Economic Commission for Europe

Inland Transport Committee

30 October 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)

Twentieth session
Geneva, 23–27 January 2012
Item 7 of the provisional agenda
Special authorizations, derogations and equivalents

Proposal for a derogation regarding the use of LNG for propulsion - Damen River Tanker 1145 Eco Liner

Transmitted by the Government of the Netherlands

Version ADN 11 okt

UNITED NATIONS ECONOMIC COMMISSION FOR EUROPE (UN-ECE)

RECOMMENDATION OF THE ADMINISTRATIVE COMMITTEE RELATING TO THE ADN REGULATIONS

RECOMMENDATION No. xx/2012
of xx xx 2012

The competent Authority of The Netherlands is authorised to issue a trial certificate of approval to the motortankvessel"Damen River Tanker 1145 Eco Liner" (ID number 54314 and BV registernumber 20629A), for use of Liquefied Natural Gas (LNG) as fuel for the propulsion installation.

Pursuant to regulation 1.5.3.2 the vessel may deviate from the regulations 7.2.3.31.1 and 9.3.2.31.1 until 30-06-2017. The Administrative committee decided that the use of LNG is sufficiently safe under the following conditions which shall be complied with at all times:

1. The vessel has a valid certificate of approval according to RIVR, based on recommendation XXX by the CCNR.
2. [The vessel shall be constructed and classified under the supervision and in accordance with the applicable rules of an recognized classification society, which has special rules for LNG installations. The class shall be maintained];
3. [The LNG propulsion system shall be annually surveyed by a recognized classification society;]
4. A HAZID study by a recognized classification society (see annex 1) shows that the safety level of the LNG propulsion system is sufficiently safe. This study to cover, but not limited to, the following issues:
    - Interaction between cargo and LNG
    - Effect of LNG spillage on the construction
    - Effect of cargo fire on LNG installation
    - Different types of hazard posed by using LNG instead of diesel as fuel
    - An adequate safety distance during bunkering operation;
5. [The LNG propulsion system is in conformity with the IGF Code (IMO Resolution MSC 285(86), June 1st 2009), except for the items listed in annex 2;]
6. [The LNG storage tanks shall comply with the requirements of EN 13530. The tank shall be connected to the vessel in a way that ensures that the tank shall remain attached to the vessel under all circumstances.]
7. The bunkering and maintenance of the LNG propulsion system shall be done according to the procedures laid down in annex 3 and 4;
8. All crewmembers shall be trained on the dangers, the use, the maintenance and the inspection of the LNG propulsion system according to the procedures laid down in annex 5;

9. A safety rota shall be provided on board the vessel. The safety rota describes the duties of the crew. The safety rota includes a safety plan;
10. The use of LNG as fuel is included in the dangerous goods report to Trafic management and in emergency notification;
11. All data related to the use of the LNG propulsion system shall be collected by the carrier. The data shall be sent to the competent authority on request;
12. An annual evaluation report shall be sent to the secretariat of the UN-ECE for information of the administrative committee. The evaluation report shall contain at least the following information:
    a. system failure;
    b. leakage;
    c. bunkering data;
    d. pressure data;
    e. repairs and modifications of the LNG system.

Attachments:
- Annex 1. Hazid Study
- Annex 2. Overview deviations from the IGF Code
- Annex 3. Bunkering procedure
- Annex 4. Maintenance procedure
- Annex 5. Training procedure

Attachment 1; Hazid study 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 is also in accordance with IGF	Safety valve arrangement

				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	

Annex 2

Overview of deviations from the IGF code

(IMO Resolution MSC 285(86), June 1st 2009).

This document is applicable to the Damen River Tanker – Ecoliner (ID 54314).

IGF code	**DRT Ecoliner**
2.8.1 LNG Tank design:	The LNG tank design is according PED/EN 13530. The tank is connected to the vessel in a way that ensures that the tank shall remain attached to the vessel under all circumstances.

LNG Bunkering Procedure

1. PURPOSE

To fill the LNG holding tanks in a safe way, the following procedures should be followed closely:

2. GENERAL

Before the vessel's LNG storage tanks can be filled on a certain place, (local) authorities should be informed. These authorities could demand for extra safety precautions. The authority's approval for the bunker transfer must be available before bunkering is started.

As long as there are no regulations for LNG bunker transfer the following can be used as guidance:

- General bunker transfer procedures for oil fuel
- Precautions and procedures for cargo filling and –discharge by inland waterway tank vessels

3. PRE-FILLING

Before LNG transfer is commenced the bunker checklist has to be filled in and signed both by a ship's representative and the delivery truck driver.

