English Version

The People's Republic of China Sixth National Report for the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management

Prepared for the Eighth Review Meeting

July, 2024

Beijing, China

Preface

The Chinese government has always given high priority to the safety of spent fuel management and the safety of radioactive waste management. On April 29, 2006, the 21st Session of the Standing Committee of the 10th National People's Congress (NPC) of the People's Republic of China decided to accede to the *Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management* (hereinafter referred to as the Joint Convention), which was adopted on September 5, 1997 by a Diplomatic Conference convened by the International Atomic Energy Agency (IAEA), and stated that the Joint Convention shall not apply to the Macao Special Administrative Region of the People's Republic of China for the time being, unless otherwise determined by the Chinese government. On September 13, 2006, China deposited its instrument of accession with the Depositary. The Joint Convention entered into force for China on December 12, 2006.

National Reports of the People's Republic of China on the fulfillment of its obligations under the Joint Convention have been submitted to the Review Meetings of the Contracting Parties in 2008, 2011, 2014, 2017 and 2020, respectively.

This report is submitted as the Sixth National Report of the People's Republic of China to the Eighth Review Meeting of the Contracting Parties, in accordance with Article 32 of the Joint Convention. This report describes how China is fulfilling its obligations under the Joint Convention and is divided into two parts. Part 1 is the report on the implementation of the Joint Convention by the central government of the People's Republic of China, and Part 2 is the report on the implementation of the Joint Convention by the Hong Kong Special Administrative Region of the People's Republic of China. The data on the inventories and lists contained in this report have been collected as of December 31, 2023.

This report does not include information on Taiwan Province of the People's Republic of China.

CONTENTS

PART 1
REPORT BY THE CENTRAL GOVERNMENT

A. INTRODUCTION

A.1 Theme of the Report

A-1 This report describes the basic policies and practices for the safety of spent fuel management and the safety of radioactive waste management in China.

A-2 The objective of spent fuel management and radioactive waste management in China is to achieve and maintain a high level of safety and to protect people, society and the environment from the possible harmful effects of ionizing radiation now and in the future, and to promote the sustainable development and peaceful use of nuclear energy and nuclear technology. To this end, China has adhered to the basic principles of ionizing radiation protection, safety of radiation sources, safety of spent fuel management, and safety of radioactive waste management. Efforts were made to improve and refine the legislative system, to clarify and assign safety management responsibilities, and to improve and enhance regulatory capabilities. Moreover, China attaches importance to and actively participates in international cooperation, so as to ensure the safety of spent fuel management and the safety of radioactive waste management.

A.2 Facilities Concerned

A-3 In accordance with the Joint Convention, this report focuses on a wide range of facilities, including facilities for the at-reactor and/or away-from-reactor storage of spent fuel from nuclear power plants (NPPs) and research reactors, radioactive waste treatment and storage facilities for nuclear facilities, radioactive waste temporary storage facilities for nuclear technology application, and facilities for the treatment, storage and disposal of radioactive waste.

A.3 Structure of the Report

A-4 As required by the *Guidelines regarding the Form and Structure of National Reports* (INFCIRC/604/Rev.4), this report describes China's fulfillment of the obligations under each article of the Joint Convention in each section. Each section begins with the relevant article of the Joint Convention, enclosed with a box. The contents, following the introduction, are listed as below:

B. POLICIES AND PRACTICES (Article 32-1)

C. SCOPE OF APPLICATION (Article 3)

D. INVENTORIES AND LISTS (Article 32-2)

E. LEGISLATIVE AND REGULATORY SYSTEM (Articles 18 to 20)

F. OTHER GENERAL SAFETY PROVISIONS (Articles 21 to 26)

G. SAFETY OF SPENT FULE MANAGEMENT (Articles 4 to 10)

H. SAFETY OF RADIOACTIVE WASTE MANAGEMENT (Articles 11 to 17)

I. TRANSBOUNDARY MOVEMENT (Article 27)

J. DISUSED SEALED SOURCES (Article 28)

K. GENERAL EFFORTS TO IMPROVE SAFETY

A-5 In order to avoid repetitive descriptions with the relevant parts of Chapters G and H, the legislative and regulatory provisions generally applicable to the safety of spent fuel management and radioactive waste management are addressed in Chapter E, as required in the *Guidelines regarding the Form and Structure of National Reports* (INFCIRC/604/Rev.4).

A.4 Response to the Challenges and Overarching Issues Identified at the Seventh Review Meeting

A-6 During the Seventh Review Meeting of the Contracting Parties, the Country Group identified three challenges for China. Since then, follow-up actions have been taken in a variety of ways to respond to these challenges.

A-7 As requested by the Seventh Review Meeting, the National Reports of the Contracting Parties for the Eighth Review Meeting should address four overarching issues. These issues are comprehensively elaborated in this National Report on the basis of current laws/regulations and practices.

A.4.1 Response to Challenges

(1) Site selection for low and intermediate level waste (LILW) disposal facilities

A-8 Since the last Review Meeting, China has constructed and put into operation the first centralized disposal facility for low level waste (LLW) from NPPs, Longhe Near Surface Disposal Facility (hereinafter referred to as Longhe Disposal Facility); completed the expansion of Feifengshan Low Level Solid Waste Disposal Facility (hereinafter referred to as Feifengshan Disposal Facility) and the Northwest Low Level Solid Waste Disposal Facility (hereinafter referred to as the Northwest Disposal Facility); and promoted R & D on the intermediate depth disposal of radioactive waste.

A-9 Details are given in B.5 and K.1.1.

(2) Geological disposal of high level waste (HLW), including

- Finalisation of the construction of an underground research laboratory;
- Development of comprehensive regulations and standards;
- International cooperation through the IAEA-designated collaboration centre.

A-10 Since the last Review Meeting, China has issued the *Geological Disposal Facilities for Radioactive Waste* (HAD 401/10-2020), commenced the construction of an underground research laboratory (URL) and synchronously launched nine scientific research projects in the course of URL construction, and established the Innovation Center for Geological Disposal of High-Level Radioactive Waste. In addition, the Beijing Research Institute of Uranium Geology (BRIUG) of China National Nuclear Corporation (CNNC) was designated as the “IAEA Collaborating Center for Geological Disposal of High-Level Radioactive Waste”.

A-11 Details are given in B.5 and K.1.2.

(3) Near surface disposal for types of disused sealed sources

- Studies on safety requirements and acceptance criteria;
- Construction of conditioning facility.

A-12 Since the last Review Meeting, China has issued the *Safety requirements for near surface disposal of disused radioactive sources* (HJ 1336-2023), made efforts to investigate special conditioning equipment for near surface disposal of disused sealed sources, and promoted the disposal of some disused sealed sources with low radioactivity.

A-13 Details are given in J.2.4 and K.1.3.

A.4.2 Response to the Requests of the Review Meeting

(1) Competence and staffing linked to timetable for spent fuel management and radioactive waste management programmes

A-14 China has taken several measures to provide competence and staffing to meet the actual needs of spent fuel and radioactive waste management. China has specified regulatory requirements for the qualification management of personnel involved in spent fuel and radioactive waste management, and has made active efforts to formulate education and training plans that will help reserve professionals for the cause.

A-15 China attaches great importance to the training and qualification management of personnel involved in the regulation of spent fuel and radioactive waste, and all the regulatory inspection personnel have been properly certified. In 2022, China expanded the nuclear and radiation safety regulatory team within the Ministry of Ecology and Environment (National Nuclear Safety Administration) (MEE/NNSA), and further staffed the regional offices for nuclear and radiation safety inspection.

A-16 All NPPs in China are staffed with specialized personnel for spent fuel management, ensuring that the establishment and staffing of positions are in line with the standard organizational structure. Operating nuclear facilities, such as NPPs and waste disposal facilities, have established organizations with clearly defined responsibilities for radioactive waste management and are staffed with professional personnel for radioactive waste management.

A-17 Details are given in K.2.1.

(2) Inclusive public engagement in radioactive waste management and spent fuel management programmes

A-18 China has effectively promoted inclusive public engagement in the radioactive waste and spent fuel management programmes through various initiatives. In addition to a well-established framework of laws and regulations, China has established a public communication mechanism for nuclear safety, which includes central government supervision, local government leadership, enterprise action, and public engagement. In this way, a top-down, multi-stakeholder public communication network is gradually being established to ensure the public's right to information, participation, expression and scrutiny in the construction projects of spent fuel and radioactive waste management facilities.

A-19 Details are given in K.2.2.

(3) Ageing management of packages and facilities for radioactive waste and spent fuel, considering extended storage periods

A-20 China has made overall planning for national spent fuel management capacity building, developed the plan for enhancing the capacity of spent fuel storage system, and promoted projects on spent fuel storage facilities and large commercial reprocessing facilities to ensure the long-term safety of spent fuel management. China has considered the safety of radioactive waste across the nation during the storage period and disposal capacity building, and promoted the construction of LLW disposal facilities to ensure the long-term safety of radioactive waste.

A-21 China focuses on the ageing management of radioactive waste packages, storage facilities, and spent fuel storage facilities. Regular random inspections and patrols are conducted to ensure the safety of waste packages during storage. Service and maintenance are carried out to strengthen the ageing management of storage facilities. Information on the ageing conditions of spent fuel storage facilities is collected by means such as water chemistry management and periodic testing.

A-22 China focuses on the ageing of facilities and equipment in the regulatory inspections of nuclear facilities, which is taken as one of the safety elements in periodic safety review (PSR) of nuclear facilities.

A-23 Details are given in K.2.3.

(4) Long-term management of disused sealed sources, including sustainable management options for regional and multinational solutions

A-24 China attaches importance to the safe management of radioactive sources and strengthens such efforts throughout the life cycle. A sound system of laws and regulations has been established to define management requirements for processes such as storage and disposal of radioactive sources. Dynamic tracking and management of sealed sources in use and disused sealed sources throughout the process is achieved through a nationwide networked information system.

A-25 Chinese regulations stipulate that Category I, II, and III disused sealed sources shall be returned to producers or original exporters in accordance with the agreement on the return of disused sealed sources.

A-26 Thirty-one provincial radioactive waste temporary storage facilities for nuclear technology application and one national centralized disused sealed sources storage facility are in operation in China, with the strategy of "dispersed provincial storage before national centralized storage" followed for disused sealed sources.

A-27 China encourages and actively practices recycling and reuse of disused sealed sources. Since the last Review Meeting, about 2,000 disused sealed sources have been recycled or reused.

A-28 China has clear regulations on the management of orphan sources, which require entities and individuals to immediately report the discovery of disused sealed sources or radioactively contaminated items and hand them over to the designated storage facilities.

A-29 For disused sealed sources that have no recycle or reuse potential, their disposal is considered and performed by grade and category based on available disposal facilities.

A-30 Details are given in K.2.4.

A.5 Major Updates since the Last Report

A-31 This report provides significant updates on the safety of spent fuel management and the safety of radioactive waste management in China as of December 31, 2023 since January 1, 2020.

Relevant newly issued and revised laws, regulations and rules

Rules on Nuclear Safety Reporting of NPP Licensees, issued by the MEE in November 2020;

Safety Rules on the Management System for NPPs, issued by the MEE in December 2020;

Rules on the Qualification of Operators of Civil Nuclear Facilities, issued jointly by the MEE and the National Development and Reform Commission (NDRC) in January 2021; and

Safety Rules on Commissioning and Operation of Nuclear Power Plants, issued by the NNSA in June 2022.

Relevant standards issued and revised:

GB 41930-2022, *Characterization of low level radioactive waste packages - Cemented waste form*;

GB/T 41024-2021, *Load combination and design criteria for structural analysis of spent fuel transport cask*;

GB/T 42290-2022, *Analysis and control specifications for airborne radioactive source term of pressurized water reactor nuclear power plant*;

GB/T 15950-2023, *Requirements for environmental radiation monitoring around near surface disposal site of radioactive solid waste*;

HJ 1202-2021, *General technical requirements for fabrication of steel spent fuel transport cask*;

HJ 1258-2022, *Technical specifications for siting, design and construction of radioactive waste repository for nuclear technology application*; and

HJ 1336-2023, *Safety requirements for near surface disposal of disused radioactive sources*.

Relevant newly constructed facilities:

(1) nineteen at-reactor spent fuel storage facilities and radioactive waste treatment and storage facilities associated with the nuclear power units (see L.1.1 and L.3.1);

(2) one near surface disposal facility (see L.3.7);

(3) one specialized radioactive waste storage facility (see L.3.5); and

(4) two specialized radioactive waste treatment facilities (see L.3.6).

Relevant licences issued:

(1) On May 11, 2020, the NNSA issued a licence (GHFFCLZ [No. 001]) to the treatment facility of Sichuan Environmental Protection and Engineering Co., Ltd. (CNNC);

(2) On May 11, 2020, the NNSA issued a licence (GHFFCZZ [No. 003]) to the disposal facility of Sichuan Environmental Protection and Engineering Co., Ltd. (CNNC);

(3) On July 5, 2023, the NNSA issued a licence (GHFFCZZ [No. 004]) to the disposal facility of Gansu Longhe Environmental Protection Technology Co., Ltd.;

(4) On July 5, 2023, the NNSA issued a licence (GHFFZCZ [No. 034]) to the storage facility of Gansu Longhe Environmental Protection Technology Co., Ltd.;

(5) On April 29, 2023, the NNSA issued a licence (GHAF [2023] No. 71) to the treatment facility of Hunan Nuclear Industry Honghua Machinery Co., Ltd.

Relevant inspections completed:

(1) From May 2020 to December 2022, the NNSA organized and carried out a special action to identify potential hazards to nuclear and radiation safety.

(2) From September 2020 to June 2021, the NNSA organized and carried out a special inspection on radioactive waste management at NPPs (Qinshan, Tianwan, Daya Bay and other nuclear power bases).

A-32 The inventories and lists are updated in this report (see D and L).

A.6 Significant Events since the Last Report

A-33 This report updates and supplements significant events in the safety of spent fuel management and the safety of radioactive waste management in China from January 1, 2020 to December 31, 2023.

(1) Construction and operation of Longhe Disposal Facility, a centralized disposal facility for LLW from NPPs

A-34 In July 2022, the NNSA issued an operating licence for Longhe Disposal Facility (GHAZ No. 2213). Then the NPPs successively transport the LLW accumulated to Longhe Disposal Facility for disposal.

(2) Construction of Beishan Underground Research Laboratory (Beishan URL), which is for deep geological disposal of HLW

A-35 The construction of Beishan URL was commenced in June 2021. By the end of 2023, the excavation of Beishan URL main shaft has been successfully finished, the drilling footage along the ramp has exceeded 3.1 km, and three turning sections of ramp have been successfully completed.

(3) Clarification of the policy for disused sealed sources disposal, and implementing disposal by grade and category

A-36 In December 2023, China issued the *Safety requirements for near surface disposal of disused radioactive sources* (HJ 1336-2023). Since 2019, nearly 30,000 disused ^{192}Ir and ^{75}Se sealed sources stored by the radioactive source producers, have been subject to near surface disposal. By the end of 2023, around 1,100 disused sealed sources have been conditioned for disposal.

A.7 Good Practices

A-37 With regard to the safety of spent fuel management and the safety of radioactive waste management, China would like to share four good practices with the Contracting Parties to the Joint Convention.

(1) Management of disused sealed sources combining sustainable development and safety throughout the life cycle

A-38 Taking into account factors such as safety, cost, and sustainable social development, priority is given to the safety of radioactive sources throughout their life cycle. Based on the actual conditions, efforts have been made to improve the security, information-based management and emergency response capacity building during the long-term storage of disused sealed sources. Additionally, channels for recovery and reuse of disused sealed sources have been expanded. The strategy for disposal has been clarified, and the storage of disused sealed sources with subsequent disposal processes has been effectively integrated. Furthermore, the final disposal of all categories of disused sealed sources is advancing by grade and category.

A-39 China has issued the *Safety requirements for near surface disposal of disused radioactive sources* (HJ 1336-2023) specifically for the disposal of disused sealed sources, and has promoted the safe disposal of some disused sealed sources gradually. Nearly 30,000 disused sealed sources have been subject to near surface disposal, and around 1,100 disused sealed sources have been conditioned for disposal.

A-40 Details are given in K.4.1.

(2) Developing a multi-stakeholder collaborative framework for development of a centralized disposal facility for LLW from NPPs, ensuring effective benefit compensation and public engagement

A-41 The competent authority and the regulatory body have worked together to promote the finalization of the overall model, the responsibility relationship and the way forward for the construction and operation of the centralized disposal facility, to address the concerns of various stakeholders, and to ensure that appropriate and sufficient benefit compensation is provided for the locality where the facility is located, thus facilitating cross-regional disposal. The nuclear power group companies and the local state-owned enterprises (SOEs) where the disposal facility is located incorporated a limited liability company as shareholders to invest in the construction of the disposal facility.

A-42 China has respected the needs of various stakeholders, innovated mechanisms, coordinated various stakeholders to fully get them involved, and effectively addressed the concerns of local governments, nuclear power group companies, the public, and other interested parties. This approach has facilitated progress in the siting, construction and operation of Longhe Disposal Facility. In July 2022, an operating licence was granted to Longhe Disposal Facility. As of the end of 2023, it had received 2,989 m^3 of LLW.

A-43 Details are given in K.4.2.

(3) Construction of URL for geological disposal of HLW with advanced engineering technologies

A-44 China has developed and adopted advanced engineering construction technologies to promote the construction of URL, which can largely decrease the excavation damaged zones (EDZs) in the host rock and be quite favorable for the long-term safety of geological disposal. For crystalline rock sites, China proposed a technical solution by utilizing full-face tunnel boring machine (TBM) technology to excavate the URL spiral ramp. China has also developed “Beishan No. 1”, the world’s first TBM capable of excavating with a small turning radius. “Beishan No. 1”, with much higher construction efficiency and less damage to the host rock to preserve the safety function of the natural barrier, will help maintain the feasibility of transforming the URL into a repository in the future. “Beishan No. 1” has been applied to the construction of the Beishan URL.

A-45 Details are given in K.4.3.

(4) Continuously advancing the R&D of new technologies on waste management and decommissioning

A-46 China pioneered a signal acquisition, detection and real-time feedback control system along with composite laser decontamination. The system can realize real-time feedback and adjustments to improve the decontamination effect. The special laser decontamination equipment developed for the inner walls of radioactive pipelines has been applied to the laser decontamination of the contaminated pipeline in the primary circuit of nuclear power reactors.

A-47 China has applied intelligent technologies such as AI and digital twins to the engineering practice of decommissioning of the 101 Heavy Water Research Reactor (101 HWRR). This enables the design of the cutting scheme and the planning of the cutting route of the equipment with the 3D model, as well as the transmission of such route to the manipulator and other equipment to complete the task intelligently.

A-48 China has developed NPP ventilation filter holding frame recycling technology and supporting equipment, radioactive organic liquid waste purification technology and device, which have been put into engineering application in NPPs and can realize the recycling of ventilation filter holding frame and the clearance of organic liquid waste, including waste oil and waste bolt cleaning agent.

A-49 Details are given in K.4.4.

A.8 Good Performances

A-50 Five good performances have been achieved in China in the safety of spent fuel management and the safety of radioactive waste management.

(1) Achieving positive progress in the recycling and reuse of scrap metals

A-51 In April 2023, the operating licence was granted to the demonstration project of Hunan Nuclear Industry Honghua Machinery Co., Ltd. for smelting of scrap metals from NPPs, China’s first production line for reuse of radioactive scrap metals from NPPs.

A-52 Details are given in K.5.1.

(2) Promoting NPP decommissioning by government-guided and industry-led systematic planning

A-53 The National Energy Administration (NEA) and other relevant departments have made overall deployment and arrangement on preparations for NPP decommissioning in China, including determining the decommissioning demonstration projects and building the R&D platform for decommissioning. CNNC, by coordinating the superior resources of its subsidiaries, has established a group company-level technology research center for decommissioning projects which integrates enterprises, universities, research institutes and end-users. The center has carried out considerable work on NPP decommissioning management and R&D focusing on the demonstration project for first reactor decommissioning of NPPs, with positive progress made.

A-54 Details are given in K.5.2.

(3) Promoting information-based management of radioactive waste in a well-managed manner

A-55 The national radioactive waste management information system developed by China was launched in 2023. The system has realized the unified management of national radioactive waste information and the permanent preservation of waste disposal information across generations, providing data support for the safety of radioactive waste management.

A-56 Details are given in K.5.3.

(4) Developing radioactive waste management strategies according to the design characteristics of new reactors

A-57 For new reactors such as small modular reactors (SMRs), high-temperature gas-cooled reactors (HTGRs) and molten salt reactors (MSRs), licencees are allowed and encouraged to carry out waste treatment-related designs according to the characteristics of the site and reactor type, e.g. adopting off-site waste treatment, or sharing the waste management facilities with the large pressurized water reactors (PWRs) based on the characteristics of the site.

A-58 Details are given in K.5.4.

(5) Achieving continuous improvement in radioactive waste reduction of multi-facility sites through goal-oriented, step-by-step roadmap formulation

A-59 China General Nuclear Power Corporation (CGN) has adhered to the goal-oriented, step-by-step formulation of the roadmap and schedule, and has developed the first five-year plan for radioactive waste based on medium-term and long-term goals for its multi-facility site. CGN has established a special task force for solid waste management, built a platform for coordinating radioactive waste management, and advanced the implementation of special actions and plans designed for each year, thus promoting continuous improvement in the radioactive waste reduction of its multi-facility site.

A-60 Details are given in K.5.5.

A.9 Matrix of Spent Fuel and Radioactive Waste Management in China

Type of Liability	Long-term Management Policy	Funding and Liabilities	Current Practice/ Facility	Planned Facilities
Spent fuel	Reprocessing	Fund for Treatment and Disposal of Spent Fuel from Nuclear Power Plants (PWR NPPs only)	Stored at 62 storage facilities for spent fuel from NPPs, and three storage facilities for spent fuel from research reactors	One reprocessing facility, four dry storage facilities for spent fuel
Nuclear fuel cycle waste including waste from NPPs	Deep geological disposal of HLW	Fund for Treatment and Disposal of Spent Fuel from Nuclear Power Plants	One URL for geological disposal (under construction)	
	Intermediate depth disposal of ILW	Waste generator	Related research underway	
	Near surface disposal of LLW	Waste generator	Four near surface disposal facilities in operation	Five near surface disposal facilities
Decommissioning liabilities	Immediate dismantling and delayed dismantling	Facility licencees and the governments	Decommissioning of two research reactors	
Disused sealed sources	To be returned to the original manufacturer, delivered for storage or disposal, clearance, and reuse	Disused sealed sources generators and the governments	Thirty-one provincial radioactive waste temporary storage facilities for nuclear technology application and one national centralized disused sealed sources storage facility	

B. POLICIES AND PRACTICES (Article 32-1)

In accordance with the provisions of Article 30, each Contracting Party shall submit a national report to each review meeting of Contracting Parties. This report shall address the measures taken to implement each of the obligations of the Convention. For each Contracting Party the report shall also address its:

(i) spent fuel management policy;

(ii) spent fuel management practices;

(iii) radioactive waste management policy;

(iv) radioactive waste management practices;

(v) criteria used to define and categorize radioactive waste.

B.1 Spent Fuel Management Policy

B-1 China adopts a spent fuel management policy that involves reprocessing spent fuel to extract and recover uranium and plutonium, so as to maximize the utilization of resources, reduce the volume of HLW, ensure the safety of spent fuel and the safety of the public, and reduce the long-term radiation risks for future generations.

B-2 In view of the immediate, medium and long-term needs of nuclear energy development, China has made an overall plan for spent fuel management capacity building, encouraged enterprises to participate in capacity building and R&D, improved the regulatory system, and cultivated high-quality professional workforce to ensure the effective implementation of the spent fuel management policy.

B.2 Spent Fuel Management Practices

B-3 Spent fuel from NPPs and research reactors is currently stored at reactors. The licencees of NPPs and research reactors are fully responsible for the safe management of the spent fuel generated by them.

B-4 The CAEA has developed a plan to improve the storage system for spent fuel from NPPs. Taking into account the requirements for generation, transport and storage of spent fuel from NPPs, the plan defines the planning and support policy for capacity building in spent fuel transport and storage, and puts forward spent fuel management principles that are adaptive to the development of nuclear power.

B-5 Spent fuel storage facilities (mainly spent fuel storage pools, supplemented by dry storage facilities) have been built at the NPPs to accommodate the spent fuel generated from NPPs within a certain period of time and ensure storage safety. More information on the spent fuel storage facilities for each NPP is given in L.1.1.

B-6 Under the *Safety Rules on Commissioning and Operation of Nuclear Power Plants* (HAF 103) and the *Research Reactor Operation Management* (HAD 202/01), the licencees of both NPPs and research reactors are responsible for all activities related to the management of the reactor core and fuel, including spent fuel. They have developed procedures for the management of nuclear fuel and reactor core components, including the preparatory work for transfer and storage on site, and transport of irradiated fuel, thus ensuring the safety of in-reactor use and on-site transfer and storage of the fuel.

B-7 Under HAF 103 and HAD 202/01, the licencees of NPPs and research reactors have developed the spent fuel assembly operation procedures applicable to various parts of spent fuel management, and implemented wide variety of activities, including spent fuel unloading operation, radiation measurement, radiation protection supervision, spent fuel storage, management and patrols of plant buildings and installations, documentation, water chemistry analysis and quality assurance (QA). Details are given in Chapter G.

B-8 The Fund for Treatment and Disposal of Spent Fuel from Nuclear Power Plants has been established in China to finance the transport, storage and reprocessing of spent fuel and the disposal of HLW. In 2010, the Ministry of Finance (MOF), the NDRC and the Ministry of Industry and Information Technology (MIIT) issued the *Interim Procedures on Collection, Utilization and Management of the Fund for Treatment and Disposal of Spent Fuel from Nuclear Power Plants*. In 2014, the *Management Measures for Projects Supported by the Fund for Treatment and Disposal of Spent Fuel from Nuclear Power Plants* was issued by the CAEA to regulate the management of the projects supported by the fund, so as to improve the efficient use of the fund.

B-9 To meet the demands of nuclear power development, China has constructed facilities for the storage, transport and reprocessing of spent fuel based on overall planning; advanced the R&D of dry storage and reprocessing technologies for spent fuel; and facilitated large commercial reprocessing plant projects. These efforts have contributed to stronger capacity in spent fuel storage and reprocessing.

B.3 Definition and Classification Criteria of Radioactive Waste

B-10 As specified in the *Law of the People's Republic of China on Prevention and Control of Radioactive Pollution*, radioactive waste refers to waste that contains, or is contaminated with, radionuclides with activity concentrations or total activity greater than the clearance levels as established by the regulatory body, for which no further use is foreseen.

B-11 In China, radioactive waste is mainly generated from NPPs, research reactors, nuclear fuel cycle facilities, nuclear technology applications and uranium (thorium) ore resources exploitation and utilization. On November 30, 2017, the former Ministry of Environmental Protection (MEP), the MIIT and the CAEA jointly announced the promulgation of *Classification of Radioactive Waste,* which provides guidance for classification of radioactive waste in nuclear industry and nuclear technology application. With reference to an IAEA safety standard *Classification of Radioactive Waste* (GSG-1), the new waste classification scheme aims to achieve the final disposal of radioactive waste in a safe way. According to the potential hazards of various types of waste, and the degree of containment and isolation for disposal, radioactive wastes are classified into very short lived waste

(VSLW), very low level waste (VLLW), low level waste (LLW), intermediate level waste (ILW) and high level waste (HLW), which may be subject to clearance after decay storage, landfill disposal, near surface disposal, intermediate depth disposal, and deep geological disposal, respectively, as shown in Figure 1.

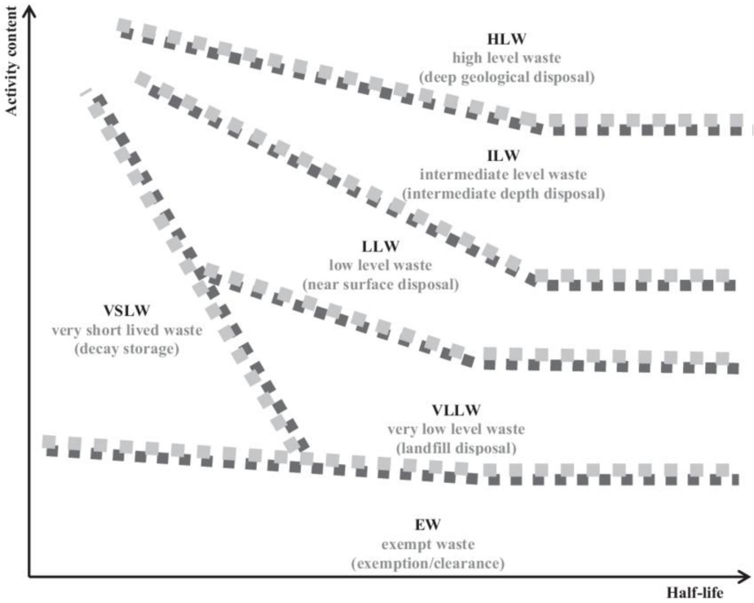

Figure 1. Conceptual illustration of the waste classification scheme

B.3.1 Exempt/Cleared Waste

B-12 Exempt/cleared waste features radionuclide activity concentrations of very low level up to the exemption levels or clearance levels, and does not require control measures for radiation protection purposes.

B-13 Exempt/cleared waste shall be treated and disposed of in a way that satisfies national regulations on solid waste management.

B.3.2 Very Short Lived Waste (VSLW)

B-14 VSLW, which mainly contains radionuclides with very short half-lives (generally, less than 100 days) and long-lived radionuclides with activity concentrations below clearance levels, may be cleared after the activity concentrations of radionuclides have reached clearance levels under storage decay for up to a few years.

B.3.3 Very Low Level Waste (VLLW)

B-15 VLLW, with the activity concentrations of radionuclides close to or slightly above the clearance levels, and with the activity concentrations of long-lived radionuclides at very limited levels. It requires only limited containment and isolation, and may be buried in surface landfills or disposed of in industrial solid waste landfills according to China’s regulations on solid waste management.

B-16 The lower limit of the activity concentration of a radionuclide in the VLLW is equivalent to the clearance level, and the upper limit is generally 10–100 times of the clearance level.

B.3.4 Low Level Waste (LLW)

B-17 LLW, with the activity concentrations of short-lived radionuclides possibly at high levels and containing limited long-lived radionuclides, requires effective containment and isolation for hundreds of years. It may be disposed of in near surface disposal facilities with engineered barrier. The depth of near surface disposal facilities is typically from the surface down to 30 meters underground.

B-18 The lower limit of the activity concentration of a radionuclide in the LLW is equivalent to the upper limit of the activity concentration of that same radionuclide in the VLLW, and the upper limits are shown in Table 1.

B-19 For radionuclides not listed in Table 1, the upper limit of activity concentration is 4E+11 Bq/kg.

Table 1. Upper limits of the activity concentrations of radionuclides in the LLW

Radionuclide	Half-life	Activity concentration (Bq/ kg)
Carbon-14	5.73×10^3a	1E+08
Carbon-14 in activated metals	5.73×10^3a	5E+08
Nickel-59 in activated metals	7.50×10^4a	1E+09
Nickel-63	96.0a	1E+10
Nickel-63 in activated metals	96.0a	5E+10
Strontium-90	29.1a	1E+09
Niobium-94 in activated metals	2.03×10^4a	1E+06
Technetium-99	2.13×10^5a	1E+07
Iodine-129	1.57×10^7a	1E+06
Cesium-137	30.0a	1E+09
Alpha emitting transuranic nuclides with half-lives greater than five years		4E+05 (average) 4E+06 (single waste package)

B.3.5 Intermediate Level Waste (ILW)

B-20 ILW, with a considerable number of long-lived nuclides, especially alpha emitting radionuclides, cannot be disposed of safely by relying solely on institutional controls, and requires more stringent containment and isolation than those provided by near surface disposal. ILW requires disposal at a depth of tens to hundreds of meters underground. In general, heat dissipation measures are not required for ILW storage and disposal.

