



**GUIDANCE NOTES  
GD21-2016**

**CHINA CLASSIFICATION SOCIETY**

**GUIDELINES FOR SELECTIVE CATALYTIC REDUCTION  
SYSTEM READY**

**(2016)**

**Effective from 1 November 2016**

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## Preface

The Marine Environment Protection Committee under the International Maritime Organization adopted, at its 66<sup>th</sup> session, the amendments to MARPOL Annex VI and the NO<sub>x</sub> Technical Code 2008 by the Resolution MEPC.251(66), which took effect on September 1<sup>st</sup>, 2015.

Through the review on the development status of the Tier III technology and repeated discussion, MEPC 66 finally decided on the time of implementation of Tier III NO<sub>x</sub> emission standards, which apply to:

(1) a diesel engine installed on a ship constructed on or after 1 January 2016 and operating in the North American Emission Control Area or the United States Caribbean Sea Emission Control Area;

(2) a diesel engine installed on a ship operating in an emission control area designated for Tier III NO<sub>x</sub> control, other than the North American Emission Control Area or the United States Caribbean Sea Emission Control Area, and constructed on or after the date of adoption of such an emission control area, or a later date as may be specified in the amendment designating the NO<sub>x</sub> Tier III emission control area, whichever is later.

Tier III emission limits reduced by around 80% compared to Tier I limits. Currently individual technologies that can meet Tier III emission standards and are relatively mature include SCR (selective catalytic reduction) technology, EGR (Exhaust Gas Recirculation) technology and low pressure injection LNG engines. The SCR technology does not affect the basic performance of engines and has a wide range of application, thus it is one of the most promising Tier III NO<sub>x</sub> emission reduction technologies.

Although Tier III standards only apply to newbuildings, it cannot be excluded the possibilities that the ships built after January 1<sup>st</sup> 2016 or after the date of entry-into-force of other emission control areas may change their routes and enter NO<sub>x</sub> emission control areas. Such ships may use the SCR technology to reach Tier III NO<sub>x</sub> emission standards, which involves the design and arrangements in various respects including the SCR chamber, reductant storage and supply systems, hull structure strengthening, stability and engine room safe design, etc. If consideration is not given to these factors in ship design and construction stage, a lot of difficulties and problems may occur in subsequent arrangement of an SCR system. Therefore, an increasing number of ship owners and designers are intended to seek a more flexible design plan, i.e. pre-design and arrangement of an SCR system. A conventional Tier II engine is still intended to be used in the ship design and construction stage, but in the same time consideration is also given to the need of future installation of an SCR system, e.g. the structures, systems and machinery and electrical installations related to SCR reductant storage and usage have completely or partially pre-designed and pre-arranged according to the relevant rules requirements of CCS, so as to facilitate future installation of SCR systems.

Based on the needs for the above special design plan, CCS has identified the technical issues that are to be taken into account in ship design, construction/conversion, installation and arrangement, and surveys, etc. and developed the Guidelines as the supplement to CCS rules, with an aim to

specify the technical requirements related to the SCR ready plan and provide guidance for ship design, construction/conversion and surveys.

## Chapter 1 General

### 1.1 Scope of application

1.1.1 The Guidelines apply to newly constructed ships for which an SCR ready plan is adopted and installation of an SCR system is intended in the future.

1.1.2 The Guidelines only provide basic requirements on SCR system design, installation and arrangement and interface, etc. for ships adopting an SCR system ready plan.

1.1.3 The components/equipment of an SCR system that have been pre-installed during the ship construction stage are to comply with the relevant requirements of the Guidelines for Application of Selective Catalytic Reduction (SCR) System Onboard Ships and the Guidelines for Approval and Surveys of Selective Catalytic Reduction (SCR) System developed by China Classification Society (hereinafter referred to as CCS).

1.1.4 In addition to complying with the relevant requirements of the Guidelines, the SCR system ready is also to comply with the applicable requirements of CCS Rules for Classification of Sea-going Steel Ships, Rules for Materials and Welding, and relevant laws, regulations and conventions.

### 1.2 Definitions and Abbreviations

1.2.1 For the purpose of the Guidelines, the following definitions apply:

(1) *SCR system ready* means that the design and arrangement related to the application of an SCR system onboard has been taken into consideration during the ship construction stage, and the space for installation of primary equipment and system interface has been reserved for future installation of the SCR system.

(2) *SCR system* means a system consisting of a reductant supply system, an SCR chamber, and an electric control system. If a separate compressed air system and a mixer are provided, they are also regarded as a part of the SCR system.

