



Guide for Survey during Construction, Commissioning and Sea Trials of LNG Gas Fuelled Ships

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GENERAL CONDITIONS

Definitions:

“Administration” means the Government of the State whose flag the Ship is entitled to fly or under whose authority the Ship is authorised to operate in the specific case.

“IACS” means the International Association of Classification Societies.

“Interested Party” means the party, other than the Society, having an interest in or responsibility for the Ship, product, plant or system subject to classification or certification (such as the owner of the Ship and his representatives, the ship builder, the engine builder or the supplier of parts to be tested) who requests the Services or on whose behalf the Services are requested.

“Owner” means the registered owner, the ship owner, the manager or any other party with the responsibility, legally or contractually, to keep the ship seaworthy or in service, having particular regard to the provisions relating to the maintenance of class laid down in Part A, Chapter 2 of the Rules for the Classification of Ships or in the corresponding rules indicated in the specific Rules.

“Rules” in these General Conditions means the documents below issued by the Society:

- (i) Rules for the Classification of Ships or other special units;
- (ii) Complementary Rules containing the requirements for product, plant, system and other certification or containing the requirements for the assignment of additional class notations;
- (iii) Rules for the application of statutory rules, containing the rules to perform the duties delegated by Administrations;
- (iv) Guides to carry out particular activities connected with Services;
- (v) Any other technical document, as for example rule variations or interpretations.

“Services” means the activities described in Article 1 below, rendered by the Society upon request made by or on behalf of the Interested Party.

“Ship” means ships, boats, craft and other special units, as for example offshore structures, floating units and underwater craft.

“Society” or “TASNEEF” means Tasneef and/or all the companies in the Tasneef Group which provide the Services.

“Surveyor” means technical staff acting on behalf of the Society in performing the Services.

Article 1

1.1. The purpose of the Society is, among others, the classification and certification of ships and the certification of their parts and components. In particular, the Society:

- (i) sets forth and develops Rules;
- (ii) publishes the Register of Ships;
- (iii) issues certificates, statements and reports based on its survey activities.

1.2. The Society also takes part in the implementation of national and international rules and standards as delegated by various Governments.

1.3. The Society carries out technical assistance activities on request and provides special services outside the scope of classification, which are regulated by these general conditions, unless expressly excluded in the particular contract.

Article 2

2.1. The Rules developed by the Society reflect the level of its technical knowledge at the time they are published. Therefore, the Society, although committed also through its research and development services to continuous updating of the Rules, does not guarantee the Rules meet state-of-the-art science and technology at the time of publication or that they meet the Society's or others' subsequent technical developments.

2.2. The Interested Party is required to know the Rules on the basis of which the Services are provided. With particular reference to Classification Services, special attention is to be given to the Rules concerning class suspension, withdrawal and reinstatement. In case of doubt or inaccuracy, the Interested Party is to promptly contact the Society for clarification.

The Rules for Classification of Ships are published on the Society's website: www.tasneef.ae.

2.3. The Society exercises due care and skill:

- (i) in the selection of its Surveyors
- (ii) in the performance of its Services, taking into account the level of its technical knowledge at the time the Services are performed.

2.4. Surveys conducted by the Society include, but are not limited to, visual inspection and non-destructive testing. Unless otherwise required, surveys are conducted through sampling techniques and do not consist of comprehensive verification or monitoring of the Ship or of the items subject to certification. The surveys and checks made by the Society on board ship do not necessarily require the constant and continuous presence of the Surveyor. The Society may also commission laboratory testing, underwater inspection and other checks carried out by and under the responsibility of qualified service suppliers. Survey practices and procedures are selected by the Society based on its experience and knowledge and according to generally accepted technical standards in the sector.

Article 3

3.1. The class assigned to a Ship, like the reports, statements, certificates or any other document or information issued by the Society, reflects the opinion of the Society concerning compliance, at the time the Service is provided, of the Ship or product subject to certification, with the applicable Rules (given the intended use and within the relevant time frame).

The Society is under no obligation to make statements or provide information about elements or facts which are not part of the specific scope of the Service requested by the Interested Party or on its behalf.

3.2. No report, statement, notation on a plan, review, Certificate of Classification, document or information issued or given as part of the Services provided by the Society shall have any legal effect or implication other than a representation that, on the basis of the checks made by the Society, the Ship, structure, materials, equipment, machinery or any other item covered by such document or information meet the Rules. Any such document is issued solely for the use of the Society, its committees and clients or other duly authorised bodies and for no other purpose. Therefore, the Society cannot be held liable for any act made or document issued by other parties on the basis of the statements or information given by the Society. The validity, application, meaning and interpretation of a Certificate of Classification, or any other document or information issued by the Society in connection with its Services, is governed by the Rules of the Society, which is the sole subject entitled to make such interpretation. Any disagreement on technical matters between the Interested Party and the Surveyor in the carrying out of his functions shall be raised in writing as soon as possible with the Society, which will settle any divergence of opinion or dispute.

3.3. The classification of a Ship, or the issuance of a certificate or other document connected with classification or certification and in general with the performance of Services by the Society shall have the validity conferred upon it by the Rules of the Society at the time of the assignment of class or issuance of the certificate; in no case shall it amount to a statement or warranty of seaworthiness,

structural integrity, quality or fitness for a particular purpose or service of any Ship, structure, material, equipment or machinery inspected or tested by the Society.

3.4. Any document issued by the Society in relation to its activities reflects the condition of the Ship or the subject of certification or other activity at the time of the check.

3.5. The Rules, surveys and activities performed by the Society, reports, certificates and other documents issued by the Society are in no way intended to replace the duties and responsibilities of other parties such as Governments, designers, ship builders, manufacturers, repairers, suppliers, contractors or sub-contractors, Owners, operators, charterers, underwriters, sellers or intended buyers of a Ship or other product or system surveyed.

These documents and activities do not relieve such parties from any fulfilment, warranty, responsibility, duty or obligation (also of a contractual nature) expressed or implied or in any case incumbent on them, nor do they confer on such parties any right, claim or cause of action against the Society. With particular regard to the duties of the ship Owner, the Services undertaken by the Society do not relieve the Owner of his duty to ensure proper maintenance of the Ship and ensure seaworthiness at all times. Likewise, the Rules, surveys performed, reports, certificates and other documents issued by the Society are intended neither to guarantee the buyers of the Ship, its components or any other surveyed or certified item, nor to relieve the seller of the duties arising out of the law or the contract, regarding the quality, commercial value or characteristics of the item which is the subject of transaction.

In no case, therefore, shall the Society assume the obligations incumbent upon the above-mentioned parties, even when it is consulted in connection with matters not covered by its Rules or other documents.

In consideration of the above, the Interested Party undertakes to relieve and hold harmless the Society from any third party claim, as well as from any liability in relation to the latter concerning the Services rendered.

Insofar as they are not expressly provided for in these General Conditions, the duties and responsibilities of the Owner and Interested Parties with respect to the services rendered by the Society are described in the Rules applicable to the specific Service rendered.

Article 4

4.1. Any request for the Society's Services shall be submitted in writing and signed by or on behalf of the Interested Party. Such a request will be considered irrevocable as soon as received by the Society and shall entail acceptance by the applicant of all relevant requirements of the Rules, including these General Conditions. Upon acceptance of the written request by the Society, a contract between the Society and the Interested Party is entered into, which is regulated by the present General Conditions.

4.2. In consideration of the Services rendered by the Society, the Interested Party and the person requesting the service shall be jointly liable for the payment of the relevant fees, even if the service is not concluded for any cause not pertaining to the Society. In the latter case, the Society shall not be held liable for non-fulfilment or partial fulfilment of the Services requested. In the event of late payment, interest at the legal current rate increased by 1.5% may be demanded.

4.3. The contract for the classification of a Ship or for other Services may be terminated and any certificates revoked at the request of one of the parties, subject to at least 30 days' notice to be given in writing. Failure to pay, even in part, the fees due for Services carried out by the Society will entitle the Society to immediately terminate the contract and suspend the Services.

For every termination of the contract, the fees for the activities performed until the time of the termination shall be owed to the Society as well as the expenses incurred in view of activities already programmed; this is without prejudice to the right to compensation due to the Society as a consequence of the termination.

With particular reference to Ship classification and certification, unless decided otherwise by the Society, termination of the contract implies that the assignment of class to a Ship is withheld or, if already assigned, that it is suspended or withdrawn; any statutory certificates issued by the Society will be withdrawn in those cases where provided for by agreements between the Society and the flag State.

Article 5

5.1. In providing the Services, as well as other correlated information or advice, the Society, its Surveyors, servants or agents operate with due diligence for the proper execution of the activity. However, considering the nature of the activities performed (see art. 2.4), it is not possible to guarantee absolute accuracy, correctness and completeness of any information or advice supplied. Express and implied warranties are specifically disclaimed.

Therefore, except as provided for in paragraph 5.2 below, and also in the case of activities carried out by delegation of Governments, neither the Society nor any of its Surveyors will be liable for any loss, damage or expense of whatever nature sustained by any person, in tort or in contract, derived from carrying out the Services.

5.2. Notwithstanding the provisions in paragraph 5.1 above, should any user of the Society's Services prove that he has suffered a loss or damage due to any negligent act or omission of the Society, its Surveyors, servants or agents, then the Society will pay compensation to such person for his proved loss, up to, but not exceeding, five times the amount of the fees charged for the specific services, information or opinions from which the loss or damage derives or, if no fee has been charged, a maximum of AED5,000 (Arab Emirates Dirhams Five Thousand only). Where the fees charged are related to a number of Services, the amount of the fees will be apportioned for the purpose of the calculation of the maximum compensation, by reference to the estimated time involved in the performance of the Service from which the damage or loss derives. Any liability for indirect or consequential loss, damage or expense is specifically excluded. In any case, irrespective of the amount of the fees charged, the maximum damages payable by the Society will not be more than AED5,000,000 (Arab Emirates Dirhams Five Millions only). Payment of compensation under this paragraph will not entail any admission of responsibility and/or liability by the Society and will be made without prejudice to the disclaimer clause contained in paragraph 5.1 above.

5.3. Any claim for loss or damage of whatever nature by virtue of the provisions set forth herein shall be made to the Society in writing, within the shorter of the following periods: (i) THREE (3) MONTHS from the date on which the Services were performed, or (ii) THREE (3) MONTHS from the date on which the damage was discovered. Failure to comply with the above deadline will constitute an absolute bar to the pursuit of such a claim against the Society.

