Accumulation of gas in surge tank resulting in explosive mixture	Fire/explosion,		Cooling system pressure greater than maximum pressure inlet system engine: gas can not reach cooling system via leaking gasket

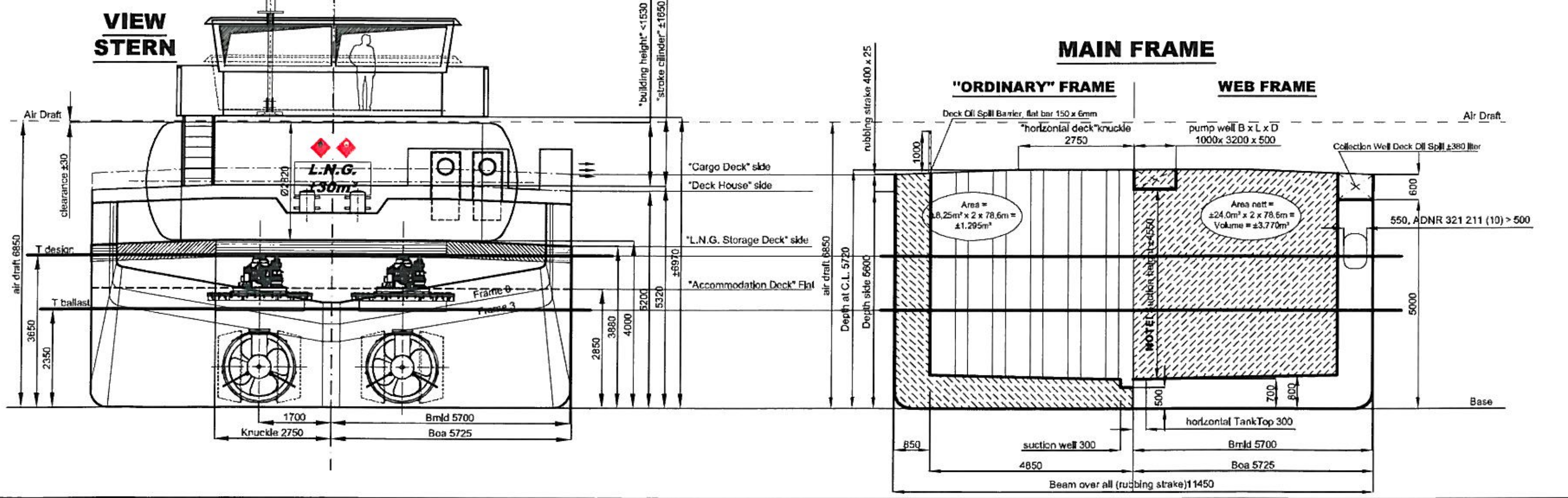
Table 3: Root Cause Analysis

Nb	Root cause	Leads to	Hazid ref.	Prevention measures	Safeguard
RC1	Collision or grounding	Rupture of LNG tank Rupture of piping system on deck Rupture of piping system in engine room	1.1 1.3 2.2	Within 1 meter of ship side and stern no gas containing components will be placed. Tanks are of the same design as tanks used for transport by road, ie EN 13530 and ADR. Design, inspection and testing is also in accordance with IGF Code. Pipe routing as short as possible The tank are fitted with baffle plates to prevent sloshing at partial filling. Tank is designed for 10 deg. static roll, 2g axial acceleration, 1 g transversal	
RC2	Degradation of system parts	Internal & external leakage Heat built up	1.3/1.4 2.1/2.2 1.5	Class approved Inspection & survey scheme Maintenance programm Gas installation under class	