After all questions on the bunker checklist are answered positive and the delivery truck driver has received all necessary documentation, transfer is commenced.

4. FILLING:

The LNG transfer diagram is presented in appendix B of this document.

During transfer the following items should continuously be checked:

- The gas pipes, -hose and connectors for leakage
- The mooring lines
- Forces on the transfer hose
- Tank pressure, which can be controlled by use of the top filling spray facility (with this procedure a vapour return is not required)

5. POST-FILLING:

After LNG transfer, and after the transferhose is disconnected, warning signs on the shore can be removed. At this time the crew and the (local) authorities have to be informed that the transfer is finished.

6. PROCEDURES

LNG transfer checklist	
Precautions and appointments made for transfer of LNG	
- Ship's particulars …….. (ship's name)	 ……. (Ship's European Identification number)
- Truck's particulars …… (Companyname)	 ……. (plate number)
- Transfer location …… (adress) …… (date)	 ……. (place) ……. (time)
LNG related particulars	
Quantity in m^3: …….	
Maximum pumprate in m^3/uur: 36	
Emergency procedure	
Filling must be stopped immediately in case leakage occurs on the connection hose or the LNG pipes between the bunker station and the storage tank. All valves have to be set in their safe position. A red flashlight will indicate the abnormal situation described. The truck driver should stop the LNG pump immediately. All personnel should evacuate the bunker station area immediately.	

The start of LNG transfer is only allowed if all questions raised on the checklist of appendix A are answered 'yes' and both responsible persons have signed the list.

If one of the items cannot be answered 'yes' LNG transfer is **NOT** allowed.

APPENDIX A.

LNG Transfer Checklist		
	Ship	**Truck**
1. Are vessels present in the direct vicinity of the transfer area informed about the LNG transfer?	○	--
2. Is the (local) authority's admittance for the LNG transfer in the designated area available?	○	--
3. Is the (local) authority informed that LNG transfer will be commenced?	○	--
4. Is the vessel well moored?	○	--
5. Is the lightning, both on the truck and on the vessel (bunker station), sufficient and in good working order	○	○
6. Are the signs, that designate the safe area around the tanktruck on the shore, placed?	--	○
7. Are all, for any possible leakage necessary, drip-trays placed and is the waterspray installation for immediate use available?	○	--
8. Is the LNG transfer hose properly supported and are there no extreme forces or stress on the hose?	○	○
9. Are the LNG transfer hose and break away coupling in good condition?	○	○
10. Is the ground cable connected in the right way?	--	○
11. Is the necessary driptray under the hoseconnection placed?	○	--
12. Are all means of communication between truck, bunkerstation and wheelhouse checked and in working condition?	○	○
13. Are all safety and control devices on the LNG installation checked and in good working order?	○	--
14. Is the amount of LNG that will be transferred agreed?	○	○
15. Do the ordered LNG specifications apply on the delivered LNG specifications?	○	○
16. Is the emergency stop procedure discussed with, and understood by, the truck driver?	○	○
17. Is there a LNG certificate available?	○	○
18. Is the crew informed that LNG transfer is commenced?	○	--
Checked and signed:		
Ship's representative: …….. (Name in capitals)	Tank truck representative: …….. (Name in capitals)	

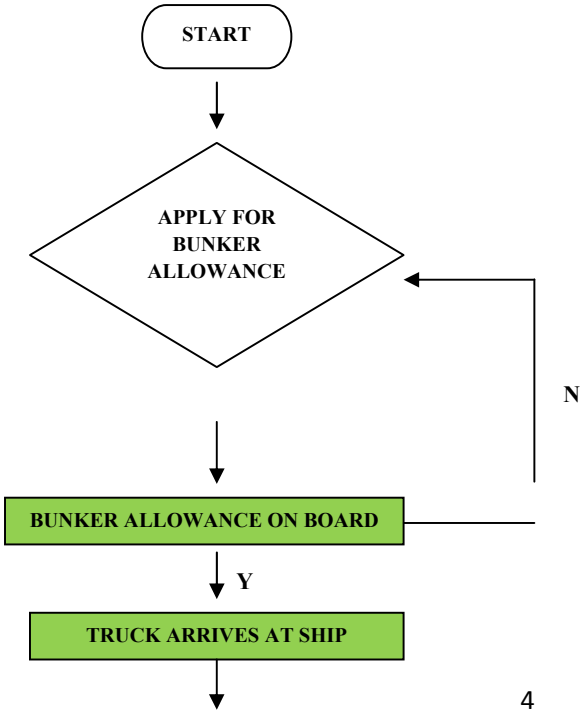
LNG Transfer Checklist		
	Ship	Truck
…… (Signature)	…… (Signature)	

