GUIDANCE NOTES
GD07-2015

CHINA CLASSIFICATION SOCIETY

Guidelines for Natural Gas Fuel Ready Ships

Effective date: 1st July 2015

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Foreword

More and more strict requirements of emission control for air pollution from ships specified by the international conventions, codes and the relevant regulations and rules of regions and countries promote the shipbuilding industry to vigorously carry out the research for various technologies and means to reduce the emission of NO_x/SO_x/PM from ships and raise the ship's energy efficiency, such as applying of low sulfur fuel oils, post-treatment of exhaust gases, alternative cleaner fuels, etc. However, with the rapid development of global emission control areas, especially in 2020, the implementation of the global 0.5% sulfur limit for ships engaged on international voyages will lead to the shortage of low sulfur fuel supply and the raising of fuel cost, therefore, the application of natural gas fuel becomes one of the main alternative programs for the shipowners and designers.

Note: A panel has been established by IMO to carry out the analysis and estimation for fuel supply and demand in global marketing, as well as the trend of development, so as to determine the availability of fuel with such sulfur content. If it is determined that the ship is infeasible to meet the requirement at that time, the fuel limit of 0.50% m/m sulfur content will be taken into force on 1st January 2025. However, the EC directive has defined that such criteria will be implemented compulsorily in 2020.

Due to the uncompleted bunkering infrastructure and network layout currently, the price trend of natural gas fuel is still uncertainty in future, the natural gas fuel used for ships involves the design and arrangement of natural gas fuel containment system, hull structure strengthening and low temperature protection, natural gas fuel processing and supply system, natural gas fuel equipment, design safety of engine room, etc. If these factors have not been considered in ship's design and construction, difficulties and problems will be met when the natural gas fuel powered system onboard the ship is converted in future, for this purpose, more and more shipowners and designers are seeking for a more flexible design program, i.e. natural gas fuel ready system, which intends to still use the traditional fuel powered system but meanwhile consider the approaching conversion demand for natural gas fuel powered system in ship's design and construction, the structures, systems, machinery and electrical equipment related to natural gas fuel storage and usage have partially or wholly been considered in accordance with the relevant requirements of CCS rules, as to facilitate future conversion to natural gas fuel powered system.

Based on the demands of this special design program, CCS has identified the technical issues on ship's design, construction/conversion, installation and survey which are to be taken into consideration, and developed the Guidelines as a supplement to CCS rules, which intends to define the technical requirements related to the natural gas fuel ready system and provide a guidance for ship's design, construction/conversion, survey, etc.

CHAPTER 1 GENERAL

1.1 Application

1.1.1 The Guidelines applies to the program of natural gas fuel ready ships.

1.1.2 The Guidelines intends to define the technical requirements of the program of natural gas fuel ready ships.

1.1.3 In addition to the relevant requirements of the Guidelines, the design, re-construction and future conversion of natural gas fuel ready ships are to meet the requirements of CCS Rules for Classification of Sea-going Steel Ships, Rules for Materials and Welding, Rules for Natural Gas Fuelled Ships and the relevant requirements of regulations, conventions and codes.

1.1.4 For a ship assigned with the class notation of DFDR (m) in accordance with the requirements of the Guidelines, unless expressly provided otherwise by the Administration, where the main engine onboard is converted to a dual fuel engine, it may not be regarded as a major conversion.

1.2 Definition

1.2.1 Natural gas fuel ready ship means it has taken the application of natural gas fuel into consideration in ship's design, although oil fuel powered system is still used for construction and operation after construction, the conversion of natural gas powered system is planned to carry out in future, and the hull structures, machinery and electrical equipment and the systems related to the natural gas fuel storage and usage have partially or wholly meet the requirements of natural gas fuel powered system in ship's construction.

1.2.2 The other definitions for terms used in the Guidelines refer to 1.1.3 of Section 1, Chapter 1 in CCS Rules for Natural Gas Fuelled Ships.

1.3 Class Notation

1.3.1 The class notation of natural gas fuel ready system is to be of DFDR (Dual Fuel Design Ready). According to the different extents of design and construction of natural gas fuel ready ship when the dual fuel ready is delivered, the corresponding suffixes are to be given, i.e. DFDR (X_1,…,X_N). The intention of X_N refers to Table 1.