Article 6

6.1. These General Conditions shall be governed by and construed in accordance with United Arab Emirates (UAE) law, and any dispute arising from or in connection with the Rules or with the Services of the Society, including any issues concerning responsibility, liability or limitations of liability of the Society, shall be determined in accordance with UAE law. The courts of the Dubai International Financial Centre (DIFC) shall have exclusive jurisdiction in relation to any claim or dispute which may arise out of or in connection with the Rules or with the Services of the Society.

6.2. However,

- (i) In cases where neither the claim nor any counterclaim exceeds the sum of AED300,000 (Arab Emirates Dirhams Three Hundred Thousand) the dispute shall be referred to the jurisdiction of the DIFC Small Claims Tribunal; and
- (ii) for disputes concerning non-payment of the fees and/or expenses due to the Society for services, the Society shall have the

right to submit any claim to the jurisdiction of the Courts of the place where the registered or operating office of the Interested Party or of the applicant who requested the Service is located.

In the case of actions taken against the Society by a third party before a public Court, the Society shall also have the right to summon the Interested Party or the subject who requested the Service before that Court, in order to be relieved and held harmless according to art. 3.5 above.

Article 7

7.1. All plans, specifications, documents and information provided by, issued by, or made known to the Society, in connection with the performance of its Services, will be treated as confidential and will not be made available to any other party other than the Owner without authorisation of the Interested Party, except as provided for or required by any applicable international, European or domestic legislation, Charter or other IACS resolutions, or order from a competent authority. Information about the status and validity of class and statutory certificates, including transfers, changes, suspensions, withdrawals of class, recommendations/conditions of class, operating conditions or restrictions issued against classed ships and other related information, as may be required, may be published on the website or released by other means, without the prior consent of the Interested Party.

Information about the status and validity of other certificates and statements may also be published on the website or released by other means, without the prior consent of the Interested Party.

7.2. Notwithstanding the general duty of confidentiality owed by the Society to its clients in clause 7.1 above, the Society's clients hereby accept that the Society may participate in the IACS Early Warning System which requires each Classification Society to provide other involved Classification Societies with relevant technical information on serious hull structural and engineering systems failures, as defined in the IACS Early Warning System (but not including any drawings relating to the ship which may be the specific property of another party), to enable such useful information to be shared and used to facilitate the proper working of the IACS Early Warning System. The Society will provide its clients with written details of such information sent to the involved Classification Societies.

7.3. In the event of transfer of class, addition of a second class or withdrawal from a double/dual class, the Interested Party undertakes to provide or to permit the Society to provide the other Classification Society with all building plans and drawings, certificates, documents and information relevant to the classed unit, including its history file, as the other Classification Society may require for the purpose of classification in compliance with the applicable legislation and relative IACS Procedure. It is the Owner's duty to ensure that, whenever required, the consent of the builder is obtained with regard to the provision of plans and drawings to the new Society, either by way of appropriate stipulation in the building contract or by other agreement.

In the event that the ownership of the ship, product or system subject to certification is transferred to a new subject, the latter shall have the right to access all pertinent drawings, specifications, documents or information issued by the Society or which has come to the knowledge of the Society while carrying out its Services, even if related to a period prior to transfer of ownership.

Article 8

8.1. Should any part of these General Conditions be declared invalid, this will not affect the validity of the remaining provisions.

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1. Scope

The scope of this guide is to collect Rules and Regulations (IGF Code and Tasneef Rules) applicable to LNG system surveys for gas fuelled ships under construction and to provide relevant advisory notes.

Required surveys are grouped for main LNG systems and main construction phases as follows:

	Tanks	Piping Systems	LNG/NG equipment	Dual Fuel Engines & Boilers	Auxiliaries
Survey during construction	3.1	3.2	3.3	3.4	3.5
Pre sea trial tests	4.1	4.2	4.3	4.4	4.5
Sea Trials	5.1	5.2	5.3	5.4	5.5

For each item, relevant applicable Rules and Regulations are quoted (omitting non relevant parts) and, where an interpretation or a suggestion about survey to carry out is deemed useful, "ADVISORY NOTES" are included.

The guide is applicable to any kind of gas fuelled ships other than liquefied gas carriers. The requested surveys need not to be carried out for equipment not provided since not necessary according to ship LNG system layout.

2. General

Where specified by the Rules:

- Testing shall be carried out in the presence of a Surveyor, and related requirements for test programs shall be observed.
- A test program for harbour and sea trials shall be prepared by the Interested Parties and accepted by the Society. The program shall specify systems and components to be tested, and the testing procedures. The Society may, in order to verify compliance with the Rules, request additional tests and/or data to be recorded.
- The tests shall give evidence as to satisfactory operation and performance in accordance with the Rules. When testing control and safety systems, failure modes shall be simulated as realistically as possible.

All the equipment to which this guide is applicable should be tested in actual working conditions.

The safety, reliability and dependability of the systems should be equivalent to that achieved with new and comparable conventional oil fuelled main and auxiliary machinery. A FMEA consistent with the "Tasneef Guide for FMEA" should be carried out for the whole gas fuelled system, including process system, electrical power supplies and control system, to check the potential existence of failure modes that can jeopardize the ship's safety. The results of the FMEA should then be used to establish a trial program.

Please remember, during survey for any item in each construction phase, that new installation of materials which contain asbestos is prohibited.

2.1. Definitions

“Tasneef Rules” means “Tasneef Rules for the Classification of Ships”

“Services” means the activities described below, rendered by the Society upon request made by or on behalf of the Interested Party:

- classification and certification of ships and certification of their parts and components
- survey activities to issue certificates, statements and reports
- implementation of national and international rules and standards as delegated by various Governments
- technical assistance activities and special services outside the scope of classification, to the extent practicable

“Society” means Tasneef Services S.p.A. and/or all the companies in the Tasneef Group which provide the Services.

“Surveyor” means technical staff acting on behalf of the Society in performing the Services.

“Interested Party” means a party, other than the Society, having an interest in or responsibility for the Ship, product, plant or system subject to classification or certification (such as the owner of the Ship and his representatives, the ship builder, the engine builder or the supplier of parts to be tested) who requests the Services or on whose behalf the Services are requested.

“Owner” means the registered Owner, the ship Owner, the manager or any other party with the responsibility, legally or contractually, to keep the ship seaworthy or in service

“Administration” means the Government of the State whose flag the Ship is entitled to fly or under whose authority the Ship is authorised to operate in the specific case.

"Ship" means ships, boats, craft and other special units, as for example offshore structures, floating units and underwater craft.

3. Rules and guidelines for survey during construction

3.1. Survey during construction for LNG fuel tanks

Tasneef Rules Pt C, Ch 1, App 7, [6.4.1]

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h) An inspection/survey plan for the liquefied gas fuel containment system is to be developed and approved by the Society. The inspection/survey plan is to identify aspects to be examined and/or validated during surveys throughout the liquefied gas fuel containment system's life and, in particular, any necessary in-service survey, maintenance and testing that was assumed when selecting liquefied gas fuel containment system design parameters. The inspection/survey plan may include specific critical locations as per 6.4.12 b)8) or 6.4.12b)9).

i) Liquefied gas fuel containment systems are to be designed, constructed and equipped to provide adequate means of access to areas that need inspection as specified in the inspection/survey plan.

Liquefied gas fuel containment systems, including all associated internal equipment are to be designed and built to ensure safety during operations, inspection and maintenance.

ADVISORY NOTE

Definitions

Fuel containment system is the arrangement for the storage of fuel including tank connections.

Fuel storage hold space is the space enclosed by the ship's structure in which a fuel containment system is situated. If tank connections are located in the fuel storage hold space, it will also be a tank connection space.

Tank connection space is a space surrounding all tank connections and tank valves that is required for tanks with such connections in enclosed spaces.

Documentation

All relevant gas fuel containment system FAT reports, survey plan and drawings are to be collected.

Inspection

All the above-mentioned items are to be visually inspected and checked for compliance to the approved drawings and FMEA results.

Verification of appropriate location as per applicable rules of each system and its component is to be performed. Particular attention is to be paid to provisions applied to facilitate cleaning, inspection and maintenance of pressure vessels.

In case of any doubt during survey, additional NDT can be required as necessary.

Particular attention and care is to be given to the inspection of any equipment subject to thermal expansion.

In hazardous areas, absence of materials and components that may accumulate static electricity is to be verified.

Presence of electric bonding, where required by the rules, is to be ascertained.

3.2. Survey during construction for LNG/NG piping systems

Tasneef Rules Pt A, Ch 3, Sec 1, [3.7.1]

The shipbuilder is to provide plans of the items which are intended to be examined and tested. These plans need not be submitted for approval and examination at the time of the kick-off meeting. They are to include:

- a) list of machinery components to be fitted on board including the machinery arrangement plans, comprehensive of:
 - 1. proposals for the examination of piping steelwork, including booklets of typical arrangements, completed with the list of the materials and fittings;*...omissis...*
- b) proposal for non destructive examination of piping steelwork, and in general for all systems requiring welding for their manufacture or installation ;*

...omissis...

Tasneef Rules Pt C, Ch 1, App 7, [15.7.3]

- a) *The regulations for testing in this section apply to fuel piping inside and outside the fuel tanks. However, relaxation from these regulations for piping inside fuel tanks and open ended piping may be accepted by the Society.*
- b) *After assembly, all fuel piping is to be subjected to a strength test with a suitable fluid. The test pressure is to be at least 1.5 times the design pressure for liquid lines and 1.5 times the maximum system working pressure for vapour lines. When piping systems or parts of systems are completely manufactured and equipped with all fittings, the test may be conducted prior to installation on board the ship. Joints welded on board are to be tested to at least 1.5 times the design pressure.*
- c) *After assembly on board, the fuel piping system is to be subjected to a leak test using air, or other suitable medium to a pressure depending on the leak detection method applied.*
- d) *In double wall fuel piping systems the outer pipe or duct is also to be pressure tested to show that it can withstand the expected maximum pressure at pipe rupture.*
- e) *All piping systems, including valves, fittings and associated equipment for handling fuel or vapours, are to be tested under normal operating conditions not later than at the first bunkering operation, in accordance with the requirements of the Society.*
- f) *Emergency shutdown valves in liquefied gas piping systems are to close fully and smoothly within 30 s of actuation. Information about the closure time of the valves and their operating characteristics is to be available on board, and the closing time is to be verifiable and repeatable.*
- g) *The closing time of the valve referred to in 8.5.8 and 15.4.2 b) (i.e. time from shutdown signal initiation to complete valve closure) is to be not greater than:*

3600 U / BR (second)

Where:

U : ullage volume at operating signal level (m³);

BR : maximum bunkering rate agreed between ship and shore facility (m³/h); or 5 seconds, whichever is the least.

