European Sustainable Shipping Forum
4th Plenary Meeting
Brussels, 16 June 2015

Final Report Submission from the ESSF sub-group on Marine LNG (ESSF LNG)
Submission from ESSF sub-group on LNG

This document reflects the outcomes of deliberations of the Marine LNG sub-group of the European Sustainable Shipping Forum of which the European Commission is part. It is not an official document adopted by the European Commission.

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1. Introduction

Compliance with the low sulphur standard (0.10% in EU SECA s as of 2015 and 0.50% outside SECA s as of 2020) introduced by Directive 2012/33/EU amending Council Directive 1999/32/EC as regards the sulphur content of marine fuels can also be achieved by using liquefied natural gas (LNG).

The Commission has been promoting actions towards a Comprehensive EU framework on LNG for shipping. This is reflected in the proposal for a Directive on the deployment of alternative fuels infrastructure. The aforementioned legislative proposal is accompanied by a Commission staff working document which presents the state of deployment of LNG as marine fuel and its main obstacles, the scope of activities and the next steps towards achieving an EU framework for LNG as an alternative fuel for shipping.

In a study commissioned by EMSA (Study on Standards and Rules for Bunkering of Gas-Fuelled Ships 2013, GL) a detailed description of the existing rule framework related to LNG bunkering was made and through a gap analysis missing and foreseeable lack of rules for bunkering LNG and related aspects were identified.

One of the main identified and outstanding regulatory barriers, identified in the EMSA study, in relation to the uptake of LNG is the current absence of a binding regulatory EU framework for LNG bunkering which may possibly lead to different safety and bunkering requirements across the EU.

Given the regulatory, technical, operational, and economic challenges, hampering the deployment and use of LNG as marine fuel, a dedicated sub-group examining these aspects in a more integrated manner was established under the European Sustainable Shipping Forum (ESSF).

1.1 Objectives

The Objectives, throughout all the meetings held, for the ESSF LNG were:

1. To address the absence of common guidelines, standards and rules for the distribution, bunkering and use (handling) of LNG for ships. The analysis shall in particular look into safety, operational, technical, and training requirements and recommend where common EU- wide guidelines, standards or rules would be justified.

2. To address the main barriers (especially market barriers, LNG availability, the permit and the building of infrastructure processes) that are hampering the deployment of LNG.

3. To maintain links and coordinate with other activities and initiatives in the LNG field—in order to avoid duplication as well as to gather relevant information—including the relevant IMO, IAPH, SIGTTO, SGMF and ISO working groups, EU and national/regional feasibility, pilot projects, EU policy- and legislative initiatives, research projects etc.

4. To exchange information on on-going and planned LNG projects and to provide guidance and support for the creation of effective business cases for provision and use of LNG.

5. To enhance the public awareness with regard to the risks and benefits of LNG.
1.2 EU LNG Study

Prior to the formation of the ESSF LNG subgroup DG Move initiated a study entitled “Study on the completion of an EU framework on LNG-fuelled ships and its relevant fuel infrastructure”. This study falls within the scope of developing a regulatory framework for the use of alternative fuels in the context of the EU Directive on the deployment of alternative fuels infrastructure (Directive 2014/94/EU).

The study consists of 4 lots:
1. LOT 1: analysis and evaluation of identified gaps and of the remaining aspects for completing an EU-wide framework for marine LNG distribution, bunkering and use of LNG
2. LOT 2: creating awareness on LNG risks and opportunities
3. LOT 3: analysis of the LNG market development in the EU
4. LOT 4: explore financing opportunities, assess and develop financial mechanisms beyond the EU financial framework aiming at supporting the deployment of marine LNG technology

The scope of the study falls within the objectives of the ESSF subgroup. The subgroup has, following the approval of the 2nd ESSF plenary (in June 2014), acted as a steering committee and dissemination platform of the DG MOVE study, in particular on lot 1. The overall objective of Lot 1 is to analyse, further evaluate and propose solutions to the identified gaps and barriers on the basis of the findings of the EMSA LNG study while taking into account the:
(a) on-going work and preliminary results at the International Standardisation Organisation (ISO) and the International Maritime Organisation (IMO)
(b) work and initiatives that have been already undertaken at local and national level
(c) findings from relevant TEN-T projects

It should also identify and address the remaining issues proposing solutions for an EU-wide harmonisation (beyond local rules and procedures already in place), including safety and security aspects of LNG storage, bunkering and handling (ports/supply side and ships).

More specific objectives of Lot 1 can be found in Annex-D.

1.3 Composition

The LNG sub-group includes members drawn from:
- The European Commission (DG Move)
- The European Maritime Safety Agency (EMSA)
- Member States
- Classification Societies
- Shipbuilders/Associations
- Engine manufacturers
- Shipowners/Associations
- Ports
- Gas owners
- LNG terminal operators
- LNG Suppliers
- Environmental Non-Governmental Organisation
2. Analysis of findings

During the 6 ESSF LNG subgroup meetings, and through diverse correspondence work and discussions, the subject matter of the forum was always dealt with by its members with a high level of commitment and dedication. LNG as a fuel for shipping has been a subject of lively discussion, in particular with regards to the main barriers challenging today the uptake of this alternative fuel as a viable solution to reduce the dependence on oil fuels. Following this, the action of the ESSF LNG subgroup can be measured by:

- Submission to IMO (MSC94) for LNG Bunker Delivery Note (to be included in the IGF-Code)
- Submission to IMO (MSC94) for a Standardization of LNG bunker connectors.¹
- Work structure distribution (work packages) and related specific discussions, papers and presentations produced.
- Showcase opportunities for LNG ship/ports projects, dissemination of results and operational experience.

In total 6 LNG subgroup meetings have taken place (see Table below)

<table>
<thead>
<tr>
<th>Meeting Description</th>
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<tr>
<td>1st ESSF Plenary (Brussels, 13 December 2013)</td>
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<td>1st meeting of the sub-group on LNG (Brussels, 11 December 2013)</td>
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<td>2nd meeting of the sub-group on LNG (Brussels, 14 March 2014)</td>
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<td>2nd ESSF Plenary (26 June 2014)</td>
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<td>4th meeting of the sub-group on LNG (Brussels, 3 September 2014)</td>
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<td>5th meeting of the sub-group on LNG (Brussels, 11 December 2014)</td>
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<td>3rd ESSF Plenary (Brussels, 4 December 2014)</td>
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<td>6th meeting of the sub-group on LNG (Brussels, 27 January 2015)</td>
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<td>4th ESSF Plenary (Brussels, 16 June 2015)</td>
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2.1 Tasks

The sub-group on Marine LNG has a central role in carrying out tasks dedicated to identifying, assessing and recommending the ESSF remedial actions and possible solution to the technical, regulatory, economic and operational issues associated with the establishment of framework conditions (guidelines, standards, regulations) facilitating the promotion and implementation of LNG as marine fuel at EU level. The following tasks have been outlined

1) Contribute to the development of common, harmonized guidelines/standards approval or/and rules for marine LNG as ship fuel covering technical, operational, safety, security and training aspects for:
   a) the transfer of LNG as a fuel (bunkering)
   b) the accreditation of LNG bunkering companies
2) Address some of the market barriers hampering the deployment of marine LNG
3) Enhance public awareness benefits LNG
4) Business case
5) Collect and share information on relevant initiatives at international, regional and national level

¹ As a result from this submission to IMO ISO has been invited to develop an international standard for LNG bunkering connectors. Following this ISO 20519 “Ships and marine technology -Vessel - LNG bunkering standard” is under development
2.2 Work Structure

The sub-group has identified priorities of work (work-packages) + coordinators for that work within the remit of the 5 tasks described in the terms of reference of the subgroup (Annex-A: Table work-packages). For each of the work priorities a small group of experts was established which have shared relevant information, defined the problem scope and proposed initial recommendations. Recommendations for the subgroup have then been forwarded to the ESSF plenary sessions for further consideration and adoption.