Class Notation of DFDR **Table 1**

X_N	Intention	Remark	Requirement
H	Indicating that the hull structures have been strengthened in accordance with the relevant requirements of natural gas fuel powered ships	Optional	2.2
T	Indicating that the natural gas fuel containment system (bunkers/fuel tanks) and its supporting members have been installed	Optional	2.3
M	Indicating that the main engine installed in ship's construction is a dual fuel engine	Alternative	2.4
m	Indicating that the main engine installed in ship's construction may be converted to a dual fuel engine in future		2.5
A	Indicating that the auxiliary engine installed in ship's construction is a dual fuel engine	Optional	2.6
a	Indicating that the auxiliary engine installed in ship's construction may be converted to a dual fuel engine in future		2.7

B	Indicating that the boiler installed in ship's construction is a dual fuel boiler	Optional	2.8
P	Indicating that the arrangement in ship's construction has been considered the approaching installation of natural gas fuel supply system and related to, including the arrangement of piping, bunkering station, compressor room, gas valve unit, fire-fighting system, etc.	Optional	2.9
E	Indicating that the power distribution system has been reserved for the equipment related to natural gas fuel powered system in ship's construction	Optional	2.10
D	Indicating that the gas dangerous zones have been taken into consideration in ship's construction	Optional	2.11

1.3.2 For a ship applying for the class notation of DFDR, a Document of Compliance for the natural gas fuel ready ship will be issued provided that plan approval and/or survey is to the satisfaction of CCS.

1.3.3 For a specific ship which has applied for the class notation of DFDR, a class notation of Dual Fuel, CNG Fuel or LNG Fuel may not be applied in the meantime.

1.3.4 The class notation of Dual Fuel, CNG Fuel or LNG Fuel, whichever is applicable, is to be assigned to a dual fuel ready ship after it is converted to the dual fuel ship in compliance with the requirements of Rules for Natural Gas Fuelled Ships and its construction has been surveyed to the satisfaction of CCS, and the class notation of DFDR is to be withdrawn.

CHAPTER 2 REQUIREMENTS OF NATURAL GAS FUEL READY SYSTEM

2.1 General Requirements

2.1.1 The effects due to the installation of fuel tanks during the future conversion of natural gas power system for the natural gas fuel ready ship are to be fully considered in design and construction. The stability, hull strength, relevant equipment and system arrangement under the following three potential operation conditions are to be taken into consideration:

(1) Single oil fuel powered system is provided when the dual fuel ready ship is delivered;

(2) Natural gas fuel powered system is provided when the dual fuel ready ship is converted , but oil fuel powered system is used during the operation;

(3) Natural gas fuel powered system is provided when the dual fuel ready ship is converted, and natural gas fuel powered system is used during the operation.

2.2 Requirements of Hull Structure Strengthening (H)

2.2.1 In the design and construction of the dual fuel ready ships, the potential three operation conditions as defined in 2.1.1 are to be considered. The hull girder strength and cargo hold structure strength considering fuel tanks are to meet the relevant requirements of Chapter A4, Appendix 1 and Chapter 4 of CCS Rules for Construction and Equipment of Ships Carrying Liquefied Gases in Bulk.

2.2.2 As the temperature of hull structure will affect the selection of material grades, appropriate thermal analysis is to be carried out for the hull structures close to natural gas fuel storage tank boundaries in accordance with Ch.4 4.8 of CCS Rules for Construction and Equipment of Ships Carrying Liquefied Gases in Bulk. Based on the analysis result, materials of the hull structures are to be selected and designed in accordance with Ch.6 Table 6.5 of CCS Rules for Construction and Equipment of Ships Carrying Liquefied Gases in Bulk. At the design and construction stage, when the thermal analysis cannot be carried out due to the lack of actual design parameters of natural gas fuel storage tanks, the material grade may be selected for the hull structures base on pre-defined design temperature. During the later retrofit installation of natural gas fuel storage tanks, the thermal analysis must be carried out as appropriate and the temperature of the hull structures is not to be lower than the pre-defined design temperature.

2.3 Requirements of Natural Gas Fuel Containment System (T)

2.3.1 The natural gas fuel ready containment system is to be incompliance with the relevant requirements of Chapter 5 in CCS Rules for Natural Gas Fuelled Ships.