The bunkering rate is to be adjusted to limit surge pressure on valve closure to an acceptable level, taking into account the bunkering hose or arm, the ship and the shore piping systems, where relevant.

Tasneef Rules Pt E, Ch 9, Sec.16 [1.1.4]

Piping, valves and fittings are to be hydrostatically tested, after assembly on board, to 1,5 times the working pressure but to not less than 0,7 MPa. Subsequently, they are to be pneumatically tested to ascertain that all the joints are perfectly tight.

Tasneef Rules Pt E, Ch 9, Sec.16 [4.2.4]

Joints on the entire length of the gas fuel supply lines are to be butt-welded joints with full penetration and to be fully radiographed, except where specially approved by the Society.

ADVISORY NOTE

Documentation

All relevant FAT reports, survey plans and drawings are to be collected, including type tests for cryogenic pipes, valves and expansion bellows.

Inspection

Piping and all the above-mentioned items are to be visually inspected and checked for compliance to the approved drawings and FMEA results.

Verification of appropriate location as per applicable rules of each piping system and its component is to be performed.

Presence of electric bonding to avoid static electricity accumulation resulting from the flow of liquids, gases and vapours, where required by the rules, is to be ascertained.

In case of any doubt during survey, additional NDT may be required as necessary.

3.3. Survey during construction for LNG/NG equipment

Tasneef Rules Pt E, Ch 9, Sec 5, [3.2.2]

All pumps are to be tested at the Manufacturer's plant in the presence of the Society's Surveyor. Testing is to include a hydrostatic test of the pump body equal to 1,5 times the design pressure and a capacity test. For submerged electric motor driven pumps, the capacity test is to be carried out with the design medium or with a medium below the minimum working temperature. For shaft driven deep well pumps, the capacity test may be carried out with water.

As an alternative to the above, if so requested by the relevant Manufacturer, the certification of a pump may be issued subject to the following:

- *the pump has been approved as required by [3.2.1] and*
- *the Manufacturer has a recognised quality system that has been assessed and certified by the Society subject to periodical audits, and the quality control plan contains a provision to subject each pump to a hydrostatic test of the pump body equal to 1,5 times the design pressure and a capacity test. The Manufacturer is to maintain records of such tests.*

ADVISORY NOTE

Documentation

All relevant FAT reports of pumps, compressors, vaporizer, etc, are to be collected.

Inspection

All the above-mentioned items are to be visually inspected and checked for compliance to the approved drawings and FMEA results.

Verification of appropriate location as per applicable rules of each system and its component is to be performed.

Presence of electric bonding, where required by the rules, is to be ascertained.

3.4. Survey during construction for dual fuel engine and boilers

Tasneef Rules Pt A, Ch 3, Sec 1, [3.7.1]

The shipbuilder is to provide plans of the items which are intended to be examined and tested. These plans need not be submitted for approval and examination at the time of the kick-off meeting. They are to include:

- a) list of machinery components to be fitted on board including the machinery arrangement plans, comprehensive of:
...omissis...
- 3) proposal for the examination of propulsion system(s) arrangement and associated fittings;
...omissis...
- c) proposals for testing of machinery components after their manufacture or installation on board;
...omissis...

ADVISORY NOTE

Documentation

All relevant FAT reports and certificates of dual fuel engines and boilers, relevant approved drawings are to be collected.

Inspection

Engines and boilers are to be visually inspected and checked for compliance to the approved drawings and FMEA results.

Verification of appropriate location as per applicable rules of each equipment is to be performed.

Particular attention is to be paid to provisions applied to facilitate cleaning, inspection and maintenance of main propulsion and auxiliary machinery, including boilers.

Presence of electric bonding to avoid static electricity accumulation resulting from the flow of liquids, gases and vapours, where required by the rules, is to be ascertained.

3.5. Survey during construction for auxiliaries

3.5.1. Survey during construction of hazardous area installations

Tasneef Rules Pt C, Ch 1, App 7 [11.3.2]

Electrical equipment and wiring, in general, is not to be installed in hazardous areas unless essential for operational purposes based on a recognized standard.

Tasneef Rules Pt C, Ch 1, App 7 [13.3.3]

Where electrical equipment is installed in hazardous areas as provided in 14.3.2 it is to be selected, installed and maintained in accordance with standards at least equivalent to those acceptable to the Organization.

Equipment for hazardous areas is to be evaluated and certified or listed by an accredited testing authority or notified body recognized by the Society.

ADVISORY NOTE

According to the definition of Tasneef Rules Pt C, Ch 2, Sec 1, [3.25], certified safe-type equipment means electrical equipment of a type for which a national or other appropriate authority has carried out the type verifications and tests necessary to certify the safety of the equipment with regard to explosion hazard when used in an explosive gas atmosphere.

Where electrical equipment and wiring are essential for operational purposes of LNG installation are installed in hazardous area, their safety certificates, issued by accredited testing authorities according to IEC or EN Standards, are to be available and collected by the Surveyor.

Tasneef Rules Pt C, Ch 1, App 7 [11.4.2]

In order to facilitate the selection of appropriate electrical apparatus and the design of suitable electrical installations, hazardous areas are divided into zones 0, 1 and 2. See also 11.5 below.

ADVISORY NOTE

Documentation

Approved drawing of the Plan of Hazardous Area of LNG installation, for the compliance with Tasneef Rules Pt C, Ch 1, App.7, [11.5], as well as a list of electrical equipment installed in hazardous area, including type, manufacturer, location, safety characteristics and number of safety certificate, is to be collected.

Inspection

Before the electrical installations in hazardous areas are put into service, they are to be inspected and all equipment, including cables, are to be verified as having been installed correctly taking into consideration that:

- in zone 0 hazardous area only electrical equipment as listed at Pt C, Ch 2, Sec 3, [10.1.4] are permitted
- in zone 1 hazardous area, only the electrical equipment listed at Pt C, Ch 2, Sec 3, [10.1.5] are permitted
- in zone 2 hazardous area, only the electrical equipment listed at Pt C, Ch 2, Sec 3, [10.1.6] are permitted
- electrical cables installed in Zone 0, Zone 1 and Zone 2 hazardous area are to comply with Pt C, Ch 2, Sec 3, [10.2]

When apparatus incorporates a number of types of protection, it is to be ensured that all are suitable for use in the zone in which it is located.

The suitability of the electrical equipment to the relevant flammable atmosphere is to be checked: i.e. temperature class (T_) and explosion group (II _) are to be suitable for methane gas.

Check that all the electrical equipment installed in hazardous area are provided with a legible certification plate complying with the characteristics laid down in the appropriate documentation in order to verify that the equipment actually fitted is that specified in the available documentation.

Particular attention is to be paid to:

- the integrity of the electrical equipment of a safe-type, e.g. missing bolts, mechanical damage, etc.
- the intrinsically safe circuits in order to verify that equipment and wiring are correctly installed (barriers are installed in safe areas, cables are to comply with the requirements of Pt C, Ch 2, Sec 3, [10.2.4] and [10.2.5]).

Verify cable runs for sheath and armouring defects and check that means of supporting the cables are in satisfactory condition.

Insulation test of circuits in hazardous area (terminating or passing through) is to be carried out.

Tasneef Rules Pt C, Ch 1, App 7 [11.3.3]

Electrical equipment fitted in an ESD-protected machinery space is to fulfil the following:

- a) in addition to fire and gas hydrocarbon detectors and fire and gas alarms, lighting and ventilation fans are to be certified safe for hazardous area zone 1; and*
- b) all electrical equipment in a machinery space containing gas-fuelled engines, and not certified for zone 1 is to be automatically disconnected, if gas concentrations above 40% LEL is detected by two detectors in the space containing gas-fuelled consumers.*

ADVISORY NOTE

In ESD-protected machinery spaces, simulation tests is to be carried out in order to check the correct de-energising of all the electrical equipment which are not certified for use in hazardous area. After the tests, correct operation of lighting and ventilation fans are to be verified.

Tasneef Rules Pt C, Ch 1, App 7 [13.3.9]

For non-hazardous spaces with access from hazardous open deck where the access is protected by an airlock, electrical equipment which is not of the certified safe type is to be de-energized upon loss of overpressure in the space.

ADVISORY NOTE

Correct de-energising of all the electrical equipment which are not certified for use in hazardous area associated with pressurised spaces are to be tested for correct operation.

Tasneef Rules Pt C, Ch 1, App 7 [12.3.2] Ventilation - Regulations

Electric motors for ventilation fans are not be located in ventilation ducts for hazardous spaces unless the motors are certified for the same hazard zone as the space served.

ADVISORY NOTE

An inspection of electrical motors for ventilation is to be carried out, in particular it is to be verified that the electrical motors serving hazardous spaces, where located in ventilation ducts, are certified safe type for the same hazard Zone (0,1 or 2) as the space served.

Fans serving spaces containing gas source are of a non-sparking construction and provided with type test certificate.

3.5.2. Survey during construction for Control, Monitoring and Safety Systems

Documentation

Approved drawings of control, monitoring and safety systems, as well as type approval certificates for equipment required by Pt C, Ch 2, Sec 15 [2.1.1], such as sensors, alarm panels, electronic protective devices, automatic and remote control equipment, programmable electronic systems, safety devices and FAT reports are to be collected.

Remarks on the approved drawings, if any, are to be additionally reviewed and verified.

Inspection

Verification of the working condition of the gas control systems, including manual and emergency operations, are to be checked. All the automatic control functions are to be verified working satisfactorily during normal load changes.

The alarm systems which are to be activated automatically are to be tested for proper operation.

Gas detectors, temperature sensors, pressure sensors, level indicators, and other equipment providing input to the gas safety system are to be tested to confirm satisfactory operating condition.

Instrumentation is to be tested to confirm proper operation as per its predetermined set points.

Tests are to be performed in order to verify the assumptions and conclusions of the FMEA, in particular the results of activation of each shutdown, shut-off and cut-out associated with the gas system including engine operation and bunkering. Correct protection and capacity of power supplies are to be checked.

Tasneef Rules Pt C, Ch 3, Sec 2 [1.1.5]

Control, monitoring and safety systems are to have self-check facilities. In the event of failure, an alarm is to be activated.

In particular, failure of the power supply of the automation system is to generate an alarm.

ADVISORY NOTE

Self-check facilities of control, monitoring and safety systems are to be verified.

Tasneef Rules Pt C, Ch 1, App 7 [14.2.1]

This chapter is related to functional requirements in 3.2.1, 3.2.2, 3.2.11, 3.2.13 to 3.2.15, 3.2.17 and 3.2.18. In particular the following apply:

...omissis...

- e) the safety systems including the field instrumentation are to be arranged to avoid spurious shutdown, e.g. as a result of a faulty gas detector or a wire break in a sensor loop; and*

...omissis...