A table with a summary of all LNG subgroup Work Packages is included in Annex-A, including main deliverables and milestones for each work folder. The following sub-chapters identify the Tasks whilst summarizing the work done and main discussion topics under each one of them.

2.3 TASK 1 - Contribute to the development of common, harmonized guidelines/standards approval or/and rules for marine LNG as ship fuel

The safety record of the maritime transport of LNG is excellent with almost no fatalities in the last 50 years. The current high level of safety needs to be ensured also in the future following a more widespread use of LNG as a fuel on board all types of ships. The group felt that harmonization between draft IGF-Code and bunker regulations will contribute to remaining the excellent safety record. Cutting corners as regards minimum safety requirements for bunkering LNG in EU ports should be avoided at all times and a common high level of safety has to be respected across the EU.

Further, as the draft IGF Code only regulates systems on ships and do not have a shore based international counter regulation the possibilities of unintended domino effects should be focused.

However, it was emphasized throughout the subgroup meetings that differences at local level cannot be avoided and that national and local regulations needs be taken into account. Moreover, a number of relevant guidance documents are already available or being developed (ISO, IAPH, SGMF, DNV/GL ...). The group agreed, from the start that, while further harmonization and closing gaps is important, it also needs to be ensured that relevant existing guidance is taken into account by all parties.

To address TASK 1, four distinct Work Packages were set up:

- WP1: standard hoses and connections
- WP2: Simultaneous bunkering while loading/unloading and/or embarking/disembarking passengers + safety distances
- WP 3: Training
- WP 4: Gas quality, heating value and CO2 reduction potential and custody transfer

2.3.1 Work package 1: standard hoses and connections

Two main issues came up during the first ESSF subgroup up in relation to the handling of hoses and the bunkering connections.

a) Handling of hoses

The handling of 'heavy' hoses and the point to which these can be handled manually (or, as of which moment these would have to be supported by a lifting appliance, e.g. crane system). Although the sub-group believes that this is a matter of concern for all types of
bunkering, the specific safety concerns related to bunkering of LNG makes that the possible risks related to hose handling will have to be minimized.

b) Standard connectors

Especially ship owners stressed the importance of setting out a standard. The group agreed that there should be a clear recommendation from the sub-group to the ESSF Plenary in favour of standard LNG bunkering connector. The basic principle for an open standard LNG quick connector is that the agreed geometry can be used by any manufacturer in their fabrication of connectors and that it can be used by any end-user.

This would facilitate LNG bunkering operations for ship owners and for gas suppliers.

This would increase safety by avoiding the use of any connector that has not been designed for the safe connection of cryogenic gasses.

It would also avoid protected company standards and prevent the safety risk of fitting additional adaptors and gaskets to convert between the various company standards.

A standard connector would further avoid the temptation of modifying/repairing adaptors without having the right equipment available, and it could secure more conformity in operations and training for all personnel involved in LNG bunkering.

During the 3rd ESSF subgroup the coordinator presented to the sub-group the report to the 2nd ESSF plenary on a standard bunker connector, including the flowchart for selecting the most appropriate connector which was not included in the final paper. The paper submitted to the 2nd plenary, recommending a submission on a standard bunker connector to the IMO can be found in Annex C.

Following an incident during the bunkering of the Bergensfjord ferry from Fjordline in May 2014 the draft submission to the IMO was updated. Based on the uncertainty concerning the robustness of the connector used in the accident it was agreed that it would be wise to change the draft IMO submission to focus on functional requirements for a connector. It was further mentioned that the ESSF recommendation to IMO could in fact contain a request to ISO to develop the appropriate standard, which will in any case take quite some time. During several meeting the sub-group discussed the finalization of the submission to MSC 94 (October 2014) regarding standard connectors to be used at bunkering stations, and preferably to be developed by ISO. A paper was finally submitted by Denmark, Italy and Norway (see Annex). At MSC 94, ISO expressed its readiness to publish an implementing standard. It was decided that the subgroup should closely following up ISO work on this (keeping in mind the entry into force of the IGF-code). In January 2015 following the request from IMO, ISO Technical Committee 8 (TC8) Working Group 8 (WG8) was established to develop a new ISO standard. The work on standard connectors developed by ESSF is one of the key inputs to this new ISO standard.

Some issues were identified which remained opened:

- The role of ports and whether or not they will allow methane releases or not will determine possible solutions. Ship owners stressed the usefulness of a common/harmonized approach. In Norway and in the DNV/GL Recommended Practices methane releases are either not allowed or will have to be reduced to an absolute minimum. On the other hand the draft IGF Code does not oblige inerting of the ship bunkering system for every bunkering operation
- The issue of the mandatory use of cranes (supporting systems) for hoses as from a certain weight
2.3.2 Work package 2: Simultaneous bunkering while loading/unloading and/or embarking/dismounting passengers + safety distances

Especially from a ship owner point of view it is crucial that bunkering procedures should be uniform as much as possible in different ports, preferably globally, but at least in the EU. The key question in this regards is how to ensure that all EU ports maintain an equally high level of safety while not compromising the commercial interests. Two topics were identified in this regard, simultaneous bunkering operations (SIMPOPS) and safety distances. Both topics fall under one WP as they are closely interlinked.

a) SIMOPS

It was emphasized that more guidance on simultaneous bunkering operations would be useful, specified for different ship types (i.e. containerships, passenger vessels, RO-PAX with open cargo holds, etc. and ship sizes). Open questions included whether cargo operations should take place at a certain minimum distance from the bunkering operation; how to deal with embarking trucks or passengers compared to loading containers (what if containers are accidentally dropped during loading/unloading), should bunkering stations be moved from the middle of the deck to the back of the ship, etc. The role of terminal operators in this respect was also mentioned as crucial.

It was acknowledged by the group that local conditions largely define the LNG bunkering procedure, which makes it difficult to have a standardized approach for simultaneous bunkering procedures. Even if the same parameters for the risk assessment are used, local conditions (e.g. distance of passing vessels) may lead to different outcomes. Despite these local conditions, the group recognized the need to have uniform procedures for SIMOPS as much as possible.

The biggest concern of the sub-group is the rather limited scope of instructions for carrying out a Risk Assessment for simultaneous operations in the ISO Technical Specifications (on LNG bunkering ISO/TS 18683). Different outcomes are possible depending on how the QRA is being conducted, and the sub-group therefore agreed that further guidance on this could be useful.