RC3	Human error during normal operations			Recognised training of crew	Automatic monitoring, control and safety systems
RC4	Human error during bunkering	Overpressure Tank liquid full Rupture & leakage of piping system on deck	1.2 1.6 1.3	Approved bunkerprocedure	Approved bunkerprocedure Safety valve arrangement
RC5	Human error during start-up and shut down of system	Backfire	2.3	Recognised training of crew	Automatic monitoring and control systems
RC6	Vessel moves during bunkering	Rupture & leakage of piping system on deck	1.3	Approved bunkerprocedure Recognised training of crew	Approved bunkerprocedure
RC7	Fire on deck	Heat build up in tank Tank liquid full	1.5 1.6	Tanks are of the same design as tanks used for transport by road, ie EN 13530 and ADR. Design, inspection and testing is also in accordance with IGF Code.	Waterspray installation Safety valve arrangement
RC8	Quality of LNG	Malfunctioning system	2.9/ 2.10	Quality control with delivering note of LNG	
RC9	Fire in engine room not due to LNG	Rupture & leakage of piping system in engine room	2.2		Fire detection ESD Fixed fire extinguishing in engine room
RC10	Extended non sailing period	Heat build up in tanks Tank liquid full	1.5 1.6	Tanks are of the same design as tanks used for transport by road, ie EN 13530 and ADR. Design, inspection and testing	Safety valve arrangement

				is also in accordance with IGF Code, in particular insulation Minimum quantity of consuming LNG	
RC11	Sinking	Rupture & leakage of piping system on deck Tank overboard	1.3 1.7		
RC12	Vibrations	Rupture & leakage of piping	1.3/ 2.1/ 2.2	Built under class (limitation of vibrations) & Maintenance	





DRT - 1145 - EL

Main Dimensions

Length	o.a.	approx	110.00	m.
Breadth	moulded		11.40	m.
Breadth	o.a.	approx	11.45	m.
Depth	at side midship		5.60	m.
	at center line		5.72	m.
Air draft	above base line	approx	6.85	m.
Airdraft	at T = 2,35 m.	approx	4.50	m.
Draft	scantling		3.65	m.
Draft	ballast	approx	2.35	m.

Cargo Tanks

Dead Weight	at T = 3,30 m.	approx	2,600	tons
10x Volume Cargo Tanks (including slob)		approx.	3.770	m³
2x Volume Slob Tanks		approx	2x 28	m³

Tank Volumes

Fresh Water	aft ship	approx	2x 5	m³
	fore ship	approx.	4	m³
Water Ballast	aft ship	approx.	....	m³
	mid ship	approx.	1.390	m³
	fore ship	approx.	120	m³
Grey Water	aft ship	approx.	2	m³
	fore ship	approx	2	m³
Black Water	aft ship	approx.	2	m³
	fore ship	approx.	2	m³
Lubrication Oil	aft ship	approx	2	m³
Dirty Oil	aft ship	approx.	2	m³

Class / Authorities

I.V.W. (Directive 2006/87/EC)
- "Richtlijnen C.E. markering"
- R.O.S.R.
- "Continue vaart"
- "aantekening één mansradar vaart"

A.D.N. (Directive 2008/68/EC)
- type C
- 50 kPa

Bureau Veritas
- ✠ 5 IN (0,6) Z
- Tanker / Double Hull
- DP = 57.5 kPa / TP = 65 kPa
- A.D.N. Type C
- ✠ M.C.

BUREAU VERITAS EXPERTS DE R... PARIS 18.. REGISTRE INTERNATIONAL

rev.	date	inspected
REV1	DATE	INSPECT

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☐ For information
☐ For construction
☐ Stamped approved by class

