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CHINA CLASSIFICATION SOCIETY

GUIDELINES FOR SURVEY OF IRRADIATED NUCLEAR FUEL CARRIERS

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Contents

CHAPTER 1 GENERAL 1
CHAPTER 2 CLASSIFICATION AND SURVEY 3
CHAPTER 3 STABILITY 5
CHAPTER 4 FIRE PROTECTION 6
CHAPTER 5 MACHINERY INSTALLATIONS 7
CHAPTER 6 HULL STRUCTURE 9
CHAPTER 7 CARGO SECURING ARRANGEMENTS 11
CHAPTER 8 ELECTRICITY 13
CHAPTER 9 RADIATION PROTECTION 15

CHAPTER 1 GENERAL

1.1 Application

1.1.1 The Guidelines are developed for irradiated nuclear fuel carriers applying for CCS class to meet the conditions for classification, or for the surveys for issuance of Certificates of Fitness or Statement of Compliance undertaken by CCS in accordance with authorization by the Administration of the flag State, based on the technical requirements of IMO International Code for the Safe Carriage of Packaged Irradiated Nuclear Fuel, Plutonium and High-Level Radioactive Wastes on Board Ships (INF CODE) and its amendments.

1.1.2 Irradiated nuclear fuel carriers intended to be classed with CCS and having obtained class notations stated in Chapter 2 of the Guidelines are also to comply with the relevant requirements of CCS Rules for Classification of Sea-going Steel Ships and Rules for Materials and Welding, in addition to the requirements of the Guidelines. Stability and fire-fighting of the irradiated nuclear fuel carriers are the conditions for classification, and are to comply with the requirements of Chapters 3 and 4 of the Guidelines, or the requirements of the Administration of the flag State after confirmation.

1.1.3 Carriers applying for Certificates of Fitness or Statement of Compliance for carriage of INF cargo issued by CCS are to comply with the requirements of the Guidelines and the Administration of the flag State.

1.1.4 Carriers to which the Guidelines apply are to comply with the relevant requirements for carriage of cargo of Class 7 of IMO International Maritime Dangerous Goods (IMDG Code).

1.2 Definitions

1.2.1 Administration means the Government of the States whose flag the irradiated nuclear fuel carrier is entitled to fly.

1.2.2 INF cargo means packaged “irradiated nuclear fuel”, “plutonium” and “high-level radioactive wastes” carried as cargo in accordance with Class 7 of the IMDG Code.

1.2.3 Irradiated nuclear fuel means material containing uranium, thorium and/or plutonium isotopes which has been used to maintain a self- sustaining nuclear chain reaction.

1.2.4 Plutonium means the resultant mixture of isotopes of that material extracted from irradiated nuclear fuel from reprocessing.

1.2.5 High-level radioactive wastes means liquid wastes resulting from the operation of the first stage extraction system or the concentrated wastes from subsequent extraction stage, in a facility for reprocessing irradiated nuclear fuel, or solids into which such liquid wastes have been converted.

1.2.6 Irradiated nuclear fuel carriers means ships carrying INF cargo.

1.2.7 Cargo space means space enclosed by the hull structure where INF cargo are located.

1.2.8 Release means the escape of irradiated nuclear fuel from its containment system due to weakness or invalidity of INF cargo package.

1.2.9 Propulsion machine is a device (e.g. diesel engine, turbine, electrical motor, etc.) which develops mechanical energy to drive a propulsor.

1.2.10 Steering system is a system designed to control the direction of movement of a ship, including the rudder, steering gear, etc.

1.2.11 Propulsor is a device (e.g. propeller, waterjet) which imparts force to a column of water in order to propel a ship, together with any equipment necessary to transmit the power from the propulsion machinery to the device (e.g. shafting, gearing, etc.).

1.2.12 Auxiliary services system means all support systems (e.g. fuel oil system, lubricating oil system, cooling water system, compressed air and hydraulic systems, etc.) which are required to run propulsion machinery, propulsors, steering systems and generating sets.