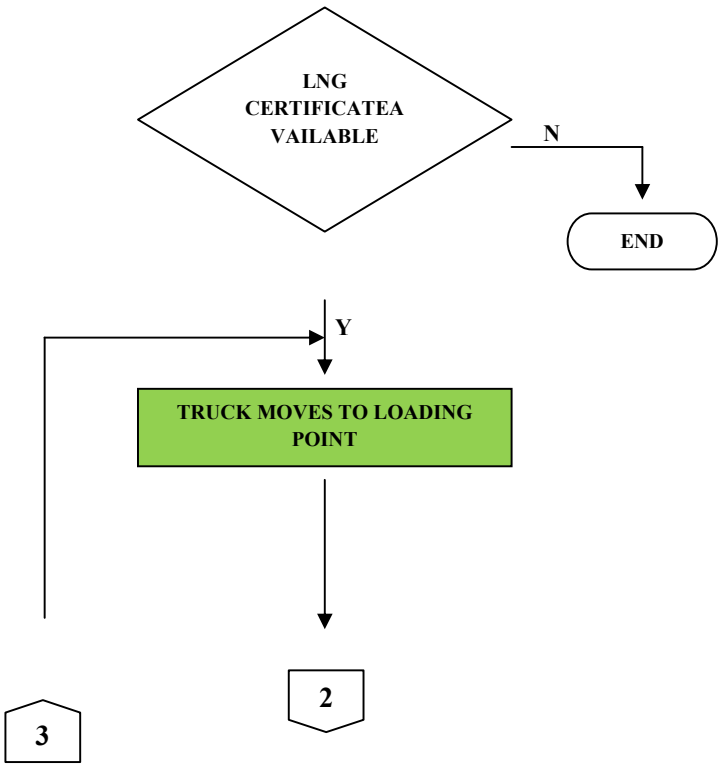
APPENDIX A.

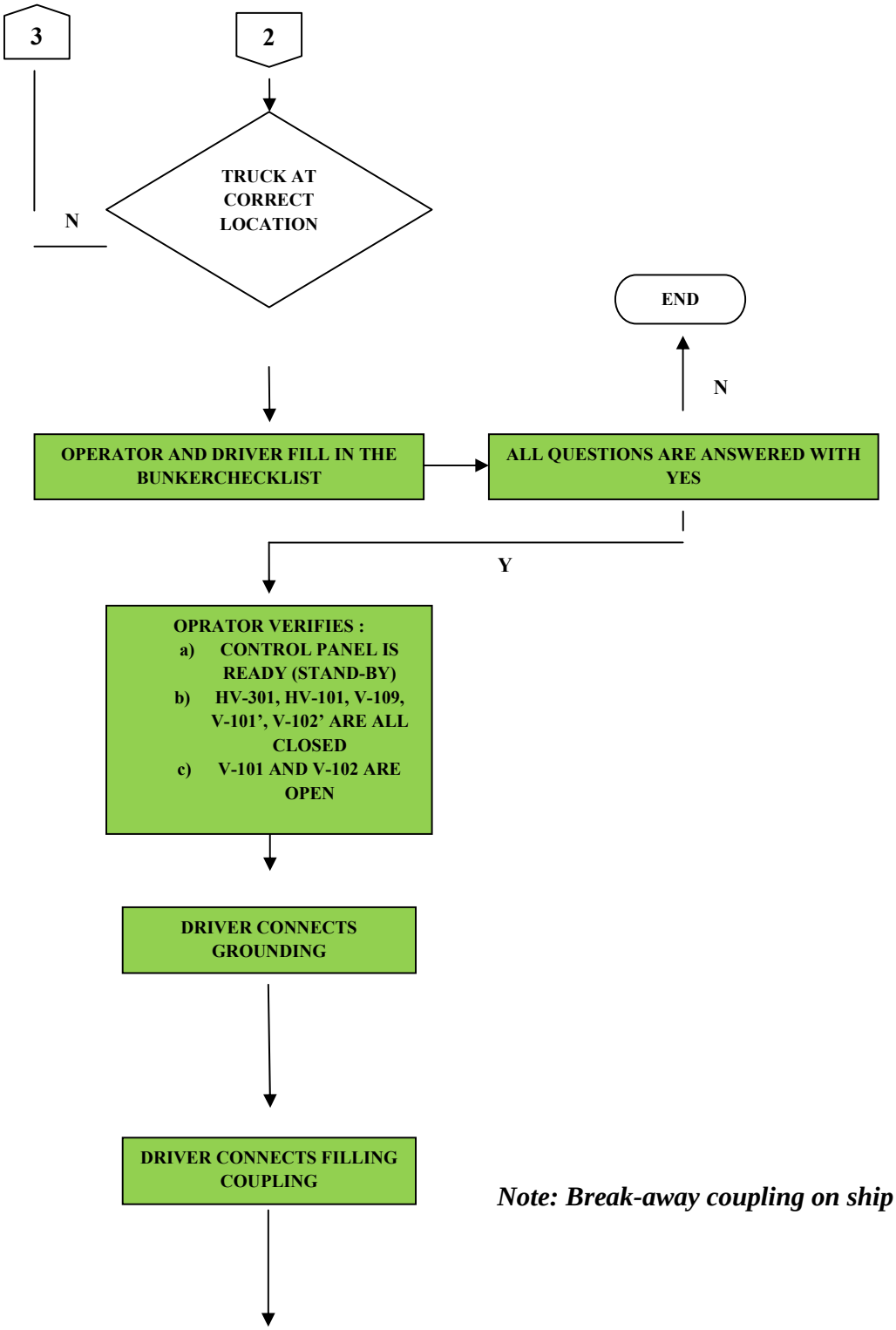
DEFINITIONS :