B-21 The lower limit of the activity concentration of a radionuclide in the ILW is equivalent to the upper limit of the activity concentration of that radionuclide in the LLW, and the upper limit is 4E+11Bq/kg, with heat release rate smaller than or equal to 2 kW/m^3.

B.3.6 High Level Waste (HLW)

B-22 HLW, with activity concentrations high enough to generate significant quantities of heat during decay, or containing large amounts of long-lived radionuclides, requires more stringent containment and isolation, heat dissipation measures, and deep geological disposal.

B-23 The lower limit of the activity concentrations of radionuclides in the HLW is 4E+11 Bq/kg, or the heat release rate is greater than 2 kW/m^3.

B.4 Radioactive Waste Management Policy

B-24 The management of radioactive waste -must adhere to the concept of taking safety as the goal and disposal as the central focus, and realizing minimization of radioactive waste, to ensure the safety for both current and future generations, without imposing undue burdens on future generations.

B-25 The generators of radioactive waste shall bear full responsibility for the safety of radioactive waste management.

B-26 Radioactive waste shall be managed by category.

B-27 Radioactive waste management facilities for the nuclear facilities shall be designed, constructed and commissioned synchronously with the main facilities.

B-28 Radioactive waste generated from nuclear technology applications shall be collected and stored centrally within a province, autonomous region or municipality directly under the central government.

B-29 The discharge of gaseous and/or liquid effluent into the environment shall be subject to the national standards on radioactive contamination prevention and control.

B-30 Radioactive waste shall be disposed of by category. LILW shall be disposed of in near surface or intermediate depth disposal facilities. HLW shall be disposed of in a centralized deep geological repository.

B-31 During the design, construction, operation and decommissioning of nuclear facilities, measures such as waste source control, recycling and reuse, clearance, waste treatment optimization and management enhancement shall be taken to keep the volume and activity of solid radioactive waste as low as reasonably achievable (ALARA) through cost-effectiveness analysis.

B-32 It is prohibited to dispose of solid radioactive waste in inland waters or seas. It is also prohibited to export radioactive waste and radioactively-contaminated articles to, or transit through, the territory of the People’s Republic of China.

B.5 Radioactive Waste Management Practices

B.5.1 Management of Radioactive Waste from Operating Facilities

B-33 All the licencees of nuclear facilities have designed, constructed and commissioned supporting radioactive waste management facilities synchronously with the main facilities as required. They have also formulated radioactive waste management programmes and procedures to manage radioactive waste by category.

B-34 Generally, the gaseous/liquid radioactive waste from the nuclear facilities is treated by the responsible licencees until the waste meets the discharge standards and then discharged, adhering to the ALARA principle. The solid radioactive waste and the liquid radioactive waste that cannot be purified for discharge are treated by the responsible licencees, packaged in stable and standardized packages that meet the disposal requirements, and then temporarily stored before being sent to a licenced solid radioactive waste disposal facility. The methods for treatment of gaseous radioactive waste from nuclear facilities include filtration, adsorption, and decay storage; for liquid radioactive waste, methods include filtration, evaporation, ion exchange, adsorption by silica gel and membrane treatment; and for solid waste, methods include cement solidification/immobilization, super compression, containing with high integrity container (HIC), and hot compression.

B-35 Continuous efforts are made to minimize radioactive waste at operating NPPs in China. The training and publicity on waste minimization have raised awareness among NPP personnel and contractors. To minimize radioactive waste, wide varieties of waste volume reduction technologies are employed, such as pre-compression and super compression, and the replacement of cement-solidified waste containers with metal drums, and protective articles such as paper garment and shoe covers made from degradable materials. Novel waste treatment technologies and operating models are incorporated into the design of newly-built NPPs, such as in-drum drying, hot compaction of spent resins, mobile liquid waste processing device, Site Radioactive Treatment Facility (SRTF), and so on.

B-36 The China Nuclear Energy Association (CNEA) organized a special peer review of radioactive waste management in Tianwan NPP on July 15–21, 2023, focusing on radioactive waste management system, safety of waste management, waste minimization, and effluent discharge. Through the assessment, good practices worthy of promotion were identified, several deficiencies were found, and improvement suggestions were put forward to help the NPP optimize its waste management system, apply good practices and advanced technologies in the industry.

B-37 China National Nuclear Power Co., Ltd. (CNNP) has established a communication platform for radioactive waste management, and formulated the *Statistical Rules for Solid Radioactive Waste from Operating Nuclear Power Plants in China* by coordinating the radioactive waste management resources of various NPPs, so as to standardize the statistical rules for all aspects of radioactive waste management and establish a unified data management platform. The company began full-process recording and analysis of radioactive waste in 2020, which made it fully understand the problems and the potential risks in the waste management process. By identifying potential problems in waste management, the waste management strategy is timely adjusted and optimized to reduce the generation of waste from the source, thus ensuring the safe disposal and minimization of waste. In accordance with the relevant management system, operating NPPs of the company have made efforts to carefully examine and approve discharge applications, strengthen discharge monitoring and supervision, and control and minimize radioactive waste discharge, achieving an annual radioactive discharge far below the authorized limit. Since 2021, the company has organized the Annual Conference on Health Physics of Nuclear Power Plants in China every year to share experience from various NPPs. From February to September 2023, it invited senior experts in the industry to carry out a special inspection on radioactive waste minimization of 25 units in five operating NPPs. This inspection provided a full understanding of the shortcomings of the target NPPs in radioactive waste management, with practical improvement measures proposed and rectification conducted under supervision.

B-38 CGN has set up a peer group for radioactive waste management, which is committed to the implementation of standardized, professional and intensive management of radioactive waste in operating NPPs, and to minimizing radioactive waste. Following the principle of “taking disposal as the central focus and realizing minimization of radioactive waste”, the peer group investigates and analyses the good performances in the field to systematically eliminate the gap, achieve and maintain the outstanding radioactive waste minimization management level. CGN has put forward the medium-term and long-term control targets of radioactive waste generated from NPPs, formulated the roadmap and the timetable step by step, established a special group for solid waste management, built a platform for coordinating radioactive waste management, optimized the whole process of waste management (design, R&D, operation, and application), promoted the implementation of special actions and plans designed every year, and fostered continuous improvement in the radioactive waste reduction for its multi-facility site. Since the last Review Meeting, by taking the incineration of combustible waste as a breakthrough point, CGN has achieved the goal of an annual solid waste output of its multi-facility site below 30 m^3/unit.

B.5.2 Radioactive Waste Disposal

B-39 China has four near surface disposal facilities in operation. In July 2022, Longhe Disposal Facility, China’s first centralized disposal site for LLW from NPPs, was approved by the NNSA and received its operating licence. The planned disposal capacity of Longhe Disposal Facility is one million cubic meters. According to the principle of “one overall plan, phased construction”, the disposal capacity of Phase I Stage I will be 40,000 m^3. In November 2022, Longhe Disposal Facility was officially put into operation to receive LLW packages from NPPs. In October 2022, the NNSA approved the change of the operating licence for the Feifengshan Disposal Facility. Phase I Stage II of the facility was put into operation, with an expanded disposal capacity of 70,000 m^3. In April 2023, the NNSA approved the modification of the operating licence for the Northwest Disposal Facility, and Phase I Stage II of the site was put into operation, with an expanded disposal capacity of 90,000 m^3.

B-40 China carried out R&D of intermediate depth disposal of radioactive waste, which includes source term investigation of ILW, the preliminary study of possible disposal options, and the preliminary investigation of potential sites for intermediate depth disposal facilities.

B-41 China attaches great importance to the disposal planning for HLW. In 2006, the CAEA, the Ministry of Science and Technology (MOST), and the former State Environmental Protection Administration (SEPA) jointly promulgated the *Guidelines on Research and Development Planning for Geological Disposal of HLW*, proposing that the general objective of China's research on geological disposal of HLW is to select geologically stable sites with favourable social and economic conditions, and build a national geological disposal facility for HLW solid waste by the middle of this century.

B-42 The CAEA has organized the siting for the HLW geological repository and related scientific research work. Screening survey was conducted in six pre-selected regions including Eastern China, Southern China, Southwestern China, Inner Mongolia, Xinjiang and Gansu, with emphasis on the study of site characteristics of Beishan in Gansu Province.

B-43 In June 2021, the construction of Beishan URL was commenced, marking that China's HLW geological disposal has entered the stage of URL construction and R&D. As of the end of 2023, the main shaft of the URL has been successfully bored, the drilling footage along the ramp has exceeded 3.1 km, and three turning sections of ramp have been successfully completed. The CAEA approved the establishment of the Innovation Center for Geological Disposal of High-Level Radioactive Waste as a national R&D platform to promote the R&D of geological disposal of HLW in China. In October 2021, the IAEA designated BRIUG as the world's first collaborating center for geological disposal of HLW.

B-44 During construction of the URL, China has made active efforts to explore URL regulation strategies adaptive to its actual conditions. Considering the future possibility to transform the URL into a repository, the North-Western Regional Office of Nuclear and Radiation Safety Inspection conducted regulatory inspection of the URL with reference to the regulatory requirements for nuclear facilities, and clarified the quarterly and annual reporting requirements for the construction stage of the URL.

B-45 In March 2023, the CAEA issued the *Management Measures on Low and Intermediate Level Solid Radioactive Waste Disposal Sites*.

B.5.3 Management of Disused Sealed Sources

B-46 China has built 31 provincial radioactive waste temporary storage facilities for nuclear technology application, which are mainly used for storing disused sealed sources generated in the fields of industry, agriculture, medicine, education and research in these provinces concerned (autonomous regions and municipalities directly under the central government). Local provincial competent authorities for ecology and environment have set up special agencies and assigned professionals for supervision and management of disused sealed sources from nuclear technology application as well as environmental monitoring. Meanwhile, China has authorized manufacturers to engage in the recovery and reuse of disused sealed sources such as ^{60}Co, ^{137}Cs, $^{241}Am/Be$ and $^{238}Pu/Be$.

B-47 China continues to promote the safe and proper disposal of disused sealed sources. On the one hand, the *Safety requirements for near surface disposal of disused radioactive sources* (HJ 1336-2023) was issued, which specifies the conditioning requirements and radionuclides activity limits for near surface disposal of disused sealed sources; and on the other hand, demonstrative disposal was carried out with some disused sealed sources that meet the near surface disposal standard. Since 2019, China has disposed of nearly 30,000 disused ^{192}Ir and ^{75}Se sealed sources, previously stored by radioactive source producers, in three batches at the Northwest Disposal Facility. At the end of 2023, around 1,100 disused sealed sources (mainly ^{90}Sr, ^{137}Cs and ^{60}Co sources) have been conditioned for disposal in the National Centralized Disused Sealed Sources Storage Facility.

C. SCOPE OF APPLICATION (Article 3)

1. This Convention shall apply to the safety of spent fuel management when the spent fuel results from the operation of civilian nuclear reactors. Spent fuel held at reprocessing facilities as part of a reprocessing activity is not covered in the scope of this Convention unless the Contracting Party declares reprocessing to be part of spent fuel management.

2. This Convention shall also apply to the safety of radioactive waste management when the radioactive waste results from civilian applications. However, this Convention shall not apply to waste that contains only naturally occurring radioactive materials (NORM) and that does not originate from the nuclear fuel cycle, unless it constitutes a disused sealed source or it is declared as radioactive waste for the purposes of this Convention by the Contracting Party.

3. This Convention shall not apply to the safety of management of spent fuel or radioactive waste within military or defence programmes, unless declared as spent fuel or radioactive waste for the purposes of this Convention by the Contracting Party. However, this Convention shall apply to the safety of management of spent fuel and radioactive waste from military or defense programmes if and when such materials are transferred permanently to and managed within exclusively civilian programmes.

4. This Convention shall also apply to discharges as provided for in Articles 4, 7, 11, 14, 24 and 26.

C.1 Applicability to Spent Fuel

C-1 This report covers the management of spent fuel from the operation of civil nuclear reactors, with the exception of the management of spent fuel held in reprocessing facilities.

C.2 Applicability to Radioactive Waste

C-2 This report covers the management of radioactive waste from the operation of civil nuclear reactors and civil nuclear fuel cycle facilities, and the management of disused sealed sources (including disused ^{226}Ra sealed sources) from nuclear technology application, with the exception of the management of radioactive waste that contains only NORM and that from nuclear technology application.

C.3 Applicability to Spent Fuel and Radioactive Waste from Defence or Military Programmes

C-3 This report excludes the management of spent fuel and radioactive waste from defence or military programmes.

C.4 Applicability to Effluent Discharges

C-4 This report covers the discharges of gaseous and liquid radioactive effluents as provided for in Articles 4, 7, 11, 14, 24 and 26 of this Convention.

D. INVENTORIES AND LISTS (Article 32-2)

This report shall also include:

i) a list of the spent fuel management facilities subject to this Convention, their location, main purpose and essential features;

ii) an inventory of spent fuel that is subject to this Convention and that is being held in storage and of that which has been disposed of. This inventory shall contain a description of the material and, if available, give information on its mass and its total activity;

iii) a list of the radioactive waste management facilities subject to this Convention, their location, main purpose and essential features;

iv) an inventory of radioactive waste that is subject to this Convention that:

a) is being held in storage at radioactive waste management and nuclear fuel cycle facilities;

b) has been disposed of; or

c) has resulted from past practices.

This inventory shall contain a description of the material and other appropriate information available, such as volume or mass, activity and specific radionuclides;

v) a list of nuclear facilities in the process of being decommissioned and the status of decommissioning activities at those facilities.

D.1 Spent Fuel Management Facilities

D-1 As of December 31, 2023, China has a total of 62 operational spent fuel storage facilities, as listed in Annex L.1.1, serving 55 nuclear reactors at 17 NPPs.

D-2 A total of three storage facilities for spent fuel from research reactors were constructed, as listed in Annex L.1.2, serving 13 research reactors operated by three licencees.

D.2 Inventory of Spent Fuel Held in Storage

D-3 As of December 31, 2023, 10,284.8 tHM of spent fuel from NPPs was held under pool storage at the reactors, and 3,086.2 tHM of spent fuel from NPPs was held under dry storage, as detailed in Annex L.2.1.

D-4 The spent fuel from research reactors, amounting to 0.226 tU, is held under pool storage at the reactors, as detailed in Annex L.2.2.

D-5 As of December 31, 2023, no spent fuel disposal activities have taken place in China.

D.3 Radioactive Waste Management Facilities

D.3.1 Radioactive Waste Treatment and Storage Facilities

D-6 A number of radioactive waste treatment and storage facilities have been constructed by the end of December 31, 2023, including 78 by the 17 NPP licencees, 11 by the three research reactor licencees, 14 by the four licencees of nuclear fuel cycle facilities, and two specialized radioactive waste storage facilities and two specialized radioactive waste treatment facilities, as shown in Annexes L.3.1–L.3.5.

D-7 In addition, 31 provincial radioactive waste temporary storage facilities for nuclear technology application have been constructed, together with one national centralized disused sealed sources storage facility, as shown in Annex L.3.6.

D.3.2 Radioactive Waste Disposal Facilities

D-8 Four near surface disposal facilities and two VLLW landfills have been put into operation in China, as detailed in Annex L.3.7.

D.4 Radioactive Waste

D-9 As of December 31, 2023, a total of 10,736.6 m^3 of conditioned radioactive waste has been stored in the radioactive waste storage facilities of the NPP licencees. The inventory and list of conditioned radioactive waste stored in the NPPs are detailed in Annex L.4.1.

D-10 As of December 31, 2023, a total of 831.8 m^3 of conditioned radioactive waste has been stored in the radioactive waste storage facilities of the research reactor licencees. See L.4.2 for the inventory and list of conditioned radioactive waste in research reactors and nuclear fuel cycle facilities.

D-11 As of December 31, 2023, a total of 49,744 disused sealed sources have been stored in 31 provincial radioactive waste temporary storage facilities for nuclear technology application and a total of 171,086 disused sealed sources have been stored in the National Centralized Disused Sealed Sources Storage Facility, as detailed in Annex L.4.3.

D-12 As of December 31, 2023, a total of 6,987.6 m^3 of LLW has been received by the two LLW storage facilities, as detailed in Annex L.4.4.

D-13 As of December 31, 2023, a total of 137 m^3 of combustible waste and 289 kg of scrap metals have been received by the two radioactive waste treatment facilities, respectively, as detailed in Annex L.4.5.

D-14 As of December 31, 2023, a total of 84,441.27 m^3 of solid radioactive waste has been received by the four near surface disposal facilities, as detailed in Annex L.4.6.

D-15 As of December 31, 2023, a total of 11,881.37 m^3 of waste has been received by the two VLLW landfills, as detailed in Annex L.4.7.

D.5 List of Nuclear Facilities being Decommissioned

D-16 Since the last Review Meeting, the 101 HWRR of the China Institute of Atomic Energy (CIAE) and the Bulk Shielding Reactor (BSR) of Tsinghua University are being decommissioned, as detailed in Annex L.5.

E. LEGISLATIVE AND REGULATORY SYSTEM (Articles 18 to 20)

E.1 Implementing Measures (Article 18)

Each Contracting Party shall take, within the framework of its national law, the legislative, regulatory and administrative measures and other steps necessary for implementing its obligations under this Convention.

E-1 In order to strengthen the efforts to fulfill China's commitment to the Joint Convention and to implement its obligations under the Joint Convention, the Working Group on the Implementation of the Joint Convention was established under the approval of the State Council, to undertake the responsibility for organizing and coordinating the work on the implementation of the Joint Convention. The Working Group is composed of the MEE/NNSA, the CAEA, the Ministry of Foreign Affairs (MFA), the Ministry of Public Security (MPS), the National Health Commission (NHC) and the National Energy Administration (NEA). The Working Group is headed by MEE/NNSA, with the CAEA as the deputy head. The Working Group's Secretariat is based at the Department of International Cooperation under the MEE.

E-2 In order to prepare the National Report for the Joint Convention, a National Report Review Committee (NRRC) and a National Report Compiling Group (NRCG) were established. The NRRC consists of experts engaged in the safety of spent fuel management and the safety of radioactive waste management. Under the guidance of the Working Group, the NRRC and the NRCG undertake the following work: (1) to prepare and review China's National Reports for the Joint Convention, (2) to preliminarily review the National Reports of other Contracting Parties, (3) to review the response to questions about China's National Reports raised by other Contracting Parties, and (4) to prepare for, take part in, and summarize the Review Meetings of the Contracting Parties to the Joint Convention and to take actions accordingly.

E.2 Legislative and Regulatory Framework (Article 19)

1. Each Contracting Party shall establish and maintain a legislative and regulatory framework to govern the safety of spent fuel and radioactive waste management.

2. This legislative and regulatory framework shall provide for:

(i) the establishment of applicable national safety requirements and regulations for radiation safety;

(ii) a system of licencing of spent fuel and radioactive waste management activities;

(iii) a system of prohibition of the operation of a spent fuel or radioactive waste management facility without a licence;

(iv) a system of appropriate institutional control, regulatory inspection and documentation and reporting;

(v) the enforcement of applicable regulations and of the terms of the licences;

(vi) a clear allocation of responsibilities of the bodies involved in the different steps of spent fuel and of radioactive waste management.

3. When considering whether to regulate radioactive substance as radioactive waste, Contracting Parties shall take due account of the objectives of this Convention.

E.2.1 Legislative Framework

E-3 Under the *Legislation Law of the People's Republic of China* and in accordance with the statutory power and procedures, China established and maintained a legislative framework governing the safety of spent fuel management and the safety of radioactive waste management, which incorporates a comprehensive set of the relevant national laws, administrative regulations, departmental rules, management guides and references, as shown in Figure 2. The laws that are applicable to the safety of spent fuel management and the safety of radioactive waste management are developed and promulgated by the NPC and its Standing Committee; administrative regulations are developed and issued by the State Council as mandated by the *Constitution of the People's Republic of China* and the relevant laws; departmental rules are developed and issued by the MEE, State Administration of Science, Technology and Industry for National Defence (SASTIND) and NHC, as mandated by the relevant national laws, regulations and the responsibility assignments and empowerment of the State Council; the management guides are developed and issued by the relevant departments of the State Council; and references are developed by the relevant departments of the State Council or their mandated agencies, and issued by the relevant departments of the State Council.

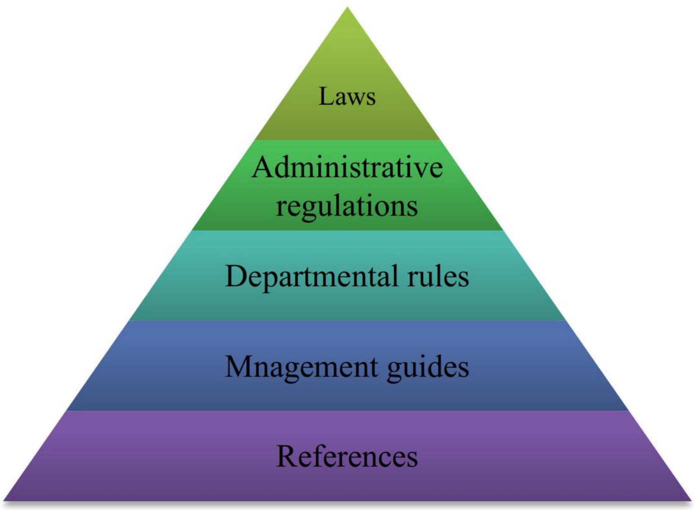

Figure 2. Legislative Framework System in China

E-4 The safety requirements for the management of spent fuel and radioactive waste have been stipulated in the laws, regulations and rules that have been in effect and applicable to such purpose, which include, for example:

—*Nuclear Safety Law of the People's Republic of China*, adopted by the Standing

Committee of the NPC in 2017;

—*Law of the People's Republic of China on Prevention and Control of Radioactive Pollution*, adopted by the Standing Committee of the NPC in 2003;

—*Rules of the People's Republic of China on the Safety Regulation for Civil Nuclear Facilities,* (HAF 001), issued by the State Council in 1986;

—*Regulations on the Safety and Protection of Radioisotopes and Radiation-Emitting Devices*, adopted by an executive meeting of the State Council in 2005; and

—*Regulations on the Safety of Radioactive Waste Management*, adopted by an executive meeting of the State Council in 2011.

E-5 The laws, regulations, rules, and guides applicable to the safety of spent fuel management and the safety of radioactive waste management are detail in L.6.1–L.6.4.

E-6 The *Nuclear Safety Law of the People's Republic of China* was promulgated in September 2017, and was implemented as of January 1, 2018. With supreme legal authority in nuclear safety, this law is the cornerstone for effectively safeguarding nuclear safety in China. This law provides for:

(1) policies, principles, responsibilities, technologies and institutions to ensure nuclear safety;

(2) qualification, duties and responsibilities of licencees of nuclear facilities;

(3) systems for licencing of nuclear facilities and nuclear materials and radioactive waste management;

(4) systems of emergency coordination committee in case of nuclear accidents, emergency plan and nuclear accident information release;

(5) system of nuclear safety information disclosure and public participation, and their subject and scope;

(6) specific measures to oversee and inspect nuclear safety; penalties for violations of this law; and

(7) institutional provisions on the compensation for damages caused by nuclear accidents.

The regulations under this law are being developed or revised by the MEE/NNSA. For example, *Safety Rules on the Management System for NPPs* was developed and issued in December 2020.

E-7 In addition, a number of technical standards were issued by the relevant governmental departments, which have further defined and clarified the technical requirements for the management of spent fuel and radioactive waste. For example:

—The *Basic standards for protection against ionizing radiation and for the safety of radiation sources* (GB 18871-2002) stipulate the basic requirements for protection against ionizing radiation and for the safety of radiation sources. It is applicable to the protection of workers against ionizing radiation in interventions or practices, and the safety of radiation sources during practices.

—The *Regulations for radioactive waste management* (GB 14500-2002) stipulates the management objectives and basic requirements for the generation, collection, pretreatment, treatment, conditioning, transport, storage, disposal and discharge of radioactive waste, as well as decommissioning, environmental remediation and other activities. It is applicable to various stages in nuclear fuel cycle and the management of radioactive waste generated by nuclear technology application.

E-8 Technical standards that are applicable to the safety of spent fuel management and the safety of radioactive waste management are listed in Annex L.6.5.

E-9 The laws, regulations, rules, and guides related to the safety of spent fuel management and the safety of radioactive waste management issued/amended since the last Review Meeting are as follows:

(1) Departmental rules

Rules on Nuclear Safety Reporting of NPP Licencees, issued by the MEE in November 2020;

Safety Rules on the Management System for NPPs, issued by the MEE in December 2020;

Rules on the Qualification of Operators of Civil Nuclear Facilities, jointly issued by the MEE and the NDRC in January 2021; and

Safety Rules on Commissioning and Operation of Nuclear Power Plants, issued by the MEE in June 2022.

(2) Management guides

Geological Disposal Facilities for Radioactive Waste (HAD 401/10-2020), issued by the NNSA on January 19, 2020;

Minimization of Radioactive Waste in Nuclear Technology Application Projects (HAD 401/11-2020), issued by the NNSA on March 10, 2020;

Pre-Disposal Management of Radioactive Waste at Nuclear Facilities (HAD 401/12-2020), issued by the NNSA on May 13, 2020;

Safety of the Spent Fuel Reprocessing Facilities (HAD 301/05-2021), issued by the NNSA on April 22, 2021;

Safety of Low-Level Radioactive Solid Waste Storage Facilities (HAD 401/13-2021), issued by the NNSA on May 22, 2021;

Decommissioning of Nuclear Technology Application Facilities (HAD 401/14-2021), issued by the NNSA on October 13, 2021;

Design of Handling and Storage System at NPPs (HAD 102/15-2021), issued by the NNSA on December 17, 2021;

Safety Assessment for Decommissioning of Nuclear Facilities (HAD 401/15-2021), issued by the NNSA on January 5, 2022;

Management of Radioactive Waste from the Use of Radioactive Material in Medicine, Industry, Agriculture, Research and Education (HAD 401/16-2023), issued by the NNSA on February 9, 2023; and

Emergency Preparedness and Response of Licensees of Near Surface Disposal Facilities for Radioactive Waste (HAD 002/09-2023), issued by the NNSA on April 28, 2023.

E.2.2 Regulatory Framework

E-10 The followings are implemented under the *Law of the People's Republic of China on Prevention and Control of Radioactive Pollution*, the *Nuclear Safety Law of the People's Republic of China*, the *Law of the People's Republic of China on Prevention and Control of Occupational Diseases*, the *Regulations of the People's Republic of China on the Safety Supervision and Management of Civilian Nuclear Installations*, the *Regulations on the Safety and Protection of Radioisotopes and Radiation-Emitting Devices*, and the *Regulations on the Safety of Radioactive Waste Management*:

(1) The licencing system has been established for spent fuel and radioactive waste management activities, and spent fuel and radioactive waste management facilities without licences are prohibited:

—The nuclear facility safety licencing system is implemented in China. The MEE/NNSA approves and grants safety licences for nuclear facilities, which include siting permission for nuclear facilities, construction licence, operating licence, and approval for decommissioning of nuclear facilities. Nuclear facilities here refer to civil nuclear facilities such as NPPs, research reactors, nuclear fuel cycle facilities, and radioactive waste treatment, storage and disposal facilities. The licencees of the said nuclear facilities shall apply for licences from the NNSA prior to siting, construction, operation, and decommissioning of nuclear facilities.

—A graded approach for management and licencing is implemented for radiation safety in China. The producers, distributors and users of radioactive sources are required to obtain the radiation safety licence. The licences for the producers of radioactive sources and the users of Category I radioactive sources (excluding users of Category I sources for medical purposes) are examined, approved, and granted directly by the MEE/NNSA, whereas the licences for the users of Category I sources for medical purposes, and those of Category II, III, IV and V sealed sources by ecology and environment departments at provincial level or below.

—Those specialized for the treatment, storage and disposal of radioactive waste shall apply for licences of such activities. The licences of such activities are examined, approved and granted by the MEE/NNSA.

(2) The system of institutional control, regulatory inspection, documentation and reporting has been established:

—China has implemented the radioactive contamination monitoring system, gaseous and liquid effluent discharge licencing system, effluent and environmental monitoring system, and nuclear accident emergency response system, and more. Additionally, a certificate management system is exercised for the regulatory inspection personnel and the practice qualification system for the technical professionals engaged in critical positions of nuclear and radiation safety.

—The NNSA and its regional offices implement routine, non-routine and daily inspections of nuclear facilities, and may dispatch inspection group (or personnel) to the nuclear equipment manufacture sites, nuclear facility construction sites and operation sites for implementing nuclear safety supervision missions. The competent authorities for ecology and environment at the county level or above, along with other related departments, perform regulatory inspection on the safety of radioactive waste treatment, storage and disposal activities in accordance with the *Law of the People's Republic of China on Prevention and Control of Radioactive Pollution*, the *Nuclear Safety Law of the People's Republic of China*, and the *Regulations on the Safety of Radioactive Waste Management*.

—The licencees of nuclear facilities shall implement file-based management of testing procedures, operating procedures, QA records, testing results and data, operation and maintenance records, and records of defects and abnormal incidents; the producers, distributors and users of radioactive sources shall establish radioactive source management ledgers, individual dose files, and occupational health institutional control files; and the licencees of solid radioactive waste treatment, storage, and disposal facilities shall establish records and files of radioactive waste treatment, storage and disposal activities and record accordingly.

—The licencees of nuclear facilities, nuclear technology application organizations, and the licencees of radioactive waste treatment and storage facilities shall report truthfully, as required by rules issued by the MEE/NNSA, the status of radioactive waste's generation, treatment, storage, discharge, clearance and delivery for disposal. The licencees of radioactive waste disposal facilities shall report truthfully, prior to March 31 every year, to the related departments the details about solid radioactive waste reception and disposal and facility operation in the previous year.

—In the event of a nuclear and radiation emergency, the licencees of nuclear facilities must report immediately to the relevant departments; the nuclear technology application organizations must report immediately to the relevant departments if the radioactive sources are found lost or stolen.

(3) The regulations and licencing provisions on spent fuel and radioactive waste management are enforced in China. For the licence holders who violate the regulations, and/or licencing provisions, the NNSA has the right to take compulsory measures when necessary, or to order the licence holders to take safety measures or stop the activity endangering safety. Depending on the seriousness, the NNSA will give warning, order to improve within a specified timeframe, or to shut down or suspend operations for rectification, or revoke the licence for penalty; for the licencees who neither implement the decision on penalty nor file a lawsuit within the time limit, the NNSA shall apply to the court for compulsory execution.

(4) The responsibilities of various authorities for spent fuel and radioactive waste management are clearly defined. The MEE/NNSA has overall regulatory control over the radioactive pollution prevention and control work throughout the country, and is responsible for the regulation of radioactive waste safety in China. The CAEA is authorized to develop the policies, regulations, plans and standards for spent fuel and radioactive waste management, coordinate and organize relevant nuclear emergency response, and coordinate efforts to push forward relevant capacity building. Other relevant departments of the State Council, in accordance with the duties assigned by the State Council, regulate the spent fuel and radioactive waste management according to law (see E.3 and E.4).