2.3.2 The related arrangement and strength after the natural gas fuel is used, including the arrangement of fuel tanks, local supporting structure strengthening, structure strengthening in special zones and etc. are to meet the relevant requirements of Chapter A4, Appendix 1 and Chapter 4 in CCS Rules for Construction and Equipment of Ships Carrying Liquefied Gases in Bulk. Where the construction of local supporting structure strengthening of fuel storage tanks is considered difficult for the future conversion of ship, it may be taken into account in 2.2 Requirements of Hull Structure Strengthening.

2.4 Requirements of Dual-Fuel Main Engine (M)

2.4.1 In addition to the relevant requirements of diesel engines in Chapter 9, PART THREE of CCS Rules for Classification of Sea-going Steel Ships, the dual fuel main engine is to meet the requirements of gas fuelled engines in Chapter 11 of CCS Rules for Natural Gas Fuelled Ships.

2.5 Requirements of Converted Dual-Fuel Main Engine (m)

2.5.1 Prior to the conversion, the main engine is to meet the relevant requirements of Chapter 9, PART THREE of CCS Rules for Classification of Sea-going Steel Ships, and the relevant documents showing that it can be converted to dual fuel engine are to be submitted.

2.5.2 The converted main engine is to be capable of matching with the original propulsion system.

2.6 Requirements of Dual-Fuel Auxiliary Engine (A)

2.6.1 In addition to the relevant requirements of diesel engines in Chapter 9, PART THREE of CCS Rules for Classification of Sea-going Steel Ships, the dual fuel auxiliary engine is to meet the requirements of gas fuelled engines in Chapter 11 of CCS Rules for Natural Gas Fuelled Ships.

2.7 Requirements of Converted Dual-Fuel Auxiliary Engine (a)

2.7.1 Prior to the conversion, the auxiliary engine is to meet the relevant requirements of Chapter 9, PART THREE of CCS Rules for Classification of Sea-going Steel Ships, and the relevant documents showing that it can be converted to dual fuel engine are to be submitted.

2.7.2 The power of auxiliary engine after conversion is to meet the demands for capacity of power station onboard ship.

2.8 Requirements of Dual-Fuel Boiler (B)

2.8.1 In addition to the applicable boiler requirements in Chapter 6, PART THEE of CCS Rules for Classification of Sea-going Steel Ships and International Code of Safety for Ships Using Gases or Other Low-flashpoint Fuels (IGF Code), the dual fuel boiler is to meet the relevant requirements on natural gas fuel usage provided by the manufacturer.

Note: The drafted IGF Code has been adopted by IMO MSC 94, although it has not been taken into force, the technical requirements of dual fuel boiler may be referred to.

2.9 Requirements of Piping System (P)

2.9.1 In the design and construction of the dual fuel ready ships, the machinery space is to be so arranged to fully consider the approaching conversion type of natural gas fuel powered system. The machinery space is generally to be of three power system arrangement types, such as gas safe machinery space, ESD protective machinery space and enhanced safety machinery space. The concerned power system arrangement types are to meet the relevant requirements of Power System Arrangement in Section 1, Chapter 3 of CCS Rules for Natural Gas Fuelled Ships.

2.9.2 The gas supply system for the approaching converted gas safe machinery space is to specially consider of design and arrangement for double-wall pipe of natural gas fuel piping and double-wall piping ventilation or inerting, and adequate spaces are to be reserved so as to install

the relevant equipment and piping. The gas supply of gas safe machinery space is to meet the relevant requirements of Section 3, Chapter 4 in CCS Rules for Natural Gas Fuelled Ships.

2.9.3 The natural gas bunkering station is to be so arranged to fully consider the approaching refilling methods and adequate space is to be reserved for the arrangement of bunkering station, meanwhile, low-temperature preventive measures (such as water curtain and protective cover) and relevant fire-fighting requirements are to be taken into consideration. The gas bunkering station is to be arranged in accordance with the relevant requirements of Refueling of Gas Fuels in Chapter 6 of the Rules for Natural Gas Fuelled Ships.

2.9.4 The natural gas fuel piping is to be so designed and installed to fully consider the type and location of gas valve unit and adequate space is to be reserved according to the type. The gas valve manifolds are to meet the relevant requirements of Section 2, Chapter 4 in the Rules for Natural Gas Fuelled Ships.

2.9.5 If pump/compressor room is provided, corresponding space is to be reversed for arrangement, and ventilation of pump/compressor room is to be considered. The pump/compressor room is to be so arranged to meet the requirements of 2.2.4 in Chapter 2 of the Rules for Natural Gas Fuelled Ships, and the ventilation is to comply with the relevant requirements of Section 5, Chapter 7 in the Rules.