BODEWES
MILLINGEN a/d RIJN
Nederland

Damen River Tanker - Eco Liner
DRT-1145- EL, Type C

drawn: WK — date: 2011-05-25
proj. no.: Sneekes
dw. no.: 000-000, 2011-05-25

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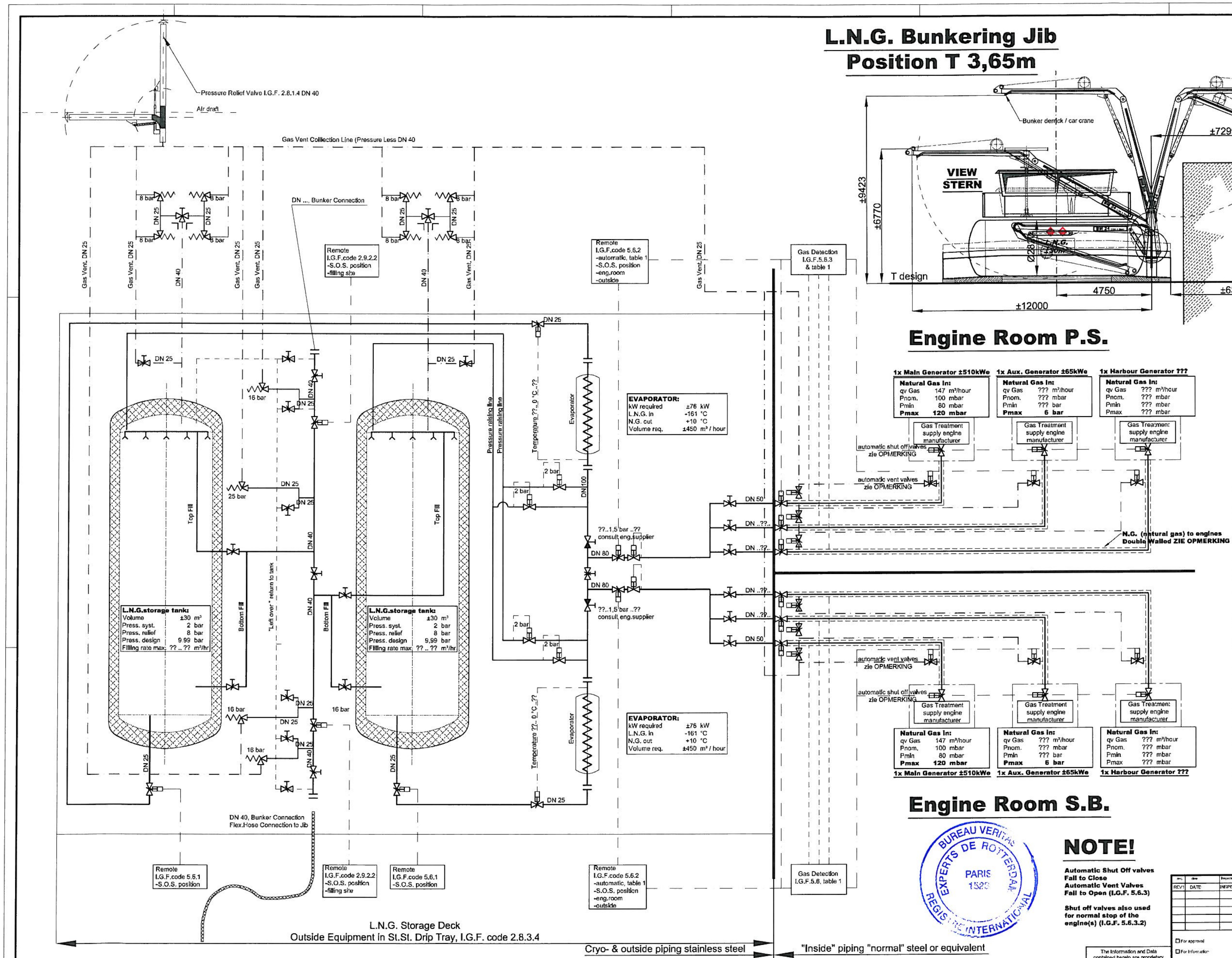

L.N.G. TANKS

Cryogenic tank constructed following the
E.N. 13530 (T.P.E.D.) code
Approved according to the
A.D.G. and I.M.O. - I.M.D.G. code

SYTEM DESIGN PRESSURE 2 bar

100% LNG-NG COMBUSTION; REDUNDANT SYSTEM

Total Installed power

2x Gen.Set 575 kW	=	1,150	kW
2x Gen Set 65 kW	=	130	kW
1x Boiler 600 kW	=	600	kW
Power total per system	=	1.880	kW

Max. Fuel consumption

Gasoil	=	42,50	MJ/kg
LNG	=	49,51	MJ/kg
Fuel consumption gasoil	=	± 190	g/kW/hour (gasoil)
1.880 kW	=	± 358	kg/hour gasoil
= ± 306			kg/hour LNG
specific gravity LNG	=	430	kg/m³
306 kg LNG	=	± 710	liter/hour LNG
specif gravity NG	=	0,68	kg/m³
306 kg NG	=	± 450	m³/hour NG