ADVISORY NOTE

Proper response of the gas safety system upon fault conditions (e.g. a faulty gas detector or a wire break in a sensor loop, etc.) is to be checked based on the assumptions and conclusions of the FMEA. Failures are to be simulated as realistically as possible, preferably by letting the monitored parameters exceed the alarm and protective safety limits. Alarm and protective safety limits shall be checked.

Tasneef Rules Pt C, Ch 1, App 7 [14.4.2]

Overflow control:

...omissis...

- d) *All elements of the level alarms, including the electrical circuit and the sensor(s), of the high, and overflow alarms, are to be capable of being functionally tested. Systems are to be tested prior to fuel operation .*

...omissis...

ADVISORY NOTE

Proper operation of high level and overflow control system, including response upon fault conditions (i.e. faulty sensors and a wire break in a sensor loop) based on the assumptions and conclusions of the FMEA is to be checked. Failures are to be simulated as realistically as possible, preferably by letting the monitored parameters exceed the alarm and protective safety limits.

Tasneef Rules Pt C, Ch 1, App 7 [14.2.1]

This chapter is related to functional requirements in 3.2.1, 3.2.2, 3.2.11, 3.2.13 to 3.2.15, 3.2.17 and 3.2.18. In particular the following apply:

...omissis...

- c) *for ESD protected machinery configurations the safety system is to shut down gas supply upon gas leakage and in addition disconnect all non-certified safe type electrical equipment in the machinery space;*

...omissis...

ADVISORY NOTE

ESD system is to be tested for proper operation for both shut-down gas supply and disconnection of non-certified safe type equipment.

Tasneef Rules Pt C, Ch 3, Sec 3 [3.10.2]

On board tests are to check that a computer based system in its final environment, integrated with all other systems with which it interacts, is:

- *performing functions it was designed for;*
- *reacting safely in case of failures originated internally or by devices external to the system;*
- *interacting safely with other systems implemented on board vessel.*

Tasneef Rules Pt C, Ch 3, Sec 3 [3.10.3]

Test specifications for final integration and on board testing of Category II and III systems, are to be submitted for approval; the tests are to be witnessed by the Society.

ADVISORY NOTE

For equipment and components whose operation is based on software, programmable electronic systems and computer systems devices, the functionality of the system is to be verified, including verifications of software name and release (to be recorded). Surveyor is to verify that there are no uncontrolled changes in respect of the initial approval and testing. Tests are to be performed based on test programs and procedures for functional tests and failure tests based on FMEA.

Tasneef Rules Pt C, Ch 1, App 7 [14.2.1]

This chapter is related to functional requirements in 3.2.1, 3.2.2, 3.2.11, 3.2.13 to 3.2.15, 3.2.17 and 3.2.18. In particular the following apply:

...omissis...

- d) the safety functions are to be arranged in a dedicated gas safety system that is independent of the gas control system in order to avoid possible common cause failures. This includes power supplies and input and output signal;*

...omissis...

ADVISORY NOTE

Interdependency of the power supplies for gas safety system and gas control system, as well as input and out signals, is to be checked.

3.5.3. Survey during construction for LNG ventilation

ADVISORY NOTE

Documentation

Before to start the survey, all relevant FAT reports and approved drawings are to be collected.

Remarks on the approved drawings, if any, are to be additionally reviewed and verified.

Inspection

Visual examination of the ventilation system (including ducts, fans, dampers, etc.), including portable ventilating equipment where provided, is to be carried out for spaces containing fuel storage, fuel bunkering and fuel supply units or components or associated systems, including air locks, pump rooms, compressor rooms, fuel preparation rooms, fuel valve rooms, control rooms and spaces containing gas burning equipment.

Where alarms, such as differential pressure and loss of pressure are fitted, these are to be operationally tested.

All sensors and relevant electrical circuits are to be capable of being functionally tested.

Required shutdown upon ventilation overpressure falling below prescribed values is to be tested.

For spaces where hazardous area classification depends on mechanical ventilation, it is to be verified that ventilation flow rate is sufficient and that required ventilation failure alarm operates correctly.

An inspection of the components for ventilation purposes is to be carried out and in particular that electrical motors are in operating condition.

Checking of the conformity of location of air inlet/air outlet with the approved drawing, in particular of hazardous spaces.

3.5.4. Survey during construction for Inert Gas System

ADVISORY NOTE

Documentation

Before to start the survey, all relevant FAT reports and approved drawings are to be collected.

Remarks on the approved drawings, if any, are to be additionally reviewed and verified.

Inspection

The survey is to include:

- visual examination of the whole system
- check of proper operation of all remotely operated or automatically controlled valves
- check, as far as practicable and using simulated conditions where necessary, all the alarms and safety devices
- verification that means for prevention of backflow of fuel vapour into the inert gas system are in satisfactory operating condition.

4. Rules and guidelines for pre sea trial tests

4.1. Pre sea trials tests for LNG fuel tanks

4.1.1. Inspection/survey plan

Tasneef Rules Pt C, Ch 1, App 7, [6.4.1]

...omissis...

- h) An inspection/survey plan for the liquefied gas fuel containment system is to be developed and approved by the Society. The inspection/survey plan is to identify aspects to be examined and/or validated during surveys throughout the liquefied gas fuel containment system's life and, in particular, any necessary in-service survey, maintenance and testing that was assumed when selecting liquefied gas fuel containment system design parameters. The inspection/survey plan may include specific critical locations as per 6.4.12 b)8) or 6.4.12b)9).*
- i) Liquefied gas fuel containment systems are to be designed, constructed and equipped to provide adequate means of access to areas that need inspection as specified in the inspection/survey plan. Liquefied gas fuel containment systems, including all associated internal equipment are to be designed and built to ensure safety during operations, inspection and maintenance.*

...omissis...

ADVISORY NOTE

Inspection and testing

All LNG fuel tanks, including fuel containment system, are to be tested in operation according to the approved programme. As far as practicable, these tests are to be performed at the building yard.

Functional tests and capacity tests, which cannot be carried out without LNG on board, may be carried at the first LNG bunkering.

Additional safety measures, if any, required by the risk assessment carried out for the evaluation of the ship's liquefied gas fuel containment system, are to be verified and tested on the assumption of the most critical events. The relevant aspects to be examined are to be clearly stated in the required inspection/survey plan.

4.1.2. Testing for tanks and pressure vessels

Tasneef Rules Pt C, Ch 1, App 7, [15.5.2]

All type A independent tanks are to be subjected to a hydrostatic or hydro-pneumatic pressure testing. This test is to be performed such that the stresses approximate, as far as practicable, the design stresses, and that the pressure at the top of the tank corresponds at least to the MARVS. When a hydropneumatic test is performed, the conditions are to simulate, as far as practicable, the design loading of the tank and of its support structure including dynamic components, while avoiding stress levels that could cause permanent deformation.

Tasneef Rules Pt C, Ch 1, App 7, [15.5.3]

Type B independent tanks are to be subjected to a hydrostatic or hydro-pneumatic pressure testing as follows:

- d) The test is to be performed as required in 16.5.2 for type A independent tanks
In addition, the maximum primary membrane stress or maximum bending stress in primary members under test conditions is not to exceed 90% of the yield strength of the material (as fabricated) at the test temperature. To ensure that this condition is satisfied, when calculations indicate that this stress exceeds 75% of the yield strength the test of the first of a series of identical tanks is to be monitored by the use of strain gauges or other suitable equipment.*

Tasneef Rules Pt C, Ch 1, App 7, [15.5.4]

- a) Each pressure vessel is to be subjected to a hydrostatic test at a pressure measured at the top of the tanks, of not less than 1.5 P₀. In no case during the pressure test is the calculated primary membrane stress at any point to exceed 90% of the yield strength of the material at the test temperature. To ensure that this condition is satisfied where calculations indicate that this stress will exceed 0,75 times the yield strength, the test of the first of a series of identical tanks is to be monitored by the use of strain gauges or other suitable equipment in pressure vessels other than simple cylindrical and spherical pressure vessels.*
- b) The temperature of the water used for the test is to be at least 30°C above the nil-ductility transition temperature of the material, as fabricated.*
- c) The pressure is to be held for 2 hours per 25 mm of thickness, but in no case less than 2 hours.*

- d) *Where necessary for liquefied gas fuel pressure vessels, a hydro-pneumatic test may be carried out under the conditions prescribed in 16.5.4 a) to 16.5.4 c).*
- e) *Special consideration may be given to the testing of tanks in which higher allowable stresses are used, depending on service temperature. However, regulation in 16.5.4.1 is to be fully complied with.*
- f) *After completion and assembly, each pressure vessel and its related fittings is to be subjected to an adequate tightness test, which may be performed in combination with the pressure testing referred to in 16.5.4 a) or 16.5.4 d) as applicable. Pneumatic testing of pressure vessels other than liquefied gas fuel tanks is to be considered on an individual case basis. Such testing is to only be permitted for those vessels designed or supported such that they cannot be safely filled with water, or for those vessels that cannot be dried and are to be used in a service where traces of the testing medium cannot be tolerated.*
Pneumatic testing of pressure vessels other than liquefied gas fuel tanks is to be considered on an individual case basis. Such testing is to only be permitted for those vessels designed or supported such that they cannot be safely filled with water, or for those vessels that cannot be dried and are to be used in a service where traces of the testing medium cannot be tolerated.

ADVISORY NOTE

Type C tank

Usually the test required from a) to e) are to be carried out in the workshop, the ones required in f) will be carried out during the pre-sea trial tests according to the approved test program.

The relevant documentation is to be checked and verified.

Tasneef Rules Pt C, Ch 1, App 7, [15.5.5]

- a) *Design development testing*
 - a) *The design development testing required in 6.4.15 d) is to include a series of analytical and physical models of both the primary and secondary barriers, including corners and joints, tested to verify that they will withstand the expected combined strains due to static, dynamic and thermal loads at all filling levels. This will culminate in the construction of a prototype scaled model of the complete liquefied gas fuel containment system. Testing conditions considered in the analytical and physical model are to represent the most extreme service conditions the liquefied gas fuel containment system will be likely to encounter over its life. Proposed acceptance criteria for periodic testing of secondary barriers required in 6.4.4 may be based on the results of testing carried out on the prototype scaled model.*
 - b) *The fatigue performance of the membrane materials and representative welded or bonded joints in the membranes is to be determined by tests. The ultimate strength and fatigue performance of arrangements for securing the thermal insulation system to the hull structure are to be determined by analyses or tests.*
- b) *Testing*
 - 1) *In ships fitted with membrane liquefied gas fuel containment systems, all tanks and other spaces that may normally contain liquid and are adjacent to the hull structure supporting the membrane, are to be hydrostatically tested.*
 - 2) *All hold structures supporting the membrane are to be tested for tightness before installation of the liquefied gas fuel containment system.*

Pipe tunnels and other compartments that do not normally contain liquid need not be hydrostatically tested.