E-11 In accordance with the *Basic standards for protection against ionizing radiation and for the safety of radiation sources* (GB 18871-2002), the *Activity concentration for material not requiring radiological regulation* (GB 27742-2011) and the *Clearance levels for recycle and reuse of steel, aluminum, nickel and copper from nuclear facilities* (GB 17567-2009), the MEE/NNSA, through such means as justification confirmation, dose assessment and activity concentration (total activity) verification, classifies waste with an activity above the authorized limit as radioactive waste subject to regulatory control and waste with an activity below the authorized limit as radioactive waste to be excluded from regulatory control. This is to protect the individuals, society and the environment from harmful effects of ionizing radiation, now and in the future, which is consistent with the objective of the Joint Convention.

E.3 Regulatory Body (Article 20)

1. Each Contracting Party shall establish or designate a regulatory body entrusted with the implementation of the legislative and regulatory framework referred to in Article 19, and provided with adequate authority, competence and financial and human resources to fulfill its assigned responsibilities.

2. Each Contracting Party, in accordance with its legislative and regulatory framework, shall take the appropriate steps to ensure the effective independence of the regulatory functions from other functions where organizations are involved in both spent fuel or radioactive waste management and in their regulation.

E-12 The regulatory bodies in China involved in the safety of spent fuel management and the safety of radioactive waste management are the MEE/NNSA, the NHC, and the MPS.

E.3.1 Independence of Regulatory Bodies

E-13 The MEE/NNSA, an independent regulatory body for nuclear and radiation safety, is authorized to regulate nuclear and radiation safety.

E-14 The responsibilities of the regulatory bodies are defined clearly in the following laws and regulations to ensure their independence: *Nuclear Safety Law of the People's Republic of China*; *Law of the People's Republic of China on Prevention and Control of Radioactive Pollution*; *Law of the People's Republic of China on Prevention and Control of Occupational Diseases*; *Regulations of the People's Republic of China on the Safety Supervision and Management of Civilian*

Nuclear Installations; *Regulations on the Safety of Radioactive Waste Management*; *and Regulations on the Safety and Protection of Radioisotopes and Radiation-Emitting Devices*. For example, the *Nuclear Safety Law of the People's Republic of China* stipulates that the NNSA shall be responsible for the regulatory control of nuclear safety; the *Law of the People's Republic of China on Prevention and Control of Radioactive Pollution* stipulates that the MEE shall implement, by law, countrywide regulatory control of radioactive pollution prevention and control; the *Regulations of the People's Republic of China on the Safety Supervision and Management of Civilian Nuclear Installations* stipulates that the NNSA shall be responsible for making, approving and granting the nuclear facility safety licences; the *Regulations on the Safety of Radioactive Waste Management* stipulates that the MEE shall carry out overall regulatory control of radioactive waste safety in China.

E.3.2 MEE/NNSA

E.3.2.1 MEE/NNSA Organizational Structure

E-15 The MEE/NNSA consists of the headquarters, regional offices, and technical support organizations, with its organizational structure illustrated in Figure 3.

E-16 The MEE/NNSA is headquartered in Beijing, with six regional offices located in Shanghai, Shenzhen, Chengdu, Beijing, Lanzhou, and Dalian, respectively, which are responsible for nuclear and radiation safety inspection in the designated region.

E-17 The specific routine work on nuclear and radiation safety of the MEE/NNSA is undertaken, respectively, by the Department of Nuclear Facility Safety Regulation, the Department of Nuclear Power Safety Regulation, and the Department of Radiation Source Safety Regulation.

E-18 To better fulfill its regulatory functions, the MEE/NNSA set up the Nuclear and Radiation Safety Center to provide technical support, and subsequently, in 2011, added a Radiation Environmental Monitoring Technology Center to further strengthen the technical capabilities for nationwide radiation environmental monitoring and management. After the last Review Meeting, the National Marine Environmental Monitoring Center was included into its technical support framework. Additionally, the MEE/NNSA has established long-term and reliable partnership with other organizations for technical support and assistance.

E-19 An Expert Committee on Nuclear Safety has been set up by the MEE/NNSA to offer technical consultation in drafting nuclear and radiation safety laws and regulations, developing nuclear safety technology/techniques and implementing nuclear safety review and oversight.

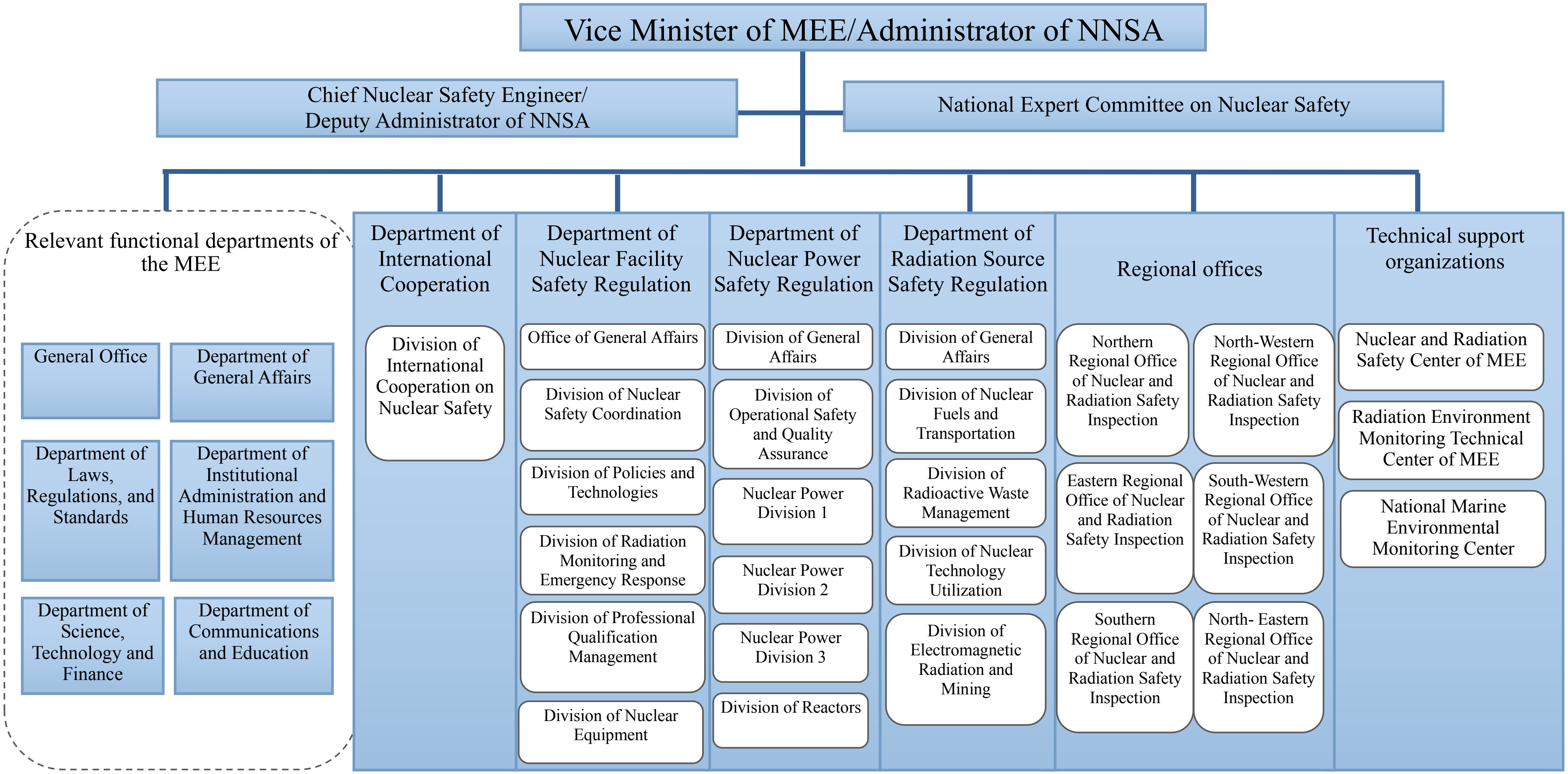

Figure 3. MEE/NNSA Organizational Structure

E.3.2.2 MEE/NNSA Responsibilities

E-20 The MEE/NNSA is principally responsible for the safety of spent fuel management and the safety of radioactive waste management in terms of:

(1) regulation of nuclear and radiation safety management, including the development of policies, planning, laws, administrative regulations, departmental rules, systems, standards and codes in relation to nuclear safety, radiation safety, electromagnetic radiation, radiation environment protection, and nuclear and radiation accidents;

(2) overall regulatory control over nuclear facility safety, radiation safety, and radiation environment protection;

(3) regulatory control over the licencing, design, manufacture, installation, and non-destructive testing of nuclear safety equipment, as well as the safety inspection of imported nuclear safety equipment;

(4) regulatory control of nuclear material control and physical protection;

(5) regulatory control of radiation safety and radiation environment protection against nuclear technology application projects, uranium (thorium) mines, and NORM, as well as radiation protection;

(6) regulatory control of radioactive waste treatment and disposal safety, and radiation environment protection; and regulatory inspection of radioactive pollution prevention;

(7) regulatory control of the safety of transport of radioactive materials;

(8) participating in nuclear emergency response, and being responsible for response to radiation emergencies;

(9) management of qualification of reactor operators and personnel for special processes of the nuclear equipment;

(10) organizing and implementing environment radiation monitoring and supervisory monitoring of nuclear facilities and key radiation sources;

(11) China’s fulfillment of international conventions on nuclear and radiation safety; and

(12) guiding the routine work at regional offices for nuclear and radiation safety inspection.

E.3.2.3 Financial and human resources of MEE/NNSA

E-21 The annual central budget on nuclear and radiation safety regulation for the MEE/NNSA was CNY 264 million, 201 million, 199 million and 217 million in 2020, 2021, 2022, and 2023, respectively.

E-22 At present, a total of 82 officially budgeted posts are allocated for the departments of the MEE/NNSA, 433 posts for the six regional offices of the MEE/NNSA, and 558 for the Nuclear and Radiation Safety Center of the MEE/NNSA. Since the last Review Meeting, additional 102 officially budgeted posts have been allocated to the six regional offices.

E.3.3 National Health Commission (NHC)

E-23 The NHC is principally responsible for the safety of spent fuel management and the safety of radioactive waste management in terms of:

(1) the prevention and control of infectious diseases, environmental sanitation, sanitation of schools, sanitation of public places, supervision and management of drinking water sanitation, and supervision over occupational sanitation and radiation sanitation, organizing the investigation and penalty of major violations in accordance with the law, and improve the comprehensive sanitation and health supervision system;

(2) undertaking the responses to health emergencies and medical rescues, organizing the preparation of specific response plans, and undertaking the organization, implementation and instructive supervision of drills or exercises of the response plans;

(3) developing policies and standards related to occupational and radiological sanitation and organizing their implementation; monitoring main occupational diseases, performing specific investigations, assessing the risk of occupational health and managing the health of occupational workers; and coordinating the prevention and control of occupational diseases.

E.3.4 Ministry of Public Security (MPS)

E-24 The MPS is principally responsible for the safety of spent fuel management and the safety of radioactive waste management in terms of:

(1) granting pass for transport;

(2) providing guidance for the investigation and penalty of the cases about lost and/or stolen radioactive materials.

E.4 Government Authorities for Nuclear Power Expansion

E.4.1 China Atomic Energy Authority (CAEA)

E-25 The CAEA is composed of the Department of General Administration, the Department of Development and Planning, the Department of Science and Technology and Quality, the Department of System Engineering, the Department of Nuclear Emergency and Safety Regulation, the Department of International Cooperation, together with National Nuclear Emergency Response Office, Nuclear Material Control Office, and Isotope Management Office. Among the technical centers affiliated to the CAEA are National Nuclear Emergency Technology Assistance Center, Nuclear Technology Support Center, State Nuclear Security Technology Center, the Southwestern China Regional Center of Nuclear Safety, the Northwester China Regional Center of Nuclear Safety, and the News Center.

E-26 Its major responsibilities are as follows:

(1) studying and proposing the policies and regulations concerning the peaceful use of atomic energy in China;

(2) studying and developing the development programs, plans and industry

standards concerning the peaceful use of atomic energy in China;

(3) organizing demonstration, examination and approval, and supervision of projects concerning the peaceful use of atomic energy in China, and coordinating efforts to implement the projects;

(4) nuclear security and nuclear material control;

(5) reviewing and managing nuclear-related imports/exports;

(6) carrying out inter-governmental and international cooperation and exchange in the nuclear field, and, on behalf of Chinese government, participating in the activities of the IAEA;

(7) undertaking the daily work of the National Nuclear Accident Emergency Coordination Committee (NNAECC), taking the lead in formulating the national nuclear accident emergency plan, and organizing its implementation after approval by the State Council; and

(8) nuclear facility decommissioning and radioactive waste management.

E.4.2 National Energy Administration (NEA)

E-27 The NEA encompasses the Department of General Affairs, the Department of Legal System and Structural Reform, the Department of Development and Planning, the Department of Energy Conservation and Technology Equipment, the Department of Electricity, the Department of Nuclear Power, the Department of Coal, the Department of Oil and Gas (National Oil Reserve Office), the Department of New and Renewable Energy, the Department of Market Regulation, the Department of Power Safety Regulation, the Department of International Cooperation, and China Nuclear Power Development Center.

E-28 The responsibilities of the NEA are:

(1) nuclear power management and taking the lead in proposing nuclear power laws, regulations and rules;

(2) proposing nuclear power development program, conditions of access, and technical standards, and organizing their implementation;

(3) proposing nuclear power planning and providing review opinions for major projects;

(4) organizing, coordinating and guiding scientific research on nuclear power; and

(5) inter-governmental and international cooperation and exchanges in the field of nuclear power, and negotiations and signing of inter-governmental protocols on the peaceful use of nuclear energy.

F. OTHER GENERAL SAFETY PROVISIONS (Articles 21 to 26)

F.1 Responsibility of the Licence Holder (Article 21)

> Each Contracting Party shall ensure that prime responsibility for the safety of spent fuel or radioactive waste management rests with the holder of the relevant licence and shall take the appropriate steps to ensure that each such licence holder meets its responsibility.
>
> If there is no such licence holder or other responsible party, the responsibility rests with the Contracting Party which has jurisdiction over the spent fuel or over the radioactive waste.

F-1 Radioactive waste is generated during the operation and decommissioning of nuclear facilities. The licence holders of such facilities are responsible for the safety of the radioactive waste and spent fuel they generate. Details are given in F.1.1.

F-2 Nuclear technology application facilities will generate disused sealed sources. The licence holders of such facilities are responsible for the safety of the disused sealed sources they generate. Details are given in F.1.2.

F-3 Organizations specializing in the treatment, storage and disposal of radioactive waste are responsible for the safety of such waste, as detailed in F.1.3.

F.1.1 General Responsibility of the Nuclear Facility Safety Licence Holders

F-4 Under the *Nuclear Safety Law of the People's Republic of China* and the *Regulations of the People's Republic of China on the Safety Supervision and Management of Civilian Nuclear Installations*, the nuclear facilities licence holders shall be fully responsible for the safety of the nuclear facilities.

F-5 The following measures have been taken to ensure that the nuclear facility safety licence holders fulfill their responsibilities:

(1) The licencees are required to provide capability of ensuring the safe operation of nuclear facilities, including the establishment of corresponding organizational and managerial systems, the allocation of adequate human and financial resources, the availability of necessary technical support and continuous improvement capabilities, and the capability of emergency response and financial guarantee for nuclear damage compensation, etc.

(2) The licencees are required to, in accordance with the requirements of laws, administrative regulations and standards, set up a defense-in-depth system and conduct PSR for nuclear facilities, and disclose relevant information.

(3) The MEE/NNSA or its regional offices have dispatched oversight personnel to the construction, operation, decommissioning, and other related sites of the nuclear facilities concerned to implement regulatory inspection. They are tasked to inspect whether the safety documents submitted are consistent with the actual

situations, whether the construction works are in accordance with the approved design, whether the management is in line with the approved QA programme, whether the construction and operation of the nuclear facilities comply with relevant nuclear and radiation safety regulations and the requirements provided for in both the Nuclear Facility Construction Licence and the Nuclear Facility Operating Licence, and whether the operating personnel are capable of ensuring safe operation and exercising emergency plans, and more.

(4) The MEE/NNSA is entitled to take compulsory measures, if necessary, to order a nuclear facility licencee to take safety measures, or to terminate the activities compromising the safety. For any licencee who violates the regulations, the MEE/NNSA would give warning, order to make correction within a specified timeframe, or order to suspend or cease operations for rectification, or revoke its licence as penalty.

F.1.2 General Responsibility of the Radiation Safety Licence Holders

F-6 Under the *Law of the People's Republic of China on Prevention and Control of Radioactive Pollution* and *Regulations on the Safety and Protection of Radioisotopes and Radiation-Emitting Devices*, an organization that produces, sells or uses a radioactive source shall apply for a radiation safety licence from the MEE/NNSA, and the radiation safety licence holders shall be responsible for the safety and protection of its radioactive sources, and shall be responsible for the radioactive hazards on its account in accordance with the law.

F-7 The following measures have been taken to ensure that the radiation safety licence holders fulfill their responsibilities.

(1) The radiation safety licence holders are required to provide the capacity of ensuring radiation safety, including a special management agency, personnel with relevant expertise and protection knowledge, sound rules and regulations, emergency measures for radiation accidents, locations, facilities and equipment that meet relevant standards and requirements, personal dose monitoring and occupational health examinations for relevant workers, and relevant waste treatment capacity or feasible treatment plan, etc.

(2) The radiation safety licence holders are required to, in accordance with the regulations, conduct routine inspections and annual assessments of the safety and protection status of their radioactive sources; and if potential hazards are found, they shall take immediate corrective action.

(3) The owners of the disused sealed sources are required to, in accordance with the regulations and agreements or requirements, return the disused sealed sources to the producers, or to the original exporters, or send them to the storage or disposal organizations.

(4) The competent authorities for ecology and environment at county level or above, based on their assigned responsibilities, coordinate with other related agencies to implement regulatory inspection of the licence holders.

(5) For any licence holder who has failed to comply with the original licencing

requirements, the competent authorities for ecology and environment at county level or above would order it to make corrections within a specified timeframe; if such improvements failed, such departments may order it to suspend or cease operations for rectification, or the original licence issuer may revoke the licence; and such departments confiscate any illegal gains along with appropriate penalties.

F.1.3 General Safety Responsibility of Licence Holders for Radioactive Waste Treatment, Storage and Disposal

F-8 Under the *Nuclear Safety Law of the People's Republic of China*, the *Regulations on the Safety of Radioactive Waste Management*, and the *Management Measures for the Licencing of Solid Radioactive Waste Storage and Disposal*, the organizations specialized in the treatment, storage, and/or disposal of solid radioactive waste, shall obtain the licence for solid waste treatment, storage and/or disposal. The licence holders shall bear the responsibility for the safety of the solid radioactive waste they treat, store, and/or dispose of in accordance with the law.

F-9 The following measures have been taken to ensure that the licence holders fulfill their responsibilities for the treatment, storage and/or disposal of solid radioactive waste:

(1) The competent authorities for ecology and environment at the county level or above coordinate with other related agencies to implement regulatory inspection of the safety of radioactive waste treatment, storage, and/or disposal based on their assigned responsibilities.

(2) For any licence holders who failed to comply with the original licencing requirements, the competent authorities for ecology and environment at the county level or above have the authority to: order the licence holder to make corrections within a specified timeframe; order the licence holder to suspend or cease operations for rectification; revoke the licence, along with confiscating any illegal gains and imposing appropriate penalties; require the licence holder to take decontamination measures within a specified timeframe; and hold the license holder accountable for all costs associated with decontamination.

F.2 Human and Financial Resources (Article 22)

Each Contracting Party shall take the appropriate steps to ensure that:

(i) qualified staff are as needed for safety-related activities during the operating lifetime of a spent fuel and a radioactive waste management facility;

(ii) adequate financial resources are available to support the safety of facilities for spent fuel and radioactive waste management during their operating lifetime and for decommissioning;

(iii) financial provision is made which will enable the appropriate institutional controls and monitoring arrangements to be continued for the period deemed necessary following the closure of a disposal facility.

F.2.1 Assurance of Qualified Workers

F.2.1.1 Human Resource Cultivation

F-10 Talent education and training plans have been under development to strengthen the cultivation of all kinds of talents. With increasing investments, talent reserves have been enhanced to meet the growing demand of human resources caused by nuclear energy and technology expansion. By means of government support and cooperation between higher education institutions and enterprises, professional programmes, including nuclear engineering and technology, and radiation protection, have been established in some higher education institutions, thus allowing more talents to be enrolled for nuclear industry and optimizing the structure of academic disciplines.

F-11 CNNC (enterprise), in combination with higher education institutions and research institutions, explores and develops progressively the "order + joint cultivation" or "enterprise-university collaboration" modes. Based on the "order + joint cultivation" mode, the subsidiary nuclear power enterprises of CNNC will sign employment intention agreement, every year, with a certain number of full-time nuclear power-related majors at grade three of higher education institutions. After graduation, these students will go to work in CNNC (enterprise). CNNC (enterprise) pays educational costs to these education institutions and provides scholarships to the students concerned. Under the "enterprise-university collaboration" mode, relevant higher education institutions enroll targeted examinees, for which CNNC pay the tuition and accommodation fees during schooling and to provide the targeted scholarships of nuclear industry. These students can also enjoy the same rights to other scholarships offered by the university as non-targeted students, and after graduation, can go to work at CNNC.

F.2.1.2 Recruitment, Training and Examination of Staff in Nuclear Facilities

F-12 Under the *Nuclear Safety Law of the People's Republic of China* and the *Safety Rules on Commissioning and Operation of Nuclear Power Plants* (HAF 103), the nuclear facilities licencees implement a system of recruitment, training, examination and authorization of the personnel engaged directly in the management of spent fuel and radioactive waste.

F-13 The nuclear facilities licencees make efforts to recruit professional talents necessary for the management of spent fuel and radioactive waste through targeted cultivation of nuclear-related talents in higher education institutions, countrywide selection of senior specialists, employment of technicians from conventional power plants and other sectors in the country, and hiring foreign experts and so on.

F-14 The requirements for post qualification are defined in accordance with relevant regulations, guides, and standards and on the basis of the post-specific task analysis. The training and retraining programmes and procedures are developed and implemented for those involved directly in spent fuel and radioactive waste management. The relevant workers can take up the relevant post with only after appropriate training and assessment, and acquire the post qualification certificate or authorization.

F-15 The above licencees implement validity period management over the personnel qualification and authorization. After expiration of the validity period, the qualification certificates are extended or renewed in accordance with the post-specific requirements. Furthermore, additional re-training and re-authorization are necessary to ensure that the personnel meet the post-specific requirements.

F-16 The relevant personnel of both Chinese and foreign contractors are subject to the same training, authorization and qualification during the operating lifetime of spent fuel and radioactive waste management facilities. They are also subject to strict control and supervision according to the contractor management policy.

F.2.1.3 Training and Examination of Radiation Safety Workers

F-17 Under the *Regulations on the Safety and Protection of Radioisotopes and Radiation-Emitting Devices*, a producer, distributor or user of radioactive sources shall provide training and follow-up examination in safety and protection knowledge to its workers directly associated with production, distribution and use of such sources. The workers who fail to pass the assessment shall not take the posts with radiation safety related responsibility.

F-18 A platform for radiation safety and protection in the application of nuclear technologies, together with the training programmes and unified video and document-based training materials, was developed by the MEE/NNSA at the end of 2019 in a bid to enhance training management and unify training and examination requirements for the professionals. Personnel with relevant training needs can learn relevant knowledge free of charge through the training platform mentioned above.

F-19 Moreover, according to the *Notice on Matters Related to the Training and Examination for Radiation Safety and Protection in Nuclear Technology Applications* issued by the MEE, ecology and environment departments at all levels no longer evaluate and recommend radiation safety training organizations, and workers involved in radiation activities are no longer be required to participate in radiation safety training organized by those organizations. Personnel engaged in radiation activities shall register through the training platform and take radiation safety and protection examinations.

F.2.1.4 Qualification, Training and Examination for Nuclear and Radiation Safety Regulatory Inspection Staff

F-20 Under the *Management Measures on Administrative Law Enforcement Certificates of the Ministry of Ecology and Environment*, the MEE/NNSA verifies the eligibility of the staff applying for administrative law enforcement certificates and provides training and examinations, including the review, training, and examination of safety supervisors for spent fuel and radioactive waste management facilities. Those passing the examinations and having the eligibility will be granted the administrative law enforcement certificates by the MEE/NNSA. The administrative law enforcement certificates are valid for five years.

F-21 The MEE/NNSA pays high attention to the training of nuclear and radiation safety regulatory inspection staff, with continuously enhanced training of nuclear safety and radiation safety regulatory inspection staff in many ways. These include developing the *Guideline for Business Training of Nuclear and Radiation Safety*

Supervisors, and the *Outline for Business Training of Nuclear and Radiation Safety Supervisors*, conducting the on-the-job training for nuclear and radiation safety regulatory inspection staff, inviting international experts to present lectures at nuclear and radiation safety training workshops or seminars, dispatching personnel to participate in short-term training workshops or seminars sponsored by foreign regulatory agencies and international organizations.

F-22 A certificate holder who applies for renewal of his/her certificate shall apply to the department or organization where he or she works for. After being reviewed by the MEE/NNSA, the renewed certificate will be granted to those eligible.

F.2.1.5 Certified Nuclear Safety Engineer System

F-23 Under the *Law of the People's Republic of China on Prevention and Control of Radioactive Pollution*, the qualification management system is applied in China for the professionals involved in radioactive pollution prevention and control. The *Interim Provisions on the Professional Qualification System of Certified Nuclear Safety Engineers* was issued in November 2002. Under the regulation, the professional qualification system is implemented for the technical workers who take key positions in organizations specialized in nuclear energy, nuclear technology applications, and technical services for nuclear safety. The working scope of a Certified Nuclear Safety Engineer involves nuclear safety review, nuclear safety regulatory inspection, manipulation and operation of nuclear facilities, nuclear quality assurance, radiation protection, environmental radiation monitoring, and other activities related closely to nuclear safety as provided by the MEE/NNSA.

F-24 The national professional qualification examination for Certified Nuclear Safety Engineer is uniformly organized annually. The qualified examinees will be granted the *Qualification Certificate of the People's Republic of China for Certified Nuclear Safety Engineer,* and practice after registration which is valid for two years. Certified nuclear safety engineers are subject to the continued education system.

F-25 To ensure the safety of storage and disposal of radioactive waste, the *Regulations on the Safety of Radioactive Waste Management* and the *Management Measures for the Licencing of Solid Radioactive Waste Storage and Disposal* clearly provide that the licencees of specialized facilities for storage and/or disposal of solid radioactive waste shall set up an organization capable of ensuring the operation safety of the facilities; the licencees of solid radioactive waste storage facilities shall be staffed with more than three technicians for radioactive waste management, radiation protection, and environmental monitoring, at least one of which shall be a certified nuclear safety engineer; the licencees of facilities for near surface disposal of solid radioactive waste shall be manned with more than ten technicians working on radioactive waste management, radiation protection, and environmental monitoring, among which at least three shall be certified nuclear safety engineers; the licencees of deep geological disposal facilities shall have more than 20 technicians working on radioactive waste management, radiation protection, and environmental monitoring, at least five of which shall be certified nuclear safety engineers.

F.2.2 Financial Guarantee

F.2.2.1 Financial Guarantee for Operation and Decommissioning

F-26 In China, the annual cost required for carrying out the activities relating to the safe operation of, and safety modification to, nuclear facilities, including spent fuel and radioactive waste management facilities, will be borne by the licencees. When an NPP is put into operation, a certain percentage of fund is allocated from the revenues of electricity generation every year, and reserved for the safety modification of the plant itself and the safe operation of spent fuel and radioactive waste management facilities. The projects and expenses associated with safety modification are prioritized in the yearly planning and financial budget of a nuclear facility.

F-27 The *Interim Procedures on Collection, Utilization and Management of the Fund for Treatment and Disposal of Spent Fuel from Nuclear Power Plants* was issued in 2010 by the MOF, the NDRC, and the MIIT. The said fund is intended for use in the treatment and disposal of spent fuel, involving: (1) spent fuel transport; (2) spent fuel away-from-reactor storage; (3) spent fuel reprocessing; (4) treatment and disposal of HLW generated from spent fuel reprocessing; (5) construction, operation, modification and decommissioning of reprocessing plants; and (6) other applications related to spent fuel treatment and disposal. The fund is collected against the actual sold on-grid sales electricity generated by PWR units in NPPs which have been put into commercial operation for more than five years. The fund is included in the electricity generation costs of the NPPs. By using the fund, the CAEA is making efforts for the capability building for the spent fuel transport and the maintenance of spent fuel storage facilities.

F-28 Under the *Nuclear Safety Law of the People's Republic of China* and *Law of the People's Republic of China on Prevention and Control of Radioactive Pollution*, the accrued expenses for radioactive waste disposal and nuclear facility decommissioning shall be earmarked in the investment estimate and production cost by the licencees for the management of disposal and decommissioning expenses. At present, the nuclear facilities licencees shall deliver the solid radioactive waste which meets the standards after treatment to the storage and disposal organizations who have obtained appropriate licences, and bear the storage and disposal expenses. The NPPs shall preserve fund and set up a special account for decommissioning. For example, the Daya Bay NPP of CGN has provided decommissioning reserves equivalent to 10% of the final accounting value of the nuclear island equipment in service, and the interest expenses determined according to the amortization cost of estimated liabilities and the effective interest rate during the lifetime of the NPP are included in the financial expenses.

F-29 With reference to the international NPP decommissioning experience, China recognizes that a large amount of fund will be required for the decommissioning of NPPs, and it is difficult to cover the decommissioning expenses by providing decommissioning reserves equivalent to 10% of the final accounting value of nuclear island equipment in service. To this end, the MOF, together with other departments, is drafting the *Interim Measures for the Management of Expenses for Nuclear Facility Decommissioning and Radioactive Waste Disposal* to standardize the withdrawal and management of the decommissioning reserves.

F-30 China has established an insurance system for nuclear accident liability. Under the *State Council's Reply on Nuclear Accident Damage Compensation Liability* (GH [2007] No.64), all NPP licencees have bought insurance enough to fulfill their nuclear liability limit, prior to the operation of the NPPs or prior to spent fuel storage, transport and reprocessing. As for the third-party liability insurance, the liability for injury or damage in the event of a nuclear accident is limited to CNY 300 million. If this limit is exceeded, financial compensation up to CNY 800 million will be provided by the state. The *Nuclear Safety Law of the People's Republic of China* requires that the nuclear facilities licencees shall make appropriate financial guarantee arrangements by taking out liability insurance and participating in mutual assistance mechanisms to ensure the timely and effective performance of the liability for nuclear damage. If a nuclear accident causes personal injury, property loss or environmental damage to others, the nuclear facilities licencees shall be liable for compensation in accordance with the national nuclear damage liability system.

F.2.2.2 Financial Guarantee for Post-Closure of Disposal Facilities

F-31 For radioactive waste disposal facilities that are closed as planned, the institutional control responsibility for the post-closure active institutional control period rests with the licencees of such facilities, otherwise with the local government during post-closure passive institutional control period. The costs required for the post-closure institutional control, monitoring and emergency response are covered in the disposal fees collected on the part of near surface disposal facilities.