The outcome of the risk assessment may be different depending on whether it is done based on a ‘deterministic approach’ or the ‘probabilistic approach’. There seemed to be a preference in the group for using the ‘deterministic approach’. The general absence of useful statistics about LNG bunkering incidents to properly calculate what can happen was also mentioned. The European Marine Casualty Information Platform (EMCIP) developed by EMSA might be helpful in this regard.

During the 6th subgroup the co-ordinator of Lot 1 of the DG Move study recommended in a presentation on the draft outcome that a common and clear approach in guidelines to address SIMOPS in a risk assessment should be based on the following principles:

- The LNG operation without taking into account SIMOPS
- The LNG operation with SIMOPS and defining mitigation measures

b) Safety Distances

As regards safety distances, two main calculation methods exist: a) determining the safety distance based on ‘frequency’ and ‘consequence’ as described in the ISO/TS 18683 QRA which will provide some probabilities, or b) a deterministic approach. Following the deterministic approach, the possible spill will be very low; the distance can also remain short (which is for instance the case for the bunkering of the Viking Grace). However,
probabilistic distances are often even shorter than deterministic ones, with the distance obtained by deterministic approach largely depending on what is selected as a credible scenario. Although the two methods will give significant different results, no clear preference for a certain approach was expressed, with Members requesting further guidance on which method to use in and with DNV-GL, as a result of LOT1 work, suggesting that the methods proposed by ISO/TS 18683 give sufficient clarification, with the possibility to further specify fixed safety distances for standard configurations.

New work item under Work package 2 has been considered as a result from later discussions within the LNG subgroup (5\textsuperscript{th} and 6\textsuperscript{th} meetings). The main addition to the work discussions has indeed been the need for specific guidance on the subject of LNG bunkering. A key contribution to the onset of discussions has been Fjordline's presentation (at the 5\textsuperscript{th} meeting) regarding the MS Bergensfjord ferry bunkering incident. A list of key technical aspects were discussed, especially with regards to the positioning of the LNG hose, break-away procedures, hose hanging crane and monitoring/communication aspects during the bunker operations. In general the discussion was centred in the need for bunkering guidance that could assist both harmonization of procedures and specifications. The need for specific EU LNG Bunkering Guidelines has been discussed. It was agreed that this work should be coordinated by DNV-GL (LOT1) and the rapporteur and that the work should be based on the existing guidelines developed/in development (IACS, SGMF, and IAPH).

2.3.3 Work package 3: Training

Adequate training of staff that will deal with LNG was emphasized throughout the subgroup meetings. The Commission/EMSA followed up and informed the ESSF subgroup on the status of the work on training for LNG fuelled vessels in the context of STCW and also who participated in the relevant IMO Correspondence Group. All members of the sub-group were invited to send specific concerns related to training to the Commission and/or EMSA.

For the time being the draft ISO Technical Specifications remain quite open as to the extent staff needs to be trained. Discussions took place regarding the length of an appropriate training course, who designs and approves the training course, who is the responsible for the training course (the bunkering company, the port authority), and to what extent the receiving ship and the bunkering company will be ‘paired’ to each other.

An example of different training requirements for different categories of staff was presented. IMO seems to be exploring two different levels of training requirements (while ISO and IGF mention 3 levels), but progress moves very slowly\(^2\). It was recognized that as long as there is no finalized IGF Code, it will be difficult for IMO to define the exact training requirements and the group highlighted the slow progress in IMO on this particular issue as a considerable problem.

The sub-group recognized that defining potential training requirements will not be so much of a problem for the personnel on board of LNG fuelled vessels, but defining appropriate training requirements is more relevant for the wider port area and all the

\(^2\) STCW amendments (and interim training guidelines STCW.7/Circ.23) were approved at MSC 94. the IGF training requirements have been stripped out of its latest version. This has however not been thoroughly addressed nor any conclusions drawn during the sub-group discussions.
involved actors on the land side where still some work needs to be done. The sub-group agreed that it is important to ensure that all ports have adequate training requirements in place. This has also been discussed in the IAPH (International Association of Ports and Harbours), but so far no clear guidelines have been issued about how to integrate training requirements into the general port rules. It was stressed for instance that the Viking Grace and its bunkering vessel Sea Gas were designed for compatibility. However, once bunker vessels will start serving different vessels also the training requirements will have to become more generic.

Following extensive discussion at the 4th subgroup the group requested the contractor for Lot 1 of the LNG study to analyse possible training requirements for the wider port area in their study.

2.3.4 Work package 4: Gas quality, heating value and CO2 reduction potential and custody transfer.

2.3.4.1 LNG Bunker delivery note

During the 1st subgroup ship owners raised the importance of the gas quality in relation to gas-fuelled engines. More specifically the allowable range for the methane number was a heavy topic of discussion. It was mentioned by the molecule owners that it is difficult to achieve a standard gas quality since the characteristics of the gas are determined by its origin and can change over time. It was mentioned that there is a mixing of LNG in terminals which may affect the methane number of the LNG over which gas providers do not always have control. Furthermore also the vaporisation process on-board, mixing of bunkered LNG with existing tank contents, aging (non-use) of the bunkered LNG and distance between the tank and the engine (which on large ships may be quite substantial), may affect the methane number. What is important is the final quality of the gas arriving the engine, with the changes in the calculated methane number as the result of the changing composition due to different modes of operation (use of boil off gas or LNG) and during gas processing.

Nonetheless, the group decided that it could be useful to have at least a certain minimum gas quality and/or a range of allowable methane number. The draft ISO Technical Specifications already contains a standard bunker delivery note. Ship owners stressed that this should also be integrated into the relevant developments at IMO (IGF Code).

The coordinator of WP4 presented the submission on a standard LNG bunker delivery note (BDN) during the 3rd subgroup, highlighting that a standard LNG BDN is necessary for safety purposes (The paper submitted to the 2nd plenary, recommending a submission on an LNG Bunker delivery note to the IMO can be found in Annex). A paper was finally submitted by Belgium, Italy and Norway (see Annex). It was decided at MSC 94 that an LNG BDN will be part to the Annex of the IGF code.

2.3.4.2 Gas Quality

Presentations on Methane Number and, more generally, standards for LNG as marine fuel were made throughout the LNG subgroup meetings, however different positions have been identified during the discussions.

At the point of the present report the LNG subgroup has decided not to promote inclusion of marine LNG fuel into developing standards so as to allow experience to be
gained from experience with different available LNG compositions in the market of LNG as a shipping fuel.

Previous Plenary meeting had endorsed this subgroup willingness to continue pursuing the minimum methane number and, at this stage, further clarity is yet to be explored on this topic.

DG-ENER has provided the LNG subgroup with the latest developments in CEN regarding development of standard gas quality (EN-16726 Gas infrastructure — Quality of gas — Group H). The final CEN meeting ahead of the vote on the H-Gas standard decided - upon proposal of the EC - to remove the Wobbe Index from the parameters of the standard as 1) there was no agreement in sight; 2) there were no clear problems yet from lack of harmonization and 3) to safeguard the other parameters and the standard itself where agreements could be reached.