"Operator" = The master or the person mandated by him
" Driver" = The driver of the truck

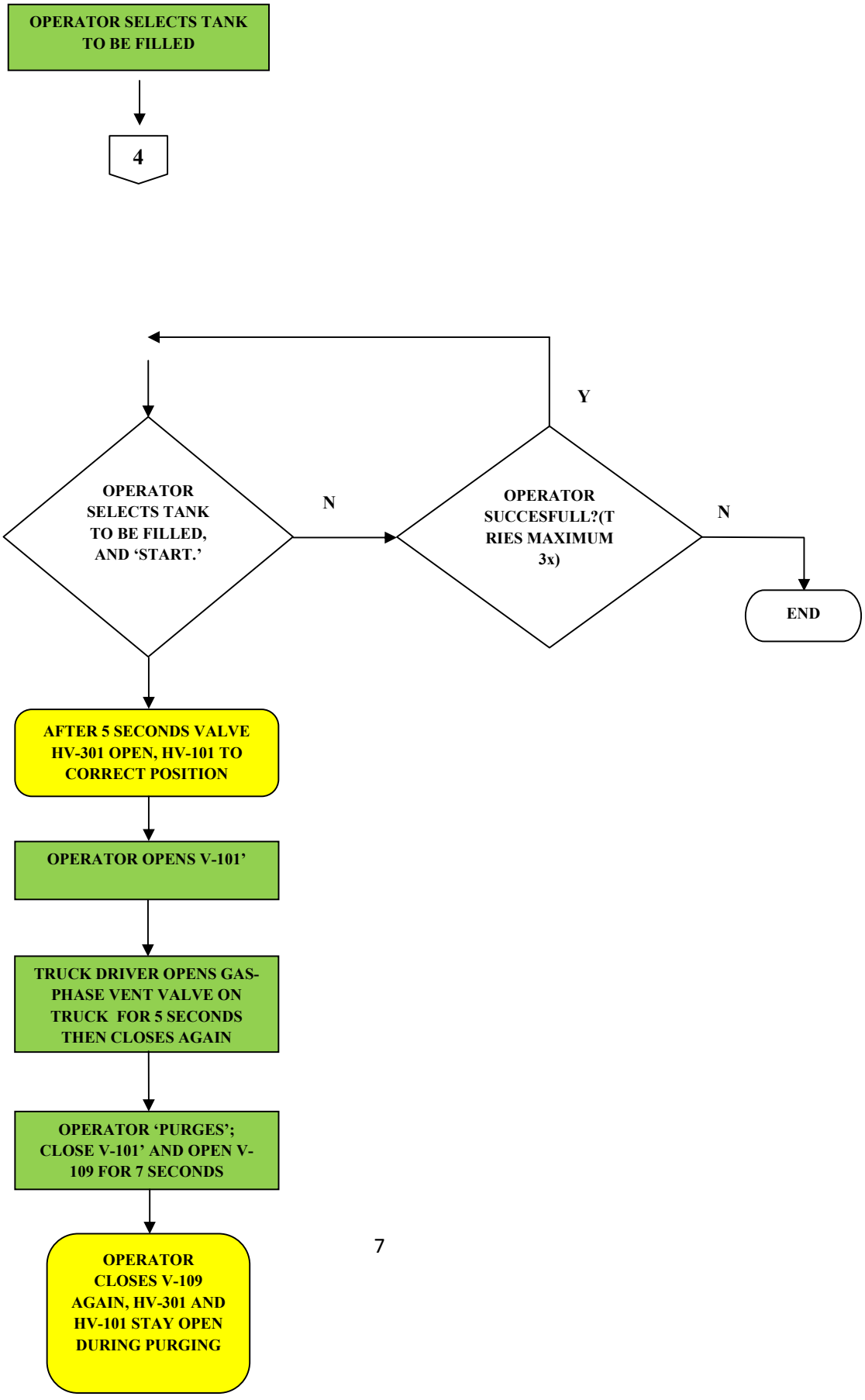
The following procedure describes the filling sequence and actions for filling the on-board Starboard storage tank with LNG coming from a road trailer, through the starboard bunker connection of the ship (through valve HV-301 and valve HV-101).
It is possible to fill both tanks from either side of the vessel (each bunker station is connected to both tanks via valves), see diagram 15-4001 for details.