F-32 Under the *Regulations on the Safety of Radioactive Waste Management*, when applying for the licence for solid radioactive waste disposal, organizations specialized in the disposal activities of solid radioactive waste shall (1) have a matched amount of registered fund, which shall be no less than CNY 30 million to be engaged in near surface disposal activities and no less than CNY 100 million to be engaged in deep geological disposal activities; (2) have the financial guarantee to ensure that disposal activities will persist to the end of safety institutional control period; and (3) the organization supplying financial guarantee shall bear the costs required for facility closure and institutional control in the case that the licencee of a solid radioactive waste disposal facility was bankrupt or its licence was revoked.

F-33 Currently, nuclear power enterprises pay an institutional control fee equivalent to 3/7 of the disposal fee when delivering waste to the Longhe Disposal Facility, which will be used for post-closure institutional control and management of the disposal facility and support the construction of the infrastructures and public service facilities in the disposal facility.

F.3 Quality Assurance (Article 23)

Each Contracting Party shall take the necessary steps to ensure that appropriate quality assurance programmes concerning the safety of spent fuel and radioactive waste management are established and implemented.

F.3.1 Basic Quality Assurance Requirements

F-34 The *Nuclear Safety Law of the People's Republic of China* provides that the nuclear facility licencees shall have a QA system that meets the requirements of nuclear safety; the nuclear facility licencees and organizations who provide equipment, engineering, and services to these licencees shall establish and implement a QA system.

F-35 Basic QA requirements are provided for under the *Rules on Quality Assurance for Safety in Nuclear Power Plants* (HAF 003), which are applicable to the QA for the management of the spent fuel and radioactive waste that are generated by NPPs. The QA for the management of spent fuel and/or radioactive waste from other nuclear facilities is implemented by reference to these basic requirements. The basic QA requirements are mainly as follows:

(1) preparing and effectively implementing the overall QA programme for the nuclear facility and the QA sub-programmes for various tasks; preparing written procedures, detailed rules and drawings; and providing periodic review and revision thereof; and making periodic management review to determine the QA programme's status and applicability and, if necessary, to take appropriate corrective actions;

(2) establishing an organization and/or body subject to explicit regulation, which sets out clearly the responsibility and authority assigned as well as a channel of internal and external communication, and controls and coordinates the working interfaces between various organizations; controlling the selection, staffing, training and qualification assessment of workers to ensure that the personnel acquire and maintain adequate technical skills;

(3) controlling the preparation, review, approval, circulation, and modification of all the documents necessary for the execution and verification of the tasks in such a manner as to prevent the use of outdated and inappropriate such documents;

(4) controlling the process, interface, change of design, and verifying the design to ensure that prescribed design requirements are correctly presented on the technical specifications, drawings, procedures or detailed rules;

(5) controlling the development of procurement documents, evaluating and selecting the proper suppliers and controlling the procured items and services to ensure the said items are consistent with requirements of procurement documents;

(6) identifying and controlling materials, parts and components, controlling the loading, unloading, storage, and transport of items and taking appropriate maintenance for items important to safety to ensure the quality of the said items is properly protected from being impaired;

(7) controlling technological processes affecting quality employed in design, fabrication, construction, test, commissioning and operation of the nuclear facility to ensure that such processes are performed by qualified personnel using qualified equipment in line with authorized procedures;

(8) establishing and effectively implementing the inspection and test programme, verifying the conformance of items and activities with specified requirements in order to verify that the structures, systems and components work in a satisfactory manner; controlling the selection, calibration, and use of the measuring and test equipment, and identifying and controlling the inspection, test and operating conditions;

(9) controlling the identification, review and treatment of non-compliances, prescribing the responsibility and authority for review and treatment and making re-inspection of repaired and reworked items;

(10) identifying and correcting the conditions that detract from quality; for the conditions that have severely detracted from quality, corrective actions shall be taken after investigation of the cause, in order to prevent re-occurrence;

(11) establishing and implementing the QA record system, controlling the codification, collection, indexing, filing, storage, maintenance and disposal of records to ensure that such records are clear, complete and correct as to provide sufficient evidence for the quality of items and/or activities; and

(12) establishing and implementing internal and external audit system to verify the implementation and validity of the QA programme; corrective measures must be taken against the defects discovered during audit, and subsequent actions shall be taken for follow-up and verification.

F-36 In addition, a series of QA guidelines have been developed which provide implementation recommendations for the above-mentioned basic requirements.

F.3.2 Quality Assurance for Spent Fuel Management

F-37 Systematic QA programmes were developed by the spent fuel management licencees and submitted to the MEE/NNSA for approval as part of the licence application documents.

F-38 All matters involved in the design and operation of spent fuel management facilities are implemented strictly as required by the QA programme. These matters include design and manufacture of items important to safety and systems in spent fuel storage facilities, maintenance of sub-criticality of stored spent fuel, radiation protection, fuel heat removal, fuel shielding, corrosion control, operational procedures involving nuclear material or fuel during commissioning, normal operation and in the event of anticipated operational occurrence, repair, test, inspection and check of safety-related equipment, records, radioactive waste management, safekeeping of the records of fuel characteristics during storage, nuclear material control system (when needed), and physical protection system.

F-39 The QA department, independent of other departments, is responsible for the development, management, supervision, assessment and improvement of the QA programme. It implements planned internal and external QA supervision, inspection, audit, and assessment through which the defects existing in the QA system will be found and improved in a timely manner. Meanwhile, it puts non-compliances and corresponding corrective measures under strict management, collects and analyses quality information and trend, and reports the results periodically to the higher competent authorities. If necessary, it will take corrective actions timely.

F-40 The management authority provides periodic scrutiny on the suitability and effectiveness of the QA programme. It focuses on the internal and external audit and inspection results within the assessment period, together with the related information, such as quality problems, corrective measures, quality trend, accidents and malfunctions, personnel qualification and training, among others. Based on the problems found in the above scrutiny, like defects in the QA programme, management, and quality, it will analyze the causes, prepare and implement specific corrective measures and notify the related departments and licencees in writing.

F.3.3 Quality Assurance for Radioactive Waste Management

F-41 Under the *Regulations for radioactive waste management* (GB 14500-2002), the following steps are taken, by the licencees of both nuclear fuel cycle facilities and radioactive waste temporary storage facilities for nuclear technology application, to ensure the development and implementation of the QA programme relevant to radioactive waste management and/or disused sealed sources:

(1) The licencees of waste management facilities have developed the QA programme according to the facility scale and complexity as well as the potential hazards of radioactive waste and/or disused sealed sources and thereby strictly implement management of radioactive waste and/or disused sealed sources in accordance with the QA programme that has been reviewed and approved by the regulatory body.

(2) In order to ensure the implementation of the QA programme, the designer, constructor and operator of any nuclear fuel cycle facility or radioactive waste temporary storage facility for nuclear technology application have developed, and have been implementing, the relevant QA sub-programmes and other quality-related documents.

(3) In the process of developing and implementing the QA management documents, the above organizations focused especially on worker cultivation of safety culture and provided relevant training and examination.

(4) The QA programme consists mainly of: quality policy and system; organizations for developing and implementing the QA programme; control of design, construction, operation and decommissioning of facilities; procurement control of materials and services; control of waste generation and segregation; identification and control of radioactive waste and/or disused sealed sources; control of technological parameters in the stages of waste management; control of documents and records; and audit.

F.3.4 Quality Assurance for Near Surface Disposal of Radioactive Waste

F-42 China has four near surface disposal facilities in operation. Under the *Safety requirements for near surface disposal of low and medium level radioactive solid waste* (GB 9132-2018), the licencees have all prepared and implemented a QA programme, which provides for the siting, design, construction, operation, closure and organized control period after closure of the disposal facilities.

F-43 The QA programme involves the potential impact of various factors on the safety of the disposal facility, and sets forth the requirements for activities, structures, systems and equipment important to safe operation and disposal according to the results of the safety assessment for the operation phase and the post-closure phase. The QA programme also provides for the update and long-term validity of relevant technical documents.

(1) The QA programme for the siting phase provides for the preparation and storage of all documents and supporting materials related to siting, so as to make them accurate, effective and representative. During the design, construction and operation of near surface disposal facility, special attention is paid to the control of engineering barrier design, waste characteristics and operating procedures, so as to ensure that the safety performance of the disposal facility will not be adversely affected. Whenever important parameters are changed, the safety assessment will be updated in a timely manner.

(2) The QA programme shall specify that the safety of the disposal facility depends not only on the licencees, but also on the predisposal management by waste generators. Waste generators shall ensure that the delivered waste packages meet the disposal requirements, and shall provide the disposal facility with documents required to meet the QA requirements (such as waste type, characteristics, radionuclide type, radioactivity concentration and activity, coding of waste packages and specifications of packaging container) and other documents that may affect the safety of disposal, and be responsible for the authenticity of these documents. The waste disposal acceptance process is described in the QA programme. The acceptance and random inspection for waste disposal acceptance include examination of the documents, and the appearance quality, sign, surface dose rate and surface contamination, as well as destructive or non-destructive performance test of the waste packages.

(3) The QA programme for closure and the institutional control period after closure shall provide for the collection and preservation of all information important to long-term safety of the disposal facility. Information of all stages of the disposal facility from siting to the institutional control period after closure shall be preserved, such as site characteristics, engineering design drawings and specifications, waste lists, safety analysis reports and environmental impact statements (EISs), environmental monitoring results, and disposal facility closure information.

F.3.5 Primary Activities of the Regulatory Body

F-44 The MEE/NNSA controls QA activities related to spent fuel and radioactive waste management with respects to:

(1) reviewing and approving the QA programmes for spent fuel and radioactive waste management and other documents important to safety, including important revisions thereof, as required by the QA and nuclear safety regulations and other safety related guides;

(2) supervising the implementation of the QA programmes for spent fuel and radioactive waste management with respect to nuclear safety; selecting control points from related quality plans in respect of major safety and quality-related activities, and overseeing and witnessing on site; organizing technical review and verification for the results of such activities; and

(3) organizing technical review for major non-compliances and overseeing effectively the process of addressing such non-compliances.

F.4 Operational Radiation Protection (Article 24)

1. Each Contracting Party shall take the appropriate steps to ensure that during the operating lifetime of a spent fuel or radioactive waste management facility:

(i) the radiation exposure of the workers and the public caused by the facility shall be kept as low as reasonably achievable, economic and social factors being taken into account;

(ii) no individual shall be exposed, in normal situations, to radiation doses which exceed national prescriptions for dose limitation which have due regard to internationally endorsed standards on radiation protection; and

(iii) measures are taken to prevent unplanned and uncontrolled releases of radioactive materials into the environment.

2. Each Contracting Party shall take appropriate steps to ensure that discharges shall be limited:

(i) to keep exposure to radiation as low as reasonably achievable, economic and social factors being taken into account; and

(ii) so that no individual shall be exposed, in normal situations, to radiation doses which exceed national prescriptions for dose limitation which have due regard to internationally endorsed standards on radiation protection.

3. Each Contracting Party shall take appropriate steps to ensure that during the operating lifetime of a regulated nuclear facility, in the event that an unplanned or uncontrolled release of radioactive substance into the environment occurs, appropriate corrective measures are implemented to control the release and mitigate its effects.

F.4.1 Keeping Radiation Exposure ALARA

F-45 Under the *Basic standards for protection against ionizing radiation and for the safety of radiation sources* (GB 18871-2002), for radiation exposure from a given source in a practice, the protection and safety shall be optimized to ensure that, economic and social factors being taken into account, the doses of individual exposure, number of exposed individuals and the possibility of exposure are all kept ALARA.

F-46 Under the *Safety Rules on Commissioning and Operation of Nuclear Power Plants* (HAF 103), the radiation exposure in nuclear facilities is ensured to have been kept at ALARA through the following measures:

(1) developing and practically implementing radiation protection programme, including prevention measures taken in terms of management and technology, for example environmental radiation monitoring and decontamination on personnel, equipment and structures and so on;

(2) verifying whether or not the radiation protection programme is properly implemented or the objective of the programme is achieved through oversight, inspection and audit; and additionally, revising the programme as needed;

(3) allocating qualified health physicists who have acquired the knowledge of radiological protection in design and operation of spent fuel and radioactive waste management facilities;

(4) deploying equipment for radiation protection monitoring in operating and accident conditions, like the stationary dose rate meter, the monitoring system for measuring activity concentrations of radioactive substance in the air, the instruments and meters used for measuring surface radioactive contamination and the dose and contamination that the individuals are exposed to;

(5) treating and/or storing spent fuel and radioactive waste with appropriate methods and conditions;

(6) taking measures to reduce the amount and concentration of radioactive substance dispersed over the site or released to the environment at a spent fuel or radioactive waste management facility;

(7) controlling the generation and discharge of radioactive effluent and waste in a reasonable manner and enhancing management of radioactive waste; and

(8) establishing the authorized limits for effluent discharge lower than the national authorized limits for effluent discharge stipulated in the *Regulations for environmental radiation protection of nuclear power plant* (GB 6249-2011), implementing such authorized limits upon approval of the MEE/NNSA, and regularly reviewing these authorized limits in the course of operation; developing methods and procedures to monitor and control the effluent discharge.

F-47 The fundamental requirements related to radiation protection at all stages of the nuclear facilities are set forth by the MEE/NNSA in a range of departmental rules on the siting, design and operation of nuclear facilities:

(1) in siting for the nuclear facilities, the public and the environment shall be protected from excess radiation impacts caused by radioactive accidents, along with release of radioactive substance in normal conditions;

(2) the radiation protection requirements shall be incorporated into the design of nuclear facilities, for example, optimizing the facility layout, arranging for shields

and reducing the activities and stay time of workers within radiation area, and radioactive substance shall be treated with appropriate methods and conditions;

(3) measures shall be taken to reduce the amount and concentration of radioactive substance released to the site or environment;

(4) full consideration shall be taken of possible accumulation of radiation level with time in the worker stay areas and the generation of radioactive waste shall be minimized;

(5) the nuclear facilities licencees shall make evaluation and analysis of radiation protection requirements and actual situation of such facilities, and develop a radiation protection programme; they must verify if their programme is properly implemented and the established goals are achieved by oversight, inspection and audit, and take corrective measures when needed; and

(6) the radiation protection functional department of the nuclear facilities licencees shall develop and implement the radioactive waste management programme and the environmental monitoring programme, and carry out assessment of environmental radiation impacts.

F.4.2 Dose Limits

F-48 The *Basic standards for protection against ionizing radiation and for the safety of radiation sources* (GB 18871-2002) sets forth the radiation protection principles, requirements and the dose limits, and adopts the recommended values from the ICRP Publication 60.

F-49 The individual dose limits of workers and the members of critical groups are as follows:

—Occupational exposure

(1) annual average effective dose limit is 20 mSv as prescribed by the regulatory body, averaged over five consecutive years, rather than any traceable average;

(2) annual effective dose limit shall not exceed 50 mSv in any single year;

(3) annual equivalent dose limit for lens of the eye is 150 mSv; and

(4) annual equivalent dose limit for extremities or skin is 500 mSv.

—Public exposure

(1) annual effective dose limit is 1 mSv;

(2) in special circumstances, a higher effective dose value of 5 mSv could be allowed in a single year, provided that the annual average over defined five successive year periods does not exceed 1 mSv;

(3) annual equivalent dose limit for lens of the eye is 15 mSv; and

(4) annual equivalent dose limit for skin is 50 mSv.

F-50 Dose constraints have been respectively set by all nuclear facilities taking account of economic and social factors.

F-51 As has been shown by the monitoring results of occupational exposure, the annual effective doses of workers in China's operating NPPs are less than the national dose limits.

F.4.3 Preventing Unplanned or Uncontrolled Release of Radioactive Substance to the Environment

F-52 Under the *Regulations for environmental radiation protection of nuclear power plant* (GB 6249-2011) and the *Management of Radioactive Effluents and Waste Arising from Nuclear Power Plants* (HAD 401/01), the following measures have been taken by the NPP licencees to prevent unplanned or uncontrolled release of radioactive substance to the environment:

(1) Based on the environmental characteristics at NPP sites and the technological level of radioactive waste treatment and in compliance with the ALARA principle, the amount of radioactive effluents to be discharged is applied to the MEE/NNSA for authorization before the initial loading (reviewed at 5-year intervals afterwards), and go into effect upon approval by the MEE/NNSA.

(2) Total annual amount discharged by an NPP is controlled on a quarterly or a monthly basis, with the total quarterly amount discharged not exceeding half of the annual amount authorized, and the total monthly amount discharged less than one-fifth of the total annual discharge.

(3) Liquid effluent is subjected to tank discharge while airborne radioactive effluent needs to be purified or stored for decay before being released into the environment via stack.

(4) To locate the total discharge outlet of liquid radioactive effluent, several aspect, such as downstream water intake, and thermal and radionuclide discharge, are considered to keep it away from centralized water intake station, aquatic breeding site, migratory route, and fishery and other environmentally sensitive zones.

(5) Discharge of liquid effluent is controlled based on activity concentration, for which optimal practicable technology is considered and is optimized in combination with site conditions and operational experience feedback.

(6) Liquid radioactive effluent in the trough is monitored prior to discharge, and automatic alarm and discharge control devices are also installed on the discharge pipelines.

(7) reliable QA system for effluent monitoring is established, an effluent monitoring programme is developed, and the airborne and liquid effluents are monitored according to the programme.

F-53 Additionally, local competent authorities for ecology and environment have conducted supervisory monitoring of effluents from NPPs within their jurisdictions, and verified the monitoring results reported by NPP licencees to prevent the unplanned or uncontrolled release of radioactive substance into the environment.

F-54 The licencees of other nuclear facilities took corresponding measures to prevent the unplanned and uncontrolled release of radioactive substances.

F-55 In March 2020, the MEE/NNSA issued the *Technical Specification of Effluent Monitoring for Nuclear Power Plants (Trial),* which standardizes the monitoring of radioactive effluents by nuclear power enterprises and the supervisory monitoring by local governments.

F.4.4 Discharge Limits

F-56 Under Article 40 of the *Law of the People's Republic of China on Prevention and Control of Radioactive Pollution*, discharge of gaseous and liquid radioactive waste must be subject to the national standards on prevention and control of radioactive pollution.

F-57 *Regulations for environmental radiation protection of nuclear power plant* (GB 6249-2011) sets forth the specific requirements for the discharge of gaseous and liquid effluents from on-land stationary NPPs in operating conditions, as follows:

(1) The constraints for effective dose caused to any individual of the public by radioactive substance released from all nuclear power reactors at any site is recommended to be 0.25 mSv per year.

(2) The total annual discharge amount of radioactive effluents shall be controlled on a one-reactor basis; the control values for a 3,000 MW (thermal power) reactor are shown in Tables 2 and 3.

Table 2 Control of airborne radioactive effluents (Bq/a)

	Light water reactor (LWR)	Heavy water reactor (HWR)
Inert gas	6×10^{14}	
Iodine	2×10^{10}	
Particle (halflife≥8d)	5×10^{10}	
Carbon-14	7×10^{11}	1.6×10^{12}
Tritium	1.5×10^{13}	4.5×10^{14}

Table 3 Control of liquid radioactive effluents (Bq/a)

	LWR	HWR
Tritium	7.5×10^{13}	3.5×10^{14}
Carbon-14	1.5×10^{11}	5.0×10^{11} (other than tritium)
Other nuclides	5.0×10^{10}	

(3) The control values for reactors with thermal power greater than or less than 3,000 MW shall be adjusted accordingly.

(4) For a site with multiple reactors of the same type, the annual total discharge from all units shall be controlled under four times the value prescribed by paragraph (2); for a site with multiple reactors of different types, the annual total discharge from all units shall be controlled under the value authorized by the MEE/NNSA.

F-58 From 2020 to 2023, the discharge of gaseous and/or liquid effluents from nuclear power plants in China during operation is all less than relevant national control limits.

F.4.5 Corrective Measures for Unplanned or Uncontrolled Release of Radioactive Substance to the Environment

F-59 Regarding corrective actions for unplanned or uncontrolled release, as pointed out in the *Regulations on the Safety of Radioactive Waste Management*, the licencees of solid radioactive waste storage and/or disposal facilities shall conduct radioactivity monitoring for groundwater, surface water, soil and air around the facility; if any potential safety hazard is discovered or any radionuclide concentration in the ambient environment is in excess of the limit in relevant national standard, they shall identify the causes immediately, and take necessary precautionary measures, and report such situation to the relevant competent authority. If it constitutes a radiation accident, then emergency response plan for the facility concerned shall be activated immediately and the situation shall be reported to the relevant bodies under the relevant laws and regulations so as to carry out the emergency response and disposal activities related to the accident.

F-60 Since the last Review Meeting, no unplanned or uncontrolled release of radioactive substance has occurred in China.

F.5 Emergency Preparedness (Article 25)

> 1. Each Contracting Party shall ensure that before and during operation of a spent fuel or radioactive waste management facility there are appropriate on-site and, if necessary, off-site emergency plans. Such emergency plans should be tested at an appropriate frequency.
>
> 2. Each Contracting Party shall take the appropriate steps for the preparation and testing of emergency plans for its territory insofar as it is likely to be affected in the event of a radiological emergency at a spent fuel or radioactive waste management facility in the vicinity of its territory.

F-61 China has already developed emergency plans and tested these plans at an appropriate frequency, in response to (1) the severe deviations from operating conditions unlikely to occur in nuclear facilities or associated nuclear activities inside and outside the territory of the country, which may potentially result in or have resulted in radioactive releases, with major radiological consequences, and to (2) the events in which radioactive sources are lost, stolen or out of control, or a radioisotope is out of control, leading to abnormal radiation exposure of the personnel.

F.5.1 Emergency Preparedness for Nuclear Accidents

F.5.1.1 Emergency Plan for Nuclear Accidents

F-62 Under relevant laws and regulations such as the *Emergency Response Law of the People's Republic of China*, the *Nuclear Safety Law of the People's Republic of China*, the *Law of the People's Republic of China on Prevention and Control of Radioactive Pollution*, and the *Regulations on Emergency Management of Nuclear*

Accidents at Nuclear Power Plants, a system of three-level emergency response organizations is implemented in China, comprising emergency response organizations at national, provincial (autonomous region and municipality directly under the central government), and facility levels.

F-63 At the national level, the *National Nuclear Emergency Plan* (revised) was issued and implemented by the State Council in June 2013. It is applicable to nuclear accidents that have already occurred or may occur at nuclear facilities within the territory of China and caused by associated nuclear activities, and it can be taken as reference for those that could have occurred outside the territory of China but could have led, and have potentials to lead, to impacts on the Chinese mainland.

F-64 At the NNAECC members' and provincial level, the members of the NNAECC and authorities at relevant provincial (autonomous region and municipality directly under the central government) level all have developed their respective emergency plans in accordance with the national nuclear emergency plan, or provincial nuclear accident emergency plans in their respective administrative regions, or off-site nuclear accident emergency plans specific to certain NPPs within their respective administrative regions.

F-65 At the level of nuclear facility licencees, the MEE/NNSA has revised and issued the *Emergency Preparedness and Response for Nuclear Power Plant*, the *Emergency Planning for Operators of Civilian Nuclear Facilities* and the *Emergency Preparedness and Response of Research Reactor Operators*. The licencees have prepared their respective on-site emergency plans and, prior to initial loading, submitted such plan together with the final safety analysis report for review and approval; and the emergency plans will be reviewed and revised during nuclear facility operation.

F-66 Additionally, at the nuclear group level, the CNNC, the CGN, the State Power Investment Corporation (SPIC), and the China Huaneng Group Co., Ltd. (CHNG) all established their respective nuclear accident emergency assistance teams, and meanwhile prepared their emergency plans and related emergency response implementation procedures.

F-67 The Chinese People's Liberation Army and the Chinese People's Armed Police Force have, in accordance with the regulations of the State Council and the Central Military Commission, established their own systems to support local emergency plans for nuclear accidents.

F-68 The organization which formulates the emergency plan will, according to the actual needs and changes in the situation, revise the emergency plan in a timely manner.

F.5.1.2 Nuclear Accident Emergency Exercises

F-69 Under the *National Nuclear Emergency Plan*, the nuclear accident emergency response organizations at various levels shall carry out nuclear emergency exercises through desktop simulations and actual exercises to test, maintain, and enhance emergency response ability for nuclear accidents. The nuclear accident emergency joint exercises at the national level are implemented under the coordination of the NNAECC, generally once every three to five years. The nuclear accident emergency joint exercises at provincial (autonomous region or municipality directly under the central government) level are organized and implemented under the coordination of the nuclear accident emergency committee at provincial (autonomous region or municipality directly under the central government) level, generally once every two to four years. Exercises with a specific purpose are organized once a year. Comprehensive exercises of nuclear facility licencees are organized and implemented under the deployment of the emergency headquarters of the nuclear facility concerned, generally held once every two years, but more frequently for those with more than three operating units. Prior to initial loading, the nuclear facility licencees have participated in the on-site and off-site joint exercises organized by the provincial nuclear accident emergency committee.

F-70 In March 2023, China participated in the ConvEx-1a exercise organized by the IAEA. In April 2021, Fangchenggang NPP, in coordination with the Nuclear Accident Emergency Committee of Guangxi Autonomous Region, completed the second joint exercise for nuclear accident emergency response. In September 2021, Hainan Changjiang NPP, in coordination with Hainan Nuclear Accident Emergency Committee, completed the on-site and off-site joint exercises for nuclear accident emergency response. In December 2021, the Daya Bay/Ling'ao NPP, in coordination with Guangdong Nuclear Accident Emergency Committee, completed the on-site and off-site joint exercises for nuclear accident emergency response.

F.5.1.3 Capacity Building for Emergency Response

F-71 The MEE/NNSA has been building up the nuclear and radiological emergency response capacity system. Nuclear and radiological emergency monitoring and dispatching platforms have been established at the headquarters of the MEE, six regional offices, and 31 provincial radiation environment monitoring organizations nationwide. A national-provincial-site three-level nuclear accident emergency monitoring and dispatching network has been essentially formed, and key safety parameters of NPPs can be obtained in real time. Data can be acquired in real time from the national radiation environment automatic monitoring network. The platform also enables video contact, emergency forces dispatching, and consequence assessment. It has strengthened the capacity to obtain information related to nuclear and radiation accident emergency treatment, and improved the efficiency of organizing and coordinating emergency response forces.

F-72 The MEE/NNSA has established a national radiation environment monitoring network system comprising 1,835 state controlled radiation environment monitoring points to carry out daily monitoring and emergency monitoring of the radiation environment nationwide; the MEE/NNSA has also established a supervisory monitoring network system for the environment around nuclear and radiation facilities under key regulation of the state, which implements supervisory monitoring for 49 such facilities. These systems have achieved dual-track monitoring of the on-site/off-site and surrounding environment of important nuclear facilities across the nation. The MEE/NNSA has strengthened the national radiation environment monitoring network, and improved the capability of automatic monitoring and aerial survey, having brought into being 500 state-controlled automatic radiation environment monitoring stations.

F-73 The NNAECC has been enhancing national nuclear emergency response capabilities. **First**, adhering to a strategy of system building, capability enhancement, and emphasis on practical application, and relying on existing professional forces, the NNAECC has established eight national nuclear emergency response professional technical support centers, 25 professional rescue teams, and three training bases, covering areas such as radiation monitoring (land, sea, and air), radiation prevention, meteorological monitoring, decontamination, engineering rescue, medical rescue, and treatment of severely contaminated radiation areas; additionally, a national nuclear emergency rescue team composed of 320 people has been established. **Second**, the NNAERO, adhering to the principles of demand-driven actions, rational layout, all-round expertise, and appropriate scale, has initiated the optimization and adjustment of national nuclear emergency forces; the reshaped national nuclear emergency force system consists of technical support forces, professional rescue forces, and integrated support forces, which involves more than 90 entities. **Third**, adhering to principles of seeking truth from facts, compliance with laws and regulations, and assessment-driven improvements, the NNAERO, together with the MEE/NNSA, has jointly conducted on-site and off-site loading exercises to assess both on-site and off-site nuclear emergency capabilities in areas such as policies and regulations, organizational structure, contingency planning, command and coordination, facility and equipment, and material readiness.

F.5.2 Emergency Preparedness for Radiation Accident

F.5.2.1 Emergency Plan for Radiation Accident

F-74 According to the *Law of the People's Republic of China on Prevention and Control of Radioactive Pollution*, the *Regulations on the Safety and Protection of Radioisotopes and Radiation-Emitting Devices*, and the *National Environmental Emergency Response Plan*, a radiation accident refers to an accident in which radioactive sources are lost, stolen or out of control, or one in which radioisotopes are out of control, causing abnormal radiation exposure to individuals, or one in which the leakage of radioactive substance causes environmental contamination. According to the nature, severity, controllability and impact extent of the radiation accidents, they are classified into exceptionally serious radiation accidents, major radiation accidents, serious radiation accidents and ordinary radiation accidents. The response and treatment of radiation accidents are classified in accordance with the *Regulations on the Safety and Protection of Radioisotopes and Radiation-Emitting Devices*.

F-75 The competent authorities for ecology and environment at county level or above have prepared radiation accident emergency plan governing the areas under their jurisdiction in conjunction with departments of public security, hygiene and health, finance, and news and press. The emergency plans were submitted to the local people's governments at the same level for authorization. Such plans present at least the following: emergency agencies and their responsibility assignment; emergency personnel organization and training; emergency response and rescue equipment, funds, materials reserve; classification of radiation accidents and corresponding emergency response measures; radiation accident survey, reporting and treatment procedures; radiation accident information disclosure and pubic communication plan.

F-76 The radiation safety licence holders have prepared emergency plans specific to their facilities based on the potential risks of radiation accidents and gotten prepared for the emergency.

F.5.2.2 Emergency Exercises for Radiation Accidents

F-77 The MEE officially initiated in 2014 nationwide joint radiation accident emergency exercises and drills at provincial level. From 2020 to 2023, the MEE coordinated and guided its regional offices to supervise the implementation of comprehensive radiation accident emergency exercises in the ecological systems of Heilongjiang, Shandong, Fujian, Guangdong, Hebei, Liaoning, Xinjiang, Hainan, Ningxia, Gansu, Inner Mongolia, Guangxi, Chongqing, Tibet, Guizhou, Jilin, Qinghai, Jiangsu, Shaanxi, Jiangxi, and other provinces (autonomous regions and municipalities directly under the central government). The scenarios of exercises involve emergency response activities for different types of radiation accidents, such as the safety of radioactive source management, the search and collection of lost radioactive sources, leakage of unsealed radioactive substance, source blockage in irradiation installation, loss of control over radiation sources, and radioactive material transport. These exercises improved the attention of local governments on radiation accident emergency response, assigned the main responsibilities of radiological emergency response to local governments, tested the teams, tried the emergency plans and facilities and equipment, and improved the capability of emergency response and disposal. In addition, through on-site assessments, the exchange of emergency experience among provinces has been strengthened, and positive effects have been achieved by replacing training with practical exercises, taking one or two excellent case(s) as example(s), guiding by demonstration, and learning from each other.

F.5.3 Emergency Preparedness in Response to Radiation Events outside the Territory

F-78 When a nuclear accident that has occurred outside the territory has or may potentially have impact upon China, the NNAECC shall, under the *National Nuclear Emergency Plan*, make unified arrangements to implement emergency response, consisting of information collection and release, radiation monitoring, consultation among departments, analysis and judgment, port control, market regulation, international notification and assistance, etc. If necessary, the national headquarters for nuclear accident emergency response will be formed to implement the unified leadership, organization and coordination of emergency response.