“Safety” versus “Availability” of LNG fuel has been a continuous topic of discussion and, even if standardizing marine LNG Gas Quality/Composition has opposed by the subgroup, the LNG Bunker Delivery Note was underlined as a key proof of the contracted quality of LNG as fuel, serving, even if to a limited extent, as the reference to the quality/composition of LNG fuel.

2.3.4.3 CO2 reduction potential

The need to have some more precise figures about the emission reduction potential of LNG (for all emissions, including SOx, NOx, PM and CO2) was also highlighted. Various figures seem to be circulating and the group should work on a better overview of the most recent and correct figures.

The coordinator of WP4 presented the submission on gas quality, heating value and Sulphur & CO2 reduction potential during the 3rd subgroup recommending the Plenary to take note of the CO2 reduction and overall greenhouse gas (incl. methane) reduction potential in addition to the almost absolute absence of sulphur emissions as well as other merits of LNG as an alternative marine fuel in comparison to marine diesel.

2.4 TASKS 2 and 4 - Address some of the market barriers hampering the deployment of marine LNG and Business Case

The price of LNG at delivery, the availability of appropriate bunkering infrastructure, and the very high CAPEX to build an LNG fuelled ship (especially the price of tanks) was stated as the largest concern for ship owners' business cases for switching to LNG as marine fuel. It was mentioned that so far, all LNG fuelled ships in Europe have been subsidized through specific funds (In Norway through the NOx Fund – financed by the industry). The current LNG price in the EU, especially when compared to the US or compared with the price of low sulphur fuel and scrubbers is only in very specific cases attractive to ship owners.

The need for a sufficient number of re-fuelling points (truck, barges) available in EU ports was emphasized. The length of the overall LNG supply chain (from the import terminal to the bunkering location) was mentioned as a vital factor determining distribution costs that are added to the price of the LNG at the quay. The further away from the hub, the higher the price of LNG will become.
Through public support for re-fuelling infrastructure the distribution costs could be decreased. However, the sub-group also mentioned that subsidies for re-fuelling infrastructure are expected to have a small impact on the price of LNG at the quay. The biggest impact could be made when focusing on strategic ports and also on mobile LNG bunkering infrastructure. The biggest positive factor to develop LNG as a widely used alternative, is the availability of cheap gas (as is the case already in Norway (despite the NOx tax) and in the US).

While some success stories with TEN-T financing were expressed (notably for re-fuelling infrastructure in ports), the TEN-T funding mechanism was found rather rigid (mainly by shipowners) for the possible financing of LNG fuelled ships. TEN-T funding seems to be too directed to infrastructure, without having a significant impact on the price of the LNG for the potential users. I was also stressed that there should be more focus on mobile and floating infrastructure (e.g. bunker vessels).

Lot 3 of the DG Move study was granted to the consortium of TNO, NEN and FleishmanHillard and aims to provide a market overview and estimations on LNG, and to assess the hindrances that prevent a quick, gradual deployment of LNG as a bunker fuel. In order to carry out these tasks the Lot will provide an analysis of the LNG bunkering fuel market and analyse the cost-structure of LNG fuelled ships. It foresees to discuss and validate the results from the cost-benefit analyses with all the industry stakeholders including those of the LNG sub-group.

The members of the sub-group mentioned that they would like to be closely involved in the implementation of this Lot as well. Even though the group has so far focused mainly on regulatory and safety issues, the costs aspects are crucial for many of the members to decide on whether to proceed with investment decisions. Therefore the outcome of Lot 3 should be discussed in the LNG sub-group besides also the ESSF Financing subgroup.

2.5 TASK 3 - Enhance public awareness on the benefits of LNG

During the 4th ESSF subgroup the coordinator of Lot 2 (Creating awareness on LNG risks and Opportunities) from PWC and DNV-GL in cooperation with the communication agency MSL Group presented the draft results of a survey. Lot 2 focuses more on the public perception of LNG as an alternative fuel and should identify the reasons behind the negative public perception of the dangers of using LNG as a fuel and will focus on developing informative materials on LNG and information campaigns.

2.6 TASK 5 - Collect and share information on relevant initiatives at international, regional and national level

Throughout the LNG subgroup meetings initiatives at all levels were presented which mainly contributed to the further development of LNG as fuel for shipping.

IMO discussions regarding the finalization of the IGF Code were presented to the subgroup, usually as a summary from MSC and MEPC committees and CCC, SDC sub-committees. EMSA has delivered presentations on the outcome of main IGF Working Group discussions, including the feedback from the two submissions by the LNG subgroup, both on LNG standard bunker connectors and LNG Bunker Delivery Note.
Also at the international level the work of i.e. SIGTTO, SGMF, ISO, IACS and IAPH on regulatory issues related to task 1 were presented, focusing mainly on the development of the regulatory and standardization frameworks. This allowed the subgroup to set the foundation for the possible further development of EU initiatives related to Task 1, namely LNG bunkering guidelines.

At EU level the main initiatives presented referred to regulatory and LNG research funding aspects, including the work undertaken under the study “Study on the completion of an EU framework on LNG-fuelled ships and its relevant fuel infrastructure”, both on LOT1 and LOT2 of the four lots project. Dissemination and discussion on the outcome of LOTs 3 and 4 could be expected if future LNG subgroup meetings take place. On the EU regulatory frame, apart from the Sulphur Directive and relevant Commission Decisions, also the Directive on Deployment of Alternative Fuels Infrastructure (Directive 2014/94/EU) was presented and object of debate. Additionally, an overview of EU-funded projects, with focus on LNG, was presented and discussed.

At the national level, the representative of France presented a matrix providing a quick overview of the requirements for people involved in LNG terminals, LNG fuel stations, ports, maritime transport, inland waterways transport and road transport. At a second stage, the objective is to identify the gaps, the possible overlaps and conflicts of various regulations in the European legislation. The final objective is to improve the safety of the use of LNG as a fuel by waterborne and road transports by qualified persons, whatever their status (crews, drivers, onshore operators), in the whole logistic chain.

At the regional level presentations were e.g. made by the port of Antwerp and Rotterdam on their bunkering guidelines (based on the draft guidelines from IAPH).

3. Summary

In line with the above, the work of the LNG subgroup can be summarized as an active initiative to complement IMO’s development of the IGF Code and other international bodies’ work, by addressing specific issues regarding the feasibility, attractiveness and potential barriers to LNG as fuel for shipping, whether they would be of a more technological or regulatory nature. LNG bunkering has been, throughout the meetings held, one of the key topics discussed. Outside the scope of IMO work, the ship-shore interface was dealt with by the LNG subgroup with a particular focus on the identification of gaps, technological, procedural or regulatory, and on the discussion and scoping of possible EU LNG bunkering guidelines, to be developed as a continuation of this subgroup activity.

Given the regulatory, technical, operational, and economic challenges, hampering the deployment and use of LNG as marine fuel, the LNG subgroup has examined these aspects in a more integrated manner. The LNG subgroup has identified 6 work packages, 4 related to harmonization/standardization of EU bunkering guidelines and 2 related to economic factors (market barriers, business cases).