Maximum velocity piping

Velocity LNG Filling	=	± 12	m/sec
Velocity LNG Combustion	=	± 2	m/sec
Velocity NG (gas)	=	± 15	m/sec

Filling

DN		Filling rate	
DN 40 mm	=	± 55	m³ LNG / hour
DN 50 mm	=	± 84	m³ LNG / hour

Combustion LNG

710 liter LNG / hour = 0,012 m (diameter)

Combustion NG

450 m³ NG / hour = 0,103 m (diameter)

Required capacity Evaporator

Heat of Evap. LNG-NG	= 510	kJ/kg			
Specific heat NG	= 2,2	kJ/kgK			
Evaporation of LNG-NG					
306kg x 510 kJ/kg	= 156.060	kJ	=	44	kW
Heating NG of -161°C up to NG of ±10°C					
306kg x 2,2kJ/kgKx171°	= 115.120	kJ	=	32	kW
		Required capacity	=	76	kW

NOTE!

Automatic Shut Off valves Fail to Close
Automatic Vent Valves Fail to Open (I.G.F. 5.6.3)

Shut off valves also used for normal stop of the engine(s) (I.G.F. 5.6.3.2)

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rev.	date	inspected
REV1	DATE	INSPECT

BODEWES MILLINGEN a/d RIJN Nederland

Principal One Line LNG Diagram

drawn: WK — date: 2011-05-25
dwg. no.: 321-000, 2011-05-25

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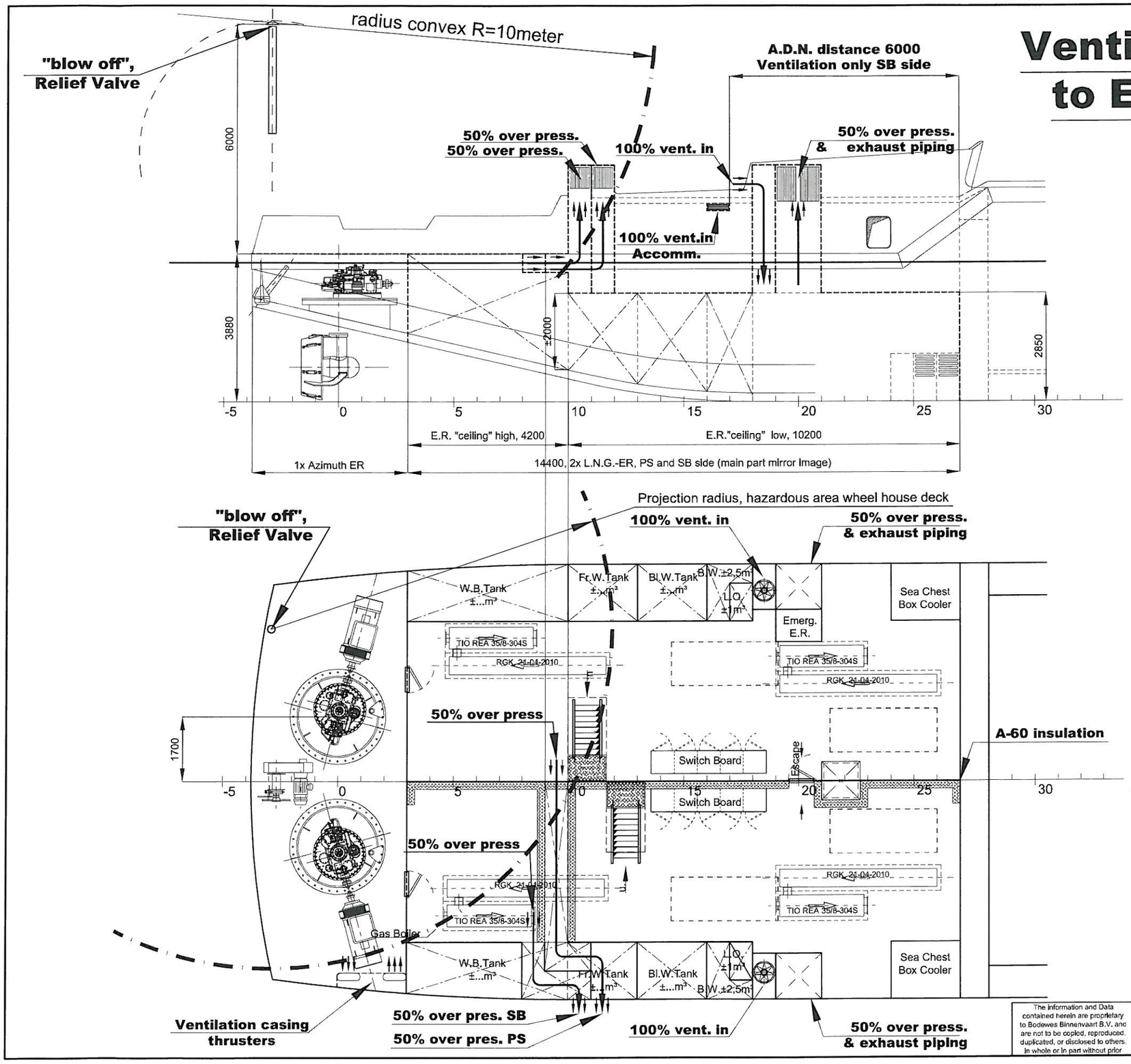
Ventilation in relation to E.U. / A.D.N. and I.G.F. code