F.6 Decommissioning (Article 26)

Each Contracting Party shall take the appropriate steps to ensure the safety of decommissioning of a nuclear facility. Such steps shall ensure that:

(i) qualified staff and adequate financial resources are available;

(ii) the provisions of Article 24 with respect to operational radiation protection, discharges and unplanned and uncontrolled releases are applied;

(iii) the provisions of Article 25 with respect to emergency preparedness are applied; and

(iv) records of information important to decommissioning are kept.

F-79 Qualified professionals are available for nuclear facility decommissioning. Under the *Safety requirements for decommissioning of nuclear facilities* (GB/T 19597-2004), the management organizations of nuclear facility decommissioning are all staffed with decommissioning experts and original operational and management personnel of the facility to be decommissioned. Among the nuclear facility decommissioning workforce are critical personnel familiar with the operation of the facility, professionals and experts involved in decontamination, robot or remote manipulation, engineering technology, dismantling and demolition, QA, waste management, and security and safety.

F-80 Adequate financial resources are available for nuclear facility decommissioning. Under the *Nuclear Safety Law of the People's Republic of China* and the *Law of the People's Republic of China on Prevention and Control of Radioactive Pollution*, the decommissioning costs shall be earmarked and included in the cost estimate and production cost. Measures for the management of nuclear facility decommissioning funds are being drafted. At present, decommissioning funds have been reserved for operating NPPs in China, including for decommissioning of on-site spent fuel and radioactive waste management facilities. For instance, Daya Bay NPP has provided decommissioning reserves equivalent to 10% of the final accounting value of the nuclear island equipment in service.

F-81 Radiation safety measures are considered and implemented in nuclear facility decommissioning, including those to ensure limited discharge. Under the *Safety requirements for decommissioning of nuclear facilities* (GB/T 19597-2004), independent radiation safety organizations have been set up for all nuclear facilities to be decommissioned and safety management is implemented in line with proper safety procedures; in preparation stage of decommissioning, the radiation protection programme have been prepared, involving abnormal decommissioning conditions and emergency measures; radiation safety equipment for exclusive use, technical procedures, administrative procedures have been employed in accordance with actual conditions; the facility to be decommissioned has been zoned according to radiation level, contamination level or radionuclides, and the sub-zones have been further divided and managed; appropriate safety system (including temporary isolation room and/or shutter) and necessary radiation monitoring meters have been deployed to keep the doses to workers and the public ALARA; radiation safety measures have been used, like effective ventilation and air purification devices; radiation monitoring have been performed including effluent monitoring; and limitation and control have been imposed on doses to workers and the public. All nuclear facility licencees to be decommissioned have managed airborne and liquid effluents from nuclear facilities in the process of decommissioning as specified by the relevant laws and regulations of China.

F-82 Emergency preparedness has been implemented for nuclear facility decommissioning. Under the *Safety requirements for decommissioning of nuclear facilities* (GB/T 19597-2004), the nuclear facility licencees have, based on specific situations, prepared and implemented emergency plans in response to the abnormal conditions likely to occur. Such emergency plans incorporate potential incident-related emergency procedures and personnel training among others. Emergency procedures are updated through emergency drills and tests.

F-83 Records important to nuclear facility decommissioning are preserved. Under the *Safety requirements for decommissioning of nuclear facilities* (GB/T 19597-2004), the licencees have implemented appropriate and most recent QA programme. In preparing the QA programme relating to decommissioning project, attention is paid to collection and preservation of records and data. The records on all decommissioning projects will be preserved for a long term.

G. SAFETY OF SPENT FUEL MANAGEMENT (Articles 4 to 10)

G.1 General Safety Requirements (Article 4)

Each Contracting Party shall take the appropriate steps to ensure that at all stages of spent fuel management, individuals, society and the environment are adequately protected against radiological hazards. In so doing, each Contracting Party shall take the appropriate steps to: (i) ensure that criticality and removal of residual heat generated during spent fuel management are adequately addressed; (ii) ensure that the generation of radioactive waste associated with spent fuel management is kept to the minimum practicable, consistent with the type of fuel cycle policy adopted; (iii) take into account interdependencies among the different steps in spent fuel management; (iv) provide for effective protection of individuals, society and the environment, by applying at the national level suitable protective methods as approved by the regulatory body, in the framework of its national legislation which has due regard to internationally endorsed criteria and standards; (v) take into account the biological, chemical and other hazards that may be associated with spent fuel management; (vi) strive to avoid actions that impose reasonably predictable impacts on future generations greater than those permitted for the current generation; (vii) aim to avoid imposing undue burdens on future generations.

G-1 In China, the primary responsibility of spent fuel management safety rests with the licencees of NPPs, research reactors and spent fuel storage facilities. The *Nuclear Safety Law of the People's Republic of China* stipulates that organizations producing, storing, transporting or reprocessing spent fuel shall take measures to ensure the safety of spent fuel, and shall be responsible for the safety of spent fuel in their possession. Under the *Rules of the People's Republic of China on the Safety Regulation for Civil Nuclear Facilities* (HAF 001), licencees shall hold overall responsibility for nuclear facilities they operate, including spent fuel management facilities, and shall be subject to the supervision of the MEE/NNSA.

G-2 The management safety of spent fuel under at-reactor storage at NPPs is subject to the provisions of the *Rules on the Safety of Nuclear Power Plant Siting* (HAF 101), the *Rules on the Safety of Nuclear Power Plant Design* (HAF 102), *Safety Rules on Commissioning and Operation of Nuclear Power Plants* (HAF 103), the *Design of Handling and Storage System at NPPs* (HAD 102/15-2021), and the *Design criteria for pressurized water reactor spent fuel storage facilities at nuclear power plant* (EJ/T 883-2006).

G-3 The management safety of spent fuel under at-reactor storage at research reactors is subject to the requirements of the *Rules on Research Reactor Design Safety* (HAF 201) and the *Rules on Research Reactor Operation Safety* (HAF 202).

G-4 The management safety of spent fuel under away-from-reactor storage is subject to the provisions of *Rules on the Safety of Civilian Nuclear Fuel Cycle* (HAF 301), *Design of Spent Fuel Storage Installation* (HAD 301/02), *Operation of Spent Fuel Storage Installation* (HAD 301/03), *Safety Assessment of Spent Fuel Storage Installation* (HAD 301/04), *Regulatory requirements for the safety of spent fuel dry storage system at NPPs (Trial)* and *Design criteria for independent spent fuel storage installation (water pool type)* (EJ/T 878-2011).

G-5 For the management of spent fuel under at-reactor/away-from-reactor storage at NPPs and research reactors, the following measures are taken to ensure that at all stages of spent fuel management, individuals, society and the environment are adequately protected against radiological hazards:

(1) Ensuring that criticality is adequately addressed. The major measures taken include: complying with the layout that has been approved, meeting the requirements for neutron absorbers in storage facilities, implementing relevant QA programme, and ensuring that the inventory of spent fuel does not exceed the maximum capacity of the storage facility. Here, the neutron absorbers may be in the form of fixed thin plate or boron-containing water in the storage pool. In addition, corresponding supervision procedures and management procedures are implemented.

(2) Ensuring that the removal of residual heat is adequately addressed. Designing the cooling capacity of the cooling system for the spent fuel storage pool based on the maximum capacity of the spent fuel storage pool, as well as the burnup and decay time, so as to ensure certain redundancy of the cooling system; providing systems with proper water make-up and drainage capability, thus enabling forced cooling to maintain the required water temperature, as well as restoring the lost forced cooling capability; and considering the coolant passageway required to derive the maximum decay heat of fuel assembly in the design of spent fuel rack. For the spent fuel dry storage systems (SFDSSs) in Tianwan NPP, Daya Bay NPP, and Qinshan NPP Phase II, the burnup, cooling time and decay heat of the spent fuel assembly are taken into account when designing the loading scheme for the spent fuel assembly, and the passive heat removal mode is adopted to decrease the cask temperature.

(3) Ensuring that the generation of radioactive waste is kept ALARA. The major measures taken for the spent fuel storage pool include: using stainless steel and other materials as fuel pool liner to ensure leak tightness of the spent fuel pool; selecting proper surface roughness of the liner for convenient surface cleaning and decontamination; providing storage areas with necessary monitoring and decontamination equipment to prevent occurrence of unacceptable contamination; preventing contaminated cooling water from leakage; and in addition, the storage facilities are designed to facilitate the decommissioning, and minimize the production of radioactive wastes.

(4) Considering interdependencies among the different steps in spent fuel management. The spent fuel from NPPs is stored temporarily in at-reactor spent fuel storage facilities, and then sent to on-site dry storage facility, centralized storage facility, or reprocessing facility. The spent fuel sent to the centralized storage facility will also be sent to the reprocessing facility. Type, burnup, cooling period and other characteristics of the spent fuel are considered in facilities and transport operations involved in all stages of the spent fuel management. In this process, the applicants submit detailed technical documents to evidence that the measures taken can ensure the safety of spent fuel management in all stages.

(5) Providing for effective protection of individuals, society and the environment. Complying with departmental rules on the siting, design and construction of NPPs, the licencees perform management of spent fuel management facilities, implement a QA programme approved by the MEE/NNSA and meet the radiation dose limit.

(6) Considering biological, chemical and other hazards that may be associated with spent fuel management; During normal operation, the temperature in at-reactor spent fuel storage facilities is maintained within the prescribed limit. Fuel plants are designed and constructed in such a manner to have the capability of preventing local fire spread.

(7) Striving to avoid actions that impose reasonably predictable impacts on future generations greater than those permitted for the current generation. Vitrification is implemented for liquid HLW generated from spent fuel reprocessing and the vitrified waste forms are disposed of in deep geological formation. Under the *Regulations on the Safety of Radioactive Waste Management*, the deep geological repository for solid HLW shall meet the requirements of safe isolation for more than 10,000 years after its closure.

(8) Aiming to avoid imposing undue burdens on future generations. The CAEA, in conjunction with other related departments, issued the *Interim Procedures on Collection, Utilization and Management of the Fund for Treatment and Disposal of Spent Fuel from Nuclear Power Plants*. The fund is intended for the costs needed for spent fuel transport, away-from-reactor storage, reprocessing and resultant HLW disposal, construction, operation, modification and decommissioning of reprocessing plants, and other expenditures for the treatment and disposal of spent fuel. China is striving to construct a large reprocessing plant.

G.2 Existing Facilities (Article 5)

Each Contracting Party shall take the appropriate steps to review the safety of any spent fuel management facility existing at the time the Convention enters into force for that Contracting Party and to ensure that, if necessary, all reasonably practicable improvements are made to upgrade the safety of such a facility.

G-6 To ensure the safety of the existing facilities, the MEE/NNSA will, prior to the construction and operation of the facilities, review the EISs, safety analysis reports and other related documents submitted by the licencees, and conduct on-site inspection. During operation of a facility, the MEE/NNSA will, together with its regional offices, conduct regulatory inspection of nuclear safety on a regular, routine or non-routine basis. Additionally, NPP licencees will conduct systematic safety re-assessment of the NPPs by means of PSR.

G.2.1 Review of Facility Safety

G-7 Under the *Nuclear Safety Law of the People's Republic of China* and the *Rules of the People's Republic of China on the Safety Regulation for Civil Nuclear Facilities* (HAF 001), prior to construction and operation, the licencees of existing NPPs and research reactors have prepared and submitted to the MEE/NNSA the EISs, preliminary safety analysis reports, final safety analysis reports, nuclear facility QA programmes, nuclear facility commissioning programmes, nuclear accident emergency plans and other related documents. The above materials have covered the EISs and safety analysis reports of spent fuel management facilities. Detailed information on the materials submitted is available in G.5.

G-8 The MEE/NNSA mandates its technical support organizations to review the documents submitted, such as EISs and preliminary safety analysis reports, and to carry out on-site inspection. After review and on-site inspection, the technical support organizations will form review opinions and present the review opinions to the National Nuclear Safety Expert Commission for further review. Subsequently, the Commission will form review results based on the review opinions of the technical support organizations. Based on the review opinions and review results, the MEE/NNSA will decide on whether or not to approve the application presented by the licencees.

G-9 After approval by the MEE/NNSA, the licencees of existing NPPs and research reactors will begin construction and operation of such facilities including spent fuel management facilities.

G.2.2 Regulatory Inspection of Facility Safety

G-10 The MEE/NNSA, together with its regional offices, conducts regular, routine and non-routine regulatory inspection of nuclear safety, so as to verify and oversee whether or not the licencees' facilities, material items and activities meet the regulatory requirements of nuclear safety and licence requirements, make the licencees correct defects and abnormal conditions and ensure facilities, material items and activities conforming with approved documents and requirements.

G.2.3 Periodic Safety Review (PSR) of Operating NPPs

G-11 Under the *Safety Rules on Commissioning and Operation of Nuclear Power Plants* (HAF 103), the licencees shall, based on the gained operational experience and the new significant safety information from related sources throughout the operating lifetime, conduct systematic re-assessment of NPP safety in accordance with the management requirements. The Regulations also specifies that the above re-assessment must be implemented via PSR. The PSR of operating NPPs has been listed in the licence review requirements for NPPs.

G-12 Conventional, specific, and periodic (10 years normally) safety reviews of the existing NPPs are conducted by the licencees under the *In-Commissioning Examination of NPPs* (HAD 103/07) and the *Periodic Safety Review for NPPs*

(HAD 103/11). The PSR is conducted in the 10th year after the NPP is put into operation, subsequently once a decade, until the end of its lifetime. The PSR covers all aspects of NPP safety, namely all in-plant facilities, structures, systems and components (including spent fuel management facilities) covered in the operating licence, as well as personnel allocation, organizational structure, emergency plans, radiation environmental impact and other safety elements relevant to nuclear power units. The scope of review related to the safety of spent fuel management covers the design and actual status of spent fuel handling and storage systems, spent fuel storage pool cooling and purification systems, together with sufficiency of relevant documents and records.

G-13 In 2021, the Qinshan NPP Phase III initiated the first review of the PSR programme for its spent fuel temporary dry storage facilities. The MEE/NNSA approved this programme in 2022. Currently, the Qinshan NPP Phase III is conducting activities in accordance with the approved PSR programme.

G.3 Siting of Proposed Facilities (Article 6)

1. Each Contracting Party shall take the appropriate steps to ensure that procedures are established and implemented for a proposed spent fuel management facility:

(i) to evaluate all relevant site-related factors likely to affect the safety of such a facility during its operating lifetime;

(ii) to evaluate the likely safety impact of such a facility on individuals, society and the environment;

(iii) to make information on the safety of such a facility available to members of the public;

(iv) to consult Contracting Parties in the vicinity of such a facility, insofar as they are likely to be affected by that facility, and provide them, upon their request, with general data relating to the facility to enable them to evaluate the likely safety impact of the facility upon their territory.

2. In so doing, each Contracting Party shall take the appropriate steps to ensure that such facilities shall not have unacceptable effects on other Contracting Parties by being sited in accordance with the general safety requirements of Article 4.

G.3.1 Examination and Approval of Siting for Spent Fuel Storage Facilities

G-14 Under the *Nuclear Safety Law of the People's Republic of China*, the *Rules of the People's Republic of China on the Safety Regulation for Civil Nuclear Facilities* (HAF 001), and the *Safety Licencing Procedures for Nuclear Power Plants, Research Reactors and Nuclear Fuel Cycle Facilities*, nuclear facility licencees shall conduct scientific assessment of geology, earthquake, meteorology, hydrology, environment and population distribution and other factors, and submit siting safety analysis reports to the NNSA on the premise of meeting the requirements of nuclear safety technology evaluation. After the reports are reviewed and considered to meet nuclear safety requirements, the nuclear facility licencees will acquire the review opinion document for nuclear facility site selection.

G-15 China has established a complete examination and approval procedure for siting:

(1) the applicant submits the site safety analysis report and EIS to the MEE/NNSA in the siting phase of an NPP, including the analysis and assessment of the spent fuel storage facility;

(2) the MEE/NNSA's technical support organizations review these submissions, and raise questions about the siting application;

(3) based on the applicant's answer to the questions and revision of the above documents, the reviewing organizations prepare the review opinions (or evaluation report) on the above documents and submit them to the MEE/NNSA;

(4) the MEE/NNSA organizes the expert panel of nuclear safety and environment to review the site safety analysis report and EIS (siting phase) submitted by the applicant along with the review opinions or evaluation report provided by the reviewing organizations; and

(5) based on the review opinions above, the MEE/NNSA will grant the siting permission and the EIA (siting phase) approval to the licencee, and copy it to other related departments.

G.3.2 Siting of Spent Fuel Storage Facilities

G-16 Under the *Nuclear Safety Law of the People's Republic of China* and the *Law of the People's Republic of China on Prevention and Control of Radioactive Pollution*, licencees of all spent fuel storage facilities have gone through scientific demonstration and approval procedures for the siting of their nuclear facilities, encompassing both the at-reactor spent fuel storage facilities and away-from-reactor spent fuel dry storage facilities built for NPPs and research reactors. Prior to undergoing approval procedures, these licencees have prepared and submitted the EISs to the MEE/NNSA for examination and approval.

G-17 Under the *Rules on the Safety of Nuclear Power Plant Siting* (HAF 101), *Rules on Research Reactor Design Safety* (HAF 201), *Rules on the Safety of Civilian Nuclear Fuel Cycle* (HAF 301) and other related nuclear safety guides, in the process of siting for the existing spent fuel storage facilities, the following tasks have been completed:

(1) evaluating the natural and human factors that may influence the safety of spent fuel management facilities in their lifetime. The former includes floods caused by rainfall and other reasons, earthquake-caused waves, floods and waves caused by broken liquid-retaining structures, surface rupture, slope instability, surface subsidence, settlement and uplift, earthquake, basement soil liquefaction, tornadoes, tropical cyclones, and other significant natural phenomena and extreme conditions. The latter includes plane crashes, chemicals explosion and other significant man-made events.

(2) evaluating the possible impacts of spent fuel management facilities on the safety of personnel, society and the environment. These efforts include estimating

potential release of radioactive materials; evaluating the atmospheric dispersion of radioactive releases with suitable models; evaluating the potential impacts of contaminated surface water on local population and the migration of radionuclides in the hydrogeological unit; evaluating the potential impacts of contaminated groundwater on local population; and assessing the capacity of performing mitigation measures, including emergency plans, that may be required under accident conditions;

(3) providing the pubic with information on the safety of such facilities. Under the *Nuclear Safety Law of the People's Republic of China*, the *Law of the People's Republic of China on Environmental Impact Assessment*, the *Guidelines for the Disclosure of Government Information in Connection with the Environmental Impact Assessments of Construction Projects* (Trial) and the *Tentative Methods on Public Participation in Environmental Impact Assessment*, the applicants in the phase of NPP siting have released the information on NPP project construction at their websites and on publicly available newspapers. The information mainly included potential impacts of the construction project on the environment, countermeasures and actions to prevent and mitigate adverse environmental impacts, summary of EIA conclusions. The applicants also proactively released the EIS to the public to solicit opinions. They also held public forums to brief on the information of the construction projects, present the main assessment results, and collect and answer questions. Among the stakeholders participating in these forums are professionals, representatives of adjacent organizations, and representatives of surrounding villagers. The MEE/NNSA makes all information of the EISs available to the public upon acceptance, publicly discloses the comments on proposed approval or rejection of such a statement before making a final decision, and publicizes the examination and approval result after making a final decision.

(4) Monitoring points are established around proposed sites for real-time continuous monitoring of air environment, marine environment, territorial water environment, soil, organisms, and electromagnetic radiation. The data concerned are made available to the public at regular intervals.

(5) Chinese NPPs are primarily located in the eastern and southern coastal areas, with spent fuel storage facilities built on site. Appropriate steps have been taken for current spent fuel storage facilities in consistent with the General Safety Requirements as stated in G.1, so that they will not cause non-acceptable impacts to any other Contracting Parties.

G.4 Design and Construction of Facilities (Article 7)

Each Contracting Party shall take the appropriate steps to ensure that:

(i) the design and construction of a spent fuel management facility provide for suitable measures to limit possible radiological impacts on individuals, society and the environment, including those from discharges or uncontrolled releases;

(ii) at the design stage, conceptual plans and, as necessary, technical provisions for the decommissioning of a spent fuel management facility are taken into account;

(iii) the technologies incorporated in the design and construction of a spent fuel management facility are supported by experience, testing or analysis.

G.4.1 Design and Construction of Spent Fuel Management Facilities at NPPs

G-18 Under the *Rules on the Safety of Nuclear Power Plant Design* (HAF 102), *Management of Core and Fuel at NPPs* (HAD 103/03), *Basic standards for protection against ionizing radiation and for the safety of radiation source* (GB 18871-2002), *Design of Handling and Storage System at NPPs* (HAD 102/15-2021), *Regulations for environmental radiation protection of nuclear power plant* (GB 6249-2011), *Safety requirements for decommissioning of nuclear facilities* (GB/T 19597-2004) and *Design criteria for pressurized water reactor spent fuel storage facilities at nuclear power plant* (EJ/T 883-2006), the following main measures were taken in the design and construction of spent fuel management facilities at NPPs in addition to those taken to prevent criticality and ensure residual heat removal:

(1) Engineering technological measures were taken for restricted release and planned release. These measures include: taking segregation and filtration measures to control iodine and other radioactive materials below the required limits; keeping airflow under control within fuel buildings, thus controlling the release of radioactive materials during fuel handling to the minimum; filtering gaseous waste before discharging; installing an airborne radioactivity monitoring system to monitor and control airborne effluents; setting a drainage sump leading to a liquid radioactive waste treatment system; adopting radioactivity monitoring devices designed to ensure continuous monitoring and recording with sufficient sensitivity; measures that automatically stop discharging when the radioactivity concentration in the effluent exceeds a specified value; and measures that prevent the storage facility from being submerged.

(2) Conceptual plan of decommissioning was considered. The structures, equipment and systems in the spent fuel storage facility were designed to facilitate future decommissioning of the entire nuclear facility. The preliminary decommissioning plan for the nuclear facility, including its spent fuel management facility, was developed and submitted to competent authorities. It encompasses considerations of basic safety issues, expected decommissioning strategy, the impacts of the current or to-be-developed technology on the facility to be decommissioned, the arrangement of interface between the facility under decommissioning with the shared auxiliary systems of the facility in service,

impacts of decommissioning process on the environment, management of decommissioning wastes, decommissioning costs and fund sources, and assurance agencies.

(3) Experience, test, and analytical means were used to support the technology to be employed in design and construction of the spent fuel management facility. The NNSA-approved engineering design specifications were used as the acceptance criteria for designing systems and components. The facility design was guided on the basis of operational experience in combination with safety analysis and safety research results. The design basis for items important to safety was developed and confirmed through an iterative process.

G.4.2 Design and Construction of Spent Fuel Storage Facilities at Research Reactors

G-19 Under the *Rules on Research Reactor Design Safety* (HAF 201), the following measures were taken in the design and construction of spent fuel management facilities at research reactors in addition to those taken to prevent criticality and ensure residual heat removal:

(1) Engineering measures were taken to prevent radioactive materials from being released to the environment. Adequate systems for containment, ventilation, filtration and decay were put in place in the spent fuel storage facility. Both a radiation monitoring system and a ventilation system, including corresponding filtration system, were installed in places where airborne radioactive concentrations were higher. Adequate sampling means were provided.

(2) Decommissioning of reactors, including their spent fuel storage facilities, was put into consideration in the design and construction phases. At the early conceptual design stage, design measures were taken to release the site for future unrestricted use after decommissioning of the facility. Measures to facilitate decommissioning and dismantling were considered. Suitable materials were selected for building structures, systems and components of the spent fuel storage facilities so as to minimize the generation of radioactive waste and to facilitate decontamination. Account was taken of the facilities necessary for managing radioactive waste generated from decommissioning.

(3) Experience, test, and analytical means were used to support the technology to be employed in design and construction of the spent fuel management facility. Appropriate safety analysis and assessment were made on the design of spent fuel storage facilities at research reactors to demonstrate adequacy in safety, and necessary functional tests were conducted for all items important to safety.

G.4.3 Design and Construction of Away-from-reactor Spent Fuel Storage Facilities

G-20 Under the *Rule on Civilian Nuclear Fuel Cycle Safety* (HAF 301), the *Design of Spent Fuel Storage Installation* (HAD 301/02), the *Operation of Spent Fuel Storage Installation* (HAD 301/03), the *Safety Assessment of Spent Fuel Storage Installation* (HAD 301/04), the *Nuclear Safety Regulatory Requirements for Dry Storage System of Spent Fuel in Nuclear Power Plant* (Trial) and the

Design criteria for independent spent fuel storage pool away from reactor (water pool type) (EJ/T 878-2011), the following main measures were taken in the design and construction of nuclear fuel cycle facilities, including their spent fuel storage facilities, in addition to those taken to prevent criticality and ensure residual heat removal:

(1) Primary barrier system, multiple secondary barrier systems, pool water purification system, appropriate containment system, ventilation system, necessary waste gas filtration system, and adequate radiation monitoring equipment were put in place to control concentrations and amounts of radioactive materials released to the environment.

(2) Decommissioning plans were developed, together with corresponding measures, including easy decontamination and dismantling of buildings and equipment, minimization of radioactive waste generated and contaminated equipment, and keeping radiation dose to decommissioning workers at ALARA.

(3) Technologies that have been proven by test and engineering to be effective were employed to conduct safety analysis and assessment in respect to design. Account was taken of human factors engineering, especially, operational control and limitation of the systems and components important to safety.

G-21 Under the *Nuclear Safety Regulatory Requirements for Dry Storage System of Spent Fuel in Nuclear Power Plant* (Trial) issued in 2015 by the NNSA, the design of a newly added SFDSS, as an auxiliary system to an NPP, must comply with the *Rules on the Safety of Nuclear Power Plant Design* (HAF 102), as well as reverent standards, including *Basic standards for protection against ionizing radiation and for the safety of radiation source* (GB 18871-2002), *Regulations for environmental radiation protection of nuclear power plant* (GB 6249-2011), and *Nuclear criticality safety for fissile materials outside reactors* (GB 15146). An on-site SFDSSs shall comply with the NNSA's guiding documents with regard to its design, construction, etc.

G-22 In 2008, the NNSA approved the application for the construction of a spent fuel temporary dry storage facility for Qinshan NPP Phase III, and approved the construction of 18 MACSTOR-400 spent fuel storage modules (QM-400 modules for short), each of which can hold 24,000 spent fuel bundles. With a design lifetime of 50 years, these storage modules can store a total of about 400,000 spent fuel bundles. As of December 31, 2023, six QM-400 modules have been built and loaded with spent fuel bundles at the Qinshan NPP Phase III.

G-23 Considering the potential life extension of units in the future and the shortage of bedrock sites suitable for the construction of spent fuel storage facilities in Qinshan area, Qinshan NPP Phase III has applied to the NNSA for changing to a high-density storage scheme, and planned to build high-density M1 modules, which can hold 82,800 spent fuel bundles, from the seventh module. In March 2022, the NNSA approved this change application. The first M1 storage module has been completed, with non-loading commissioning conducted in July 2023.

G-24 In 2018, the NNSA approved the applications submitted by the Daya Bay NPP and the Tianwan NPP for adding on-site spent fuel dry storage facilities. With a design lifetime of 50 years and using NUHOMS®32PTH1 storage module systems, the spent fuel dry storage facility applied by the Daya Bay NPP has a storage capacity of about 400 tHM, which can meet the spent fuel storage requirements of six units for three years. 27 dry storage modules have been built, and three of them have been put into operation. Following the principle of "one overall plan, phased construction", NUHOMS®31VTH sealed canisters was adopted for the first stage of the spent fuel dry storage facility of the Tianwan NPP, and CNSC-HV sealed tanks will be adopted in subsequent stages. More storage units will be added to the facility as planned according to the demands for spent fuel storage.

G-25 In 2020, Qinshan NPP Phase II applied for the construction of an on-site dry storage facility. It applied for the construction of 25 dry storage modules in the first stage to temporarily store 800 spent fuel assemblies generated by its four units. It applied for the construction of 40 dry storage modules in the second stage to temporarily store 600 spent fuel assemblies generated by the unit of Qinshan NPP Phase I. The CNSC-HS storage system independently designed and manufactured by China will be used in both stages. In April 2021, the NNSA approved the application for the first stage, and the facility has begun operation. In July 2022, the licencee submitted the application for the second stage, on which the NNSA is preparing for a technical review.

G.5 Assessment of Safety of Facilities (Article 8)

Each Contracting Party shall take the appropriate steps to ensure that:

(i) before construction of a spent fuel management facility, a systematic safety assessment and an environmental assessment appropriate to the hazard presented by the facility and covering its operating lifetime shall be carried out;

(ii) before the operation of a spent fuel management facility, updated and detailed versions of the safety assessment and of the environmental assessment shall be prepared when deemed necessary to complement the assessments referred to in paragraph (i).

G-26 Under the *Nuclear Safety Law of the People's Republic of China*, the *Law of the People's Republic of China on Prevention and Control of Radioactive Pollution*, and the *Rules of the People's Republic of China on the Safety Regulation for Civil Nuclear Facilities* (HAF 001), prior to applying for construction and operating licences for a proposed nuclear facility and going through the decommissioning approval procedure, the licencee shall prepare an EIS and submit it to the MEE/NNSA for examination and approval. Prior to its construction, the licencee must submit to the MEE/NNSA the *Application for Nuclear Facility Construction*, *Preliminary Safety Analysis Report* and other related documents. Prior to its operation, the licencee must submit to the MEE/NNSA the *Application for Nuclear Facility Operation*, the *Final Safety Analysis Report*, and other related documents. No fuel loading or commissioning operations can be carried out until the relevant authorizations have been granted.

G-27 In accordance with the *Safety Licencing Procedures for Nuclear Power Plants, Research Reactors and Nuclear Fuel Cycle Facilities*, prior to the construction of a nuclear facility, the licencee shall apply to the MEE/NNSA for construction of such facility, and submit (1) an application for nuclear facility construction; (2) preliminary safety analysis report; (3) EIA document; (4) QA document; and (5) other materials required by laws and administrative regulations. Before initial loading of a nuclear facility, the licencee shall apply to the MEE/NNSA for its operation, and submit (1) an application for nuclear facility operation; (2) final safety analysis report; (3) QA document; (4) emergency plan; and (5) other materials required by laws and administrative regulations.

G-28 For existing spent fuel storage facilities, both safety analysis and EIA were conducted prior to construction and operation and corresponding safety analysis report and EIS were prepared, with increasingly extended scope and profundity. The safety analysis and the EIA encompass detailed description of structures, systems and components; performance criteria used; description of design process; description of facility construction and management; general description of facility operation; performance predication and analysis and assessment methods. Regarding performance predication, the models, parameters, boundary conditions, assumptions and reasons used in such analysis and assessment were made clear, and potential impacts on the spent fuel storage facility from natural conditions and phenomena, and external man-made and natural events were identified, with the degrees and temporal variation of impacts analysed, where, natural conditions and phenomena include weather, climate, hydrogeology, geological conditions, topography and geomorphology, potential natural fire and explosion, external man-made events include explosion, fire, aircraft crash, projected object, dropping of fuel containers and other weights, and release of toxic, hazardous or radioactive materials, and external natural events include flood, earthquake, surface subsidence and landslide; based on structural analysis, the integrity of the facility's components was demonstrated under the operating conditions (including the structural and mechanical loads, thermal load and its acting process, temporal variation of materials nature, measures incorporated in the design) and accident conditions; radioactive and/or non-radioactive impacts of the spent fuel storage facility on human and the environment were analysed under normal operating and accident conditions, and compared against the developed performance criteria, involving maintenance of sub-criticality, decay heat removal and radiation protection; the conclusions were drawn on safety analysis and EIA.