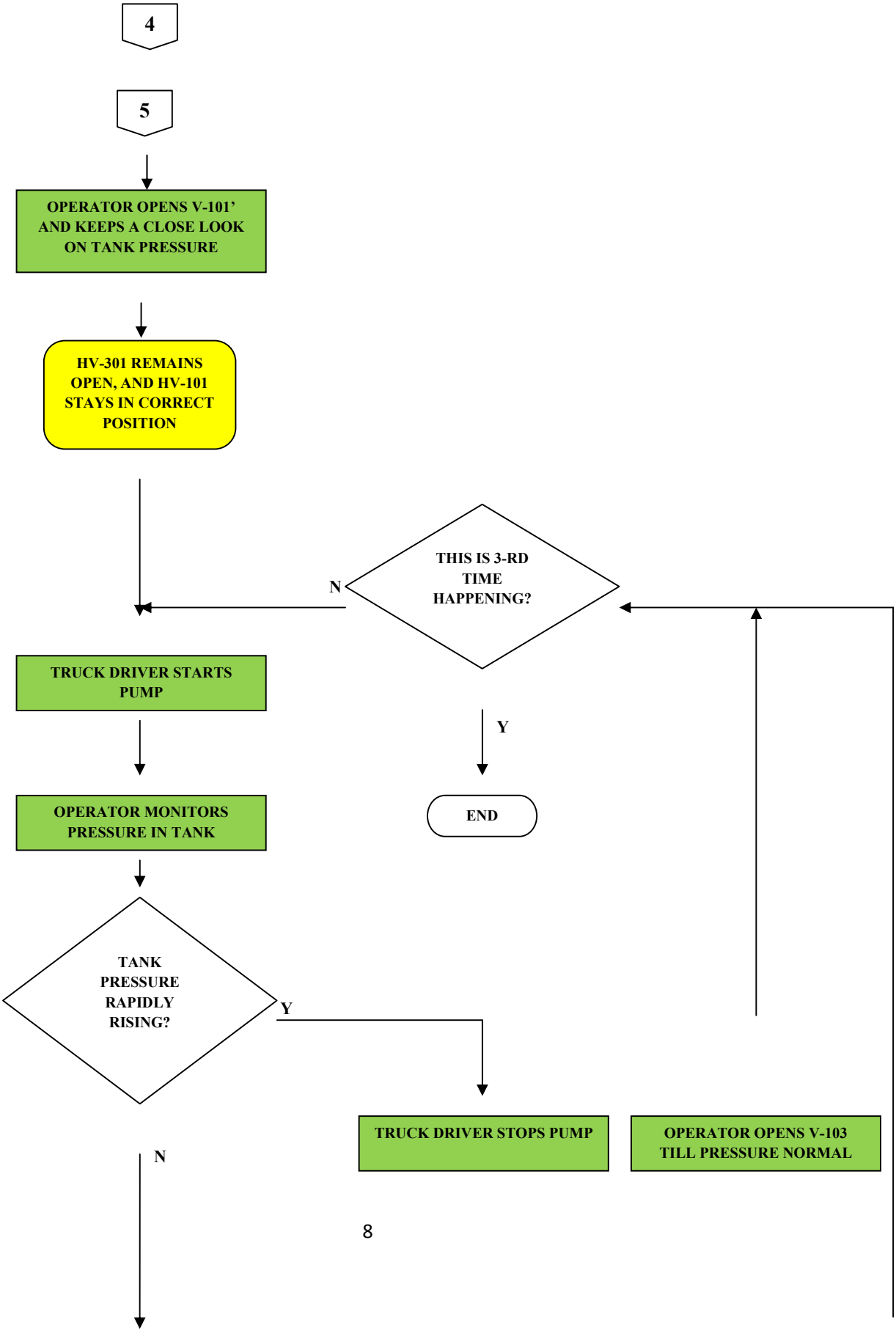


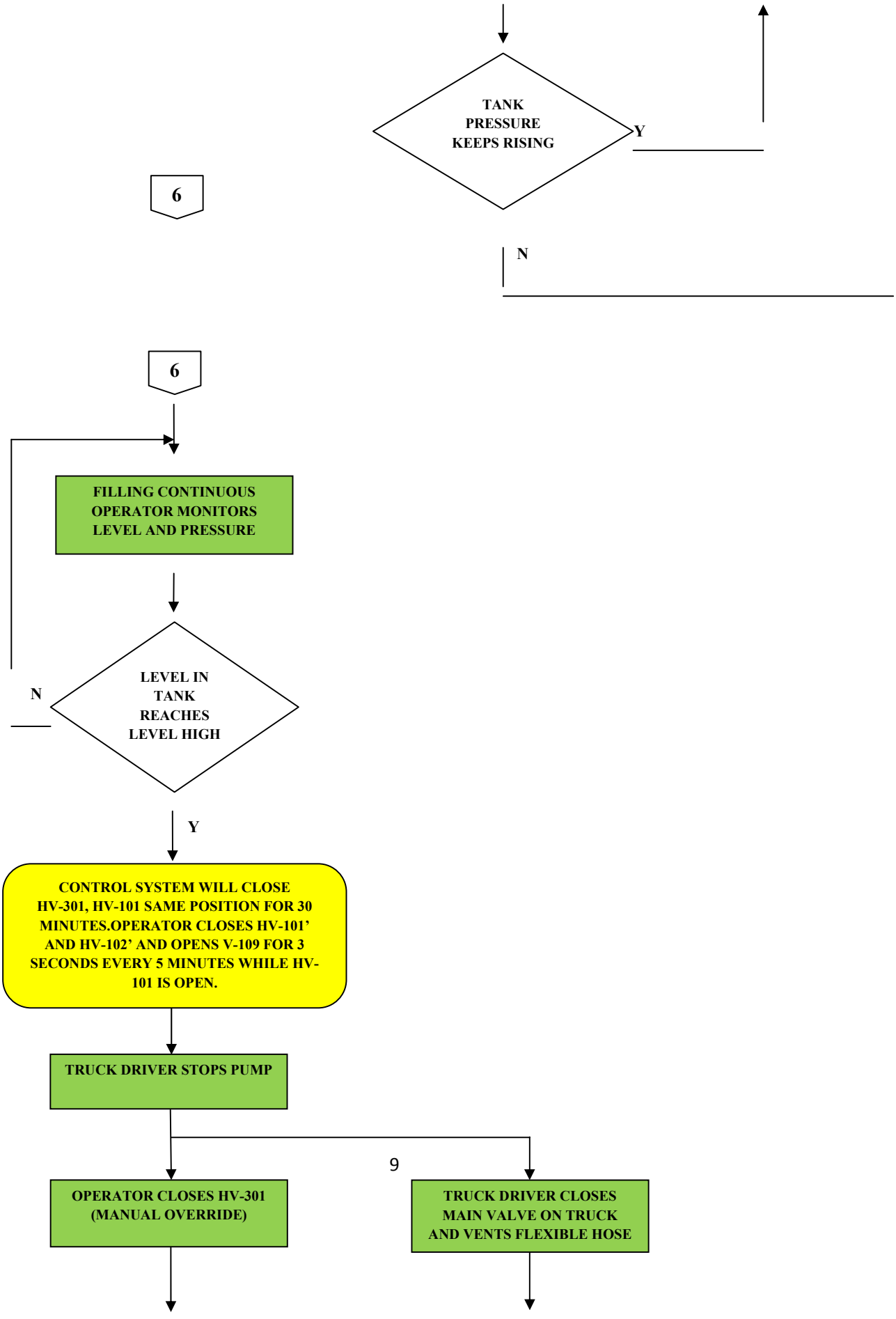

LNG
CERTIFICATEA
VAILABLE
N
END
Y
TRUCK MOVES TO LOADING
POINT
2
3



Note: Break-away coupling on ship's side of hose


OPERATOR SELECTS TANK TO BE FILLED
4
OPERATOR SELECTS TANK TO BE FILLED, AND 'START.'
N
OPERATOR SUCCESFULL?(TRIES MAXIMUM 3x)
Y
N
END
AFTER 5 SECONDS VALVE HV-301 OPEN, HV-101 TO CORRECT POSITION
OPERATOR OPENS V-101'
TRUCK DRIVER OPENS GAS-PHASE VENT VALVE ON TRUCK FOR 5 SECONDS THEN CLOSES AGAIN
OPERATOR 'PURGES'; CLOSE V-101' AND OPEN V-109 FOR 7 SECONDS
OPERATOR CLOSES V-109 AGAIN, HV-301 AND HV-101 STAY OPEN DURING PURGING