CHAPTER 2 CLASSIFICATION AND SURVEY

2.1 Conditions of classification

2.1.1 The irradiated nuclear fuel carriers applying for CCS class are to comply with the provisions of the Guidelines and the other relevant requirements of PART ONE of CCS Rules for Classification of Sea-going Steel Ships.

2.2 Characters of classification and class notations

2.2.1 Characters of classification

2.2.1.1 For ships the hull (including equipment) and machinery (including electrical installations) of which are approved by and classed with CCS, such ships are to be assigned appropriate characters of classification according to the relevant provisions of PART ONE of CCS Rules for Classification of Sea-going Steel Ships.

2.2.2 Class notations

2.2.2.1 Class notations of irradiated nuclear fuel carriers are to indicate different level of the total radioactive activity of the carried cargo (the unit is becquerel (Bq), and TBq is 10^{12} Bq), and are indispensable necessary class notations indicating cargo and loading characteristics. They are to be assigned together with the characters of classification and appended to the characters of classification.

2.2.2.2 The class notations of the irradiated nuclear fuel carriers are as follows:

INF 1——applicable for the ships which are certified to carry INF cargo with an aggregate activity less than 4,000 TBq.

INF 2——applicable for the ships which are certified to carry irradiated nuclear fuel or high-level radioactive wastes with an aggregate activity less than 2×10^6 TBq and ships which are certified to carry plutonium with an aggregate activity less than 2×10^5 TBq.

INF3——applicable for the ships which are certified to carry irradiated nuclear fuel or high-level radioactive wastes and ships which are certified to carry plutonium with no restriction of the maximum aggregate activity of the materials. The passenger ships stipulated in IMO International Convention for the Safety of Life at Sea (SOLAS Convention) are not to be assigned with the class notation INF3.

2.3 Examination of plans and documents

2.3.1 Irradiated nuclear fuel carriers intended to be classed with CCS are to provide the plans and documents required by Chapters 3 to 9 of the Guidelines and other plans and documents required by CCS.

2.3.2 Prior to commencement of construction of the ship, the applicant is to submit the plans and documents in triplicate to a plan approval unit designated by CCS for examination. Where the plans will be submitted in batches, at least the necessary hull plans and documents are to be submitted first.

2.4 Classification surveys

2.4.1 Surveys during construction

2.4.1.1 The surveys during construction of the irradiated nuclear fuel carriers are to comply with the requirements of Chapter 4 of PART ONE of CCS Rules for Classification of Sea-going Steel Ships and the Guidelines.

2.4.2 Surveys after construction

2.4.2.1 Surveys after construction of the irradiated nuclear fuel carriers are to comply with the applicable requirements of sections 1 to 4 of Chapter 5 of PART ONE of CCS Rules for Classification of Sea-going Steel Ships, in addition to the requirements of the Guidelines.

2.4.2.2 Surveys of the outside of the ship's bottom and related items, surveys of machinery, surveys of electrical installations, surveys of propeller shafts and tube shafts and boiler surveys are to comply with the provisions of Sections 9, 10, 11, 12 and 13 of Chapter 5 of PART ONE of CCS Rules for Classification of Sea-going Steel Ships respectively.

2.4.2.3 In addition to the applicable requirements of survey of Chapter 5 of PART ONE of CCS Rules for Classification of Sea-going Steel Ships, the annual survey and the intermediate survey are to include the following survey items:

(1) check the cooling arrangement and its ancillary pumping and drain arrangement in cargo space, and confirm that the operation method has been conspicuously identified;

(2) check the temperature control equipment in cargo space, and confirm that the temperature measuring arrangement and the related alarm device are in an effective operating condition;

(3) confirm that the radiation monitoring equipment and its related alarm device are in a good working condition and hold the identification and calibration report or the related statement issued by a qualified inspection and monitoring organization.

2.4.2.4 Special survey is usually to be carried out in dry dock.

2.4.3 Initial classification surveys of ships constructed not under the supervision of CCS

2.4.3.1 Initial classification surveys of ships constructed not under the supervision of CCS are to comply with the requirements of section 14 of Chapter 5 of PART ONE of CCS Rules for Classification of Sea-going Steel Ships and the Guidelines.