BUREAU VERITAS EXPERTS DE ROTTERDAM PARIS 1828 REGISTRE INTERNATIONAL

Ventilation according:

1. **I.M.O.: Resolution M.S.C. 285 (86) (adopted om 1 June 2009) (I.G.F.guidelines, Interim Guidelines On Safety for Natural Gas-Fuelled Engine Installations in Ships)**
2. **European Regulations: Code 2006 / 87 / EC**
3. **European Regulations: Code 2008 / 68 / EC**

rev.	date	Inspected
REV1	DATE	INSPECT

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BODEWES MILLINGEN a/d RIJN Nederland
Rijndijk 6566 CG Millingen a/d Rijn Netherlands
Telephone 0481436 208 Telefax 0481 433 166
info@bodewes-millingen.nl www.bodewes-millingen.nl

DRT-1145-EL
Eng.Room Lay Out & Ventilation in relat. to A.D.N. & I.G.F.

drawn:	WK	date:	2011-05-25
proj. no.:	Sneekes	ident. to drw. no.:	----------
yard no.:	----------	derived fr. drw. no.:	----------
scale:	-------		

drw. no. **200-000, 2011-05-25**

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Gas Electrical (Power Management)

P.S. Eng.Room | S.B. Eng.Room

Gas motor 420kWg-1800rpm — Gen. — 350kWe
Gas motor 295kWg-1800rpm — Gen. — 246We
Gas motor 420kWg-1800rpm — Gen. — 350kWe
Gas motor 295kWg-1800rpm — Gen. — 246We
Gas motor 75kWg-1500rpm — Gen. — 62We
Wal Aansl. 230-400V /50Hz, 63A

N.C.

230-400V 50Hz

±30 kWe Emerg.Power
- Emerg.FiFi Pump
- Emerg.Lighting
- etc. etc.

Tank Heating ±3x 250kW pos.670

rend. 97,5% — rend. 94% — M — Z-drive ± 500kW pos.210

Aantal?? rend. 97% ???

M — 2 x Cargo Pumps ±285kW pos.633

M — Bow Thruster ±400kW?? pos.223

Emer. FiFi Pump pos.310 — M

Emergency propulsion
R.O.S.R. art.10.03b

N.C.

rend. 97,5% — rend. 94% — M — Z-drive ± 500kW pos.210

Main FiFi Pump pos.310 — M

230-400V 50Hz

230-400V 50Hz

±30kWe Aux.Power
- Main FiFi Pump
- Power consumers
- Lighting
- Hotel services
- 24 V DC equipment

BUREAU VERITAS EXPERTS DE ROTTERDAM PARIS 1828 REGISTRE INTERNATIONAL

P.S. Eng.Room | Bow Thruster Room | S.B. Eng.Room

rev.	date	inspected
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BODEWES
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DRT - 1145 - EL
Proposal Power Management

drawn: WK | date: 2011-05-25 | scale: .....
proj. no.: Sneekes | ident. to drw. no.: .....
yard no.: ..... | derived fr. drw. no.: .....