2.10 Requirements of Power Distribution System (E)

2.10.1 In the design and construction of the dual fuel ready ships, the relevant electrical equipment, such as compressor, inert gas system, etc. of natural gas supply system is to be fully taken into considered to reserve adequate capacity of the power station onboard the ships, so that it is unnecessary to add the number or capacity of generators after such equipment has been installed, at meanwhile, spaces of power supply switches for such equipment are to be reserved in the switchboard or power distribution box.

2.11 Requirements of Gas Dangerous Zone (D)

2.11.1 In the design and construction of the dual fuel ready ships, locations of natural gas fuel tanks and their vents, gas fuel compressor rooms and their vents, ventilation outlets of double-wall pipes, interlock valve outlets, etc. are to be fully taken into consideration. The gas dangerous zones are to be classed according to the requirements of Chapter 9 in CCS Rules for Natural Gas Fuelled Ships, the entrances and exits of safety zones, such as superstructures, engine rooms, etc. are to be avoided being located in the dangerous zones.

CHAPTER 3 PLANS AND DOCUMENTS

3.1 General Requirements

3.1.1 For the ships intended to apply for natural gas fuel ready system, at least the following plans and documents are to be submitted:

(1) General arrangement and capacity plans before and after conversion;

(2) Arrangement of engine room before and after the conversion;

(3) Loading manuals typical conditions and damage stability calculations of under the required three potential operation conditions required in 2.1.1;

(4) Tonnage calculations, equipment number calculations (if necessary);

(5) Arrangement of natural gas fuel tanks and the relevant calculations;

(6) Specifications of machinery installations (including main engine, auxiliary engine, boiler, piping system, etc.);

(7) Specifications of design and arrangement of natural gas fuel ready system.

3.2 Other Plans and Documents Related to Natural Gas Fuel Ready System

3.2.1 Based on the different extents of natural gas fuel ready system in design and construction of natural gas fuel ready ship, the following relevant plans and documents are to be submitted.

3.2.2 Hull structure strengthening (H) and natural gas fuel containment system (T).

(1) Internal pressure, sloshing, filling limits calculations of natural gas fuel tanks;

(2) Structure details of fittings and supporting members for natural gas fuel tanks and the strength evaluation report;

(3) Specifications of material grades.

3.2.3 Main engine and auxiliary engine systems (m and a)

(1) Conversion specifications for dual fuel main engine and auxiliary engine systems in future.

3.2.4 Piping system (P), the following plans are at least to include the information on arrangement and space of the related systems.

(1) Natural gas fuel piping system;

(2) Ventilation system (related to natural gas fuel);

(3) Degassing and inert gas purging system;

(4) Natural gas fuel heating system;

(5) Venting system (related to natural gas fuel);

(6) Fire-fighting system (related to natural gas fuel);

(7) Gas detection system.

3.2.5 Power distribution system (E)

(1) Electric power system plan and single line plan (including parameters of power supply switches of related electrical equipment, type of cables, sectional areas, etc. for natural gas fuel supply system);

(2) Electric power load calculations (including rated power, operating condition of related electrical equipment for natural gas fuel supply system, etc.).

3.2.6 Dangerous zones (D)

(1) Classification of dangerous zones;

(2) Arrangement of mechanical ventilation for dangerous zones;

(3) Fire structure plan for the arrangement of gas tanks and bunkering station.

3.3 Conversion Plans and Documents of Natural Gas Fuel Powered System

3.3.1 In ship's conversion, the relevant plans and documents involved the conversion of natural gas fuel powered system are to be submitted to CCS for examination.

CHAPTER 4 SURVEYS

4.1 General Requirements

4.1.1 All survey procedures, methods, types, intervals, conditions, preparations before survey, inspection and test requirements and ship's drawings, information, certificates, records, reports, etc. are to be maintained in compliance with the relevant requirements of CCS Rules for Classification of Sea-going Steel Ships or of Regulations for Classification of Sea-going Ships Engaged on Domestic Voyages or of Rules for Classification of Ships Engaged on Inland Waters.

4.2 Special Requirements

4.2.1 The survey during construction for the dual fuel ready ships is to meet the relevant requirements of 1.4.2 in Chapter 1 of CCS Rules for Natural Gas Fuelled Ships.