The Work Structure that has been setup from the beginning has favoured a holistic approach to LNG as an alternative fuel for shipping, with the diversity of stakeholders involved providing a multiplicity of views that enriched the discussions. Where the IGF Code, under finalization, has left room for complementary work, the LNG subgroup has taken the opportunity in order to address important aspects of the Ship-Shore interface, in particular during LNG bunkering operations. Two successful submissions to IMO have underlined the relevance of the LNG subgroup in shaping its particular international regulatory framework.
On the four work packages dedicated to the harmonization/standardization of EU bunkering, the LNG subgroup work has resulted in:

1. **LNG Bunker Delivery Note**, with a submission for inclusion of such document within the draft IGF Code, now under finalization at IMO, approved in principle, with a view to adoption at MSC95 and entry into force in 1 January 2017. The impact of the LNG Bunker Delivery Note is expected to be very significant, especially where discussions on Gas Quality have been so far inconclusive. To a certain extent we can consider the BDN to be an instrument favouring “contracted Gas Quality” and, therefore, filling partially the gap left by a lack of international standard for LNG gas quality/composition.

2. **Standard LNG Bunker connectors**, with a submission to IMO which is now addressed to ISO for the development of an International Standard. Safety and harmonization of procedures are expected to be significantly optimized as a result from the development of such standards. Both IGF Code and future LNG bunkering guidelines will be able to have this as a reference to regulation.

3. **Active steering of the EU LNG Project “Study on the completion of an EU framework on LNG-fuelled ships and its relevant fuel infrastructure”,** in particular with regards to LOT1, where subjects related to different Work Packages were dealt with, namely SIMOP’s, Training, LNG Risk & Safety aspects, amongst others. LOT1 work has identified important gaps and drafted recommendations/solutions. By the time the present report comes to a closure the impact analysis from implementation of different recommendations is being finalized.

4. **Request to the Plenary**

The LNG sub-group requests that the ESSF Plenary to note and endorse this report. Further, the sub-group requests that the ESSF Plenary approves:

- That the LNG sub-group remains active continuing its work beyond June 2015 and further into 2016, subject to confirmation of extension of mandate for the ESSF. The significant number of LNG related initiatives, discussion forums, new projects and technological solutions, expected intensification of operational activity, underline the relevance of the LNG subgroup, in particular of its structure where the main players of the LNG business, as a fuel for shipping, coexist.

- That the sub-group continues to develop its work in the particular subjects where open issues are still left:
  - **Bunkering Guidelines**, with the need to compile, analyse and evaluate the existing LNG bunkering related guidance instruments, aiming at possibly drafting of EU Guidance on LNG Bunkering, covering Safety, Training, Gas quality aspects, Ship-Supplier commercial relation, Procedural/Operational aspects, Certification and Standardization. Different documents have been developed regarding LNG Bunkering, and others are still under development. The LNG subgroup would here play an important role in identifying and bridging the gaps between the relevant initiatives and, possibly, creating specific EU harmonized guidelines.
  - **Training**, where the definition of a harmonized approach, including both ship and shore aspects, is still required. The LNG Bunkering Guidelines are expected to play an important role in the edification of training requirements and on the
envisaged and necessary harmonization. The LNG sub-group would continue the work on determining appropriate minimum training requirements especially for persons in the wider port area, including terminals, which will at some point be confronted with LNG. When keeping in mind that more ship types are starting to use LNG (container, break bulk,...) staff at non gas dedicated terminals will have to be trained and informed to have a minimal knowledge of LNG properties and behaviour.

- To follow up on recommendations from the EU LNG “Study on the completion of an EU framework on LNG-fuelled ships and its relevant fuel infrastructure”, in particular regarding LOT1 (Analysis and evaluation of identified gaps and of the remaining aspects for completing an EU-wide framework for marine LNG distribution, bunkering and use). The study is expected to deliver a significant number of recommendations, when addressing the gaps identified by EMISA’s 2012 LNG Study. Only by being able to follow up on these recommendations, discussing them and drafting operational solutions it can be possible to optimize the investment in such a study. The emerging need for regulatory development goes here in parallel with the continuous awareness that Risk & Safety is a key aspect in the business uptake for LNG as an alternative fuel. The LNG subgroup, due to the expertise of its members, would play a key role in taking LOT1 recommendations further, towards planning and facilitating implementation.

- To follow up on IMO submissions, both on LNG Bunker Delivery Note and Standard LNG Bunker Connectors. The first even if agreed to be part of the draft IGF Code can still be subject to modifications. The LNG subgroup would be the relevant forum to discuss these. With regards to the second, ISO has welcomed the work for development of an International Standard on LNG bunker connectors. These are to be finalized prior to entry into force of the IGF Code (expected to 1st January 2017) and the technical work is now underway in the relevant ISO group. The ESSF LNG would follow up on the relevant outcomes from ISO work, being available to complement on the relevant technical information. ISO will establish a working group on “Specifications for LNG as marine fuel” and the ESSF LNG sub-group may also provide input and should keep an active exchange with this upcoming ISO working group.

- To continue discussions and work with regards to methane release. The impact of methane as a relevant GHG emission (20 times worse than CO2) is here seen by the LNG subgroup as an important topic that needs further discussion and ideas for Risk mitigation. The very important environmental benefits of LNG as an alternative fuel shall not be hampered by the more negative side of methane as a GHG. Methane emissions can occur in different situations, resulting from Methane Slip (emission of non-combusted gas in the engine cycle), venting release or bunkering incidents. The LNG subgroup would here play an important role in proposing, together or along with the LNG bunkering guidelines, a possible methane release management/mitigation plan, with the goal of “zero-methane emission” operations as a continuous research driver to optimize engine technology.

- To continue discussion on Simultaneous Operations (SIMOPS). For many commercial shipping operations, to make LNG a truly feasible alternative fuel, the need to be able to bunker LNG safely whilst undertaking cargo and passenger operations is essential and will draw a parallel with current oil bunkering. The LNG subgroup can support the identification of hazards associated with undertaking SIMOPS, development of credible release scenarios for input into QRAs, provide clarity on the expected process a QRA should follow and harmonised practical risk acceptance criteria.
To link the ESSF work with the Sustainable Transport Forum (STF), dealing with the deployment of alternative fuels infrastructure, following the adoption of Directive 2014/94/EU. In order to avoid duplication of work, the STF will not deal with maritime issues, which will continue to be dealt with by the ESSF. Appropriate links shall be established to serve as channels for exchange of information between the ESSF and the STF. The ESSF LNG subgroup would be able to contribute with aspects specifically related to shipping by:

- providing advice and technical expertise on the development and implementation of legislation, policies, projects and programmes in the specific area of LNG as an alternative fuel for shipping
- facilitating exchanges of information on initiatives, projects and partnerships dealing with LNG as fuel for shipping
- delivering opinions, submitting reports, or developing and proposing innovative solutions, liaising with the two identified groups in the particular aspects of LNG fuelled shipping