2.5 Survey for Certificate of Fitness or Statement of Compliance

2.5.1 The Certificate of Fitness or Statement of Compliance for the Carriage of INF Cargo is to be issued after satisfactory completion of the survey in accordance with authorization of the Administration of the flag State, or the application or contract/agreement of the Owner or the designer or the construction unit and the provided standards.

2.5.2 For ships classed with CCS, classification survey and survey for certificate of fitness are to be carried out together.

2.5.3 In addition to the provisions of the above mentioned Administration of the flag State and/or the standards provided by the applicant, the survey for the Certificate of Fitness or Statement of Compliance for the carriage of INF cargo is to be dealt with in accordance with 2.4 of the Chapter in the light of the types of surveys.

CHAPTER 3 STABILITY

3.1 Intact stability

3.1.1 The intact stability of the irradiated nuclear fuel carriers are to comply with the relevant requirements of the International Code on Intact Stability, 2008 (2008 IS Code).

3.2 Damage stability

3.2.1 A ship assigned with class notations INF1and INF2 is to:

(1) if it is built to the standards for a passenger ship, comply with the damage stability requirements of Part B-1 of Chapter II-1 of the SOLAS Convention;

(2) if it is built to the standards for a cargo ship, comply with the damage stability requirements of Part B-1 of Chapter II-1 of the SOLAS Convention, regardless of the length of the ship. For ships less than 80 m in length, the subdivision index *R* in way of 80 m is to be used, where the length of the ship means the length measured between perpendiculars taken at the extremities of the deepest subdivision load line.

3.2.2 Ships assigned with class notation INF3 are to comply with the following (1) or (2) requirements for damage stability:

(1) the damage stability requirements for type I ship survival capability and location of cargo spaces in IMO the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC Code); or

(2) regardless of the length of the ship, the damage stability requirements in Part B-1 of Chapter II-1 of the SOLAS Convention, using the subdivision index *R* as given below:

$$R = R_0 + 0.2(1 - R_0)$$

where: R_0 - the subdivision index calculated in accordance with Part B-1 of Chapter II-1 of the SOLAS Convention.

For ships less than 80 m in length, the subdivision index *R* in way of 80 m is to be used, where the length of the ship means the length measured between perpendiculars taken at the extremities of the deepest subdivision load line.

CHAPTER 4 FIRE PROTECTION

4.1 General requirements

4.1.1 Unless otherwise provided in this Chapter, the fire protection of irradiated nuclear fuel carriers is to comply with the relevant requirements of PART SIX of CCS Rules for Classification of Sea-going Steel Ships.

4.1.2 For ships assigned with class notations INF1 and INF2, the fire protection, fire detection and fire extinction are to comply with the applicable requirements of the SOLAS Convention for cargo ships (or applicable requirements of the SOLAS Convention for passenger ships, as appropriate) as well as requirements of 4.2 in this Chapter.

4.1.3 For ships assigned with the class notation INF3, the fire protection, fire detection and fire extinction are to comply with the applicable requirements of the SOLAS Convention for cargo ships as well as requirements of 4.2 and 4.3 in this Chapter.

4.2 Cargo space cooling arrangements

4.2.1 Means are to be provided for effectively cooling the designated under-deck cargo space by at least 5 L/min per square metre of the horizontal area of cargo spaces, either by a fixed arrangement of spraying nozzles or by flooding the cargo space with water. The drainage and pumping arrangements are to be such as to prevent the build-up of free surfaces. The drainage system is to be sized to remove no less than 125% of the combined capacity of both the water spraying system pumps and the required number of fire hose nozzles. The drainage system valves are to be operable from outside the protected space at a position in the vicinity of the extinguishing system controls. Bilge wells are to be of sufficient holding capacity and are to be arranged at the side shell of the ship at a distance from each other of not more than 40 m in each watertight compartment. If this is not possible, the adverse effect upon stability of the added weight and free surface of water are to be taken into account in the stability information.