G-29 Under *Regulatory Requirements for the Safety of Spent Fuel Dry Storage System at NPPs* (Trial) issued in 2015, the licencee of an NPP shall provide technical support documents on design demonstration, safety analysis and test validation items for the SFDSS and submit them to the MEE/NNSA in a form of *SFDSS Safety Analysis Report*. This Report shall incorporate the information on location, layout and foundation condition of the SFDSS within the plant area, as well as the design and operation of related support systems and spent fuel handling and transport system. It shall include other related inputs that incorporate the operation and safety management of the SFDSS into the current management system of the NPP. Such inputs include, but are not limited to, radiation protection, waste management, nuclear material accountancy and physical protection, emergency plans, environmental monitoring, operational limits and conditions, periodic testing, and in-service inspection. For an SFDSS serving as an on-site temporary option, the Report shall also address the interfaces with the NPP, the transport system, and the spent fuel reprocessing plant, and shall validate the operability. It shall also provide information on the EIA of the SFDSS and demonstrate the environmental impact of adding the SFDSS complies with licence requirements of the NPP.

G.6 Operation of Facilities (Article 9)

Each Contracting Party shall take the appropriate steps to ensure that:

(i) the licence to operate a spent fuel management facility is based upon appropriate assessments as specified in Article 8 and is conditional on the completion of a commissioning programme demonstrating that the facility, as constructed, is consistent with design and safety requirements;

(ii) operational limits and conditions derived from tests, operational experience and the assessments, as specified in Article 8, are defined and revised as necessary;

(iii) operation, maintenance, monitoring, inspection and testing of a spent fuel management facility are conducted in accordance with established procedures;

(iv) engineering and technical support in all safety-related fields are available throughout the operating lifetime of a spent fuel management facility;

(v) incidents significant to safety are reported in a timely manner by the holder of the licence to the regulatory body;

(vi) programmes to collect and analyse relevant operating experience are established and that the results are acted upon, where appropriate;

(vii) decommissioning plans for a spent fuel management facility are prepared and updated, as necessary, using information obtained during the operating lifetime of that facility, and are reviewed by the regulatory body.

G-30 In China, the licencees of nuclear facilities are directly responsible for the safety of the nuclear facilities they operate, and take overall safety responsibility. Organizations that provide equipment, engineering, and services to nuclear facility licencees shall bear corresponding responsibilities. Under the *Nuclear Safety Law of the People's Republic of China* and the *Rules of the People's Republic of China on the Safety Regulation for Civil Nuclear Facilities* (HAF 001), prior to construction and operation, the licencees of nuclear facilities shall submit relevant documents to the NNSA in phases. Only after approved by the NNSA, can the construction and operation of such facilities be started.

G.6.1 Operation of Spent Fuel Storage Facilities at NPPs

G-31 The licencees prepared commissioning programmes for their own spent fuel storage facilities (i.e., on-site spent fuel storage pools and dry storage facilities).

Such programmes cover commissioning, operation, maintenance and modification, inspection, test and examination, radiation protection, prevention of radioactive release to the environment, accident and emergency preparedness, accident records, reporting and investigation, QA and audit, personnel training, nuclear materials regulation, physical protection, etc., to the extent that, in terms of level of details, each of such aspects corresponds to the importance of a specific system or issue to safety.

G-32 In order to manage and control risks to safety within the facility, the licencee developed, as required by the *OL&C and Operational Procedure for Nuclear Power Plant* (HAD 103/01), operational limits and conditions in accordance with the technical specifications for design, test, operational experience and corresponding assessment of the spent fuel storage facility. These conditions include spent fuel burnup, cooling time, loading quantity and other limits of the dry storage facility, the reactivity margin, and the radiation monitoring requirements of the storage area; minimum cooling capacity of the cooling system of the spent fuel storage pool and the minimum water level above the spent fuel, minimum backup storage capacity, reactivity redundancy required, and radiation monitoring requirements in the spent fuel storage area. These limits and conditions all have been approved by the NNSA. Additionally, target values for operation management lower than these limits were also established by the licencees with a view to preventing violation of such operational limits and conditions approved.

G-33 All licencees managed their own spent fuel storage facilities in accordance with their programmes and procedures prepared and approved before these facilities are put into operation. The programmes said here cover those concerning operation, periodic maintenance, monitoring, test, examination and inspection on which the safety systems closely related to operation safety and the safety-related structures and components are based. The procedures include those related to water chemistry monitoring, fuel handling, sub-criticality maintenance, radiation protection and fuel containment of storage facilities, maintenance and validation of heat removal, shielding maintenance, monitoring of loose components and vibration, periodic testing, inspection of storage facilities, response to operational events and accident conditions, emergency plans, management of periodic review, and other related procedures.

G-34 For the management of spent fuel assemblies in the storage pool, the main assurance conditions for operation are as follows:

(1) recording in detail the serial number, storage location, and storage time of spent fuel assemblies, and label them;

(2) monitoring water temperature, water level and leakage through liners of the spent fuel storage pool, maintaining normal operation of the spent fuel storage pool cooling and cleaning systems, carrying out periodic water sampling and analysis to control water quality parameters, and ensuring that recharged water meets the quality requirements for desalted water;

(3) maintaining normal and continuous operation of the radiation monitoring system and the ventilation system in the plant;

(4) prohibiting fuel hoisting operation and preventing heavy items other than hoisting equipment from moving above the spent fuel storage pool without written approval when spent fuel is stored in the pool, so as to prevent spent fuel assemblies from being damaged by falling heavy items; and

(5) verifying and inspecting neutron absorbers in the case of high-density storage.

G-35 For the management of spent fuel assemblies in dry storage facilities, the assurance conditions for operation are as follows:

(1) loading assemblies which conform to the combination of requirements on burnup, cooling time, and more to ensure that the temperature of these fuel assemblies do not exceed the limit;

(2) setting neutron poison in the fuel basket to ensure the maintenance of sub-criticality; and

(3) monitoring temperature, and monitoring radiation to prevent personnel from accidental exposure.

G-36 The inspections of irradiated fuel assemblies are as follows:

(1) preparing the fuel inspection plan prior to each shutdown for refueling and inspecting irradiated fuel assemblies in accordance with the approved plan;

(2) timely repairing the defects, if discovered, of irradiated fuel assemblies in accordance with procedures; and

(3) recording the inspection and repair conditions of irradiated fuel assemblies.

G-37 The licencees of spent fuel management facilities affiliated to NPPs have obtained the engineering and technical supports in all safety-related fields, like fuel management, performance analysis, in-service inspection, environmental monitoring, evaluation of design modification or procedure revision, chemical control, overhaul, and decontamination, throughout the operating lifetime of such facilities in accordance with the *Organization and Operational Management of Operators of NPPs* (HAD 103/06). These were achieved through signing contracts with relevant entities (including advisory companies, engineering companies, suppliers to NPPs, equipment manufacturers and contractors), employing experts in the fields of metallurgy, health physics, seismology, etc., and using equipment and devices needed for data processing, training, chemical experiment, radioactive test, etc.

G-38 The licencees of NPPs submit their annual operation safety reports to the NNSA every year. Under the *Rules of the People's Republic of China on the Safety Regulation for Civil Nuclear Facilities* (HAF 001) and *Regulations on Nuclear Safety Reports for Operators of Nuclear Power Plants* (MEE Order No.13), any accident occurring during spent fuel management, as part of production activities at NPPs, shall be reported to the NNSA.

G-39 Pursuant to the *Management Measures on Experience Feedback about Operating NPPs*, the NNSA organizes experts to analyse and release experience feedback information necessary for operating NPPs and issues regulatory requirements; as required by the NNSA, the NPP licencees develop and effectively implement the NPPs experience feedback programme or management procedure and respond timely to the experience feedback management requirements made by the NNSA; the Nuclear and Radiation Safety Center carries out periodic comprehensive analysis and assessment of domestic and international experience feedback information, as well as performance indicator data, and provides the NNSA with regulatory recommendations and suggestions; the NNSA's regional offices are responsible for regulatory inspection on the experience feedback work and activities of operating NPPs. The NNSA built, in November 2014, an operating NPPs experience feedback platform, which has been put into trial operation. As an integral part of the operating NPPs experience feedback system, the platform is mainly used for gathering and releasing the operational experience feedback information of NPPs with its functions of information collection and inquiry, significance determination of anomalies, corrective action tracking, and safe state evaluation. The platform was officially put into operation in July 2016.

G-40 Under the *Safety requirements for decommissioning of nuclear facilities* (GB/T 19597-2004), after a period of operation of a nuclear facility, or after a major event or accident occurs in the facility, a mid-term decommissioning plan for the nuclear facility must be developed. A very wide range of possible occurrences must be considered when developing such mid-term plan, like advances in decommissioning technology, changes in national laws, regulations and policies, current situations of the nuclear facility, decommissioning resources assurance, and estimated commissioning costs. The impacts of any possible event or accident occurring during the operation of the nuclear facility on its decommissioning must be reflected in the mid-term plan.

G.6.2 Operation of Spent Fuel Storage Facilities at Research Reactors

G-41 Fundamental requirements for the management of spent fuel assemblies are specified in *Rules on Research Reactor Operation Safety* (HAF 202), to which supplementary explanations are made in the *Research Reactor Operation Management* (HAD 202/01) and the *Management of Core and Fuel at NPPs* (HAD 202/07), detailing the safety requirements for and providing guidance and recommendations on core management and spent fuel handling for research reactors.

G-42 The licencees of research reactors are responsible for and organize all activities covered by core management and on-site fuel management. In order to ensure the safety of spent fuel assembly handling and storage, the licencees prepared technical specifications in relation to the operation safety of their own spent fuel management facility. These technical specifications specified the operational limits and conditions of research reactors, including their spent fuel storage facilities. For instance, the k_{eff} limit was developed to ensure sub-criticality; storage pool water level limits were developed to ensure the minimization of radiation exposure and the removal of residual heat; and storage water quality limits were developed to prevent the integrity of fuel cladding from degrading. Additionally, the accident handling procedures were established to cope with possible accidents during fuel handling.

G-43 In practical operation and handling, with procedures developed strictly implemented, and necessary measures taken, sufficient redundancy is provided, so that operational limits and conditions will not be exceeded. After the spent fuel assemblies are removed from reactor cores, they are generally put on at-reactor fuel racks to facilitate the decay of short lived radioactive materials, and are subsequently transferred to storage pools. For handling of spent fuels, strict control was implemented on materials movement over spent fuel storage racks to prevent materials from dropping and causing damage to fuel assemblies. Additionally, safety interlocks were installed on handling equipment to prevent fuel assemblies from being damaged due to dropping during transport by crane. Underwater cameras and other monitoring equipment were used for periodic inspection of spent fuel assemblies to eliminate potential hazards in a timely manner. Safety supervision was enhanced to determine whether the quality of the pool water meets the standards required; and the pool water was monitored and sampled at regular intervals for analyzing the presence of radionuclides and their activity concentrations so as to ensure the quality of the pool water meets the standards required. Measures to ensure normal operation of the ventilation system were taken to make the concentrations of airborne contaminants within the range of the operational limits and conditions. A comprehensive set of record system was established to document the details of spent fuel assemblies and ensure the accuracy and traceability of information related to such assemblies.

G-44 Any events occurring at research reactors shall be reported and handled in strict accordance with relevant provisions. After handling, written reports shall be promptly submitted to competent authorities and regulatory bodies.

G-45 Analyses of data collected during the operation of the spent fuel storage facility indicates that, in order to reduce the exposure of workers to radiation, necessary modifications to the spent fuel storage facility may be conducted where appropriate. Modifications that are important to safety must be reported to the NNSA for examination and approval. Such modifications must comply with the procedures of safety analysis, design, construction and commissioning.

G-46 During the operating lifetime of a research reactor, the licencee and the reactor operation management organization shall prepare the decommissioning plan abiding strictly by the decommissioning requirements for the reactor, including its spent fuel management facility.

G.6.3 Operation of Away-from-reactor Spent Fuel Storage Facilities

G-47 The *Rule on Civilian Nuclear Fuel Cycle Safety* (HAF 301) put forth fundamental requirements for the operation and management of civilian nuclear fuel cycle facilities, including away-from-reactor spent fuel storage facilities. The *Operation of Spent Fuel Storage Installation* (HAD 301/03) defines the safety requirements and recommendations on operation management of away-from-reactor spent fuel storage facilities. The *Regulatory Requirements for the Safety of Spent Fuel Dry Storage System at NPPs* (Trial) describes the regulations and standards applicable to the operation of spent fuel dry storage facilities in NPPs and other activities.

G-48 Away-from-reactor spent fuel storage facilities comply with design and safety requirements. The licencees established the scheme for safe operation of spent fuel storage facilities, including operating procedures, commissioning plan, QA programme, training plan, radiation protection programme, emergency preparedness, and prevention of radioactive release to the environment.

G-49 Operational limits and conditions were defined, including the maintenance of sub-criticality, radiation safety, and residual heat removal. For instance, any spent fuel bundle to be transferred into a fuel basket is required to have cooled for five years in a spent fuel pool before being transported to a temporary spent fuel dry storage facility.

G-50 The operation, maintenance, monitoring, inspection, and testing of a spent fuel away-from-reactor storage facility were implemented in line with the plans, provisions, procedures and requirements that have already been formulated and approved. The above plans, provisions, procedures, and requirements are comprised of spent fuel storage plan; management provisions on location numbers of storage modules, storage drums, and fuel baskets; requirements on the inspection, ducking, loading, drying, welding, transport and lifting of fuel baskets; management provisions on gamma-rays continuous monitoring; management provisions on radiation protection monitoring in the module storage area; provisions on routine inspection and monitoring of storage drums; inspection and maintenance plan for storage modules, storage drums, fuel baskets, and shielded workboxes; and equipment maintenance, testing and acceptance procedures.

G-51 All engineering and technical supports related to safety were available for away-from-reactor spent fuel storage facilities during their lifetime.

G-52 Any event or accident deviating from operating conditions were reported, as specified, to the relevant regulatory bodies with respect to its nature, extent, consequence and remedial measures.

G-53 Operating data of away-from-reactor spent fuel storage facilities were collected, including monitoring of gamma-ray radiation in on-site environment, and radiation monitoring inside storage modules and at workplace. In addition, air sampling from storage drums and heat conductivity monitoring inside modules were conducted in an attempt to validate the design and accumulate experience for subsequent module manufacturing.

G-54 The decommissioning plan shall be reviewed and updated where necessary, during the operation of an away-from-reactor spent fuel storage facility, based on advances in decommissioning technology, possible events, revision of national laws, regulations and policies, experience gained from facility operation, variation in decommissioning costs, etc.

G.7 Disposal of Spent Fuel (Article 10)

If, pursuant to its own legislative and regulatory framework, a Contracting Party has designated spent fuel for disposal, the disposal of such spent fuel shall be in accordance with the obligations of Chapter 3 relating to the disposal of radioactive

waste.

G-55 China’s spent fuel management policy aims to reprocess spent fuels and extract and recover uranium and plutonium, so as to achieve maximum use of resources. With economic and technical factors taken into account, however, the likelihood for direct disposal of a few types of spent fuels is not excluded in the future. No spent fuel is designated to propose to undergo direct disposal at present in China.

H. SAFETY OF RADIOACTIVE WASTE MANAGEMENT (Articles 11 to 17)

H.1 General Safety Requirement (Article 11)

Each Contracting Party shall take the appropriate steps to ensure that at all stages of radioactive waste management individuals, society and the environment are adequately protected against radiological and other hazards.

In so doing, each Contracting Party shall take the appropriate steps to:

(i) ensure that criticality and removal of residual heat generated during radioactive waste management are adequately addressed;

(ii) ensure that the generation of radioactive waste is kept to the minimum practicable;

(iii) take into account interdependencies among the different steps in radioactive waste management;

(iv) provide for effective protection of individuals, society and the environment, by applying at the national level suitable protective methods as approved by the regulatory body, in the framework of its national legislation which has due regard to internationally endorsed criteria and standards;

(v) take into account the biological, chemical and other hazards that may be associated with radioactive waste management;

(vi) strive to avoid actions that impose reasonably predictable impacts on future generations greater than those permitted for the current generation;

(vii) aim to avoid imposing undue burdens on future generations.

H-1 In China, a systematic set of policies and strategies, along with a complete set of laws, regulations and standards, on radioactive waste management and a wide range of measures envisaged for implementing the safety of radioactive waste management have been established, so as to achieve the goals of protecting individuals, society and the environment against radiological and other hazards.

H-2 Appropriate steps have been taken by China to ensure the residual heat produced during radioactive waste management can be removed properly. Under the *Regulations for radioactive waste management* (GB 14500-2002) and the *Regulations for designing storage building of high level radioactive liquid waste* (GB 11929-2011), for the design of liquid HLW storage tanks, all factors that may affect criticalilty safety shall be analysed comprehensively, and all reasonable and practical approaches shall be taken to ensure criticality safety. These storage tanks shall be provided with in-built cooling systems with a full standby capability, and equipped with redundant and diverse instrumentations to measure important process parameters such as temperature and liquid level. Independent emergency cooling systems shall be provided in the storage tanks to ensure that the temperature in these storage tanks remains below 60℃ in the event of cooling water supply failure.

H-3 China's laws and regulations require that the quantity of radioactive waste generated shall be kept at levels that are ALARA. Under the *Law of the People's Republic of China on Prevention and Control of Radioactive Pollution*, any nuclear facility licencees and nuclear technology utilities shall adopt advanced technologies and equipment, and reasonably select and utilize raw materials, in such a way that the amount of radioactive waste is minimized. Under the *Regulations for radioactive waste management* (GB 14500-2002), the generation of waste shall be controlled in all nuclear activities so that the radioactivity and volume of waste are kept ALARA. Under the *Regulations for environmental radiation protection of nuclear power plant* (GB 6249-2011), the *Radioactive Waste Minimization at Nuclear Facilities* (HAD 401/08-2016) and the *Minimization of Radioactive Waste in Nuclear Technology Application Projects* (HAD 401/11), the organizations engaged in the design, construction, operation, and decommissioning of a nuclear facility or in nuclear technology application shall, with respect to the minimization of radioactive waste, implement waste source control, recycling and reuse, clearance, optimized waste treatment, and enhanced management, and conduct cost-benefit analysis, so that the amount (volume and activity) of solid radioactive waste generated can be controlled at ALARA.

H-4 In the process of waste management, these organizations shall optimize the overall control of gaseous, liquid and solid wastes and the whole process from generation to disposal, so as to obtain the optimal technical, economic, and social effects, and facilitate sustainable development. In the regulations, standards, guides that have been issued, the interdependency between several different steps to manage radioactive waste has been taken into account. These steps include radioactive waste generation, collection, classification, treatment and conditioning, storage, disposal and discharge, and even recycling and reuse.

H-5 A legal framework comprising national laws, administrative regulations, departmental rules (national standards), management guides and references governing radioactive waste management has been established and maintained in China. Implementation of these documents can provide effective protection to individuals, society and the environment. These documents were developed and issued after stringent review by relevant authorities including regulatory bodies. They set out the management requirements (such as those for the radioactive waste management licencing system, and disposal facility closure system), technical requirements (such as discharge limits, dose limits, and safety provisions for near surface disposal), and requirements, criteria and methods for protecting the public, the workers, and the environment in main links in waste management, which are basically consistent with internationally endorsed standards and criteria. The MEE/NNSA, alongside with SASTIND, conducts regulatory inspection and supervisory monitoring on the licencees of such facilities for their implementation of and compliance with relevant standards.

H-6 China has taken full consideration of biological, chemical and other hazards that are likely attributable to the management of radioactive waste. Under the announcement on *Classification of Radioactive Waste*, the *Safety requirements for* *near surface disposal of low and medium level radioactive solid waste* (GB 9132-2018) and the *Regulations for radioactive waste management* (GB 14500-2002), when developing the classification system of radioactive waste, account was taken of potential chemical and biological hazards, and the waste received and disposed of had enough chemical, biological, thermal and radioactive stability and would not produce toxic gases. Radioactive waste treatment systems have been equipped with fire protection and explosion-proof devices in such a way as to ensure that radioactive waste and other hazardous waste released to the environment are below regulatory limits.

H-7 In developing and implementing relevant laws, regulations and standards, China made efforts to avoid taking actions that impose reasonably predictable impacts on future generations greater than those permitted for the current generation. Under the *Regulations on the Safety of Radioactive Waste Management*, the solid radioactive waste generated in nuclear facilities within their operating lifetime, and the liquid radioactive waste that cannot be discharged after purification shall be treated and converted into stabilized and standardized solid waste, and then handed over to a licenced solid radioactive waste disposal facility for disposal. The *Safety requirements for near surface disposal of low and medium level radioactive solid waste* (GB 9132-2018) provides that when a disposal site is closed, permanent signs shall be arranged at appropriate locations to indicate the waste burial sites and related matters; after the closure of the disposal facility, active or passive institutional control shall be implemented in accordance with the institutional control program, and appropriate environmental monitoring shall be retained and carried out according to the operating history and the situation of closure and stabilization; the long-term safety assessment after closure shall determine the time range of long-term safety analysis and assessment after closure, cover the time when the maximum/peak dose or hazard occurs, and evaluate the performance of the disposal system, and unintentional human intrusion activities, etc.

H-8 In developing relevant laws, regulations and standards, China adheres to the principle of avoiding undue burdens on future generations. Under the *Regulations on the Safety of Radioactive Waste Management*, radioactive waste management must not impose undue burdens on future generations. *Interim Procedures on Collection, Utilization and Management of the Fund for Treatment and Disposal of Spent Fuel from Nuclear Power Plants* was issued in July 12, 2010 (see F.2.2.1). The document *Management Measures on Expenses for Nuclear Facility Decommissioning and Radioactive Waste Disposal* is being developed. China already has four near surface disposal facilities in operation, and is planning and building new ones according to the needs of nuclear energy development in the country. The work on geological disposal of radioactive waste is also proceeding as planned.

H.2 Existing Facilities and Past Practices (Article 12)

Each Contracting Party shall in due course take the appropriate steps to review:

(i) the safety of any radioactive waste management facility existing at the time the Convention enters into force for that Contracting Party and to ensure that, if necessary, all reasonably practicable improvements are made to upgrade the safety of such a facility;

(ii) the results of past practices in order to determine whether any intervention is needed for reasons of radiation protection bearing in mind that the reduction in detriment resulting from the reduction in dose should be sufficient to justify the harm and the costs, including the social costs, of the intervention.

H.2.1 Periodic Safety Review for Nuclear Facilities

H-9 Under the *In-Commissioning Examination of NPPs* (HAD 103/07) and the *Periodic Safety Review for NPPs* (HAD 103/11), the 10-year PSR has been conducted from 2020 to 2023 at China's operating NPPs, such as Tianwan NPP, Fangchenggang NPP, Hongyanhe NPP, and Ningde NPP, covering solid radioactive waste management and radiation environmental impact. Review of the solid radioactive waste management focused on assessment of seismic performance, shielding performance, operability, maintainability, heat removal measures, leakage prevention capability of spent resin storage tanks; the safety of low level solid waste storage system and waste form storage system; the property stability of cemented waste forms during long-term storage; the retrievability of low level solid waste and waste forms; and the durability of containers. The review results indicate that the assessed systems, as a whole, meet the requirements of current safety criteria.

H-10 Under the *Periodic Safety Review for NPPs* (HAD 103/11), a PSR was conducted from 2020 to 2023 at China North Nuclear Fuel Co., Ltd. This review encompasses safety analysis; actual status of structures, systems and components; hazard analysis; radiation environment impact assessment, etc. As has been stated by the review results, the technical modifications and specific actions taken in the past years have made relevant systems, such as the waste treatment system and the radiation protection system, meet the requirements of current standards as a whole.

H-11 A PSR was conducted from 2020 to 2022 at the Northwest Disposal Facility, covering the design of the disposal facility, actual status and performance evolution of structures, systems and components, safety performance, safety assessment, operation and management of the disposal facility, organizational structure and management system, and radiation environmental impacts. The Northwest Disposal Facility is the first near surface disposal facility in China that has undergone the PSR. The review results indicate that, after addressing identified weaknesses through corrections and safety improvements, the safety and radiation risks of the Northwest Disposal Facility are controllable as a whole, before the next PSR.

H.2.2 Peer Review for Radioactive Waste Management

H-12 The MEE/NNSA has taken the lead to prepare technical documents, to serve as a technical basis, for peer review for radioactive waste management of NPPs since 2020, and has determined the form of peer review, namely, guided by the NNSA, implemented under the organization of the CNEA, and participated in by NPPs.

H-13 From July 15 to 21, 2023, the CNEA conducted the first peer review for radioactive waste management of NPPs in China at the Tianwan NPP. Four factors, namely, the management system, waste safety management, waste minimization, and effluent discharge, in the field of radioactive waste management were reviewed comprehensively via personnel interview, document and data review, on-site verification, etc.

H.2.3 Safety Inspection to Nuclear Facilities

H-14 The MEE/NNSA, together with its regional offices, exercises regular, routine and non-routine regulatory inspection of nuclear safety.

H-15 The MEE/NNSA carries out routine nuclear safety inspection of nuclear facilities. The routine inspection after an NPP overhaul and prior to the first criticality is focused on the management of radioactive waste generated both from previous fuel cycle and during overhaul. Its regional offices have a responsibility for developing supervision plans and implementing daily and specific nuclear safety supervision and inspection.

H.3 Siting of Proposed Facilities (Article 13)

> Each Contracting Party shall take the appropriate steps to ensure that procedures are established and implemented for a proposed radioactive waste management facility:
>
> (i) to evaluate all relevant site-related factors likely to affect the safety of such a facility during its operating lifetime as well as that of a disposal facility after closure;
>
> (ii) to evaluate the likely safety impact of such a facility on individuals, society and the environment, taking into account possible evolution of the site conditions of disposal facilities after closure;
>
> (iii) to make information on the safety of such a facility available to members of the public;
>
> (iv) to consult Contracting Parties in the vicinity of such a facility, insofar as they are likely to be affected by that facility, and provide them, upon their request, with general data relating to the facility to enable them to evaluate the likely safety impact of the facility upon their territory.
>
> In so doing, each Contracting Party shall take the appropriate steps to ensure that such facilities shall not have unacceptable effects on other Contracting Parties by being sited in accordance with the general safety requirements of Article 11.

H.3.1 Siting of Facilities

H-16 China attaches high priority to the siting of radioactive waste management facilities, with relevant regulations and standards developed to standardize the siting of different radioactive waste management facilities.

H.3.1.1 Siting of Nuclear Facility-Affiliated Radioactive Waste Management Facilities

H-17 It is stipulated that a radioactive waste management facility affiliated to a nuclear facility shall be sited in accordance with the requirements for siting such nuclear facility.

H-18 During the process of siting, account was taken of site-related factors, such as geographical location, population distribution, natural resources (mineral reserves, food, economic crops, aquatic products, etc.), industry, transport, meteorology (tropical cyclone, tornadoes, thunderstorms, etc.), hydrology, geology, and earthquake.

H-19 During the process of siting, evaluations were made of annual individual dose equivalent and annual collective dose equivalent for licencees at different posts (operation, maintenance, radioactive waste handling, and in-service inspection) in such a facility; possible impacts of such a facility on the ambient environment under normal and accidental conditions were evaluated to demonstrate the acceptability of site conditions and safety facilities.

H-20 China's existing nuclear facility-affiliated radioactive waste management facilities will not have effects on other Contracting Parties.

H.3.1.2 Siting of Radioactive Waste Temporary Storage Facilities for Nuclear Technology Application

H-21 The site-related factors were evaluated. As required by the *Regulations for radioactive waste management* (GB 14500-2002) and the *Technical specifications for siting, design and construction of radioactive waste repository for nuclear technology application* (HJ 1258-2022), the natural conditions and socioeconomic conditions at the site were evaluated during the siting of radioactive waste temporary storage facilities for nuclear technology application.

(1) Natural conditions at site feature relatively flat topography, small slope, relatively simple geological structure, low seismic intensity, deep underground water level and far from surface water, stable geological conditions (there is no debris flow, landslide, quicksand, karst cave or other surface phenomena adverse to engineering), poor permeability of rock and foundation soil of enough bearing capacity, favourable meteorological conditions (temperature, humidity, contents of corrosive components in air, etc.), and avoidance of potential flood, tide or waterlogging.

(2) In terms of the socioeconomic conditions, the facilities are not located in densely populated urban planning area, and they are kept away from facilities that produce or store flammable, explosive or dangerous articles which could have impacts on the safety of the waste storage facility. The facilities are also kept away

from mineral areas of important development value, scenic spots, natural reserves, drinking water source conservation areas, or economic development zones; and convenient transport and water and power supply are available.

H-22 The impacts of such a facility on individuals, society and the environment were evaluated. The potential impacts of external man-made events and natural events on radioactive waste temporary storage facilities for nuclear technology application and possible impacts of such facilities on individuals and the environment from the releases of radioactive and hazardous materials were evaluated during siting for such facilities. These efforts have been made to ensure providing adequate isolation from the public and the environment and robust confinement for radioactive waste during the design lifetime, so as to meet the requirements of the relevant regulatory bodies, achieve safe operation and management, and facilitate future expansion, alteration and decommissioning.

H-23 China's existing radioactive waste temporary storage facilities for nuclear technology application will not have effects on other Contracting Parties.

H.3.1.3 Siting of Solid Radioactive Waste Disposal Facilities

H-24 The site-related factors were evaluated. Under the *Regulations for radioactive waste management* (GB 14500-2002), the *Safety requirements for near surface disposal of low and medium level radioactive solid waste* (GB 9132-2018), the *Siting of Radioactive Waste Near Surface Disposal Facility* (HAD 401/05) and the *Siting of High Level Radioactive Waste Geological Facility* (HAD 401/06), the site-related factors were evaluated during the siting of a solid radioactive waste disposal facility, including seismic and geological stability, geological structure and lithology, engineering geology, hydrogeology, geochemistry, surface action, meteorological conditions, mineral resources, natural and cultural resources, population density, and the distances from surface water, drinking water, urban area, airports, and warehouses for inflammable, explosive and other dangerous goods.

H-25 The impacts of such a facility on individuals, society and the environment were evaluated, with account taken of the post-closure evolution of the site conditions. Under the *Safety requirements for near surface disposal of low and medium level radioactive solid waste* (GB 9132-2018) and the *Regulations for radioactive waste management* (GB 14500-2002), analyses and safety assessment were made, in the process of siting solid radioactive waste disposal facilities, of the quantity and probability of migration of radionuclides into human environment, the associated mechanisms, pathway, and velocity that these radionuclides enter into human body, together with preliminary estimation regarding the individual dose equivalent and collective dose equivalent under normal conditions, natural events and man-made events; and analysis and evaluation were made of the environmental impacts of disposal facilities during construction, operation and post closure, and possible impacts of the surrounding environment on the disposal facilities.

H-26 Under the *Regulations on the Safety of Radioactive Waste Management*, as well as other relevant standards and guides, the siting for Beilong, Northwest, Feifengshan and Longhe disposal facilities were completed in full accordance with the requirements of planned siting, area survey, site characterization and site identification. Sufficient investigation and demonstration were conducted for geological structure, hydrogeology as well as other natural and socioeconomic conditions of the sites. The above near surface disposal facilities have already entered the operation phase. Their candidate sites were identified at the area screening stage based on information collection and comparison, taking into account natural conditions and social factors, such as geology, population, economy, transport and so on. On the basis of field reconnaissance on and comparison of these candidate sites, suitable sites were recommended. The site characterization was conducted at several candidate sites, for which, the EISs and the safety analysis reports for site approval application phase were developed. At last, these sites were approved by the NNSA based on the review opinions.