4.1.3. Overall performance of the fuel containment system

Tasneef Rules Pt C, Ch 1, App 7, [15.5.1]

...omissis...

- f) The overall performance of the fuel containment system is to be verified for compliance with the design parameters during the first LNG bunkering, when steady thermal conditions of the liquefied gas fuel are reached, in accordance with the requirements of the Society. Records of the performance of the components and equipment, essential to verify the design parameters, are to be maintained on board and be available to the Society.*
- g) The fuel containment system is to be inspected for cold spots during or immediately following the first LNG bunkering, when steady thermal conditions are reached. Inspection of the integrity of thermal insulation surfaces that cannot be visually checked is to be carried out in accordance with the requirements of the Society.*

...omissis...

ADVISORY NOTE

For a gas-fuelled ship new-building, in accordance with Tasneef checklist IGF_INI item GFI.2.11.1, during the initial cool down, first full loading and discharging/use of fuel, the overall performance of the fuel containment system is to be examined and verified.

Confirmation that the system is in compliance with the design parameters is to be ascertained.

Bunkering, unloading use and transfer operations relevant to the complete gas fuel containment and handling system is to be performed in order to demonstrate that the fuel containment arrangements are capable of being inerted, cooled, loaded and unloaded in satisfactory way and that all the safety devices operate correctly.

The extent of requested test must be the maximum possible, considering the temperature at which the LNG operations will be carried out.

4.2. Pre sea trials tests for LNG/NG piping systems

4.2.1. Piping (Bunkering)

Tasneef Rules Pt C, Ch 1, App 7 - [16.7.3]

- a) The regulations for testing in this section apply to fuel piping inside and outside the fuel tanks. However, relaxation from these regulations for piping inside fuel tanks and open ended piping may be accepted by the Society.*
- b) After assembly, all fuel piping is to be subjected to a strength test with a suitable fluid. The test pressure is to be at least 1.5 times the design pressure for liquid lines and 1.5 times the maximum system working pressure for vapour lines. When piping systems or parts of systems are completely manufactured and equipped with all fittings, the test may be conducted prior to installation on board the ship. Joints welded on board are to be tested to at least 1.5 times the design pressure.*

- c) After assembly on board, the fuel piping system is to be subjected to a leak test using air, or other suitable medium to a pressure depending on the leak detection method applied.
- d) In double wall fuel piping systems the outer pipe or duct is also to be pressure tested to show that it can withstand the expected maximum pressure at pipe rupture.
- e) All piping systems, including valves, fittings and associated equipment for handling fuel or vapours, are to be tested under normal operating conditions not later than at the first bunkering operation, in accordance with the requirements of the Society.
- f) Emergency shutdown valves in liquefied gas piping systems are to close fully and smoothly within 30 s of actuation. Information about the closure time of the valves and their operating characteristics is to be available on board, and the closing time is to be verifiable and repeatable. The closing time of the valve referred to in 8.5.8 and 15.4.2 b) (i.e. time from shutdown signal initiation to complete valve closure) is to be not greater than:

$$\frac{3600U}{BR} \text{ (seconds)}$$

where:

U : ullage volume at operating signal level (m³);

BR : maximum bunkering rate agreed between ship and shore facility (m³/h); or 5 seconds, whichever is the least.

The bunkering rate is to be adjusted to limit surge pressure on valve closure to an acceptable level, taking into account the bunkering hose or arm, the ship and the shore piping systems, where relevant.

ADVISORY NOTE

Witness emergency shutdown system testing before to commencement of operation and verify the requirements about timing.

4.3. Pre sea trials tests for LNG/NG equipment

Tasneef Rules Pt C, Ch 1, Sec.16 - [2.1]

Trials at the moorings are to demonstrate the following:

- a) *satisfactory operation of the machinery in relation to the service for which it is intended*
- b) *quick and easy response to operational commands*
- c) *safety of the various installations, as regards:*
 - *the protection of mechanical parts*
 - *the safeguards for personnel*
- d) *accessibility for cleaning, inspection and maintenance.*

Where the above features are not deemed satisfactory and require repairs or alterations, the Society reserves the right to require the repetition of the trials at the moorings, either wholly or in part, after such repairs or alterations have been carried out.

ADVISORY NOTE

Arrangements are to be provided to prevent in-operation freezing of the intermediate heat exchange mediums containing products with higher freezing points than LNG, such as Ethylene Glycol, by establishing adequate flow prior to establishing flow of LNG to the heat exchanger/vaporizer or by some other equivalent control strategy.

4.4. Pre sea trials tests for dual fuel engine and boilers

4.4.1. Tests of boilers

ADVISORY NOTE

General

The satisfactory operation of the main and auxiliary boilers supplying essential services is to be ascertained in all operating conditions during the trials at the moorings and the sea trials.

Tests to be performed

After installation on board, the following tests are to be carried out in the presence of the Surveyor:

- a) Test in the hot condition of boilers and superheaters
- b) Accumulation tests and setting of safety valves of boilers and superheaters
 - Safety valves are to be set to lift at a pressure not exceeding 103% of the design pressure
 - For boilers fitted with superheaters, the safety valves of the latter are to be set to lift before or, at the latest, at the same time as the valves of the saturated steam chest
- c) Verification that, at the maximum steaming rate, the boiler pressure does not exceed 110% of the design pressure when the stop valves of the boiler, except those which must remain open for the burning operation, are closed. The boiler is to be fed so that the water level remains normal throughout the test. The test is to last:
 - 15 minutes for fire tube boilers
 - 7 minutes for water tube boilers.
- d) Test and simulation of all safety devices, alarms, shut-off and automatic starting of standby equipment.

Alternative requirement

- a) When it is recognised, for certain types of boilers, that accumulation tests might endanger the superheaters, the omission of such tests may be considered.
- b) Such omission can be permitted, however, only if the drawings and the size of safety valves have been reviewed by the Society, and provided that the safety valves are of a type whose relieving capacity has been established by a test carried out in the presence of the Surveyor, or in other conditions deemed equivalent to those of the actual boiler.
- c) When the Society does not agree to proceed with an accumulation test, the valve manufacturer is to supply, for each safety valve, a certificate specifying its relieving capacity for the working conditions of the boiler. In addition, the boiler manufacturer is to supply a certificate specifying the maximum steam capacity of the boiler.

Engines driving auxiliaries

- a) Engines driving generators or important auxiliaries are to be subjected to an operational test for at least 4 hours. During the test, the set concerned is required to operate at its rated power for at least 2 hours.
- b) It is to be demonstrated that the engine is capable of supplying 100% of its rated power and, in the case of shipboard generating sets, account is to be taken of the times needed to actuate the generator's overload protection system.

4.5. Pre sea trials tests for auxiliaries

4.5.1. First bunkering operation (considered to be full filling)

ADVISORY NOTE

Stated the verification relevant to the Fuel Bunkering System are to be carried out according to the specific arrangements, as far as the containment system is concerned, the priority is to be given to the latter stages of filling of the fuel tanks (approx. last 2 hours and according to the bunkering timing).

The operations are to be carried out according to the Operation Manual and test procedure, and a review of the operations logs and alarm reports is to be achieved.

Tasneef Rules Pt C, Ch 1, App 7, [14.4.1]

Level indicators for liquefied gas fuel tanks:

- a) *Each liquefied gas fuel tank is to be fitted with liquid level gauging device(s), arranged to ensure a level reading is always obtainable whenever the liquefied gas fuel tank is operational. The device(s) is (are) to be designed to operate throughout the design pressure range of the liquefied gas fuel tank and at temperatures within the fuel operating temperature range.*
- b) *Where only one liquid level gauge is fitted, it is to be arranged so that it can be maintained in an operational condition without the need to empty or gas-free the tank.*
- c) *Liquefied gas fuel tank liquid level gauges may be of the following types:*
 - 1) *indirect devices, which determine the amount of fuel by means such as weighing or in-line flow metering; or*
 - 2) *closed devices, which do not penetrate the liquefied gas fuel tank, such as devices using radio-isotopes or ultrasonic devices.*

Tasneef Rules Pt C, Ch 1, App 7, [14.4.2]

- a) *Each liquefied gas fuel tank is to be fitted with a high liquid level alarm operating independently of other liquid level indicators and giving an audible and visual warning when activated.*
- b) *An additional sensor operating independently of the high liquid level alarm is to automatically actuate a shutoff valve in a manner that will both avoid excessive liquid pressure in the bunkering line and prevent the liquefied gas fuel tank from becoming liquid full.*
- c) *The position of the sensors in the liquefied gas fuel tank is to be capable of being verified before commissioning. At the first occasion of full loading after delivery and after each dry-docking, testing of high level alarms is to be conducted by raising the fuel liquid level in the liquefied gas fuel tank to the alarm point.*
- d) *All elements of the level alarms, including the electrical circuit and the sensor(s), of the high, and overflow alarms, are to be capable of being functionally tested. Systems are to be tested prior to fuel operation in accordance with 18.4.3.*

- e) *Where arrangements are provided for overriding the overflow control system, they are to be such that inadvertent operation is prevented. When this override is operated, continuous visual indication is to be provided at the navigation bridge, continuously manned central control station or onboard safety centre.*

Tasneef Rules Pt C, Ch 1, App 7, [14.4.3]

The vapour space of each liquefied gas fuel tank is to be provided with a direct reading gauge. Additionally, an indirect indication is to be provided on the navigation bridge, continuously manned central control station or onboard safety centre.

Tasneef Rules Pt C, Ch 1, App 7, [14.4.4]

The pressure indicators are to be clearly marked with the highest and lowest pressure permitted in the liquefied gas fuel tank.

Tasneef Rules Pt C, Ch 1, App 7, [14.4.5]

A high-pressure alarm and, if vacuum protection is required, a low-pressure alarm is to be provided on the navigation bridge and at a continuously manned central control station or onboard safety centre. Alarms are to be activated before the set pressures of the safety valves are reached.

Tasneef Rules Pt C, Ch 1, App 7, [14.4.6]

Each fuel pump discharge line and each liquid and vapour fuel manifold is to be provided with at least one local pressure indicator

Tasneef Rules Pt C, Ch 1, App 7, [14.4.7]

Local-reading manifold pressure indicator is to be provided to indicate the pressure between ship's manifold valves and hose connections to the shore.