(3) *Reductant injection system* means a system, which consists of the pump(s) to supply reductant to the nozzle(s), the nozzle(s) spraying reductant into the exhaust gas stream and control device(s) of the spray.

(4) *Reductant supply system* means a system consisting of reductant storage/preparation tank, reductant supply piping system and reductant injection system.

(5) *Catalyst block* means a block of certain dimension through which exhaust gas passes and which contains catalyst composition on its inside surface to reduce NO<sub>x</sub> from exhaust gas.

(6) *SCR chamber* means an integrated unit, which contains the catalyst block(s), and into which flows exhaust gas and reductant.

(7) *SCR electric control system* means a system to realize the function of reductant injection volume control, system state monitoring and safe protection, etc., which mainly consists of sensors, electronic control unit, actuator and external interface.

1.2.2 For the purpose of the Guidelines, the following abbreviations apply:

(1) SCR: Selective Catalytic Reduction;

(2) SCRS: Selective Catalytic Reduction Systems;

(3) NO<sub>x</sub>: nitrogen oxide;

(4) GPS: Global Positioning System.

1.2.3 For other terms, definitions, abbreviations and nomenclatures involved in the Guidelines,

please refer to the requirements of the Guidelines for Application of Selective Catalytic Reduction (SCR) System Onboard Ships, Chapter 1, 1.3 and the Guidelines for Approval and Surveys of Selective Catalytic Reduction (SCR) System, Chapter 1, 1.4.

### 1.3 Class notation

1.3.1 Upon the request of the ship owner or ship yard/designer and satisfactory plan approval by CCS, the class notation SCR Ready(X) may be assigned according to the reductant type of the pre-designed SCR system. The meaning of X is given in Table 1.

Table 1 Class Notation SCR Ready (X)

Symbol		Meaning	Remarks
X	U	SCR with reductant using aqueous urea solution	either of the two should be selected
	A	SCR with reductant using aqueous ammonia	

Note: an example of the class notation SCR Ready is as follows:

SCR Ready (U) ----- means that the ship is intended to install an SCR system with reductant using aqueous urea solution. The plans and documents related to installation, design and arrangement of the SCR system onboard have been examined. Installation space and system interface for primary equipment have been reserved and are suitable for future installation and modification onboard.

1.3.2 After the class notation SCR Ready (X) is assigned and before the installation and modification of SCR system onboard, if the ship has undergone other conversion which leads to the change of the plans and documents as specified in 1.4 of this Chapter, such changed plans need be submitted to CCS for review.

1.3.3 Upon completion of installation and modification of the SCR system onboard and after surveys by CCS showing that relevant requirements of the Guidelines for Application of Selective Catalytic Reduction (SCR) System Onboard Ships, relevant provisions of the Guidelines for Testing and Survey of Emission of Nitrogen Oxides from Marine Diesel Engines in force, and applicable IMO requirements including Resolution MEPC.198(62) are complied with, the class notation NEC(SCRS) may be assigned and the notation SCR Ready(X) is to be withdrawn.

### 1.4 Plans and Documents

1.4.1 For a ship intended to apply for SCR Ready, the following plans and documents related to the SCR system ready are to be submitted:

- (1) instructions of SCR system ready, including working principles and processes, main performance and specification of the SCR system, treatment capacity of the SCR system, compatibility of the SCR system with the engine, etc.;
- (2) information on reductant, including the corrosion, toxicity, flammability, chemical reaction, etc. as well as the relevant limitation conditions for its storage, transfer, disposal and usage;
- (3) arrangement of equipment related to the SCR system, including a list of SCR-related equipment;
- (4) arrangement of reductant storage tank and related calculations, including capacity calculation;
- (5) installation and arrangement of the SCR chamber, including exhaust gas collection device (if applicable), bypass and isolation devices (if installed), and soot blower (if applicable), etc.;
- (6) arrangement of the reductant filling station (if applicable);
- (7) piping diagram related to the SCR system;
- (8) electrical load calculations, including rated power and operating condition of electrical installations related to the SCR system;

(9) diagrams of power systems and single line diagram of main switchboard related to the SCR system, including parameters of breakers, type and cross section of cables of electrical installations related to the SCR system;

(10) arrangement of electrical equipment related to the SCR system, including control cabinets, pumps, fans, emergency shutdown devices of the SCR system;

(11) other necessary plans and documents.