H-27 The CAEA organized efforts to make research on the geology, hydrogeology, seismic geology and socioeconomic conditions of the candidate Beishan site located in Gansu for the HLW disposal repository, following the initial comparison of pre-selected granite regions, namely, East China, South China, Southwest China, Inner Mongolia, Xinjiang and Gansu. Bore drilling activities were partly conducted to obtain the in-depth samples of rock core and water and other relevant information, granite site evaluation methods were established, the site for the URL was determined, and the construction of the URL and supporting scientific research work were started. In the next few years, the R&D of HLW geological disposal will be further strengthened, (preliminary) laboratory R&D tasks in various disciplines will be completed, and the construction of the URL will be completed. On the basis of the preliminary investigation of pre-selected clay rock areas, the CAEA organized a supplementary survey on the key pre-selected clay rock areas in Inner Mongolia for the HLW geological disposal repository, and recommended two sites to carry out preliminary investigation, entering the area survey stage for siting for the clay rock disposal repository.

H-28 China’s existing near surface disposal facilities will not have effects on other Contracting Parties.

H.3.2 Information Disclosure

H-29 The *Nuclear Safety Law of the People’s Republic of China*, which was implemented in 2018, established a special chapter on “Information Disclosure and Public Participation”, which provides for the disclosure of nuclear safety-related information and public participation, and clarifies requirements for the competent and regulatory authorities of the nuclear industry, and the licencees of nuclear facilities, strengthening the foundation of the rule of law for safeguarding the public’s rights to information, participation and supervision.

H-30 As provided in the *Measures for Public Participation in Environmental Impact Assessments* implemented in 2019, prior to submitting the EIS to the MEE/NNSA, the development organization of construction projects, including radioactive waste management facilities, shall disclose the full text of their EIS to be submitted for approval and instructions for public participation through website platform. After accepting the EIS, the full text of the EIS, instructions for public participation, and the ways and means of public opinions shall be disclosed by the MEE/NNSA through its website or other means. Before making a decision on the approval of the EIS, information including the overview of the construction project, major environmental impacts and environmental protection strategies and measures shall be disclosed to the public. Within seven working days from the date on which a decision on approval of the EIS is made, the full text of the approval decision shall be announced to the public. In addition, China published the *Nuclear Safety in China* in the form of a governmental white paper for the first time in 2019, with a view of sharing the basic principles, policies and regulatory practices of China in nuclear safety.

H-31 The *Measures for Disclosure of Nuclear Safety Information* (GHGHS [2020] No.1), implemented in 2020, clarify the specific requirements for the disclosure of nuclear safety information by NPP licencees and nuclear safety regulatory authorities, and stipulate the specific contents and channels of nuclear safety information that need to be disclosed.

H-32 China is enhancing the information disclosure channels. The major platforms for information disclosure are government websites of MEE/NNSA, CAEA and NEA. Additional channels include China Environmental Status Bulletin, China Environmental Yearbook, the NNSA's Annual Report, Annual Report on Radiation Environment Quality, China Environmental Paper, radio and television, network website, WeChat official accounts as well as other media and channels.

H-33 China has been promoting the timely and standardized release of nuclear-related information. Government departments have increased transparency in the operations of the government in accordance with the law, established a press spokesperson system and a mechanism of regular communication with the media. These have enabled explanations on major nuclear safety policies, and promptly release of information on licencing examination and approval, surveillance and law enforcement, the overall safety situation, radiation environment quality, and incidents and accidents, thus enhancing the transparency of government work. Nuclear-related enterprises have taken the initiative to disclose important information such as the safety status of nuclear facilities and annual nuclear safety reports in a timely manner, and actively responded to public concerns.

H.4 Design and Construction of Facilities (Article 14)

Each Contracting Party shall take the appropriate steps to ensure that:

(i) the design and construction of a radioactive waste management facility provide for suitable measures to limit possible radiological impacts on individuals, society and the environment, including those from discharges or uncontrolled releases;

(ii) at the design stage, conceptual plans and, as necessary, technical provisions for the decommissioning of a radioactive waste management facility other than a disposal facility are taken into account;

(iii) at the design stage, technical provisions for the closure of a disposal facility are prepared;

(iv) the technologies incorporated in the design and construction of a radioactive waste management facility are supported by experience, testing or analysis.

H-34 A wide spectrum of standards on radioactive waste management have been issued in China, such as *Regulations for radioactive waste management* (GB 14500-2002), *Regulations for environmental radiation protection of nuclear power plant* (GB 6249-2011), *Safety requirements for near surface disposal of low and medium level radioactive solid waste* (GB 9132-2018), *Design of Radioactive Waste Management System for Nuclear Power Plant* (HAD 401/02), *Technical specifications for siting, design and construction of radioactive waste repository for nuclear technology application* (HJ 1258-2022), and *Decommissioning of Nuclear Technology Application Facilities* (HAD 401/14). These are intended to govern the design and construction of nuclear facility-affiliated radioactive waste management facilities, the radioactive waste temporary storage facilities for nuclear technology application and the solid LILW disposal facilities.

H.4.1 Design and Construction of Nuclear Facility-Affiliated Radioactive Waste Management Facilities

H-35 The following measures were mainly considered and taken in the design and construction of nuclear facility-affiliated radioactive waste management systems in accordance with the *Design of Radioactive Waste Management System for Nuclear Power Plant* (HAD 401/02):

(1) The design and construction of radioactive waste management systems are separated from those of non-radioactive waste management systems.

(2) The radioactive waste management facility was zoned based on the radiation level and contamination extent, and comprehensive measures taken, covering the design of appropriate radiation shield and the installation of radiation monitoring meters.

(3) The technological processes of classification, collection and treatment of radioactive waste were designed according to the origin and property of such waste. Proper waste treatment technologies were designed, such as filtration, adsorption and washing, chemical flocculation, centrifugal separation, evaporation, ion-exchange, membrane processing, super-compression, and solidification. Gas flow direction was arranged for the waste gas treatment system and ventilation system in the radioactive operations area, with a certain amount of negative pressure and/or air changes maintained and electric-gas interlocks and other precautionary measures taken.

(4) Suitable materials were selected in line with the operating conditions within the expected lifetime of the systems and by taking into account the corrosion, decontamination and radiation effects during operation.

(5) For the systems that need to be maintained or inspected after decontamination, their inner surface was designed smooth, and washing or cleaning connectors are provided.

(6) Sampling points were arranged at appropriate parts of the systems, using sampling pipes as short as possible and installing concurrently-used-with-system pipelines for frequent sampling activities. Continuous or periodic monitoring was carried out on gaseous and liquid radioactive effluents prior to discharge. The monitored items may be gross alpha and gross beta radioactivity levels and concentrations of major radionuclides in terms of source terms within the facility. As activity concentrations in effluents exceed specified limits or once discharge valves to control effluents fail to obtain driven power, the discharge of effluents will be stopped automatically. Suitable flow measuring equipment was set to control the discharge of effluents.

(7) For the structure design and layout of buildings, additional loading that could be created during or after its decommissioning is considered, together with such factors as the place and space required for decommissioning.

(8) Necessary precautionary measures were considered in an attempt to reduce the impacts potentially from the major risks discovered in the safety analysis, such as earthquake, flood, air crash, and other natural and man-made events; these measures include main equipment, fittings, and supports of the system, and the ability of equipment to endure the impact from the operating basis earthquake.

(9) Functions to detect and automatically control explosive gas, if any, and trigger alarms were designed for the system to minimize the possibility of explosion or equip the system with explosion-proof function.

H-36 Conceptual plan is considered for the decommissioning of radioactive waste management facilities except for disposal facilities. Under the *Rules on the Safety of Nuclear Power Plant Design* (HAF 102-2016), the *Safety requirements for decommissioning of nuclear facilities* (GB/T 19597-2004) and the *Provisions on the safety management of civilian nuclear facility decommissioning* under development, the licencee of a nuclear facility shall take into account of future decommissioning in the design phase and develop a preliminary decommissioning plan. Such a plan shall encompass considerations of basic safety issues, expected decommissioning strategy, the demonstration of safety and feasibility of the current or to-be-developed decommissioning technology, management of decommissioning waste, decommissioning costs and fund sources, and assurance agencies.

H-37 The technical specifications, as incorporated in the design and construction documents of radioactive waste management facilities, all cited the relevant national standards and nuclear safety laws and regulations that have been formally approved and issued and are currently in effect. These specifications have also drawn on the experiences of operation and management experience gained over the past.

H-38 Prior to granting a construction licence, the NNSA organized review and evaluation of the EIS, the preliminary safety analysis report and the QA programme submitted by the licencees for licence application in the construction phase. In the process of nuclear facility construction, the NNSA and its regional offices dispatch nuclear safety inspection personnel (or group) to fabrication and construction sites for the implementation of the following nuclear safety inspection missions:

(1) reviewing whether the safety data submitted corresponds to the reality;

(2) supervising whether the facility is constructed in accordance with the approved design documents; and

(3) supervising whether the management process conforms to the approved QA programme, etc.

H-39 An on-site radioactive waste treatment facility shared by all nuclear units was designed and constructed using well-proven technologies at Sanmen NPP and Haiyang NPP, respectively. As a supplement to waste treatment systems in the nuclear islands, such facility can treat all sorts of waste that are generated by all on-site nuclear islands but can't be directly treated, thus avoiding unnecessary duplication of equipment at multiple units. The radioactive waste treatment facility on site is divided into three areas: waste processing building, laundry, and interim waste storage facility. Its main functions are to treat solid radioactive waste and chemical waste liquid, wash work clothes and shoes for reuse, and provide interim storage of waste packages. The design of radiation protection associated follows the ALARA principle. The facility employs waste volume reduction technologies, such as compaction and super compression, to minimize the volume of radioactive waste generated. In addition, the treated liquid waste will be discharged using a trough system after continuous monitoring by sampling.

H.4.2 Design and Construction of Radioactive Waste Temporary Storage Facilities for Nuclear Technology Application

H-40 The following measures were mainly considered and taken in the design and construction of radioactive waste temporary storage facilities for nuclear technology application in accordance with *Technical specifications for siting, design and construction of radioactive waste repository for nuclear technology application* (HJ 1258-2022) that have been issued:

(1) The entire site of the facility was divided into storage area, office area and isolation zone, with the storage area and the office area away from each other, and the isolation zone set outside the enclosing wall of the temporary storage facility.

(2) In the plane design of the facility, the routes for people flow and goods flow were arranged properly to avoid cross-contamination; the people flow follows the principle of flowing from low radiation area to high radiation area.

(3) The process design met the requirements for the systems, equipment, instruments and handling devices required for the acceptance, transfer, storage, retrieval, outbound transport, waste treatment and disposal, decontamination and dismantling activities conducted during the operation, maintenance and decommissioning of the temporary storage facility. Specific measures include classification, ground-based arrangement and storage of waste and disused sealed sources, with a certain spacing between the groups, and storing disused sealed sources with high activity or high surface dose rate in pits with shielded lids, while

those with low activity or short half-life in iron cabinets on the ground; radioactive waste should be classified and stored on the ground.

(4) The facility was provided with proper ventilation equipment to direct the airflow properly and to ensure adequate ventilation rate.

(5) Necessary radiation monitoring means and meters were provided to monitor the contamination level of workers at workplaces and in air. These include stationary gamma dose rate on-line monitoring systems, potable dose rate meters, neutron radiation monitors, surface contamination monitors, potable aerosol monitoring equipment or aerosol samplers.

(6) Necessary personal dose meters and personal protective articles, such as protective clothes, gloves, shoes and masks, were provided for workers involved in nuclear work such as handling, lifting, inspection, storage and monitoring of radioactive waste.

(7) Human, physical, and technical protection systems were provided for the storage facility based on the radioactive source terms and surrounding social and safety environment.

H-41 Under the *Decommissioning of Nuclear Technology Application Facilities* (HAD 401/14), the following decommissioning measures shall be considered during the siting, design, construction and operation phases of nuclear technology application facilities:

(1) minimize the number and range of contaminated areas;

(2) ensure the accessibility of buildings, systems and components;

(3) minimize the number of underground pipelines and pipelines embedded in buildings or structures;

(4) adopt a modular construction method that is convenient for decommissioning and dismantling;

(5) arrange radioactive and non-radioactive systems and components by zones;

(6) use protective covers, cladding and other structures that are easy to decontaminate and remove;

(7) use materials that are not easily activated, resistant to chemical degradation, and wear-resistant to reduce the risk of diffusion of radioactive contamination;

(8) adopt a design that can avoid unnecessary accumulation of chemical or radioactive materials, and use technological processes that generate less waste;

(9) use smooth, seamless and non-adsorbent work surfaces and floors, or use peelable coatings, in areas that may be contaminated;

(10) take ventilation and other measures to prevent or control the diffusion of radioactive contamination during operation and decommissioning;

(11) waste generated from operation or temporarily stored waste allows easy retrieval;

(12) avoid, as much as possible, using substances that may generate hazardous and radioactive waste or that are difficult to treat or dispose of later.

H-42 One principle followed in the design of radioactive waste temporary storage facilities for nuclear technology application is to use the technology, process, equipment and instrumentations that have been tested in practices and proven to be safe, reliable and effective. The technical specifications, as incorporated in the design and construction documents of these facilities, all cited national standards and guides that have been formally approved and issued and currently in effect.

H.4.3 Design and Construction of Near Surface Disposal Facilities

H-43 The following measures were considered and taken, in accordance with *Regulations for radioactive waste management* (GB 14500-2002) and *Safety requirements for near surface disposal of low and medium level radioactive solid waste* (GB 9132-2018), in the design and construction of near surface disposal facilities:

(1) Multiple barriers, consisting of engineering barriers (waste form, container, disposal structure, and backfilling materials) and natural barriers, are provided.

(2) Proper waterproof and drainage systems are designed. Engineering barriers are set to prevent the infiltration of groundwater and surface water in such a way as to minimize the contact of waste with water. Waterproof design is focused on preventing surface water and rainwater from infiltration into disposal units. Permeability and adsorbability of rocks, surface runoff and ground water table and other site characteristics are considered in waterproof design of disposal facilities. The drainage system is designed to ensure the timely drainage of impounded water on the ground of the disposal facilities and in disposal units.

(3) In addition to drainage and waterproof aspects, the design of the disposal facilities also involves unit backfilling, overburden structure, surface treatment, and plantation; a buffer zone is established between the disposal unit and the boundary of the disposal facility, and groundwater monitoring wells are set up at the upstream and downstream of the groundwater flow in the buffer zone.

(4) Access, channels, contaminated area and non-contaminated area are arranged in line with the overall plan for a disposal facility.

(5) For disposal facilities that receive waste packages with high surface dose rate, equipment for long-distance or remote transfer and placement of the waste packages are provided.

(6) Waste acceptance zones are equipped with vehicle and cask inspection instrumentations for dose rate, surface contamination, and cargo certificate accuracy; devices for unloading and separately verifying the waste drums (boxes); radiation monitoring and warning systems; installations to treat damaged containers; devices for decontamination of transport equipment, and facility to treat waste generated from decontamination.

(7) Laboratories are established for conducting routine analysis of water, soils, air and plant samples; and other facilities are provided for individual decontamination,

individual and environmental monitoring, instrumentation and equipment maintenance, and equipment decontamination.

H-44 Under the *Safety requirements for near surface disposal of low and medium level radioactive solid waste* (GB 9132-2018), the near surface disposal facilities in operation have been provided in design phase with technical preparation measures for later closure. These include buffer zone between disposal unit and disposal site boundary, underwater monitoring wells set in appropriate locations in the buffer zone, and on-site laboratories for analyzing samples of water, soil, air, animals and plants, which enables safety analysis of on-site and ambient environment. Additionally, in accordance with design requirements, enough distance is left above the disposed waste and below the disposal facility overburden. If necessary, anti-intrusion barrier is established to protect unintentional intruders within institutional control period. The overburden of disposal facility is designed in such a way as to control water seepage to as low as practically feasible, leads infiltrated or surface water to the outside of the disposal units, and protects them from erosion due to geological process and biological activities.

H-45 The designs of the Northwest, Beilong, Feifengshan and Longhe near surface disposal facilities all comply with the *Safety requirements for near surface disposal of low and medium level radioactive solid waste* (GB 9132-2018).

H-46 The disposal units of the Northwest Disposal Facility are structures with concrete base plate, where the space between the waste drums and that between the waste drums and the walls of the disposal unit are filled with cement mortar, and the reinforced concrete roof is poured after the disposal unit is full. When the disposal facility is closed, a final overburden of 2 m thick is laid on top of the disposal units.

H-47 The eight disposal units of Beilong Disposal Facility have been completed with the structure of all-above-ground grave mound. The disposal units were constructed with reinforced concrete structure, and space between waste drums was filled with sand and cement grout. Each unit, when filled up with waste, was covered with reinforced cement cap. After closure, the site will be covered with 5 m thick final overburden. In order to reduce entry of rainwater into the disposal units, interception (drainage) ditches are designed around the disposal facility with each unit provided with mobile water shelter. Below the unit base plate, a seepage collecting system is arranged.

H-48 The disposal units of Feifengshan Disposal Facility are mount-type reinforced cement structures on the ground, with the space between waste packages filled with cement mortar. When the disposal units are full, reinforced cement will be poured to form the top plate. A 20-ton PLC crane with mobile rain shelter is used to remotely put waste drums in place. An underground pipe gallery is arranged in the middle part of the bottom of the disposal units, which is used to receive rain water and seepage water. Off-site flood interception ditches are arranged near the disposal facility and drainage ditches are set on site, which are used to export rain water. After closure, a 5 m thick overburden composed of 6 layers of different materials will be laid.

H-49 Longhe Disposal Facility is a semi-underground reinforced concrete structure, and the base plate of the disposal units are reinforced concrete. After the disposal units are full and cement mortar is poured on the top floor, the disposal units will be capped and reinforced cement will be poured to form the top plate. A drainage sump is set at the bottom of each disposal unit. The impounded water in the disposal unit finally converges into the sump, and will be pumped out with a submersible pump and discharged to the drainage ditches via hoses. After closure, a 2 m to 5 m thick final overburden composed of four layers of different materials will be laid.

H.5 Assessment of Safety of Facilities (Article 15)

Each Contracting Party shall take the appropriate steps to ensure that:

(i) before construction of a radioactive waste management facility, a systematic safety assessment and an environmental assessment appropriate to the hazard presented by the facility and covering its operating lifetime shall be carried out;

(ii) in addition, before construction of a disposal facility, a systematic safety assessment and an environmental assessment for the period following closure shall be carried out and the results evaluated against the criteria established by the regulatory body;

(iii) before the operation of a radioactive waste management facility, updated and detailed versions of the safety assessment and of the environmental assessment shall be prepared when deemed necessary to complement the assessments referred to in paragraph (i).

H-50 Under the *Nuclear Safety Law of the People's Republic of China*, the *Law of the People's Republic of China on Prevention and Control of Radioactive Pollution* and the *Rules of the People's Republic of China on the Safety Regulation for Civil Nuclear Facilities* (HAF 001), proper safety analysis and EIA were completed before the construction of the current radioactive waste management facilities.

H-51 Before construction of a radioactive waste management facility, an appropriate systematic safety analysis and an EIA are carried out. Under the *Regulations for radioactive waste management* (GB 14500-2002), the *Regulations for designing storage building of high level radioactive liquid waste* (GB 11929-2011), the *Requirements on safety analysis report for solid LILW interim storage* (EJ 532-1990), the *Technical Requirements on Siting, Design and Construction of Nuclear Technology Application Radioactive Waste Storage Facility*, the *Safety requirements for near surface disposal of low and medium level radioactive solid waste* (GB 9132-2018), *The Safety Case and Safety Assessment for the Disposal of Radioactive Waste* (NNSA-HAJ-0001-2020) and the *Format and Content of Solid Radioactive Waste Near-Surface Disposal Facility Safety Analysis Report* (NNSA-HAJ-0002-2023), the safety analyses and EIAs were completed to some extent before the construction of the current radioactive waste management facilities by: considering possible accident spectrum during the operation of facility (such as ventilation system failure, waste lifting accidents, waste transfer accidents, packaging container leakage accidents, earthquake, flood, sandstorm, fire, mis-operation, and inadvertent intrusion); defining the models, parameters, assumptions and rationales envisioned in the analyses and assessments; analyzing the impact of assumed accidents on the facilities and the safety of the facilities under assumed accidents; analyzing possible environmental and human impacts under normal and accident conditions; calculating maximum annual individual effective dose equivalent, annual average effective dose equivalent and annual collective dose equivalent in assessed area under the accident conditions; comparing with performance criteria established; drawing on the conclusions on safety analysis and EIA; and making clear the problems existing in current facilities and the countermeasures to be taken to improve safety quality.

H-52 Before construction of a disposal facility, a systematic safety analysis and an EIA for the period following closure were carried out. Under the *Safety requirements for near surface disposal of low and medium level radioactive solid waste* (GB 9132-2018), predication, analysis and assessment were made for possible environmental impacts of the existing disposal facilities during their construction, operation and post-closure phases and the potential impact of surrounding environment impact on the disposal facilities, etc. The assessment results of the existing disposal facilities show that the disposal facilities were chosen in closed environment with low population and good geological stability; natural disasters such as typhoon, flood and earthquake would not lead to destructive threat to the disposal facilities; local geological media featuring low permeation rate and strong adsorption of radionuclides, all in line with national requirements on LILW disposal. In the normal conditions after closure of the disposal facilities, the annual maximum individual exposure dose of the public due to the release of radionuclides through groundwater is far below the national limit. Even in the case of inadvertent intrusion after closure of a disposal facility, the dose to the intruder will be below the national limit. Therefore, the disposal facilities will not lead to any unacceptable impacts on the environment.

H-53 According to *The Safety Case and Safety Assessment for the Disposal of Radioactive Waste* (NNSA-HAJ-0001-2020), during the construction and operation of a disposal facility, its licencee shall update various documents about safety case for the whole process of radioactive waste disposal safety on a regular basis, once every ten years. The documents about safety case for the whole process of radioactive waste disposal safety shall be updated in time in case of systematic improvement of the site data, major changes in site conditions, accidents, safety issues or potential safety hazards, and important modifications to the design or operation.

H.6 Operation of Facilities (Article 16)

Each Contracting Party shall take the appropriate steps to ensure that: (i) the licence to operate a radioactive waste management facility is based upon appropriate assessments as specified in Article 15 and is conditional on the

completion of a commissioning programme demonstrating that the facility, as constructed, is consistent with design and safety requirements;

(ii) operational limits and conditions, derived from tests, operational experience and the assessments as specified in Article 15 are defined and revised as necessary;

(iii) operation, maintenance, monitoring, inspection and testing of a radioactive waste management facility are conducted in accordance with established procedures. For a disposal facility the results thus obtained shall be used to verify and to review the validity of assumptions made and to update the assessments as specified in Article 15 for the period after closure;

(iv) engineering and technical support in all safety-related fields are available throughout the operating lifetime of a radioactive waste management facility;

(v) procedures for characterization and segregation of radioactive waste are applied;

(vi) incidents significant to safety are reported in a timely manner by the holder of the licence to the regulatory body;

(vii) programmes to collect and analyse relevant operating experience are established and that the results are acted upon, where appropriate;

(viii) decommissioning plans for a radioactive waste management facility other than a disposal facility are prepared and updated, as necessary, using information obtained during the operating lifetime of that facility, and are reviewed by the regulatory body;

(ix) plans for the closure of a disposal facility are prepared and updated, as necessary, using information obtained during the operating lifetime of that facility and are reviewed by the regulatory body.

H-54 Under the *Law of the People's Republic of China on Prevention and Control of Radioactive Pollution*, the nuclear facility-affiliated radioactive waste management facilities shall be designed, constructed and put into operation synchronously with the main project.

H.6.1 Operation of Nuclear Facility-Affiliated Radioactive Waste Management Facilities

H-55 Under the *Law of the People's Republic of China on Prevention and Control of Radioactive Pollution*, the *Rules of the People's Republic of China on the Safety Regulation for Civil Nuclear Facilities (HAF 001)* and *Management Measures for the Licencing of Solid Radioactive Waste Storage and Disposal*, before operation of a nuclear facility, its licencee have submitted the *Application for the Operation of Nuclear Facilities* to the MEE/NNSA, together with the Final Safety Analysis Report and other related documents. The MEE/NNSA reviews these documents and grants the Nuclear Facility Operating Licence if the construction and safety requirements are met. In general, the existing radioactive waste treatment and storage facilities equipped for the NPPs, research reactors and nuclear fuel cycle facilities are only responsible for treatment and storage of wastes generated by the facilities concerned, so the licence for such a facility is not issued separately but included in the operating licence of the main facility.

H-56 Operational limits and conditions were set by the nuclear facility licencees for radioactive waste management facilities under the *Safety Rules on Commissioning and Operation of Nuclear Power Plants* (HAF 103), the *OL&C and Operational Procedure for Nuclear Power Plant* (HAD 103/01), the *Rules on Research Reactor Operation Safety* (HAF 202), *Research Reactor Operation Management* (HAD 202/01) and the *Rule on Civilian Nuclear Fuel Cycle Safety* (HAF 301), and other technical specifications relating to the NPPs' radioactive waste treatment systems. These include evaporation and concentration limits, continuous workload of immobilization or solidification process, and alarming limits and detectable limits of radiation monitoring meters (including effluent monitoring). These operational limits and conditions are reviewed and updated by the licencees in keeping with experience gained and technological progress.

H-57 Under the *Safety Rules on Commissioning and Operation of Nuclear Power Plants* (HAF 103), the *Rules on the Safety of Research Reactor Operation* (HAF 202), the *Rule on the Safety of Civilian Nuclear Fuel Cycle* (HAF 301), *Organization and Operational Management of Operators of NPPs* (HAD 103/06), and the *Research Reactor Operation Management* (HAD 202/01), the nuclear facility licencees have prepared operational programme, maintenance programme, environmental monitoring programme, oversight programme, and waste management programme, etc. According to these programmes, additional operating procedures are prepared covering system technological processes, main equipment, valve manipulation, and preset operating procedures; besides, the maintenance plans and procedures for the radioactive waste management facilities are prepared, along with radioactive effluent discharge controlling and monitoring procedures. And project-scale non-radioactive simulation tests and inspection procedures are prepared including operating models and parameters related to radioactive waste management system and equipment. The nuclear facility licencees all follow strictly the above programmes and procedures.

H-58 Under the *Organization and Operational Management of Operators of NPPs* (HAD 103/06), the maintenance workers may take turns to attend training, on a regular basis, held by construction contractors or equipment manufacturers during the entire operating lifetime of a NPP's radioactive waste management facility; advices are available from professional institutions, including external experts, with respect to operational experience of the facilities, and failure and accident analysis; the relevant QA review and audit can be performed independently by qualified external experts; and advices about radioactive effluent discharge and on-field waste treatment may be obtained from professional institutions. In similarity, the engineering and technical support in safety-related fields is also available to the licencees throughout the operating lifetime of the nuclear facility-affiliated radioactive waste management facilities built for other nuclear facilities.

H-59 In general, the licencees of NPPs classify radioactive wastes generated at the NPPs into process waste, technical waste and other types of waste according to their origin. Furthermore, according to physical behavior, the licencees classify process waste into evaporated distillation residue, spent resin, sludge and filter cores, etc.; and technical wastes into compressible and incompressible waste and combustible and incombustible waste. The licencees developed the procedures for classification of radioactive waste to characterize all classes of wastes.

H-60 As provided by the *Nuclear Safety Law of the People's Republic of China*, relevant departments of the State Council shall establish a nuclear safety experience feedback system. Under the *Management Measures on Experience Feedback about Operating NPPs*, the licencees of NPPs employ the analytical methods recommended by the MEE/NNSA to investigate and study operational events, if any, and report to the MEE/NNSA. The licencees submit periodically to the MEE/NNSA the lists and abstracts of internal events, together with the reports deemed necessary by the NNSA. As required by the MEE/NNSA, they have also prepared and effectively implemented the programmes or management procedures of experience feedback for their own respective NPPs.

H-61 Under the *Safety requirements for decommissioning of nuclear facilities* (GB/T 19597-2004), after a period of operation of a nuclear facility, the licencee of such a facility must prepare the mid-term decommissioning plan, which must provide a detailed description of how to treat radioactively contaminated or exposed structures, systems and components during maintenance of its radioactive waste management facility, in order to develop the decommissioning plan of the radioactive waste management facility.

H.6.2 Operation of Radioactive Waste Temporary Storage Facilities for Nuclear Technology Application

H-62 Under the *Management Measures for the Licencing of Solid Radioactive Waste Storage and Disposal*, the licencees of all radioactive waste temporary storage facilities for nuclear technology application have obtained the licences for the storage of solid radioactive waste.

H-63 Operational conditions are set for the radioactive waste temporary storage facilities for nuclear technology application, such as surface dose rate limits of disused sealed source storage containers and of various locations of such facilities, and number of ventilation changes in different areas, etc.

H-64 A full range of procedures has been established and implemented strictly by the licencees of radioactive waste temporary storage facilities for nuclear technology application, such as those for equipment operating and processing, those for acceptance, inspection and verification of disused sealed sources, those for packaging and conditioning of disused sealed sources, those for workers' body surface contamination inspection and decontamination, those for vehicle and tool contamination inspection and decontamination, operational monitoring plan and radiation environmental monitoring plan, procedures for periodic equipment inspection and testing, and requirements for the safety prevention system of radioactive waste temporary storage facilities.

H-65 Radioactive waste temporary storage facilities for nuclear technology application are provided with engineering and technical support in all areas related to safety during their entire operating lifetime.

H-66 Procedures for characterization and segregation of radioactive waste are prepared by the licencees.

H-67 According to *Regulations on the Safety of Radioactive Waste Management*, the licencees shall, upon discovery of any potential safety hazard or environmental radioactivity in excess of relevant national limit, identify the causes, take protective measures and report to the competent authority for ecology and environment of the province, autonomous region or municipality directly under the central government where such a facility is located; in case of a radiation accident, it shall be reported in accordance with relevant provisions, and emergency response shall be activated.

H.6.3 Operation of Near Surface Disposal Facilities

H-68 The MEE/NNSA granted operating licences to the Northwest and Beilong Disposal Facilities in 2011 and to the Feifengshan Disposal Facility in 2016, and approved a change in the operating licence for the Feifengshan Disposal Facility in October 2022, and a modification of the operating licence for the Northwest Disposal Facility in April 2023. It granted an operating licence to Longhe Disposal Facility in 2023. The operating licences specify the category of waste allowed for disposal, radionuclides inventory allowed for disposal, waste disposal activity and licenced period.

H-69 Under the *Safety requirements for near surface disposal of low and medium level radioactive solid waste* (GB 9132-2018), the Northwest, Beilong, Feifengshan and Longhe Disposal Facilities have specified the limits of radionuclide content, surface radiation level, and surface contamination limits of waste packages to be subjected to near surface disposal, performance requirements for waste forms such as mechanical stability, leaching resistance, free liquid, chemical composition, thermal and radiation stability, anti-ignitability, anti-microbial destructivity, and requirements for the packaging containers and loaded rate.