To promote information dissemination of LNG shipping EU co-funded projects, acting as a preferred showcase platform for discussion on the outcomes of studies and implementation works financed under TEN-T, Motorways of the Sea or similar funding program supporting clean transport solutions and LNG sustainable shipping initiatives. Furthermore, difficulties and barriers to particular projects could be presented and discussed, promoting the continuous development of new technological solutions favouring LNG overall risk, both on investment and in safety.
ANNEXES

A. Work Packages progress table ESSF LNG subgroup - updated 11 May 2015

B. Submission to IMO – Standard Bunker Delivery Note

C. Submission to IMO – Standard LNG Bunker Connectors.

D. Topics from preliminary presentation from EU LNG Project “Study on the completion of an EU framework on LNG-fuelled ships and its relevant fuel infrastructure”
ANNEX-A

Work packages Table – ESSF LNG Subgroup
<table>
<thead>
<tr>
<th>Agenda Item</th>
<th>WP</th>
<th>Work-Package Title</th>
<th>Coordinator(s)</th>
<th>Members</th>
<th>Expected Delivery + Deadline</th>
<th>Milestones</th>
</tr>
</thead>
</table>
|             | 1  | Hoses and connections | Norway         | Shell, SIGTTO, Classificatio societies | Follow-up with ISO on the LNG Bunker Connectors standard development (following from IMO submission) | Approach ISO with initial contact.  
> Christophe Erhel as Point of Contact to submit information to ISO. |
|             | 2a | Simultaneous bunkering while loading/unloading cargo and/or embarking/disembarking passengers | RBSA/EMSA | Lot 1 DG MOVE LNG tender | Enhanced focus on quantitative risk assessments for simultaneous operations (SIMOPS)  
> Determine effective prohibition of methane releases in ports during bunkering | All topics under Work package 2 are within the scope of the EU LNG Study (LOT1). Preliminary results have been presented to the LNG subgroup.  
> Discussions have served to integrate the results and to steer the Study, in collaboration with the EC/EMSA.  
> Different initiatives on drafting of LNG Bunkering guidance have been presented and discussed. Has been decided to wait until all these (SGMF, IACS) could be analysed, possible gaps identified and thoroughly discussed.  
> Initiative to draft EU LNG Bunkering Guidelines as a function of existing guidance evaluation. |
|             | 2b | Safety distances | Port of Rotterdam, Stockholm, VDR, Shell, Norway | | Effort to harmonize quantitative risk assessments for simultaneous operations (SIMOPS) | |
|             | 2c | Bunkering Guidelines | Port of Rotterdam, Stockholm, VDR, Shell, Norway | | Development of Harmonized EU Guidelines for LNG Bunkering | |
|             | 3  | Training | EC/EMSA | Port of Rotterdam, Stockholm, VDR, Shell, Norway | Continuing discussion on Issue papers with differentiated approaches for the port side and the ship side. | SGMF guidelines “Gas as a marine fuel – safety guidelines” have been presented and discussed  
> Issue paper from Ports of Stockholm and Rotterdam for continuous discussion  
> Training on LNG as fuel, for the wider port area, is a continuous and necessary point of discussion, addressing especially the challenges posed in the ship-shore interface. |
|             | 4a | Gas quality, heating value and CO2 reduction potential | VDR | | Continue discussions in 4th LNG subgroup (3 September on on-going work of the CEN/EN + ISO regarding gas quality | Extensive discussion have taken place about the GHG reduction potential, setting of the methane number + methane calculation method  
> LNG Bunker Delivery Note regarded as a minimum gas quality/composition contract, serving the interest of shipping. |
|             | 4b | Standard bunker delivery note | Port of Rotterdam, Stockholm, VDR, Shell, Norway | | LNG Bunker Delivery Note in the IGF Code – Adoption of the Code in MSC95 – June’15 | |
|             | 5  | EU co-financed projects and their objectives | EC/EMSA | EU funded LNG related projects – overview of R&D TEN-T programs | | Update on different LNG related R&D projects.  
> EU co-funded projects, on LNG sustainable shipping, have been presented at 6th session.  
> Value of the LNG subgroup as a showcase platform for dissemination of EU funded project results has been demonstrated. |
|             | 6  | LNG pricing | EC/EMSA | Lot 3 DG MOVE LNG tender | To be followed-up by the DG MOVE consultants | LOT3 awarded to CE-Delft – Kick off meeting in 17FEB. No update yet. |
ANNEX-B

Submission to IMO

MSC 94-11-1 - Defining a standard LNG Bunker Delivery Note and standards of gas quality (Belgium, Italy and Norway)
SUMMARY

Executive summary: This document follows the discussion on the development of the IGF Code. In order to enhance safety when bunkering and using LNG as a fuel, this submission proposes the development of a standard format for an LNG Bunker Delivery Note and parameters to define gas specifications at delivery.

Strategic direction: 5.2

High-level action: 5.2.1

Planned output: 5.2.1.2

Action to be taken: Paragraph 14

Related documents: MSC.285(86); MSC 93/INF.8 and CCC 1/WP.3, annex 2

Introduction

1 Recalling discussions at MSC 93 where document MSC 93/INF.8 (ICS and IPTA) was considered in the context of traditional liquid hydrocarbon fuels, the seriousness of potential safety problems arising from the supply of "out of specification" marine fuels was recognized by MSC and it was also understood that MSC should coordinate with MEPC to consider this issue further with respect to ship safety as well as environmental and health issues.

2 With regard to the development of the IGF Code, while the draft IGF Code (see annex 2 to document CCC 1/WP.3) provides, inter alia, criteria for the arrangement and installation of machinery, equipment and systems for vessels operating with LNG, the co-sponsors of this document believe that minimum international requirements on the gas delivered will enhance a wider and safe application of LNG as fuel.

3 This could be achieved by developing a standard bunker delivery note (BDN) for LNG deliveries and by further defining an appropriate calculation method and an operationally safe range for the methane number that would ensure safe use of the current and planned LNG infrastructure on board vessels.
4 The specifications of the gas supplied may have a significant influence on ship safety. The parameters of the LNG provided (including its methane number) and the required specification for the engines on board must be compatible. Furthermore, in combination with the installed tank volume, the energy content of the LNG supplied, expressed as Lower Heating Value (LHV), will limit the total energy available on board for propulsion and auxiliary power.

5 Therefore, it is essential that the master has access to accurate information on the LNG composition which should be made available by the LNG supplier at every LNG bunkering operation, and the proposed BDN could be the means to provide this information in a common format. The availability of a standard BDN would facilitate harmonized global procedures and be beneficial to ship safety and consistency of onboard records.

6 The co-sponsors propose to amend section 18.4 in the draft IGF Code by inserting a reference to an annex (x), which defines the standard LNG Bunker Delivery Note and the particulars thereof (see annex).

7 This issue has also been considered in the European Sustainable Shipping Forum (ESSF), which includes a dedicated sub-group on LNG with representatives from the industry and several EU Member States.

Background

8 The Interim Guidelines on safety for natural gas-fuelled engine installations in ships (resolution MSC.285(86)), adopted on 1 June 2009, has already anticipated this issue by stating: "The gas composition can vary depending on the source of natural gas and the processing of the gas."

9 In the course of transport, storage and transhipment the characteristics of LNG may change due to mixing of LNG of different origins in terminal storage tanks. The boil-off rate and duration from the individual tanks can also have an influence on the LNG composition and characteristics.