Tasneef Rules Pt C, Ch 1, App 7, [14.4.8]

Fuel storage hold spaces and interbarrier spaces without open connection to the atmosphere are to be provided with pressure indicator.

Tasneef Rules Pt C, Ch 1, App 7, [14.4.9]

At least one of the pressure indicators provided is to be capable of indicating throughout the operating pressure range.

Tasneef Rules Pt C, Ch 1, App 7, [14.4.10]

For submerged fuel-pump motors and their supply cables, arrangements are to be made to alarm in low-liquid level and automatically shut down the motors in the event of low-liquid level. The automatic shutdown may be accomplished by sensing low pump discharge pressure, low motor current, or low-liquid level. This shutdown is to give an audible and visual alarm on the navigation bridge, continuously manned central control station or onboard safety centre.

Tasneef Rules Pt C, Ch 1, App 7, [14.4.11]

Except for independent tanks of type C supplied with vacuum insulation system and pressure build-up fuel discharge unit, each fuel tank is to be provided with devices to measure and indicate the temperature of the fuel in at least three locations; at the bottom and middle of the tank as well as the top of the tank below the highest allowable liquid level.

Tasneef Rules Pt C, Ch 1, App 7, [14.5.1]

Control of the bunkering is to be possible from a safe location remote from the bunkering station. At this location the tank pressure, tank temperature if required by 15.4.11, and tank level are to be monitored. Remotely controlled valves required by 8.5.3 and 11.5.7 are to be capable of being operated from this location. Overfill alarm and automatic shutdown are also to be indicated at this location.

Tasneef Rules Pt C, Ch 1, App 7, [14.5.2]

If the ventilation in the ducting enclosing the bunkering lines stops, an audible and visual alarm is to be provided at the bunkering control location, see also 15.8.

Tasneef Rules Pt C, Ch 1, App 7, [14.5.3]

If gas is detected in the ducting around the bunkering lines an audible and visual alarm and emergency shutdown is to be provided at the bunkering control location..

ADVISORY NOTE

Cooling of gas fuel tanks and measuring of the gas fuel tanks temperatures.

During cooling down of the gas fuel vessels, the following shall be verified:

All piping systems, including valves, fittings and associated equipment for handling fuel or vapours, shall be tested under normal operating conditions.

Fuel or vapours lines of each vessels, in single wall piping running inside the different space were this arrangement is admitted, are to be checked and inspected for any unexpected cold spot (e.g. where pipeline are insulated or in way of pipeline supports) and any unexpected gas leakage (including the LNG vessel domes covers). The double walled piping space of the others ones is to be monitored according to the system adopted and in accordance to the standard procedure of monitoring stated in the operation manual. The system for the control of the tank pressure fitted on board is to be put in operation and it is to be verified its proper working at the design parameters. The performances of the system shall be verified (temperature gradient, ability to keep the temperature set up inside the LNG vessels, pressure control within the specified value, etc.).

Liquid and gas lines of each vessels and equipment are to be inspected for any unexpected cold spot (e.g. where pipeline are insulated or in way of pipeline supports), any unexpected gas leakage and any unexpected cold spot of the different spaces were the lines running (if any);

Witness topping off process for LNG tanks including high level alarms activated during normal loading. Examination of LNG piping systems including expansion and supporting arrangements. Examination of vessels domes expansion/supporting arrangements and tank connection space arrangements.

During bunkering operations the following shall be verified:

- the whole functionality of the liquid and gas lines shall be monitored (large quantity of LNG flowing)
- the temperature measurements shall be performed inside the spaces accommodating the LNG vessels in order to verify the absence of cold spots: the temperatures shall be taken in places measuring of the air temperature
 - measuring of the ambient air temperature and the sea water temperature
- some hours after bunkering, absence of hoarfrost on the insulating external surface of the LNG tanks is to be verified
- examination of the hull and insulation during and record the results in the ship's logbook to be examined in the following days

The temperatures are to be measured in way of:

- the hull structures adjacent to the LNG tanks
- LNG tanks supports and anti-rolling/anti-pitching devices
- double bottom plates in way of the LNG tanks supports

4.5.2. Bunkering system

Tasneef Rules Pt C, Ch 1, App 7, [8.5.1]

An arrangement for purging fuel bunkering lines with inert gas is to be provided.

Tasneef Rules Pt C, Ch 1, App 7, [8.5.2]

The bunkering system is to be so arranged that no gas is discharged to the atmosphere during filling of storage tanks.

Tasneef Rules Pt C, Ch 1, App 7, [8.5.3]

A manually operated stop valve and a remote operated shutdown valve in series, or a combined manually operated and remote valve is to be fitted in every bunkering line close to the connecting point. It is to be possible to operate the remote valve in the control location for bunkering operations and/or from another safe location.

Tasneef Rules Pt C, Ch 1, App 7, [8.5.4]

Means are to be provided for draining any fuel from the bunkering pipes upon completion of operation.

Tasneef Rules Pt C, Ch 1, App 7, [8.5.5]

Bunkering lines are to be arranged for inerting and gas freeing. When not engaged in bunkering, the bunkering pipes are to be free of gas, unless the consequences of not gas freeing is evaluated and approved.

Tasneef Rules Pt C, Ch 1, App 7, [8.5.6]

In case bunkering lines are arranged with a cross-over it is to be ensured by suitable isolation arrangements that no fuel is transferred inadvertently to the ship side not in use for bunkering.

Tasneef Rules Pt C, Ch 1, App 7, [8.5.7]

A ship-shore link (SSL) or an equivalent means for automatic and manual ESD communication to the bunkering source is to be fitted.

Tasneef Rules Pt C, Ch 1, App 7, [8.5.8]

If not demonstrated to be required at a higher value due to pressure surge considerations a default time as calculated in accordance with 16.7.3 g) from the trigger of the alarm to full closure of the remote operated valve required by 8.5.3 is to be adjusted.

ADVISORY NOTE

Witness satisfactory operation according to the above regulations to be complied with, in particular the drainage, inerting and gas freeing means of the lines.

Witness satisfactory operation of ship-shore link (SSL) and relevant ESD communication with the bunkering source.

4.5.3. Fuel supply systems and safety functions

Tasneef Rules Pt C, Ch 1, App 7 - 14.11.1

If the fuel supply is shut off due to activation of an automatic valve, the fuel supply is not to be opened until the reason for the disconnection is ascertained and the necessary precautions taken. A readily visible notice giving instruction to this effect is to be placed at the operating station for the shutoff valves in the fuel supply lines.

Tasneef Rules Pt C, Ch 1, App 7 - 14.11.2

If a fuel leak leading to a fuel supply shutdown occurs, the fuel supply is not to be operated until the leak has been found and dealt with. Instructions to this effect are to be placed in a prominent position in the machinery space.

Tasneef Rules Pt C, Ch 1, App 7 - 14.11.3

A caution placard or signboard is to be permanently fitted in the machinery space containing gas-fuelled engines stating that heavy lifting, implying danger of damage to the fuel pipes, is not to be done when the engine(s) is running on gas.

4.5.4. Safety Systems

Tasneef Rules Pt C, Ch 1, App 7, [9.4.1]

Fuel storage tank inlets and outlets are to be provided with valves located as close to the tank as possible. Valves required to be operated during normal operation¹⁶ which are not accessible are to be remotely operated. Tank valves whether accessible or not are to be automatically operated when the safety system required in 15.2.2 is activated.

Tasneef Rules Pt C, Ch 1, App 7, [9.4.2]

The main gas supply line to each gas consumer or set of consumers is to be equipped with a manually operated stop valve and an automatically operated "master gas fuel valve" coupled in series or a combined manually and automatically operated valve. The valves are to be situated in the part of the

pipings that is outside the machinery space containing gas consumers, and placed as near as possible to the installation for heating the gas, if fitted. The master gas fuel valve is to automatically cut off the gas supply when activated by the safety system required in 15.2.2.

Tasneef Rules Pt C, Ch 1, App 7, [9.4.3]

The automatic master gas fuel valve is to be operable from safe locations on escape routes inside a machinery space containing a gas consumer, the engine control room, if applicable; outside the machinery space, and from the navigation bridge.

Tasneef Rules Pt C, Ch 1, App 7, [9.4.4]

Each gas consumer is to be provided with "double block and bleed" valves arrangement. These valves are to be arranged as outlined in a) or b) so that when the safety system required in 15.2.2 is activated this will cause the shutoff valves that are in series to close automatically and the bleed valve to open automatically and:

- a) the two shutoff valves are to be in series in the gas fuel pipe to the gas consuming equipment. The bleed valve is to be in a pipe that vents to a safe location in the open air that portion of the gas fuel piping that is between the two valves in series; or the function of one of the shutoff valves in series and the bleed valve can be incorporated into one valve body, so arranged that the flow to the gas utilization unit will be blocked and the ventilation opened.*

Tasneef Rules Pt C, Ch 1, App 7, [9.4.5]

The two valves are to be of the fail-to-close type, while the ventilation valve is to be fail-to-open.

Tasneef Rules Pt C, Ch 1, App 7, [9.4.6]

The double block and bleed valves are also to be used for normal stop of the engine.

Tasneef Rules Pt C, Ch 1, App 7, [9.4.7]

In cases where the master gas fuel valve is automatically shut down, the complete gas supply branch downstream of the double block and bleed valve is to be automatically ventilated assuming reverse flow from the engine to the pipe.

Tasneef Rules Pt C, Ch 1, App 7, [9.4.8]

There is to be one manually operated shutdown valve in the gas supply line to each engine upstream of the double block and bleed valves to assure safe isolation during maintenance on the engine.

Tasneef Rules Pt C, Ch 1, App 7, [9.4.9]

For single-engine installations and multi-engine installations, where a separate master valve is provided for each engine, the master gas fuel valve and the double block and bleed valve functions can be combined.

Tasneef Rules Pt C, Ch 1, App 7, [9.4.10]

For each main gas supply line entering an ESD protected machinery space, and each gas supply line to high pressure installations, means are to be provided for rapid detection of a rupture in the gas line in the engine-room. When rupture is detected a valve is to be automatically shut off. This valve is to be

located in the gas supply line before it enters the engine-room or as close as possible to the point of entry inside the engine-room. It can be a separate valve or combined with other functions, e.g. the master valve.

ADVISORY NOTE

Witness satisfactory operation of all emergency shut-down valves, check valves, block and bleed valves, master gas valves, remote operating valves, isolating valves for pressure relief valves in the fuel storage, fuel bunkering, and fuel supply piping systems.

Witness satisfactory operation of gas detectors, temperature sensors, pressure sensors, level indicators, and other equipment providing input to the fuel safety system

Proper response of the fuel safety system upon fault conditions is to be verified.