4.3 Special requirements for ships assigned with class notation INF3

4.3.1 In a ship assigned with class notation INF3, accommodation spaces, service spaces, control stations and machinery spaces of category A are to be fitted either forward or aft of the cargo spaces, due regard being paid to the overall safety of the ship.

CHAPTER 5 MACHINERY INSTALLATIONS

5.1 General requirements

5.1.1 Unless otherwise provided in this Chapter, machinery installations of irradiated nuclear fuel carriers are to comply with the relevant requirements of PART THREE of CCS Rules for Classification of Sea-going Steel Ships.

5.1.2 Refrigeration arrangements complying with the requirements of 5.3 of this Chapter are to comply with the relevant requirements of PART FIVE of CCS Rules for Classification of Sea-going Steel Ships.

5.1.3 Irradiated nuclear fuel carriers are to comply with relevant requirements of 5.1 to 5.4 of this Chapter while ships assigned with class notation INF3 are to comply with the requirements of 5.5 of this Chapter as well.

5.2 Plans and documents

5.2.1 Apart from the applicable plans in 5.1 required by CCS Rules for Classification of Sea-going Steel Ships, calculation details and relevant supporting documents (if any) regarding cargo space temperature control measures as required by 5.3, the INF cargo to be carried as well as the ambient conditions of the navigation area are also to be submitted, so as to examine the applicability of temperature control measures.

5.3 Cargo space temperature control

5.3.1 Adequate ventilation or refrigeration of enclosed cargo spaces is to be provided so that the average ambient temperature within such spaces does not exceed 55℃ at any time.

5.3.2 To meet the requirements of 5.3.1, the ambient condition of cargo spaces intended for the transport of INF cargo is to be presumed as Table 5.3.2 for the purpose of calculation in the design of cargo space ventilation or refrigeration systems. The calorific value of INF cargo is also to be taken into account in calculations.

Ambient condition Table 5.3.2

Medium	Ambient boundary temperature
Seawater temperature	32℃
Air temperature	45℃

5.3.3 Ventilation or refrigeration systems serving cargo spaces is to be independent of those serving other spaces.

5.3.4 Equipment or installations essential to temperature control of cargo spaces, such as fans, compressors, heat exchangers, cooling water supply, are to be provided in duplicate for each cargo space. Equipment or installations in duplicate are to be independent and not to affect each other, and each set of equipment or installation is to meet the temperature control requirement in 5.3.1.

5.4 Temperature monitoring and alarm

5.4.1 Each cargo space is to be equipped with an effective temperature monitoring system, which is to be able to send visual and audio alarm signals to the navigation bridge and cargo control room (if provided) when 95% of the average ambient temperature as required by 5.3.1 is reached.

5.5 Special requirements for ships assigned with class notation INF3

5.5.1 At least two propulsion machines and two propulsors are to be provided. The propulsion machines, shafting, transmission gearing and auxiliary service systems are to be arranged in the same compartment.

5.5.2 At least two steering systems are to be provided. The steering gear and auxiliary service systems may be arranged in the same compartment.

5.5.3 At least two independent auxiliary service systems, including fuel oil service tanks, are to be provided. These two systems may be designed to be completely independent, or with interconnections between them provided that effective means to disconnect or isolate the systems from each other are fitted.

5.5.4 The ship is to ensure that at least the following functions are maintained in the event of any failure in the propulsion machine, steering system or auxiliary service system:

(1) The propulsion system will enable the ship to maintain a full load speed not less than 7 knots under sea conditions corresponding to Beaufort scale 3 weather conditions. Adequate steering capability is also to be maintained at this speed.

(2) The propulsion system will enable the ship to maintain its position and heading under sea conditions corresponding to Beaufort scale 8 weather conditions. The results of model testing may be accepted.

CHAPTER 6 HULL STRUCTURE

6.1 General requirements

6.1.1 Unless expressly provided otherwise in the Guidelines, the hull structure is to comply with the relevant requirements of Chapter 2, PART TWO of CCS Rules for Classification of Sea-going Steel Ships.