4
5
OPERATOR OPENS V-101' AND KEEPS A CLOSE LOOK ON TANK PRESSURE
HV-301 REMAINS OPEN, AND HV-101 STAYS IN CORRECT POSITION
THIS IS 3-RD TIME HAPPENING?
N
Y
END
TRUCK DRIVER STARTS PUMP
OPERATOR MONITORS PRESSURE IN TANK
TANK PRESSURE RAPIDLY RISING?
Y
N
TRUCK DRIVER STOPS PUMP
OPERATOR OPENS V-103 TILL PRESSURE NORMAL


TANK
PRESSURE
KEEPS RISING
Y
N
6
6
FILLING CONTINUOUS
OPERATOR MONITORS
LEVEL AND PRESSURE
LEVEL IN
TANK
REACHES
LEVEL HIGH
N
Y
CONTROL SYSTEM WILL CLOSE
HV-301, HV-101 SAME POSITION FOR 30
MINUTES.OPERATOR CLOSES HV-101'
AND HV-102' AND OPENS V-109 FOR 3
SECONDS EVERY 5 MINUTES WHILE HV-
101 IS OPEN.
TRUCK DRIVER STOPS PUMP
OPERATOR CLOSES HV-301
(MANUAL OVERRIDE)
TRUCK DRIVER CLOSES
MAIN VALVE ON TRUCK
AND VENTS FLEXIBLE HOSE

Description of Maintenance Procedures

(Concerning gas fuel equipment)

1. GENERAL

Depending on the type of maintenance, duration of maintenance, ships location and the condition (pressure) of the LNG storage tanks, which might give an additional hazardous situation, correct precaution should be taken. It is the responsibility of the crew to allocate the type of maintenance in the right category, however 4 levels are defined hereunder, including precautions and limitations.

These types of procedures are not only limited to the planned maintenance, but also apply in case of calamities, such as grounding, collisions etc. Action taken depends on the nature of the calamity, ships location and external facilities.

2.1 MAINTENANCE PROCEDURE- level 1

Descriptions: Services & checks of the LNG installation.

Conditions: The ships' crew will survey the LNG system visually on a weekly basis. Procedures as required according ADN and instructions given by the owner shall be followed. In principle the limitations as given for a tank vessel being **not** gas free is also valid for the LNG storage tank area (for the area: See the hazard zone diagram).

Required precautions: For the LNG system and Power stations the normal maintenance procedures according ADN can be followed.

Limitations: This procedure is suitable for regular maintenance.

(see also chapter 5 of training procedure).

2.2 MAINTENANCE PROCEDURE – level 2

Descriptions: Maintenance, which needs a special permit (for example hot work).

Conditions: Procedures as required according ADN and instructions given by the owner should be followed. Due to the construction of the LNG storage tank, which ensures safe storage, no other requirement are needed as long as the job is outside the hazard zone of the LNG storage tank (for the area: See the hazard zone diagram).

Were specific maintenance is done in the power stations, gas supply must be blocked by the emergency shut down valve as well as the manual supply valve.

Required precautions: Maintenance should be done outside the Hazard zone of the LNG storage tank with cold box. Gas supply should be blocked to the relevant power station if maintenance is done in that area.

Limitations: This procedure is suitable for maintenance outside the LNG storage tanks with cold box and with blocked gas supply to the power stations.

2.3 MAINTENANCE PROCEDURE - level 3

Descriptions: Major maintenance (for example during dry-docking) within the hazard zone area of the LNG storage tanks.

Conditions: Procedures depend on the location (local regulations), the type of work and duration of the work. If dry docking is only done for hull inspection and will take only a few days, LNG storage tanks might stay in normal condition. (level 2)

Required precautions: In case major maintenance is planned, the LNG storage tank should be emptied. For this purpose an empty receiving facility (truck) can be connected to the bunker station. The safety procedures identical for bunkering should be applied. With the pressure build up unit heat can be added to the tank. The pressure in the tank will push the liquefied LNG toward the truck. After emptying the LNG storage tank the tank must be purged by nitrogen (N2) to make the LNG storage tank gas safe.