drw. no.: 400-000, 2011-05-25

MaterialSafetyDataSheet
Liquefied methane, cryogenic
LBG -- LNG

1.identification of substance and supplier

Product name	**Liquefied methane, LNG, LBG**	
Product supplier	**LNGEurope bv,**	Phone: + 31 6 20502738
	Driehuizerkerkweg 37	Contact: J.R. Kuin
	1985 EJ Driehuis Nederland	

2. components – information on ingredients

component	Cas-nr.	EC-nr	Weight %	classe	R-phrases
- Methane	74-82-8	200-812-7	approx 93,5	F+	12
- Ethaane	74-84-0	200-814-8	approx 5	F+	12
- Propane	74-98-6	200-827-9	approx 1	F+	12
- Butane	106-97-8	203-448-7	approx 0,5	F+	12

Remarks: see articles 15 and 16 for the risks (the R phrases) as mentioned above

T+= extremely poisonous, T= poisonous, C=corrosive, Xn=harmful, X= irritating, E=explosive O=oxidizing, F+=extremely flammable, F= flammable, N=environmental hazardous, M=mutagenic, A=allergic reactions, K=Carcinogenic, R=reproductive hazardous

3. risk identification

Extremely flammable, F+

4. first aid measures

In general:	Seek medical advice if one feels unwell, or if symptoms appear
inhalation:	Remove person to fresh air. If the person is not breathing: give artificial respiration. If breathing is difficult, give oxygen. Seek immediate medical attention
Skin:	Remove contaminated clothing and flush affected area with cool to lukewarm water. Treat frostbite as burns. Seek medical attention.
Eyes	Flush eyes immediately and during at least 15 minutes, seek immediate medical attention.
Medical information	Treat accordingly to symptoms. Medical providers are urged to contact region/national Poison Center

5. fire fighting

Specific procedures	If, without any additional risks possible, remove product from the area. Use water only to cool containment, however, the use of water to fight fires will lead to severe fire development
Extinguishing media	Dry chemical, Carbon dioxide, dry foam. Do not use water. Large fires typically require NIOSH/MSHA-approved pressure-demand self-contained breathing apparatus with full facepiece and full protective clothing.
Hazards	Empty vessels may explode

6. accidental release

Personal protection	Treat accordingly article 7. Remove all ignition sources. Use personal protection accordingly art. 8.
Environmental protection	Gas leakage might be reduced by cooling with liquefied CO2 or by covering with foam.
cleaning	Spilled liquefied methane will vaporize quickly

7. handeling and storage

Handling	Prevent all contact with eyes or skin. Prevent all ignition- or heat sources. A strict ban on smoking
Storage	Store in a cool and well ventilated area. Vessels should be appropriately closed.

8. exposure controls/personal protection

component	Cas-nr	EC-nr	MAC (mg/m3)	remarks
propane	74-98-6	200-827-9	900	-
butane	106-97-8	203-448-7	600	-

Workplace	Use forced ventilation in order to keep exposure below admissible levels
Respiratory protection	At high concentration levels use pressure-demand self-contained breathing apparatus
Hand protection	When manual contact is unavoidable, use cryogenic gloves, prevent manual contact!
Facial protection	When facial contact might be possible, use facial protection
Skin protection	Use protective clothing, when contact with skin is possible, prevent any contact with skin !

9. physical and chemical properties

appearance	Liquefied gas, boiling fluid, refrigirated
color	colorless
Solubility in water	Non soluble
Specific weight	445 kg/m3 (ambient pressure/1 bara)
Boiling point	-162^{o}C (ambient pressure /1 bara)
flashpoint	-180^{o}C
Ignition temperature	Approx. 650^{o}C
Explosion area	5 – 15 vol %

10. stability and reactivity

stability	Stable under recommended storage conditions
to be avoided	Heath, open fire, sparks, static electricity
reactivity	Reacts strongly with oxidizing agents

11. health hazard information

inhalation	High levels of vapor may be health hazardous and may cause headache and dizziness. At even higher levels suffocation may appear because of lack of oxygen.
skin	May cause serious frost bites
eyes	May cause serious eye damages by freezing