6.1.2 The material and welding design of hull structure is to meet the applicable requirements of Chapter 1, PART TWO of CCS Rules for Classification of Sea-going Steel Ships.

6.2 Longitudinal strength

6.2.1 The hull longitudinal strength is to comply with the requirements of Section 2, Chapter 2, PART TWO of CCS Rules for Classification of Sea-going Steel Ships.

6.2.2 In the calculation of hull girder section properties, drastic changes in the transverse section modulus of cargo area are to be avoided as far as possible, so as to ensure smooth transition and the continuity of junction pieces essential to the longitudinal strength of the ship.

6.2.3 The buckling strength is to be checked considering the requirements of deduction of thickness in Table 2.2.7.4 of Chapter 2, PART TWO of CCS Rules for Classification of Sea-going Steel Ships.

6.3 Double bottom and double hull structure of cargo area

6.3.1 For ships assigned with class notation INF2, double bottom is to be provided within the cargo area. The double bottom is to comply with the provisions in Section 6, Chapter 2, PART TWO of CCS Rules for Classification of Sea-going Steel Ships. The height of double bottom is to be not less than B/15 or 6 m, whichever is lesser, where B is the breadth of ship.

6.3.2 For ships assigned with class notation INF3, double hull and double bottom are to be provided within the cargo area. The double hull is to comply with the provisions in Section 14, Chapter 8, PART TWO of CCS Rules for Classification of Sea-going Steel Ships. The breadth of double hull is to be not less than B/15 or 11.5 m, whichever is lesser. The double bottom is to comply with the provisions in Section 6, Chapter 2, PART TWO of CCS Rules for Classification of Sea-going Steel Ships. The height of double bottom is to be not less than B/15 or 6 m, whichever is lesser, where B is the breadth of ship.

6.4 Local strength

6.4.1 The hull structure in cargo area is to be capable of withstanding the loads applied to it by INF cargo and the loads are to be calculated in accordance with the cargo securing inertial acceleration in 7.2.1, Chapter 7 of the Guidelines.

6.4.2 Under the action of the loads mentioned in 6.4.1, the permissible stresses of hull structure within cargo area are as follows (R_{eH} is the yield stress, in N/mm^2, of the material):

Permissible shear stress: $[\tau]=0.4R_{eH}$

Permissible equivalent stress: $[\sigma]=0.88R_{eH}$

6.5 Special conditions

6.5.1 If the drainage and pumping equipment described in 4.2.1, Chapter 4 of the Guidelines cannot prevent the build-up of free surfaces, the longitudinal strength of hull under actual loading

condition is to comply with the provisions of Section 2, Chapter 2, PART TWO of CCS Rules for Classification of Sea-going Steel Ships. The wave load under this condition is to be 80% of the wave load specified in Section 2, Chapter 2, PART TWO of CCS Rules for Classification of Sea-going Steel Ships.

CHAPTER 7 CARGO SECURING ARRANGEMENTS

7.1 General requirements

7.1.1 The securing system is to be designed to be capable of fixing INF cargo loaded on ship structure under all transport conditions. However, under normal or emergency condition, it is to be possible to separate INF cargo from ship through specially designed release unit or by means of destroying securing devices to ensure integrity of INF cargo.

7.1.2 The securing system is to meet relevant requirements of CCS Guidelines for the Preparation of the Cargo Securing Manual, and to be designed not to damage INF cargo under normal transport condition or generate stress exceeding yield limit to INF cargo parts and securing devices.

7.1.3 Using collision chocks fixed on the deck can limit horizontal movement of INF cargo effectively, and collision chocks can be used in combination with other securing means, but are to be so arranged that they will not interfere or prevent cooling air flow which may be necessary under the provisions of Chapter 5 of the Guidelines.

7.2 Effectiveness of securing

7.2.1 Adequate permanent securing devices are to be provided to prevent movement of INF cargo within the cargo spaces. In designing permanent devices, consideration is to be given to the orientation of INF cargo and following ship inertia acceleration:

— 1.5 *g* longitudinally;

— 1.5 *g* transversely;

— 1.0 *g* vertically up;

— 2.0 *g* vertically down;

where: g is gravity acceleration, to be taken as 9.81 m/s^2.