Pressure, temperature and level indicating equipment are to be calibrated in accordance with the manufacturer's requirements.

Tasneef Rules Pt C, Ch 1, App 7 - 14.11.4

Compressors, pumps and fuel supply are to be arranged for manual remote emergency stop from the following locations as applicable:

- a) navigation bridge;
- b) cargo control room;
- c) onboard safety centre;
- d) engine control room;
- e) fire control station; and
- f) adjacent to the exit of fuel preparation rooms.

The gas compressor is also to be arranged for manual local emergency stop.

ADVISORY NOTE

All the above requirements are to be confirmed complied with.

Witness satisfactory operation of the requested Automatic shutdown of tank valve or Automatic shutdown of gas supply to machinery space containing gas-fuelled engines according to the specifications of the below:

Parameter	Alarm	Automatic shutdown of tank valve (6)	Automatic shutdown gas supply to machinery space containing gas-fuelled engines	Comments
Gas detection in tank connection space at 20% LEL	x			
Gas detection on two detectors (1) in tank connection space at 40% LEL	x	x		

Fire detection in fuel storage hold space	x			
Fire detection in ventilation trunk for fuel containment system below deck	x			
Bilge well high level in tank connection space	x			
<p>(1) Two independent gas detectors located close to each other are required for redundancy reasons. If the gas detector is of self monitoring type the installation of a single gas detector can be permitted</p> <p>(2) If the tank is supplying gas to more than one engine and the different supply pipes are completely separated and fitted in separate ducts and with the master valves fitted outside of the duct, only the master valve on the supply pipe leading into the duct where gas or loss of ventilation is detected is to close.</p> <p>(3) If the gas is supplied to more than one engine and the different supply pipes are completely separated and fitted in separate ducts and with the master valves fitted outside of the duct and outside of the machinery space containing gas-fuelled engines, only the master valve on the supply pipe leading into the duct where gas or loss of ventilation is detected is to close.</p> <p>(4) Only double block and bleed valves to close.</p> <p>(5) If the duct is protected by inert gas (see 9.6.1a)) then loss of inert gas overpressure is to lead to the same actions as given in this table.</p> <p>(6) Valves referred to in 9.4.1. (Fuel storage tank inlets and outlets are to be provided with valves located as close to the tank as possible. Valves required to be operated during normal operation which are not accessible are to be remotely operated. Tank valves whether accessible or not are to be automatically operated when the safety system required in 15.2.2 is activated).</p>				

4.5.5. Bunkering control

Tasneef Rules Pt C, Ch 1, App 7, [14.5.1]

Control of the bunkering is to be possible from a safe location remote from the bunkering station. At this location the tank pressure, tank temperature if required by 15.4.11, and tank level are to be monitored. Remotely controlled valves required by 8.5.3 and 11.5.7 are to be capable of being operated from this location. Overfill alarm and automatic shutdown are also to be indicated at this location.

Tasneef Rules Pt C, Ch 1, App 7, [14.5.2]

If the ventilation in the ducting enclosing the bunkering lines stops, an audible and visual alarm is to be provided at the bunkering control location, see also 15.8.

Tasneef Rules Pt C, Ch 1, App 7, [14.5.3]

If gas is detected in the ducting around the bunkering lines an audible and visual alarm and emergency shutdown is to be provided at the bunkering control location.

4.5.6. Bunkering manifold

Tasneef Rules Pt C, Ch 1, App 7 - [8.4.1]

The bunkering manifold is to be designed to withstand the external loads during bunkering. The connections at the bunkering station are to be of dry-disconnect type equipped with additional safety dry break-away coupling/ self-sealing quick release. The couplings are to be of a standard type.

ADVISORY NOTE

Witness satisfactory operation of the coupling and related additional safety device.

4.5.7. Gas detection

Tasneef Rules Pt C, Ch 1, App 7, [14.8.1]

Permanently installed gas detectors are to be fitted in:

- a) the tank connection spaces;*
- b) all ducts around fuel pipes;*
- c) machinery spaces containing gas piping, gas equipment or gas consumers*
- d) compressor rooms and fuel preparation rooms;*
- e) other enclosed spaces containing fuel piping or other fuel equipment without ducting;*
- f) other enclosed or semi-enclosed spaces where fuel vapours may accumulate including interbarrier spaces and fuel storage hold spaces of independent tanks other than type C;*
- g) airlocks;*
- h) gas heating circuit expansion tanks;*
- i) motor rooms associated with the fuel systems; and*
- j) or at ventilation inlets to accommodation and machinery spaces if required based on the risk assessment required in 4.2.*

Tasneef Rules Pt C, Ch 1, App 7, [14.8.2]

In each ESD protected machinery space, redundant gas detection systems provided.

Tasneef Rules Pt C, Ch 1, App 7, [14.8.3]

The number of detectors in each space is to be considered taking into account the size, layout and ventilation of the space.

Tasneef Rules Pt C, Ch 1, App 7, [14.8.4]

The detection equipment is to be located where gas may accumulate and in the ventilation outlets. Gas dispersal analysis or a physical smoke test is to be used to find the best arrangement.

Tasneef Rules Pt C, Ch 1, App 7, [14.8.5]

Gas detection equipment is to be designed, installed and tested in accordance with a recognized standard.

Tasneef Rules Pt C, Ch 1, App 7, [14.8.6]

An audible and visible alarm is to be activated at a gas vapour concentration of 20% of the lower explosion limit (LEL). The safety system is to be activated at 40% of LEL at two detectors (see footnote 1 in table 1).

Tasneef Rules Pt C, Ch 1, App 7, [14.8.7]

For ventilated ducts around gas pipes in the machinery spaces containing gas-fuelled engines, the alarm limit can be set to 30% LEL. The safety system is to be activated at 60% of LEL at two detectors (see footnote 1 in table 1).

Tasneef Rules Pt C, Ch 1, App 7, [14.8.8]

Audible and visible alarms from the gas detection equipment are to be located on the navigation bridge or in the continuously manned central control station.

Tasneef Rules Pt C, Ch 1, App 7, [14.8.9]

Gas detection required by this section is to be continuous without delay.

ADVISORY NOTE

Witness satisfactory operation of the Gas detection system according to the specific distribution of the detectors.

4.5.8. Pre sea trials of hazardous area installations

ADVISORY NOTE

Please refer to the whole IGF CODE CH. 11

Before the engine runs with LNG, inspect the integrity and correct installation of electrical equipment and cables in hazardous areas.

Witness insulation testing of all the circuits in hazardous area (terminating or passing through).

4.5.9. Pre sea trials for Control, Monitoring and Safety Systems

ADVISORY NOTE

Please refer to the whole IGF CODE CH. 15

Check by visual inspection all installed equipment, sensors and other equipment providing input to the gas safety system.

Witness satisfactory operation of alarms, instrumentation, gas control system(s), including manual and emergency operations and automatic control functions.

Checks the availability of power supplies.

4.5.10. Pre sea trials for LNG ventilation

ADVISORY NOTE

Please refer to the whole IGF CODE CH. 12

Check by visual inspection all installed equipment e.g. flow controller, sensors, electrical motors.

Before the engine runs with LNG, witness satisfactory operation of ventilation systems with all doors and openings of the corresponding room closed during the tests.

Check for each room/system air flow of all fans.

Witness satisfactory operation of alarms and shut-down in case of ventilation fans failure.

When required by the rules, check that the redundant fan system start immediately and that ventilation capacity is adequate after fail simulation of one fan or group of fans with common circuit.

Witness dampers testing, check by visual inspection "Open/Closed" indicators and their accessibility.

Witness satisfactory operation of automatic fail-safe fire dampers.

4.5.11. Pre sea trials for Inert Gas System

Tasneef Rules Pt C, Ch 1, App 7 – [6.13.1]

Arrangements to prevent back-flow of fuel vapour into the inert gas system are to be provided as specified below.

Tasneef Rules Pt C, Ch 1, App 7 – [6.13.2]

To prevent the return of flammable gas to any non-hazardous spaces, the inert gas supply line is to be fitted with two shutoff valves in series with a venting valve in between (double block and bleed valves). In addition, a closable non-return valve is to be installed between the double block and bleed arrangement and the fuel system. These valves are to be located outside non-hazardous spaces.

Tasneef Rules Pt C, Ch 1, App 7 – [6.13.3]

Where the connections to the fuel piping systems are nonpermanent, two non-return valves may be substituted for the valves required in 6.13.2.

Tasneef Rules Pt C, Ch 1, App 7 – [6.13.4]

The arrangements are to be such that each space being inerted can be isolated and the necessary controls and relief valves, etc. are to be provided for controlling pressure in these spaces.

Tasneef Rules Pt C, Ch 1, App 7 – [6.13.5]

Where insulation spaces are continually supplied with an inert gas as part of a leak detection system, means are to be provided to monitor the quantity of gas being supplied to individual spaces.

ADVISORY NOTE

Checks the availability of power supplies.

Check by visual inspection all the equipment i.e. sensors, cables, piping connections, valves.

Witness satisfactory operation of sensors and relevant alarms.

Check the safety shutdowns.

Witness product capacity, purity and the delivery pressure verification of Nitrogen.

5. Rules and guidelines for Sea trial tests

5.1. Sea trials tests for LNG fuel tanks

Tasneef Rules Pt C, Ch 1, App 7 – [15.5.1]

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- g) *The fuel containment system is to be inspected for cold spots during or immediately following the first LNG bunkering, when steady thermal conditions are reached. Inspection of the integrity of thermal insulation surfaces that cannot be visually checked is to be carried out in accordance with the requirements of the Society*

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ADVISORY NOTE

During the initial gas trials, the equipment and systems are to be confirmed for satisfactory operation, including associated controls, alarms and shutdowns. The tests are to be conducted in accordance with the testing procedure during gas trials.

Tests are to be performed at the minimum service temperature or a temperature very close to it.

Witness topping off process for gas fuel tanks including high level alarms activated during normal loading

5.2. Sea trials tests for LNG/NG piping systems

Tasneef Rules Pt C, Ch 1, Sec. 16 – [2.2.1]

Sea trials are to be conducted after the trials at the moorings and are to include the following:

- a) demonstration of the proper operation of the main and auxiliary machinery, including monitoring, alarm and safety systems, under realistic service conditions*
- b) check of the propulsion capability when one of the essential auxiliaries becomes inoperative*
- c) detection of dangerous vibrations by taking the necessary readings when required*
- d) checks either deemed necessary for ship classification or requested by the interested parties and which are possible only in the course of navigation in open sea.*

Tasneef Rules Pt C, Ch 1, Sec. 16 – [3.10.1]

During the sea trials, piping systems serving propulsion and auxiliary machinery, including the associated monitoring and control devices, are to be subjected to functional tests at the nominal power of the machinery. Operating parameters (pressure, temperature, consumption) are to comply with the values recommended by the equipment manufacturer.