1.4.2 If the SCR chamber or reductant storage tank is of a big size (e.g. in case of engineering ships long-termly operating within ECA area) which may affect the longitudinal strength and/or stability of the ship, the following plans and documents related to the SCR system are to be additionally submitted:

(1) assessment of the effect on ship's longitudinal strength after installation of the SCR system;

(2) plans of supporting structures of SCR chamber and assessment of local strength and vibration;

(3) stability calculation information related to SCR system ready, including estimation of the weight and center of gravity of the SCR system and its relevant hull structures, capacity plan/table (if applicable), calculation of loading conditions (if applicable), damage stability calculations (if applicable), tonnage calculations (if applicable).

1.4.3 For plans and documents related to other conventional systems and/or equipment of a ship used also for the SCR system, plan approval and surveys are to be carried out in accordance with class requirements.

1.4.4 The components/equipment of the SCR system which have been pre-installed are to be clearly identified on the submitted plans and documents (e.g. the pre-designed reductant tank) and inspected in accordance with relevant requirements.

## **Chapter 2 SCR System Ready Requirements**

### **2.1 General requirements**

2.1.1 For an SCR system ready ship, full consideration is to be given to the influence on the ship before and after the arrangement of the SCR chamber, reductant storage tank and supply system during the ship design and construction stage.

2.1.2 In order to ensure that the space, location and interface reserved at the construction stage of a ship are suitable for the installation and modification of the SCR system on board in the future, the SCR system ready plan is to be developed based on a product with finalized design instead of a prototype product or a novel design, unless such design has obtained qualified third-party certification. When the SCR system is installed on board in the future, similar systems may be selected for replacement and the plans and documents of such systems are to be submitted.

2.1.3 Consideration is to be given to the compatibility between the SCR system and the main and auxiliary engines for which the system is intended.

2.1.4 The intended type of connection of the SCR system to the main and auxiliary engines is to be specified. Consideration is to be given to necessary measures to be taken to ensure that the backpressure of all connected engines can remain within the limits stated by the manufacturer.

2.1.5 The reductant intended to be used for the SCR system is to be specified. The material of the relevant pipings and equipment of the SCR system is to be suitable to the characteristics of the medium coming into contact with them and working conditions.

2.1.6 For SCR system ready, consideration is to be given to the needs of system operation and maintenance in addition to the needs of installation and arrangement of the system and equipment.

### **2.2 Matching design**

2.2.1 When developing the SCR system ready plan, factors such as the mass flow rate, temperature and pressure of the exhaust gas of the designated main and auxiliary engines onboard, sulfur content in the fuel used, backpressure, etc. are to be comprehensively considered in order to ensure that the SCR system intended to be installed is capable of effective treatment of the maximum mass flow rate of exhaust gas generated in various conditions and operating modes from the connected engines.

2.2.2 In case of multiple engines sharing one SCR system for exhaust gas treatment onboard, if not all of the engines connected with the system work simultaneously in actual operation, the exhaust gas treatment capacity of the SCR system can be determined according to the sum total of the maximum possible exhaust gas in actual operation.

### **2.3 Exhaust system**

2.3.1 The pressure resistance of the SCR chamber is to be analyzed in accordance with the connection method and operation conditions of the SCR system and the main and auxiliary engines, in order to assess whether the exhaust backpressure of all connected engines, after installation of the SCR system, can remain within the limits stated by the manufacturer. Where other after-treatment devices (e.g. EGC) are installed or intended to be installed in the future in addition to the SCR system, the assessment of backpressure is also to take into account the effect of such devices.

2.3.2 Where exhaust gas fans need to be fitted to maintain the required exhaust backpressure of the connected engines upon assessment, the information on the provision of such fan is to be indicated in the ready plan. The provision of the fan is to take into account of the means to ensure the continued operation of the engines in case of failure of the fan, e.g. provision of standby fans

or other equivalent measures.

2.3.3 If the connection of an SCR system to multiple engines is intended, consideration is to be given to the provision of effective isolation devices in order to prevent the exhaust gas from flowing back to the stopped or operating engines.

## **2.4 Structure and strength**

2.4.1 The effect of the installation of SCR system on hull girder strength is to be considered.

2.4.2 The supporting to the SCR chamber and the reductant storage tank is to be considered.

2.4.3 Structural strengthening as mentioned in 2.4.2 may be pre-installed in order to facilitate the future installation of the SCR system.

## **2.5 Subdivision and stability**

2.5.1 The influence on the lightship weight and center of gravity after installation of the SCR system is to be assessed.