12. ecological information

persistence	Quickly evaporates in a gas lighter than air
Ecological toxicity	No data found
toxicity	Simple asphyxiant, suffocation by reduction of oxygen concentration
Bioaccumulation	No data found, methane will be oxidized in H_2O en CO_2

13. disposal instructions

Given the condition of sufficient ventilation, limited amounts of liquefied methane can be removed by vaporization. Larger spills should be handled as classified waste. EAK 160501 – high pressure gas container

14. transport information

UN-no	1972
label	
Proper shipping name	Natural gas, liquefied
classification	
ADR	2
RID	2
IMDG (sea)	2.1
EmS	F-D (fire), S-U (spill)
Stowage category	D
Marine polutant	No
ICAO (air)	Not restricted
Special provisions	-

Packing instructions for packing groups:		
	Packing instructions	Max. Net Qty
Passenger aircraft	Forbidden	-
Cargo aircraft	forbidden	-
Limited quantity	-	-

15. regulatory information

symbol:

Extremely flammable

R-phrase: R12: Extremely flammable

S-phrase: S 9: store containers in well ventilated areas

S 16: keep removed from ignition sources, do not smoke

16. additional information

All R-phrases mentioned in article 15

Date of issue : 2010-12-01 **LNG**Europe bv
e-mail: blaazer@LNGEurope.eu + 31 6 20502738.

System description:

- For the transfer of LNG a one hose LNG connection will be used and a one hose vapour return will be used. The coupling will be done by dry disconnection couplings. Differential pressure will be measured in order to activate safe emergency shut-down. When on ambient temperature transfer lines will carry gaseous methane. The systems will be integrated in a loading arm
- In case of emergency the safety link will activate the emergency shut-off safety valves on both ships. If safety link is disrupted or disconnected before deactivation, the emergency shut-off valves on both ships will automatically close the LNG and vapour lines. The safety link can be deactivated only when the manual valves are closed.
- The LNG supply contract details the conditions of transfer

Before bunkering

- Call
- Arrival
- Mooring
- Checklist to receiving ship
- Connection link
- Connection hose
- Return of signed checklist
- Ready signal both ships

During bunkering

- Start sequence
- Transfer sequence
- Stop sequence

After bunkering

- Shut manual valves
- Disconnection link
- Delivery cargo document
- Un-mooring
- Departure

Before bunkering

- Call
  - contract details:
    - no contract no LNG
  - Exchange of in contract detailed requirements
  - Exchange methane number,
  - Await customer acceptance of methane number
  - Required volume
  - pressure and temperature of LNG onboard receiving ship
    - when out of range: No LNG, follow the cool down procedure

- Arrival
  - see nautical procedure
  - first visual check by bunker personal

- Mooring
  - See nautical procedure

- Checklist to receiving ship
  - Checklist according to contract
  - First check on pressure and temperature

- Connection link
  - Check manual valves (must be closed)
  - Fasten safety link
  - Activate safety link
  - Check functioning safety link
  - Non functional safety link: no transfer of LNG

- Connection hose (LNG and vapour return)
  - Make sure that transfer lines are closed and on system pressure
  - Make sure manifolds within contractual range
  - when range is off limits: no transfer of LNG
  - Check presence and functionality of safety devices, flanges etc
  - Connect

- Return of signed checklist
  - Check signed list
  - Set volume of LNG to be transferred according to volume ex checklist

- Ready signal both ships

During bunkering

- Start sequence
  - Monitor safety links
  - Make sure gas phase pressure is within contractual range
  - Start cool down procedure
  - Set the expected transfer volume

- Transfer sequence
  - Arrange transfer according to set volume
  - At end of transfer pay close attention to process

- Stop sequence
  - Derev pumps etc
  - Switch off pumps
  - Check balance in vapour pressure
  - Contact captain vessel customer
  - Give the signal decoupling
  - Decouple LNG line
  - Decouple vapour return line

After bunkering

- Shut manual valves
  - On board LNG barge
  - On board customer

- Disconnection link
  - Deactivate the link
  - Disconnect the link

- Delivery cargo document

- Un-mooring
  - See nautical procedure

- Departure
  - See nautical procedure