7.2.2 Effectiveness of the securing system is to be checked according to the method for evaluating effectiveness of non-standardized cargo securing arrangement (hereinafter referred as “the method”) in CCS Guidelines for the Preparation of the Cargo Securing Manual. Basic acceleration value in the method adopts inertia acceleration value in paragraph 7.2.1 of this Chapter to carry out transverse and longitudinal sliding and tipping calculation according to orientation of INF cargo.

7.2.3 For INF cargo loaded on the vehicle for ro-ro transportation, effectiveness of securing is to be checked according to additional provisions for ro-ro ships in CCS Guidelines for the Preparation of the Cargo Securing Manual.

7.2.4 For INF cargo loaded in the container for transportation, effectiveness of securing is to be checked according to the container securing method in CCS Rules for Classification of Sea-going Steel Ships and using inertia acceleration value in paragraph 7.2.1 of this Chapter.

7.2.5 Unless material for strengthening friction is provided, friction force between INF cargo and deck is not taken for effectiveness check of securing.

7.3 Securing devices

7.3.1 Suitable devices are to be selected according to calculation result of paragraph 7.2 of this Chapter and meet requirements for safe workload and breaking strength of securing devices in CCS Guidelines for the Preparation of the Cargo Securing Manual and Rules for Classification of

Sea-going Steel Ships.

7.3.2 Permanent securing devices on board ship are to be arranged on strong points of the deck.

7.3.3 For securing systems fixed by bolts, tensile strength and shear strength of each bolt are to be checked, and safety factor with respect to yield strength of bolt material is not to be less than 2.0.

CHAPTER 8 ELECTRICITY

8.1 General requirements

8.1.1 Unless expressly provided otherwise in the Guidelines, electrical installations of irradiated nuclear fuel carriers are to comply with the relevant requirements of PART FOUR of CCS Rules for Classification of Sea-going Steel Ships.

8.2 Electrical power and power supply

8.2.1 Power supply of ships assigned with class notations INF1, INF2 and INF3 is to comply with requirements for power supply of electrical installations on board ship in Chapter 2, PART FOUR of CCS Rules for Classification of Sea-going Steel Ships.

8.2.2 Ships assigned with class notations INF1 and INF2 are to meet following additional requirements:

(1) An alternative source of electrical power complying with the requirements of IEC 60092-201 standard of International Electro Technical Commission is to be provided so that damage involving the main supply will not affect the alternative source.

(2) The power available from the alternative source is to be sufficient to supply the following services for at least 36 h:

① the device provided for cargo space cooling arrangements required by paragraphs 4.2.1 and 5.3 of the Guidelines;

② all emergency services required by the SOLAS Convention.

8.2.3 Ships assigned with class notation INF3 are to meet following additional requirements:

(1) Power supply is to comply with the requirements of paragraph 8.2.2 of this Chapter.

(2) The alternative source is to be located outside the extent of any damage envisaged under damage stability calculation in Chapter 3 of the Guidelines.

8.3 Additional requirements for carrying INF cargo with other hazard

8.3.1 In addition to radioactivity and fissionability, any secondary hazard characteristics of cargo within INF cargo package (such as explosibility, flammability and pyrophorisity, etc.) are to be considered during transportation. Electrical installations within hazardous area where the ship carries INF cargo or expanded hazardous area are to comply with applicable provisions of Section 18, Chapter 2, PART FOUR of CCS Rules for Classification of Sea-going Steel Ships, as well as all provisions relating to hazardous cargoes in the IMDG Code and applicable provisions of Reg.II-2/19 of the SOLAS Convention.

8.4 Security system

8.4.1 Security system is to have following functions:

(1) capable of implementing video monitoring management and access permission control inside ship;

(2) capable of giving ship intrusion alarm.