2.5.2 The subdivision and stability of the ship after the installation of the SCR system are to be assessed.

## **2.6 SCR chamber**

2.6.1 Sufficient space is to be reserved for the installation and arrangement of the SCR chamber. In arranging such reserved space, consideration is to be given to the need for installation of the inlet pipe section of sufficient length for the SCR chamber, the mixer (if provided), bypass and isolation devices (if provided), exhaust gas collection device (if provided), heat exchanger (if provided) and soot blower (if provided), in addition to fulfill the geometry of the catalyst block.

2.6.2 Sufficient space is to be reserved around the SCR chamber, in order to facilitate the change, servicing, repair, maintenance and cleaning of the catalyst block and other components of the SCR chamber.

## **2.7 Storage of reductant**

2.7.1 Sufficient space is to be reserved for the arrangement of the reductant tank. Such space is not to be located at the control station, accommodation and service spaces.

2.7.2 The reductant tank is not to be arranged over boilers or hot surfaces required to be insulated, nor is it to be arranged in the adjacent of vapor piping and exhaust piping.

2.7.3 As too high or low temperature will affect the performance of the reductant, consideration is to be given to the provision of necessary temperature control system for the reductant tank according to the routes or operation area of the ship and the storage temperature range of the reductant.

2.7.4 If an SCR system using aqueous ammonia as the reductant is intended in the SCR ready plan, the tank in which the aqueous ammonia storage tank and aqueous ammonia injection system is arranged (hereinafter referred to as the aqueous ammonia tank) is to be a separate compartment, isolated by gastight bulkheads and decks, for the prevention of leakage of aqueous ammonia into other compartments. Consideration is also to be given to the provision of the means of access/passage to the aqueous ammonia tank and space is to be reserved for this purpose.

2.7.5 If an SCR system using aqueous ammonia as the reductant is intended in the SCR ready plan, the aqueous ammonia drain tank is to be arranged in a position below the aqueous ammonia tank, and the unprocessed aqueous ammonia in the drain tank is not to be discharged overboard. Consideration is to be given to reserving space for the aqueous ammonia discharge system for the aqueous ammonia tank, drain tank and aqueous ammonia processing system.

2.7.6 If an SCR system using aqueous ammonia as the reductant is intended in the SCR ready plan, the aqueous ammonia tank is to be provided with effective negative pressure ventilation

system, which is to be close to the aqueous ammonia storage tank and can be operated from the outside of the aqueous ammonia tank. Sufficient space is to be reserved for the arrangement of the outlet of the ventilation system and the outlet of the air pipes of the ammonia storage tank.

2.7.7 If an SCR system using aqueous ammonia as the reductant is intended in the SCR ready plan, consideration is to be given to reserving space for the aqueous ammonia filling station, independent filling pipe systems and drip trays. The open end of the filling pipe is to be positioned on the open deck, and the aqueous ammonia filling pipes are to be arranged over the aqueous ammonia storage tank and in close proximity to the tank as far as possible.

2.7.8 If an SCR system using aqueous ammonia as the reductant is intended in the SCR ready plan, consideration is to be given to the reserved space for the gas detection and alarm systems.

## **2.8 Reductant supply system**

2.8.1 Sufficient space is to be reserved for the arrangement of the piping and equipment in relation to the reductant supply system.

2.8.2 The reductant supply system is not to be provided in or pass through accommodation spaces, service spaces and control stations.

2.8.3 The piping system for the supply, filling and transfer of the reductant is not to be arranged over boilers or in close proximity to steam pipes, exhaust gas pipes and hot surfaces required to be insulated.

2.8.4 If an onboard reductant preparation device is used, sufficient space is to be reserved for the arrangement of the onboard reductant preparation device.

## **2.9 Electrical system**

2.9.1 The ship's power station is to be designed by taking into account the power needs of electrical installations such as pumps and fans which are necessary for the operation of the SCR system and sufficient capacity is to be reserved to ensure that the number or capacity of generators need not be added after installation of the above equipment.

2.9.2 Consideration is to be given to reserving feeder breakers for electrical installations related to the SCR system on the main switchboard or the distribution board. If it is intended to be supplied by the distribution board, the capacity of the feeder breaker for the distribution board on the main switchboard is to ensure the normal use after installation of the SCR system.

## **2.10 Control and monitoring**

2.10.1 Consideration is to be given to reserving space for local control box/cabinet of the SCR system and it is recommended to reserve the space for the emergency shutdown devices of the SCR system in the engine room central control station.

2.10.2 For onboard equipment required to transmit signals to the SCR system, e.g. engine room monitoring and alarm system, GPS etc., consideration is to be given to reserving signal transmission interfaces.