Limitations: All maintenance can be done which will not effect the construction of the storage tank. Also maintenance of the LNG piping can be done, but only by qualified personal. Before putting the LNG storage tank into operations again, the “First filling procedure” must be followed.

2.4 MAINTENANCE – level 4

Descriptions: Major maintenance which might effect the construction of the LNG holding tank. (for example: steel repair in close vicinity of the LNG storage tank)

Conditions: If the gas free condition of the LNG holding tank is insufficient, alternatively the LNG storage tanks can be removed from the vessel. Following steps should be taken:

Required precautions:

- De-bunkering of the LNG storage tank.
- Purging of the LNG storage tank with inert gas.
- Disconnecting of the control system (control air & automation).
- Disconnection of (1) LNG bunker cross-over’s, (2) GAS cross-over, (3) GAS consumption line.
- Disconnect the heating water supply and return line.
- Lose the tank from the deck foundation and prepare for transport.

Limitations: There are no limitations since the LNG storage tank(s) is (are) removed. Before putting the LNG storage tank into operations again, the first filling procedure must be followed.

3.1 FIRST FILLING PROCEDURE

Before the tank is filled with LNG for the first time (at new build and each time after the tank is completely emptied), the following procedure has to be followed.

The storage tank should first be filled with liquid nitrogen. This is done for:

- Cool the storage tank down, so that it can be filled with LNG.
- Tests of all alarm and control functions

This procedure must be done under supervision of an expert (for instance the tank manufacturer). Special attentions should be given to adjustment of alarms and controls.

Afterwards the tank(s) can safely be filled with LNG.

Description of the training of the crew on board of LNG driven inland waterway vessels

A. Purpose of the course

The main purpose of the course is to familiarise the crew of inland waterway vessels with the properties and hazards of LNG and to get knowledge how to work with LNG as fuel onboard the vessel. For instance in case of bunkering and maintenance.

The course will include a theoretical part, consisting of the topics mentioned under B and a practical training on board the vessel in which the theoretical items will be dealt with in practice.

B. The LNG course will cover the following topics:

1. Legislation

1.1 General legislation / best practice for ADN, ROSR, European Directive EU 2006/87 and new developments
1.2 Available international legislation concerning LNG (for seagoing / best practices) IMO, IMDG and new developments
1.3 Provisional rules of Bureau Veritas
1.4 Legislation concerning health and safety
1.5 Local regulations and permits

2. Introduction to LNG

2.1 The definition of LNG, critical temperatures, LNG hazards, atmospheric conditions
2.2 Compositions and qualities of LNG, LNG- quality certificates
2.3 MSDS (safety sheet): physical / product characteristics

3. Safety

3.1 Hazards and risks
3.2 Risk management
3.3 The use of personal protection

4. The techniques of the installation

4.1 Explanation of the effects of liquefied natural gas
4.2. Temperatures and pressures
4.3 Valves and automatic controls, ATEX
4.4. Alarms
4.5 Materials (hoses, pressure relief valves)
4.6 Ventilation

5. Service & checks of the LNG installation

5.1 Daily maintenance
5.2 Weekly maintenance
5.3 Periodical maintenance
5.4 Failures

6. Bunkering of LNG (see attached procedure)

6.1 Bunkering procedure LNG
6.4 Gas freeing / flushing of the LNG system
6.5 Check lists and delivery certificate

7. Maintenance (see attached procedure)

7.1 Gas free certificate
7.2 Gas freeing / flushing of the LNG system before docking
7.2 Inerting of the LNG system
7.3 Procedure de-bunkering of the bunker tank
7.4 First filling of the LNG bunker tank (cool down)
7.5 Start up after dock period

8. Emergency Scenario’s

8.1 Emergency plan
8.2 LNG Spill on deck
8.3 LNG skin contact
8.4 Release of natural gas on deck
8.5 Release of natural gas in enclosed spaces (power stations)
8.6 Fire on deck in the vicinity of the LNG storage tank.
8.7 Fire in engine rooms
8.8 Specific hazard in case of transport of dangerous goods
8.9 Grounding/collision of the vessel

C. The LNG training on board will cover the following topics

9. Description of practical training on board:

9.1 Get familiarised with the content of the ships management system, in particular the chapters concerning the LNG installation.
9.2 Check safety awareness and the use of safety equipment for LNG
9.3 Awareness of monitoring, controls and alarms of the LNG installation on board.
9.4 Awareness of maintenance and control procedures of the LNG installation.
9.5 Awareness and familiarisation with the bunker procedure (preferable in practice)
9.6 Awareness of the maintenance procedures for docking
9.7 Awareness of the emergency scenarios