10 In order to facilitate documentation and comparison of LNG specifications it is important to, first of all, have a standard list of parameters. The following standards provide useful examples:

   • Definition of properties of natural gas
   • Natural gas definition
   • Properties of LNG
   • Wobbe Index

11 As variance in heating values (paragraph 9), in the case of LNG, is approximately 16% between different sources of LNG, it may not be appropriate for LNG to be supplied on a mass basis only (as per the current practice for conventional liquid bunker fuels) while ignoring other important parameters such as energy content which will have an effect on the safe operational range of ships.

12 In case the chosen approach were to use Coriolis mass flow meters for parcel allocation, then the mass of LNG transferred/received will form the basis for the energy transferred/received calculations using also the calorific value of the LNG parcel. If this approach is taken, the LNG density would not be strictly necessary on the LNG BDN. However, there are also ultrasonic volumetric flow meters in use in the LNG trade and in this case the LNG density would be required, since the LNG density and volume would be used together with the LNG calorific value to calculate the energy content of LNG transferred/received.
13 The term "liquid delivery" in the draft BDN shall describe the amount of energy delivered to the ship during the whole process; that means the LNG sent to the ship. Calculation of the total energy content of the fuel supplied should take, to the extent that this can be measured, account of energy lost because of gas returned via the vapour return line during bunkering.

**Action requested of the Committee**

14 The Committee is invited to consider the comments and proposals in paragraphs 3 to 7 above and take action as appropriate.
**ANNEX**

LNG-BUNKER DELIVERY NOTE**

LNG AS FUEL FOR

LNG-Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methane number</td>
<td></td>
</tr>
<tr>
<td>Lower calorific (heating) value</td>
<td>MJ/kg</td>
</tr>
<tr>
<td>Higher calorific (heating) value</td>
<td>MJ/kg</td>
</tr>
<tr>
<td>Wobbe Indices $W_s / W_i$</td>
<td>MJ/m³</td>
</tr>
<tr>
<td>Density</td>
<td>kg/m³</td>
</tr>
<tr>
<td>Pressure</td>
<td>bar (abs)</td>
</tr>
<tr>
<td>LNG temperature delivered</td>
<td>°C</td>
</tr>
<tr>
<td>LNG temperature in storage tank(s)</td>
<td>°C</td>
</tr>
<tr>
<td>Pressure in storage tank(s)</td>
<td>bar (abs)</td>
</tr>
</tbody>
</table>

2. LNG-Composition

<table>
<thead>
<tr>
<th>Component</th>
<th>% (kg/kg) /mol%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methane, CH₄</td>
<td></td>
</tr>
<tr>
<td>Ethane, C₂H₆</td>
<td></td>
</tr>
<tr>
<td>Propane, CH₃</td>
<td></td>
</tr>
<tr>
<td>Isobutane, C₃H₈</td>
<td></td>
</tr>
<tr>
<td>N-Butane, n C₄H₁₀</td>
<td></td>
</tr>
<tr>
<td>Pentane, C₅H₁₂</td>
<td></td>
</tr>
<tr>
<td>Hexane, C₆H₁₄</td>
<td></td>
</tr>
<tr>
<td>Heptane, C₇H₁₈</td>
<td></td>
</tr>
<tr>
<td>Nitrogen, N₂</td>
<td></td>
</tr>
<tr>
<td>[No] negligible &lt;5ppm</td>
<td></td>
</tr>
<tr>
<td>H₂S, hydrogen, ammonia, chlorine, fluorine, water</td>
<td></td>
</tr>
</tbody>
</table>

3. Total delivered: t. MJ m³

4. Signature(s):

Supplier Company Name, address and telephone number: ________________________________

Signature: ____________________ Place / date: __________________________

Bunkering Company Name: ________________________________

The LNG properties and composition allow the operator to act in accordance with the known properties of the gas and any operational limitations linked to that.

Preferably above 70 and referring to the used methane number calculation method in DIN EN 16726. This does not necessarily reflect the methane number that goes into the engine.
ANNEX-C

Submission to IMO

MSC 94-11-2 - Standards for connectors to be used at bunkering stations for LNG for inclusion in the draft IGF Code (Denmark, Finland, Italy and Norway)
CARRIAGE OF CARGOES AND CONTAINERS

Standards for connectors to be used at bunkering stations for LNG for inclusion in the draft IGF Code

Submitted by Denmark, Finland, Italy and Norway

SUMMARY

Executive summary: To enhance safety in conjunction with bunkering of LNG this document proposes standards for connectors to be used at the bunkering manifold (draft IGF Code, section 8.4 - Regulations for manifold)

Strategic direction: 5.2

High-level action: 5.2.1

Planned output: 5.2.1.2

Action to be taken: Paragraph 17

Related documents: BLG 17/8/1 and CCC 1/WP.3

Introduction

1 The Sub-Committee on Carriage of Cargoes and Containers (CCC), at its first session, agreed on the draft IGF Code (CCC 1/WP.3, annex 2) for submission to MSC 94 for approval. Based on proposals from Finland and Norway, the outcome of round 3 discussions of the IGF Correspondence Group established by BLG 17, as reported in document BLG 17/8/1, resulted in requirements for bunker manifold in paragraph 8.4.1 of the draft IGF Code that included provisions for the generics of the connections located in the bunkering manifold.

2 Paragraph 8.4.1 of the draft Code specifies that: "The bunkering manifold shall be designed to withstand the external loads during bunkering. The connections at the bunkering station shall be of dry-disconnect type equipped with additional safety dry break-away coupling/self-sealing quick release. The couplings shall be of a standard type." However, the standard to be used is not indicated.

3 Following up on the issue of relevant standards to be accepted and the intention to enhance safety of bunkering operation, the matter has been brought into the development of the ISO 118683, Annex G, Guideline on bunkering, resulting in information on a standard dry disconnect male part of a LNG coupling in the guideline.
The issue has also been debated in the European Sustainable Shipping Forum (ESSF) where all aspects of sustainable shipping relevant to a cost-efficient and coherent implementation of the new rules on sculpture emissions from ships are discussed. ESSF brings together 29 states and 32 maritime organizations to enable a structured dialogue, exchange of best practices and coordination of current issues, with, among others, a dedicated subgroup on LNG.

The ESSF supports the specification of standard connectors for bunkering of LNG. Ship owners, especially, have stressed the importance of setting out such standard. The role model for the recommendation on standardization is the aviation industry and its use of standard quick dry disconnect coupling which allows for efficient and safe bunkering world-wide.

The alternative would be company standard adaptors of various designs, as has been the case historically with traditional oil-fuel bunkering. The result has been ships and bunker barges with an arsenal of adaptors. Such a situation should be avoided when handling cryogenic fuels such as LNG (-161°C), which may pose a danger for personnel and constructions.

Bolted standard flanges may be an alternative but they require manual fitting and manual retightening of 8-12 bolts at cryogenic temperatures. Any quick fix: gasket, bolts or modified adaptor unit may represent a danger, as only special materials are suitable.