8.4.2 Closed-circuit television monitoring system is to carry out video monitoring to main deck and important parts of compartments of ship, with storage and playback functions. Such system is to be supplied by main source of electrical power, alternative source of electrical power and emergent source of electrical power.

8.4.3 Door control system is to set authority management at ship access and important compartment access relating to INF cargo so as to give visual and audible alarm at manned spaces when unauthorized incidents occur. In case of ship and INF cargo emergency conditions, mandatory over-control is to be carried out to door control barrier. The system is to be supplied by main source of electrical power, alternative source of electrical power, emergent source of electrical power and temporary emergent source of electrical power (if independent accumulator battery is provided to meet power supply of 0.5h).

8.5 Communication

8.5.1 For ships assigned with class notations INF1, INF2 and INF3, redundant internal communication is to be provided between navigation bridge and important compartments relating to INF cargo, and internal communication can be carried out by means of portable UHF radiotelephone.

CHAPTER 9 RADIATION PROTECTION

9.1 General provisions

9.1.1 In order to realize radiation protection safety, ship's special design, arrangement and device provided are to be subject to CCS special consideration to ensure navigational safety of ship.

9.1.2 Following plans and documents are to be submitted to CCS for approval:

(1) structure of radiation shielding (if any);

(2) arrangement and fixation of radiation monitoring device;

(3) power supply principle of radiation monitoring device;

(4) arrangement of device relating to management of radioactive waste (if any).

9.1.3 Following plans and documents are to be submitted to CCS for information:

(1) arrangement of control area, supervision area and decontamination space;

(2) specification of radiation shielding calculation;

(3) specification and schematic diagram of radiation monitoring system;

(4) specification of decontamination method of radioactive pollution (if any).

9.2 Division of radiation working area

9.2.1 In order to facilitate radiation protection management and occupational exposure control, specified area on board ship is to be divided according to actual or potential radiation hazard of anticipated transportation of INF cargo, generally into control area, supervision area and unrestricted area. The area boundary line can be specified by either structure division or management measures.

9.2.2 The control area is generally enclosed INF cargo space. Decontamination space is to be provided at access to the control area, which can only be entered through decontamination space. Decontamination space is to be provided with skin and clothing pollution monitoring device, polluted clothing and article collecting device, clothes changing room and washing or shower facilities. The clearly marked warning sign is to be provided at control area access.

9.2.3 In general, supervision area does not need special radiation protection means or safety measures, but frequent supervision and evaluation of occupational exposure condition are needed.

9.3 Radiation monitoring device

9.3.1 Permanent dosage monitoring device and aerosol monitoring device are to be provided in each control area of ship as a minimum, including γ and neutron dosage measuring instrument as a minimum to indicate and record radiation level of the area. Radiation level and aerosol concentration level are to be presented in navigation bridge and cargo control room (if fitted) to give visual and audible alarm signal to navigation bridge and cargo control room (if fitted) when radiation level and aerosol concentration level exceed the set value.

9.3.2 Sufficient portable detectors are to be provided on board ship for routine and/or emergent radiation monitoring. Such detectors are to include γ and neutron dosage measuring instrument as well as α and β pollution level measuring instrument as a minimum.

9.3.3 Sufficient personal dosimeters for all person on board ship are to be provided on board ship.

9.3.4 Radiation monitoring device is to be subject to survey and calibration by qualified

inspection and monitoring organization with relevant certificate.

9.4 Radioactive contamination

9.4.1 Radioactive contamination of ship and device due to carriage of INF cargo is to be inspected at regular interval, and quick decontamination is to be carried out by qualified personnel when contamination level exceeds the limit. For areas and devices not suitable for decontamination, protective shield is to be provided or easily replaceable devices are to be adopted.

9.5 Management of radioactive waste

9.5.1 Radioactive waste (e.g. waste from decontamination and radioactive contaminant) due to carriage of INF cargo is to be subject to proper management by ship to ensure that harm to personnel on board ship and environment is minimized to acceptable level. Independent storage device, shipboard processing device, convey pipeline and discharge device are to be provided as needed.