Tasneef Rules Pt C, Ch 1, Sec. 16 – [3.10.2]

The Society reserves the right to require performance tests, such as flow rate measurements, should doubts arise from the functional tests.

5.3. Sea trials tests for LNG/NG equipment

ADVISORY NOTE

During Sea Trial, relevant data about LNG pumps, heaters, BOG compressors are to be collected according to the agreed testing plan.

Delivery system for LNG and BOG is to be checked and relevant values collected.

Switch over test between pumps in the LNG tank, combined configuration of vaporizers and pumps to engines, vaporizers and BOG compressors, LNG transfer between the tanks (both via pumps or pressure build up, if feasible) are to be carried out as well.

Alarm and shutdown pressure of the BOG compressors, including BOG compressor discharge pressure alarm and BOG compressor discharge pressure shut down are to be reported.

BOG production rate is to be evaluated.

The BOG compressor is to be inspected when it is running. It is possible to verify any leakage from the shaft seal and from the control piping circuit and ascertain the good working of all safety devices relevant to low pressure suction, high pressure delivery, high temperature, loss of lubrication, etc. It is also recommended to test the high temperature selected switch and verify the setting of the instrumentation.

Particular attention has to be paid to leakages from the seals in way the shaft penetration in the pump/compressor casing and to the operation of the automatic shutdown system requested for pumps/compressors in case the ESD system is activated.

During sea trials, the water glycol heating/cooling system (i.e.: heater, refrigerant, circulating pumps, low level alarm of the expansion tank, etc). is also to be checked.

The sea trial report, issued by the shipyard and signed by the surveyor in charge and the Owner's representative is to be submitted to our Office in charge for testing for review.

5.4. Sea trials tests for dual fuel engine and boilers

Tasneef Rules Pt C, Ch 1, Sec. 16 – [2.2.1]

Sea trials are to be conducted after the trials at the moorings and are to include the following:

- a) demonstration of the proper operation of the main and auxiliary machinery, including monitoring, alarm and safety systems, under realistic service conditions*
- b) check of the propulsion capability when one of the essential auxiliaries becomes inoperative*
- c) detection of dangerous vibrations by taking the necessary readings when required*
- d) checks either deemed necessary for ship classification or requested by the interested parties and which are possible only in the course of navigation in open sea.*

Tasneef Rules Pt C, Ch 1, Sec. 16 – [3.1.1]

Except in cases of practical impossibility, or in other cases to be considered individually, the sea trials are to be carried out at a displacement as close as possible to the deadweight (full load).

Tasneef Rules Pt C, Ch 1, Sec. 16 – [3.1.2]

- a) The power developed by the propulsion machinery in the course of the sea trials is to be as close as possible to the power for which classification has been requested. In general, this power is not to exceed the maximum continuous power at which the weakest component of the propulsion system can be operated. In cases of diesel engines and gas turbines, it is not to exceed the maximum continuous power for which the engine type concerned has been approved.*
- b) Where the rotational speed of the shafting is different from the design value, thereby increasing the stresses in excess of the maximum allowable limits, the power developed in the trials is to be suitably modified so as to confine the stresses within the design limits.*

Tasneef Rules Pt C, Ch 1, Sec. 16 – [3.1.3]

The rotational speed of the shafting is to be recorded in the course of the sea trials, preferably by means of a continuous counter.

In general, the power is to be determined by means of torsionometric readings, to be effected with procedures and instruments deemed suitable by the Society. As an alternative, for reciprocating

internal combustion engines and gas turbines, the power may be determined by measuring the fuel consumption and on the basis of the other operating characteristics, in comparison with the results of bench tests of the prototype engine. Other methods of determining the power may be considered by the Society on a case by case basis.

ADVISORY NOTE

In general, a dual fuel engine is to satisfy the same requirements as a standard internal combustion engine.

If the dual fuel engine is expected to be used in normal operation in all modes, i.e. fuel oil and gas, the requirements are to be met in all these modes.

Type testing and shop testing are to be as specified in Section 4-2-1. Dual fuel engines are to be so tested for both fuel modes. Tests performed are to demonstrate smooth changeover from gas to oil mode and from oil to gas mode at the test load points. The rapid (emergency) changeover testing is only required from gas to oil mode. The engine manufacturer is to specify the lowest permissible operating speeds for both oil and gas modes, and these speeds are to be demonstrated during the type tests.

An integration test is to be performed with the aim of demonstrating that the response of the engine as a whole, including mechanical, hydraulic and electronic system, is as predicted for all intended operational modes. In particular, the transients during changeover from oil to gas and vice versa are to be smooth and are not to cause power output transients not compatible with the continuity of the expected service.

The tests are to be carried out at the manufacturer's premises or during sea trials. The detailed scope of these tests is to be agreed with the Society for all the expected normal operational modes and for selected cases of abnormal scenarios based on the FMEA, according to the technology employed.

In case of shutoff of the gas fuel supply, the engines are to be capable of continuous operation by oil fuel only without interruption.

An automatic system is to be fitted to change over from gas fuel operation to oil fuel operation and vice versa with minimum fluctuation of the engine power. Acceptable reliability is to be demonstrated through testing. In the case of unstable operation on engines when gas firing, the engine shall automatically change to oil fuel mode. Manual activation of gas system shutdown shall always be possible.

In case of a normal stop or an emergency shutdown, the gas fuel supply is to be shut off not later than the ignition source. It shall not be possible to shut off the ignition source without first or simultaneously closing the gas supply to each cylinder or to the complete engine.

Dual-fuel type engines shall be capable of immediate change-over to oil fuel only. All starting is to be carried out on oil fuel only.

5.4.1. Navigation and manoeuvring tests

Tasneef Rules Pt C, Ch 1, Sec. 16 – [3.2.2]

- a) *The ability of the machinery to reverse the direction of thrust of the propeller in sufficient time, and so to bring the ship to rest within reasonable distance from maximum ahead service speed, shall be demonstrated and recorded.*

- b) *The stopping times, ship headings and distances recorded on trials, together with the results of trials to determine the ability of ships having multiple propellers to navigate and manoeuvre with one or more propellers inoperative, shall be available on board for the use of the Master or designated personnel.*

Where the ship is provided with supplementary means for manoeuvring or stopping, the effectiveness of such means shall be demonstrated and recorded as referred to in paragraphs a) and b).

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5.4.2. Inspection of machinery after sea trials

Tasneef Rules Pt C, Ch 1, Sec. 16 – [4.1.1]

- a) *For all types of propulsion machinery, those parts which have not operated satisfactorily in the course of the sea trials, or which have caused doubts to be expressed as to their proper operation, are to be disassembled or opened for inspection. Machinery or parts which are opened up or disassembled for other reasons are to be similarly inspected.*
- b) *Should the inspection reveal defects or damage of some importance, the Society may require other similar machinery or parts to be opened up for inspection.*
- c) *An exhaustive inspection report is to be submitted to the Society for information.*

Tasneef Rules Pt C, Ch 1, Sec. 16 – [4.2.1]

- a) *In general, for all diesel engines, the following items are to be verified:*
- the deflection of the crankshafts, by measuring the variation in the distance between adjacent webs in the course of one complete revolution of the engine*
 - the cleanliness of the lubricating oil filters.*
- b) *In the case of propulsion engines for which power tests have not been carried out in the workshop, some parts, agreed upon by the interested parties, are to be disassembled for inspection after the sea trials.*

5.5. Sea trials tests for auxiliaries

5.5.1. Sea trials of hazardous area installations

ADVISORY NOTE

In ESD-protected machinery spaces, simulation tests is to be carried out in order to check the correct de-energising of all the electrical equipment which are not certified for use in hazardous area under normal operating conditions. After the tests correct operation of lighting and ventilation fans are to be verified.

Simulation tests of correct de-energising of all the electrical equipment which are not certified for use in hazardous area associated with pressurised spaces are to be tested for correct operation under normal operating conditions.

5.5.2. Sea trials for Control, Monitoring and Safety Systems

ADVISORY NOTE

Please refer to the whole IGF CODE CH. 15

A sea trial program in written form with all required tests has to be issued by the shipyard and submitted to the surveyor in charge.

The sea trial report, issued by the shipyard and signed by the surveyor in charge and the Owner's representative is to be submitted to our Office in charge for testing for review.

The sea trials reports is to be issued in order to verify the satisfactory operation of control, monitoring, alarms and safety systems under normal operating conditions.

5.5.3. Sea trials for LNG ventilation

ADVISORY NOTE

Please refer to the whole IGF CODE CH. 13

A sea trial program in written form with all required tests has to be issued by the shipyard and submitted to the surveyor in charge.

The sea trial report, issued by the shipyard and signed by the surveyor in charge and the owner's representative is to be submitted to our Office in charge for testing for review. The sea trials reports is to be issued in order to verify proper working of ventilation systems and satisfactory operation of alarms and shut-down under normal operating conditions.

5.5.4. Sea trials for Inert Gas System

Tasneef Rules Pt C, Ch 1, App 7 – [6.13.1]

Arrangements to prevent back-flow of fuel vapour into the inert gas system are to be provided as specified below.

Tasneef Rules Pt C, Ch 1, App 7 – [6.13.2]

To prevent the return of flammable gas to any non-hazardous spaces, the inert gas supply line is to be fitted with two shutoff valves in series with a venting valve in between (double block and bleed valves). In addition, a closable non-return valve is to be installed between the double block and bleed arrangement and the fuel system. These valves are to be located outside non-hazardous spaces.

Tasneef Rules Pt C, Ch 1, App 7 – [6.13.3]

Where the connections to the fuel piping systems are nonpermanent, two non-return valves may be substituted for the valves required in 6.13.2.

Tasneef Rules Pt C, Ch 1, App 7 – [6.13.4]

The arrangements are to be such that each space being inerted can be isolated and the necessary controls and relief valves, etc. are to be provided for controlling pressure in these spaces.

Tasneef Rules Pt C, Ch 1, App 7 – [6.13.5]

Where insulation spaces are continually supplied with an inert gas as part of a leak detection system, means are to be provided to monitor the quantity of gas being supplied to individual spaces.

ADVISORY NOTE

A sea trial program in written form with all required tests has to be issued by the shipyard and submitted to the surveyor in charge.

The sea trial report, issued by the shipyard and signed by the surveyor in charge and the Owner's representative is to be submitted to our Office in charge for testing for review

The sea trials reports is to be issued in order to verify proper working of nitrogen system and satisfactory operation of alarms and shut-down under normal operating conditions.