A specified standard quick dry-disconnect coupling will therefore be beneficial for the safe development of LNG as a fuel in shipping. It will be cost-effective to introduce a standard at this early stage as the number of ships is relatively low. While also recognizing that some existing projects have other solutions today, it will be feasible and economical to change to an agreed IMO standard.

The advantages of standard quick connectors are as follows:

1. avoid mix-up and use of any connector designed for other fluids or gasses through the safety of a unique standard geometry;
2. allow for a quick and easy mechanical solution with efficient and safe connection specially designed for cryogenic LNG;
3. avoid company standards that will normally be protected by property rights and may be limited to contracts and brand distributors, which normally results in less competition and hamper public procurement;
4. prevent the safety risk of fitting additional adaptors and gaskets to convert between different company standards and the risk of using parts not adequate for cryogenic fluids;
5. avoid the temptation to make or modify adaptors, to fix something on short notice, with possible limited access to the right material and manufacturing equipment;
6. eliminate the need for manual bolting and manual re-tightening after down-cooling to cryogenic temperatures;
7. avoid leaks (methane slip) and problems due to uneven tightening and any accident if wrong studs have been used;
8 avoid versatility and torsion problems as the connectors have swivel features and thus torsion problems that may arise on flanges do not exist; and

9 ensure conformant operation and safety training for all personnel involved in bunkering on a world-wide basis.

10 The challenge is, however, the need for flexibility to support different bunkering methods and flow rates. For this reason two standard options are proposed.

11 Based on LNG flow rates and liquid line size, it is proposed that the following standards should be used for bunkering of marine LNG:

1. **Standard I**
   A marine LNG quick bunkering connector for bunkering rates up to 650 m³/h and pipeline size up to DN150/6"; and

2. **Standard II**
   A marine LNG remotely operated bunkering connector for bunkering rates over 650 m³/h and pipeline size over DN150/6".

**Standard I**

12 For 2" to 6" bunkering lines and flow rates up to 650 m³/h it is recommended to define a standard marine LNG quick dry-disconnect bunkering connector based on the principles for the open NATO standard for avionic fuelling. A range of dry-disconnect LNG male geometry of couplings is already presented in the ISO 118683 Annex G Guideline on bunkering. This dry-disconnect LNG connector male geometry should be evaluated according to the functional requirements.

13 Proposed functional requirements for a marine LNG quick bunkering connector:

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Marine LNG quick bunkering connector</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety</td>
<td></td>
</tr>
<tr>
<td>a. PN 16</td>
<td></td>
</tr>
<tr>
<td>b. Tested for LNG</td>
<td></td>
</tr>
<tr>
<td>c. Compatible to the standards EN 12434/EN 1474-1 and 2/EN 13768/EN 10380</td>
<td></td>
</tr>
<tr>
<td>d. Not interchangeable with connector for other liquids</td>
<td></td>
</tr>
<tr>
<td>e. Dry connect/disconnect</td>
<td></td>
</tr>
<tr>
<td>f. Swivel function to avoid torsion forces</td>
<td></td>
</tr>
<tr>
<td>g. Defined tension and stress capacity</td>
<td></td>
</tr>
<tr>
<td>h. Passive or active dry emergency release or breakaway before failure due to tension and stress. Separate equipment may be relevant</td>
<td></td>
</tr>
<tr>
<td>i. Failsafe in relation to icing</td>
<td></td>
</tr>
<tr>
<td>j. Intuitive and logic functions</td>
<td></td>
</tr>
<tr>
<td>Size and rates</td>
<td></td>
</tr>
<tr>
<td>a. Nominal sizes; 2&quot;, 2.5&quot;, 3&quot;, 4&quot; and 6&quot; for rates up to 650 m³/h and a maximum flow speed of 10 m/s.</td>
<td></td>
</tr>
</tbody>
</table>
### Operation/Operability

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>Specified operation instructions incl. any load and stress limits (tension, bending or torsion)</td>
</tr>
<tr>
<td>b.</td>
<td>Single action connection and disconnection</td>
</tr>
<tr>
<td>c.</td>
<td>Low internal flow resistance</td>
</tr>
<tr>
<td>d.</td>
<td>Specified release of LNG from a disconnection operation, if any</td>
</tr>
<tr>
<td>e.</td>
<td>Manual operation max force 300N</td>
</tr>
</tbody>
</table>

### Inspection and Maintenance

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>Easy to detect defects and unacceptable wear or tear on any critical element</td>
</tr>
<tr>
<td>b.</td>
<td>Maintenance system</td>
</tr>
<tr>
<td>c.</td>
<td>Test procedures (what, when and how)</td>
</tr>
</tbody>
</table>

---

**Standard II**

14 For bunkering lines over DN150/6" and flow rates over 650 m3/h it is recommended to define a second standard based on use of rigid arms or handling cranes/manipulators with remotely operated mechanical connectors similar to the latest generation of loading systems used on LNG tankers and LNG terminals.

15 On this basis, the second standard proposed for high bunkering rates should be remotely operated mechanical connectors with dry connect/disconnect valves designed to connect to ANSI standard flange geometry.

**Proposal**

16 Based on this, the co-sponsors propose that ISO be invited to develop a standard which defines the:

1. standard I for marine LNG quick bunkering connector size 2"- 6"; and
2. standard II for marine LNG mechanical remotely operated connector larger than 6".

and include provisions in a relevant existing standard or a new standard based on the paragraphs 12 to 15 in this document, with a view to forwarding it to [MSC 95] for evaluation. Based on the outcome a suitable reference should be included in the draft IGF Code.

**Action requested of the Committee**

17 The Committee is requested to consider the proposals in paragraph 16 and take action as deemed appropriate.
Topics from preliminary presentation from EU LNG Project “Study on the completion of an EU framework on LNG-fuelled ships and its relevant fuel infrastructure”
Initial results from the work under LOT 1, of the EU LNG Project “Study on the completion of an EU framework on LNG-fuelled ships and its relevant fuel infrastructure” have been conveyed with the ESSF-LNG sub-group.

Preliminary recommendations are:

- Establish an EU wide practice for the development of bunkering procedures
- Create a level playing field with regard to compliance enforcement of the fuel sulphur limitations as from January 2015
- Comprehensive approaches for methane slip management (BOG / vapour management /venting)
- Reflect on interaction with other elements that influence risk profile in land use planning in ports (e.g. installation of wind mills in port areas)
- Common approach for emergency repairs / salvation of stranded LNG fuelled vessels / requirements for shipyards
- Agreed approach for security aspects: ISPS-like regulations
- Agreed approach for bunkering suppliers accreditation schemes
- Equipment standardisation e.g. update of EN 1474 for small scale

Three focus points are also:

1) Quantitative Risk Assessment (QRA) and risk acceptance criteria, where contents of ISO DTS 18683 were explored with regard to QRA approach. Differences in software & model input data and also differences in risk acceptance criteria were also addressed as challenges to effective QRA.

Having identified the key challenges with regards to the QRA, DNV-GL has drafted also the structure of a proposed study to focus in particular the QRA subject.

2) Permitting Processes, in particular the different requirements for permitting regarding installation of LNG land based bunkering facilities.

3) Incident Reporting