H-70 Under the *Regulations on the Safety of Radioactive Waste Management* and the *Safety requirements for near surface disposal of low and medium level radioactive solid waste* (GB 9132-2018), the Northwest, Beilong, Feifengshan and Longhe Disposal Facilities developed and strictly implemented operating procedures for waste disposal, involving QA programme, operating and processing procedures, radiation protection programme, environmental monitoring plan, accident emergency plan, and procedures for periodic testing of equipment, etc. In consistent with disposal facility surveillance and management requirements, operational monitoring plan and radiation environment monitoring plan, in addition to facility safety inspection, the radiation monitoring was conducted for groundwater, surface water, rocks and soils of certain depth, plants, and air in the surrounding environment. Monitoring and inspection data were recorded truthfully. Every year, the summary report of the previous year is reported to the MEE/NNSA before March 31. Monitoring results indicate that no significant variations were found in the environmental situation at the four facilities above, before and/or after waste acceptance.

H-71 Radioactive waste disposal facilities are provided with engineering and technical support in all areas related to safety during their entire operating lifetime.

H-72 Procedures for characterization and segregation of radioactive waste are prepared by the licencees of radioactive waste disposal facilities.

H-73 Under the *Regulations on the Safety of Radioactive Waste Management*, if the disposal facility licencee discovers potential safety hazards, or radionuclides in the surrounding environment exceeding the limit specified by the national standard, the cause shall be immediately found out and appropriate preventive measures shall be taken accordingly, and it shall be reported to the MEE and SASTIND; in case of a radiation accident, it shall be reported in accordance with the relevant provisions, and emergency response shall be activated.

H.7 Institutional Measures after Closure (Article 17)

Each Contracting Party shall take the appropriate steps to ensure that after closure of a disposal facility:

(i) records of the location, design and inventory of that facility required by the regulatory bodies are preserved;

(ii) active or passive institutional controls such as monitoring or access restrictions are carried out, if required; and

(iii) if, during any period of active institutional control, an unplanned release of radioactive materials into the environment is detected, intervention measures are implemented, if necessary.

H-74 In China, there has not yet been any activity or practice related to the closure of a disposal facility. However, the relevant institutional control requirements can be found in existing relevant laws, regulations and standards.

H-75 A licencee of solid radioactive waste disposal facility shall, under the *Nuclear Safety Law of the People's Republic of China* and the *Regulations on the Safety of Radioactive Waste Management*, establish archives for solid radioactive waste disposal to accurately and completely record the origin, quantity, characteristics, and location of solid radioactive waste. The archives on solid radioactive waste disposal shall be preserved permanently.

H-76 Under the *Regulations on the Safety of Radioactive Waste Management*, a solid radioactive waste disposal facility shall be closed pursuant to relevant laws and regulations, and subsequently permanent signs shall be set up in the designated areas. After closure of a disposal facility, the licencee of such a facility shall carry out institutional control according to the approved institutional control programme. Under the *Rules on Radioactive Waste Safety* (HAF 401), the *Safety requirements for near surface disposal of low and medium level radioactive solid waste* (GB 9132-2018) and the *Monitoring and Inspection of Radioactive Waste Disposal Facilities* (HAD 401/09), after the disposal facility is closed, institutional control shall be carried out, which can be either active (monitoring, supervision and facility maintenance) or passive (restricting land use, setting up permanent site signs). According to the operation history of the disposal facility and the situation of closure and stabilization, the appropriate environmental monitoring functions shall be retained to ensure that early alarm can be given before the radionuclides in the disposal facility are released to the outside of the site boundary.

H-77 Under the *Rules on Radioactive Waste Safety* (HAF 401), institutional controls shall be carried out after the closure of disposal facility, so that necessary remedial actions can be implemented.

I. TRANSBOUNDARY MOVEMENT (Article 27)

1. Each Contracting Party involved in transboundary movement shall take the appropriate steps to ensure that such movement is undertaken in a manner consistent with the provisions of this Convention and relevant binding international instruments. In so doing: (i) a Contracting Party which is a State of origin shall take the appropriate steps to ensure that transboundary movement is authorized and takes place only with the prior notification and consent of the State of destination; (ii) transboundary movement through States of transit shall be subject to those international obligations which are relevant to the particular modes of transport utilized; (iii) a Contracting Party which is a State of destination shall consent to a transboundary movement only if it has the administrative and technical capacity, as well as the regulatory structure, needed to manage the spent fuel or the radioactive waste in a manner consistent with this Convention; (iv) a Contracting Party which is a State of origin shall authorize a transboundary movement only if it can satisfy itself in accordance with the consent of the State of destination that the requirements of subparagraph (iii) are met prior to transboundary movement; (v) a Contracting Party which is a State of origin shall take the appropriate steps to permit re-entry into its territory, if a transboundary movement is not or cannot be completed in conformity with this Article, unless an alternative safe arrangement can be made. 2. A Contracting Party shall not licence the shipment of its spent fuel or radioactive waste to a destination south of latitude 60 degrees south for storage or disposal. 3. Nothing in this Convention prejudices or affects: (i) the exercise, by ships and aircraft of all States, of maritime, river and air navigation rights and freedoms, as provided for in international law; (ii) rights of a Contracting Party to which radioactive waste is exported for processing to return, or provide for the return of, the radioactive waste and other products after treatment to the State of origin; (iii) the right of a Contracting Party to export its spent fuel for reprocessing; (iv) rights of a Contracting Party to which spent fuel is exported for reprocessing to return, or provide for the return of, radioactive waste and other products resulting from reprocessing operations to the State of origin.

I-1 At the time of joining the Joint Convention, China has made a statement expressing its comprehension of transboundary movement from a Contracting Party as referred in Articles 2 (u) and 27 of the Joint Convention. Namely, a Contracting Party to the *Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management*, as a State of destination, prior to consenting to the transboundary movement of any entity from another Contracting Party, shall confirm to the State of origin that it has authorized such a transboundary movement.

I-2 Under Article 47 of the *Law of the People's Republic of China on Prevention and Control of Radioactive Pollution*, both radioactive waste and goods contaminated with radioactivity are prohibited from being imported to, or transiting through, China's territory. However, radioactive waste and goods contaminated with radioactivity which is generated from the products exported from the People's Republic of China can be returned to the country's territory if approved according to law, if they are required under relevant regulations to return to China for treatment and disposal. Article 16 of the *Regulations on the Safety and Protection of Radioisotopes and Radiation-Emitting Devices* requires the Ministry of Commerce (MOC), in conjunction with the MEE, the General Administration of Customs, the General Administration of Quality Supervision, Inspection and Quarantine, and the competent industry authorities for radioisotopes producers, to develop and issue both the catalog of limited radioisotopes for import and export and the catalog of prohibited radioisotopes for import and export. The radioisotopes that are listed in the catalog of limited radioisotopes for import and export shall not be imported unless they have been reviewed and approved by the MEE, and have been granted import licence by the MOC, in accordance with relevant national foreign trade regulations. The radioisotopes other than the above-specified can be imported after going through import procedures in accordance with relevant national foreign trade regulations.

I-3 Under the *Regulations for the safe transport of radioactive material* (GB 11806-2019), international transport of radioactive materials shall be subject to the regulations on the international transport of radioactive materials that are issued by State of transit and/or State of destination. Some types of consigned goods shall be subject to permission from each of such States. The overall safety level during transport shall be sufficient to meet all applicable requirements.

I-4 In the case of transboundary movement, China takes the appropriate steps to ensure that such movement is undertaken in a manner consistent with the provisions of the Joint Convention and relevant binding international instruments. As a State of origin, China requires the involved State of destination to confirm that such a transboundary movement has been authorized by China, and requires the involved consigner to have obtained the prior notification of such a State of destination. China approves and regulates any transboundary movement of radioactive waste within its boundary by law. China, as a State of destination, affirms to have the administrative and technical capacity, together with the regulatory system, necessary for managing spent fuel or radioactive waste in a manner consistent with the Joint Convention, and examines and approves any inbound transport activities and ensures the activities are consistent with this Convention.

I-5 As of December 31, 2023, China has never shipped spent fuel or radioactive wastes to any destination south of latitude 60 degrees south for storage or disposal.

J. DISUSED SEALED SOURCES (Article 28)

> Each Contracting Party shall, in the framework of its national law, take the appropriate steps to ensure that the possession, remanufacturing or disposal of disused sealed sources takes place in a safe manner.
>
> A Contracting Party shall allow for reentry into its territory of disused sealed sources if, in the framework of its national law, it has accepted that they be returned to a manufacturer qualified to receive and possess the disused sealed sources.

J-1 Radioactive sources are widely used in industry, agriculture, medicine, research, education, and other fields, featuring multiple types, large quantity, and wide distribution. In recent years, with the rapid growth of China's economy, the number of radioactive sources in use is growing rapidly. Meanwhile, the number of disused sealed sources is also growing.

J-2 According to the statistics of the National Radiation Safety Management System for Nuclear Technology Application, as of December 31, 2023, China has more than 120,000 nuclear technology application organizations and 169,000 radioactive sources in use. 215,000 disused sealed sources are stored.

J.1 Requirements for the Management of Disused Sealed Sources

J-3 The Chinese government attaches great importance to the safety of radioactive source management. The supervision and management system of radioactive sources during their entire lifetime is established in line with the IAEA *Code of Conduct on the Safety and Security of Radioactive Sources*, and its supplementary *Guidance on the Import and Export of Radioactive Sources* and *Guidance on the Management of Disused Sealed Sources*, defining the management requirements for the production, sales, use, transfer, import and export, storage, and disposal of radioactive sources. The full-process dynamic tracking and management of radioactive sources is achieved through the nation-wide networked information system (the National Radiation Safety Management System for Nuclear Technology Application).

J-4 As stipulated in the *Law of the People's Republic of China on Prevention and Control of Radioactive Pollution*, any organization that produces radioactive sources shall, in accordance with the regulations of the MEE, recover and recycle disused sealed sources; any organization that uses radioactive sources shall, in accordance with the regulations of the MEE, return disused sealed sources to the organization that produces such sources or send such sources to the organization that is specialized in storing or disposing of solid radioactive waste.

J-5 The *Regulations on the Safety and Protection of Radioisotopes and Radiation-Emitting Devices* puts forward more specific requirements, that organizations producing and importing radioactive sources shall, when selling Category I, II or III radioactive sources to other organizations for use, sign contracts with organizations using radioactive sources for the return of disused sealed sources; organizations using radioactive sources shall return the disused sealed sources to the producers or to the original exporters in accordance with the provisions of the contract for the return of the disused sealed sources. If it is really impossible to return disused sealed sources to the producer or to the original exporter, they shall be sent to and stored in a centralized storage unit of radioactive waste with corresponding qualifications. Organizations using radioactive sources shall, in accordance with the regulations of the MEE, pack and condition Category IV or V disused sealed sources and send them to the centralized storage organizations with corresponding qualifications for storage. In addition, in view of the problem that the orphan sources are likely to flow into scrap metal smelting enterprises, which may cause metal contamination by radionuclides, metal smelting enterprises are required to take monitoring measures, accordingly.

J-6 *The Management Measures on Safety Licencing for Radioisotopes and Radiation-Emitting Devices* includes regulations on the storage time of disused sealed sources, that organizations using Category I, II or III radioactive sources shall, in accordance with relevant contract provisions, return the disused sealed sources to the producers or to the original exporters within three months after the radioactive sources have been idle or disused. If it is, in fact, impossible to return them, they shall be sent to qualified organizations for the centralized storage of radioactive waste. Organizations using Category IV or V radioactive sources shall, in accordance with the provisions of the MEE, send the radioactive sources, after packaging and conditioning, to qualified organizations for the centralized storage of radioactive waste, within three months after the radioactive sources have been idle or disused.

J-7 The *Management Measures on Safety and Protection for Radioisotopes and Radiation-Emitting Devices* provides more specific regulations on the storage, recovery and reuse of disused sealed sources and the radiation monitoring of scrap metal: when transferring Category I, II, or III radioactive sources, both parties shall sign an agreement on the return of disused sealed sources, and for the transfer of imported radioactive sources, the transferee shall obtain a copy of the commitment document that the original exporter is responsible for recovery; if the organization using the radioactive sources is revoked, dissolved, bankrupted or terminated for other reasons according to law, the radioactive sources held by the organization shall be transferred according to law, returned to the producer, returned to the original exporter, or delivered to the designated storage facilities in advance; radioactive sources intended to be recycled and reused shall undergo safety validation or be processed by the producer in accordance with the requirements for producing radioactive sources to meet the requirements of relevant safety and technical parameters; the expenses incurred by a scrap metal smelting enterprise in sending and storing disused sealed sources or radioactive contaminated articles shall be borne by the original owner or supplier of such sources or contaminated articles. For those whose origin cannot be ascertained, the expenses incurred shall be borne by the scrap metal smelting enterprise itself.

J-8 China achieves full-process dynamic tracking and management of radioactive sources through the National Radiation Safety Management System for Nuclear Technology Application, from the import and production of radioactive sources to the final disposal of disused sealed sources. Since the last Review Meeting, the

MEE upgraded the functions of the National Radiation Safety Management System for Nuclear Technology Application, realized real-time monitoring for high-risk sources, and developed a mobile client for regulatory inspection. Information management system was established in some provinces for radioactive waste temporary storage facilities for nuclear technology application, which enable real-time views of the distribution of tunnels in the facility area, the storage pits of disused sealed sources, and the monitoring data of the site. Some radioactive source producers have developed a radioactive source safety management system, in which the number, location and responsible person of recovered disused sealed sources can be checked, further enhancing information management of disused sealed sources.

J-9 In November 2023, the MEE, the State Administration for Market Regulation (SAMR), the MPS, and other three ministries and commissions jointly issued the *Notice on Strengthening the Safety Management of Purchase and Sale of Radioisotopes and Radiation Devices on the Internet*, prohibiting the purchase and sale of radioactive sources through e-commerce platforms to effectively guard against the potential risks of the circulation of radioactive sources through the Internet.

J.2 Practices for the Management of Disused Sealed Sources

J-10 Disused sources in China mainly come from nuclear technology applications in industrial and medical fields, such as irradiation installations, gamma flaw detectors, bone densitometers, teletherapy machines, brachytherapy afterloaders, gamma knives, blood irradiators, surface applicators, and instrument and equipment calibration source, These radioactive sources become disused when they are no longer effective due to a service time exceeding their safe lifetime, or decay, or cannot be used for other reasons. The Chinese government mainly adopts four methods for the disposal of the above-mentioned disused sealed sources, including returning such sources to the manufacturers, sending them to radioactive waste temporary storage facilities for nuclear technology application, recovering and recycling them by the manufacturers, and disposing of them.

J.2.1 Returning to the Manufacturers

J-11 Chinese regulations stipulate that Category I, II, and III disused sealed sources shall be returned to the producers or the original exporters in accordance with the agreement on return of disused sealed sources. Since the last Review Meeting, Chinese radioactive source manufacturers have recovered more than 16,000 disused sealed sources.

(1) Import and export of medical Category III ^{192}Ir radioactive sources

J-12 The medical Category III ^{192}Ir radioactive sources used in China are mainly imported. The half-life of the ^{192}Ir radioactive sources is short. And the radioactive source for the brachytherapy afterloaders needs to be replaced after about one and a half years. Therefore, their import and export frequencies are rather high. In order to save the cost for transport of radioactive sources and reduce the burden on enterprises, while the safety is ensured, China implements concurrent import and export licencing for the replacement of medical ^{192}Ir radioactive sources, i.e., to grant a licence for the import of new radioactive sources when the disused sealed sources have not yet returned to the country of origin. In this way, the transport casks carrying the new sources can be used to transport the disused sealed sources back to the country of origin, so as to save the cost.

(2) Centralized return of Category I ^{60}Co radioactive sources

J-13 Smooth channels for the return of disused sealed sources have been established between China and Russia/Canada, the main producing countries of Category I radioactive sources. The problem with the return of ^{60}Co sources for industrial irradiation is that the number of disused sealed sources from a single organization is small, which makes the transport more expensive. In order to solve this problem, China has tried the mode of centralized return, i.e., to collect the sources from several organizations, and then return them to the original manufacturers. In 2023, CNNC Tongxing (Beijing) Nuclear Technology Co., Ltd. cooperated with Nordion (a Canadian company) in the centralized return of 171 Nordion ^{60}Co sources from three Chinese organizations. In February 2022, China overcame the difficulties during COVID-19 outbreak and returned 55 expired Russian-made radioactive sources from five organizations to the country of origin.

J-14 China Isotope & Radiation Corporation set up temporary packing sites in Suzhou and Changzhou respectively for centralized packing inspection of disused sealed sources and temporary storage before shipping. Since 2018, hundreds of expired imported ^{60}Co sources have been safely returned to the exporters via these temporary packing sites. China is exploring the establishment of fixed container packing sites to reduce the safety risks in packing and storage of disused sealed sources for export by ocean shipping, aiming to returning disused sealed sources to states of origin in a continuous, batched, economic, safe and orderly manner.

(3) Return of radioactive sources exported

J-15 Abiding by the IAEA *Code of Conduct on the Safety and Security of Radioactive Sources* and its supplementary *Guidance on the Import and Export of Radioactive Sources*, China promises to recover the radioactive sources exported. Radioactive source exporters shall submit the application for licencing of radioactive source export to the MEE, along with a copy of the effective agreement signed with the importer, and qualification certificate of the importer. There is an entry in the licencing application form on whether or not such sources will be returned to the exporter.

J-16 China now has the capacity to produce Category I ^{60}Co irradiation sources and medical ^{60}Co sources for gamma knife. The Chinese government allows and undertakes to actively facilitate the return of high level radioactive sources that have been exported abroad after they have been disused.

(4) Management of orphan sources

J-17 The Chinese government has clear regulations on the management, restoration and control of orphan sources, requiring all organizations and individuals to report promptly when discovering disused sealed sources or items contaminated with radioactivity and deliver them to the designated storage facilities. In practice, the Chinese government has adopted measures such as reducing or exempting recovery and storage fees and door-to-door collection of orphan sources discovered and radioactive sources from bankrupt organizations. In order to reduce the disused sealed sources entering into the scrap metal smelting industries, the Chinese government requires scrap metal smelting enterprises to establish radiation monitoring systems, staff for radiation monitoring posts, and conduct radiation monitoring before raw materials are put into furnaces and before products leave the factory.

J.2.2 Sending to Radioactive Waste Temporary Storage Facilities for Nuclear Technology Application

J-18 China operates 31 provincial radioactive waste temporary storage facilities for nuclear technology application and one national centralized disused sealed sources storage facility to provide storage service for the disused sealed sources.

J-19 As of December 31, 2023, nearly 50,000 disused sealed sources have been stored in provincial radioactive waste temporary storage facilities for nuclear technology application. Since the previous Review Meeting, radioactive source inventory clearance was conducted in Zhejiang, Guangdong, Hebei, Shanxi and other provinces, and more than 20,000 disused sealed sources were sent to the National Centralized Disused Sealed Sources Storage Facility for storage.

J-20 With a view to standardizing the siting, design, and construction of radioactive waste temporary storage facilities for nuclear technology application, and ensuring the safe storage of radioactive waste from nuclear technology application and disused sealed sources, the MEE issued *Technical specifications for siting, design and construction of radioactive waste repository for nuclear technology application* (HJ 1258-2022) in 2022, which integrates the requirements for the security protection system of radioactive waste repositories. In addition, technical standards, such as the technical specifications for the operation and management of radioactive waste temporary storage facilities for nuclear technology application, and specifications for recovery and storage of radioactive waste (disused sealed sources), are also under development.

J-21 China has strengthened the management of safety and security of disused sealed sources, and completed security upgrades for all provincial radioactive waste temporary storage facilities for nuclear technology application and the National Centralized Disused Sealed Sources Storage Facility. China has strengthened its emergency response capacity for disused sealed sources. Scenarios such as dropping of disused sealed sources during transport and the discovery of orphan sources have been included in the radiation accident emergency response scenarios of provincial ecological and environmental departments. In response to concerned accidents involving the dropping of radioactive sources during long-distance transport that have actually occurred in recent years, China has used the actual disused sealed sources in provincial radioactive waste temporary storage facilities for nuclear technology application, and has taken the approach of randomly selecting the place where the accident occurred and conducting on-site drills on the loss of radioactive sources during transport without prior notification to further test response capacity.

J.2.3 Recovery and Recycling of Disused Sealed Sources

J-22 Article 33 of The *Management Measures on Safety and Protection for Radioisotopes and Radiation-Emitting Devices* (Decree No. 18 of MEP) provides that radioactive sources, which have been put in storage or returned to the original producers but still usable, may be transferred and reused after going through relevant formalities in accordance with provisions of the *Regulations on the Safety and Protection of Radioisotopes and Radiation-Emitting Devices* accordingly. For radioactive sources to be reused, the producer shall carry out safety validation or processing in accordance with the requirements for the production of radioactive sources until such sources meet the requirements of safety and technical parameters, and issue a certificate of conformity, clarify the conditions of use, and code such sources.

J-23 The competent authorities of the Chinese government have been actively promoting the recycling of disused sealed sources, and have approved manufacturers to recover and reuse ^{60}Co, ^{137}Cs, ^{241}Am/Be, ^{238}Pu/Be and other disused sealed sources. From 2020 to 2023, China reused about 2,000 disused sealed sources such as ^{241}Am, ^{137}Cs, Pu-Be, ^{60}Co, and ^{252}Cf. The new radioactive sources produced are widely used in cement plants, oilfield exploration logging, nuclear power, coal mining, petrochemical industry, reactor start-up, fuel rod clearance detection, industrial automation measurement and control, steel mills and other fields. In 2022, the MEE/NNSA approved a ^{60}Co source model for irradiation made by recycling disused ^{60}Co gamma knife source, which is slightly larger than commonly used ^{60}Co irradiation sources and can be used in conjunction with specially designed source racks for gamma irradiation installations. In 2023, Chengdu Gaotong Isotope Co., Ltd. (CNNC) used more than 1,600 recovered disused gamma knife sources to make more than 120 ^{60}Co sources for irradiation, with a total activity of about 110,000 curies. The recycling and reuse of disused sealed sources can effectively reduce the number of disused sealed sources, mitigate the pressure of storage, promote waste reduction and resource conservation, and better protect the environment.

J-24 China has been increasingly expanding the recycling of disused sealed sources. In the future, it intends to actively explore the down-selection of disused sealed sources stored in provincial radioactive waste temporary storage facilities for nuclear technology application, and return valuable disused sealed sources to manufacturers for recycling and reuse after they pass the verification of pollution and activity levels, nuclide composition, and overall dimension, and have been conditioned, so as to supplement domestic demand for radioactive sources.

J.2.4 Disposal of Disused Sealed Sources

J-25 For disused sealed sources that have no reuse value, China stores them in the National Centralized Disused Sealed Sources Storage Facility or provincial radioactive waste temporary storage facilities for nuclear technology application, or returns them to the manufacturers for storage. As of December 31, 2023, China has cumulatively stored more than 220,000 disused sealed sources.

J-26 Considering that long-term storage is not the ultimate solution for the safe management of disused sealed sources, China considers the disposal of disused sealed sources by grade and category based on the degree of risk posed by the nuclides and activity of the disused sealed sources, where the actual situation of existing disposal facilities permits.

(1) For disused sealed sources that can be cleared theoretically by storage for a certain period of time, such as ^{192}Ir and ^{75}Se, they can be disposed of in small containers as ordinary radioactive wastes after being stored for about two to five years, taking into account the fact that they cannot be completely cleared as they contain a small number of impurity nuclides (e.g., ^{60}Co and ^{63}Ni). Since 2019, nearly 30,000 such disused sealed sources have been disposed of in three batches.

(2) For other disused sealed sources (including ^{60}Co) containing nuclides with a half-life of less than five years, disused radioactive source disposal organizations may set a limit on the number of waste packages of disused sealed sources that can be accepted in accordance with radiation protection requirements, instead of setting a limit on the total activity of disused sealed sources in a single package for disposal, and then dispose of them after conditioning.

(3) For disused sealed sources containing nuclides with a half-life of five to thirty years, the total activity limit of the disused sealed sources in a single waste package after conditioning is determined by the radiation protection requirements and the scenarios after the disposal facility is closed.

(4) For disused sealed sources with a half-life of more than 30 years, they shall be subject to geological disposal.

J-27 With a view to regulating the disposal of disused sealed sources, China issued the *Safety requirements for near surface disposal of disused radioactive sources* (HJ 1336-2023) in 2023.

J-28 Since the last Review Meeting, China plans to dispose of more than 100,000 disused sealed sources stored in the National Centralized Disused Sealed Sources Storage Facility in three stages. At present, the implementation scheme of Phase I of the Project has been approved by the MEE/NNSA in August 2023; the CAEA has also approved the final disposal plan of this batch of disused sealed sources. In this scheme, CNNC Everclean Environmental Technology Engineering Co., Ltd. (CNNC Everclean) intends to select more than 1,000 Category IV and V disused sealed sources (^{60}Co, ^{137}Cs and ^{90}Sr) that are easy to retrieve and have low radioactive levels in the National Centralized Disused Sealed Sources Storage Facility for disposal in the Northwest Disposal Facility after such sources are conditioned. At present, the conditioning of this batch of disused sealed sources has been completed in accordance with the requirements of *Safety requirements for near surface disposal of disused radioactive sources* (HJ 1336-2023).

J-29 In response to the above-mentioned disused source conditioning activities, China has been investigating special conditioning equipment which can realize multiple functions such as retrieval, conditioning, detection, and transfer before near surface disposal of specific disused sealed sources, and reduce the surface dose rate of disused source disposal containers and the exposure dose of operating personnel. In particular, for the conditioning and disposal of disused sealed sources, the NNSA requires the licencees to use imaging equipment to keep the relevant information about the conditioning and disposal of disused sealed sources, and have them witnessed by regulators before they can be finally marked in the information system as disposal completed, so as to ensure that the disused source objects are consistent with the accounts during the storage and disposal period.

J-30 Since the last Review Meeting, China has carried out the first peer assessment of radioactive waste management among radioactive source producers, established radiation safety assessment criteria covering the minimization of radioactive waste during the production of radioactive sources, radioactive waste treatment and disposal, recovery of expired radioactive sources, and recovery and recycling of disused sealed sources, accurately identified strengths and weaknesses, and continued to enhance radioactive waste management and improve radiation safety performance of radioactive source producers.

K. GENERAL EFFORTS TO IMPROVE SAFETY

K.1 Measures Taken in Response to the Suggestions and Challenges Identified at the Last Review Meeting

K-1 With respect to the three challenges identified at the last Review Meeting, China has taken many measures to respond to these challenges.

K.1.1 Site Selection for LILW Disposal Facilities

K-2 Based on the distribution of domestic nuclear facilities and the operation of existing disposal facilities, China has promoted the siting and construction of LILW disposal facilities steadily. Since the last Review Meeting, China has continued to carry out preparatory work for the siting of solid LILW disposal facilities in areas where nuclear power development is relatively concentrated. A centralized disposal facility for LLW from NPPs has been constructed, and the operating near surface disposal facilities have been expanded.

K-3 In 2022, Longhe Disposal Facility, the first centralized disposal facility for LLW from NPPs in China, was constructed. In 2020, the CAEA issued a reply for the approval of Longhe Disposal Facility project. In April 2021, the NNSA issued the construction licence for the first stage of the Longhe Disposal Facility Phase I. The Longhe Disposal Facility was designed with a disposal capacity of 1,000,000 m^3, with the capacity of 40,000 m^3 completed in this stage. In June 2022, the construction of the main part of Longhe Disposal Facility was completed. The NNSA issued an operating licence in July 2022. Longhe Disposal Facility has begun to receive LLW packages from NPPs.

K-4 Since the last Review Meeting, the expansion of the operational Feifengshan Disposal Facility and the operational Northwest Disposal Facility has been completed. The NNSA approved the modification of the operating licence for the Feifengshan Disposal Facility in October 2022. The second stage of the Feifengshan Disposal Facility Phase I was completed and put into operation, with an expanded disposal capacity of 70,000 m^3. The NNSA approved the modification of the operating licence for the Northwest Disposal Facility in April 2023. The second stage of the Northwest Disposal Facility Phase I was completed and put into operation, with an expanded disposal capacity of 90,000 m^3.

K-5 Since the last Review Meeting, China has continued to promote the R&D on intermediate depth disposal of radioactive waste. Relying on some research projects, China has carried out the source term investigation of ILW, the preliminary study of possible disposal options, and the preliminary study of potential sites for intermediate depth disposal facilities.

K.1.2 Geological Disposal of HLW

K-6 Under the *Guidelines on Research and Development Planning for Geological Disposal of HLW* jointly issued by the CAEA, the MOST and the former SEPA in 2006, China has systematically promoted the R&D of geological disposal of HLW, including the URL, as detailed in B.5.

K-7 The NNSA issued the *Geological Disposal Facilities for Radioactive Waste*

(HAD 401/10-2020) in January 2020, which stipulates the siting objectives, phasing, siting criteria and QA requirements for HLW geological disposal facilities. *The Safety Case and Safety Assessment for the Disposal of Radioactive Waste* (NNSA-HAJ-0001-2020) was issued in March 2020, specifying the safety objectives and basic safety requirements for radioactive waste disposal, the main content and composition of the safety case for the whole process of the safety of radioactive waste disposal, the radiological impact assessment after the closure of the disposal facility, and requirements for preparation of relevant documents.

K-8 The CAEA approved the feasibility study report on the Beishan URL construction project in May 2020. In June 2021, the construction of the URL was officially commenced, indicating the entry of China's HLW geological disposal into the stage of URL construction and R&D. As of the end of 2023, the excavation of main shaft of the URL has been successfully finished and the drilling footage along the ramp has exceeded 3.1 km. Meanwhile, three turning sections of ramp have been successfully completed.

K-9 In conjunction with the URL construction project, in January 2021, China launched a series of scientific research projects in the course of URL construction, including site investigation on the deep geological environment, hydrogeological characteristics, host rock mechanics and long-term performance, environmental monitoring, rock excavation technology, mechanical excavation equipment, in-situ testing of buffer materials, nuclide migration behavior and preliminary research on disposal concept. At present, the "multi-method and multi-element" shaft and tunnel geological logging technique has been established for the URL construction period, and the rock mass integrity of the URL site has been validated. Special grouting materials for the URL have been developed, and the groundwater monitoring network, microseismic monitoring network and ecological environment monitoring network have been established for the URL site.

K-10 In January 2021, the CAEA approved the establishment of the Innovation Center for Geological Disposal of High-Level Radioactive Waste as a national R&D platform to promote the R&D on geological disposal of HLW in China. The Innovation Center has conducted joint technical research with relevant Chinese scientific research institutions, universities and enterprises, and conducted research on site characteristic evaluation, engineered barrier material development, integral ultra-hard rock excavation, and long-term safety assessment of disposal facilities. It has made breakthroughs in key technologies such as monitoring and evaluation of excavation disturbance of host rock fissure water, fabrication and assembly of engineering-scale buffer material blocks, low-damage and high-efficiency excavation of granite, and uncertainty analysis of safety assessment. In addition, the Innovation Center has fully played its role as a platform, opening up relevant research topics to the public and attracting young researchers to engage in the research field, thus ensuring the sustainable development of R&D in geological disposal.

K-11 In October 2021, BRIUG was designated as the first "IAEA Collaborating Center for Geological Disposal of High-Level Radioactive Waste". The

Collaborating Center is an international R&D platform established by the IAEA and the CAEA to strengthen international cooperation in geological disposal of HLW, and represents a new milestone for China to carry out technical cooperation in geological disposal of HLW with other countries through the IAEA. Since its establishment, the Collaborating Center has overcome the impact of uncertainties such as the outbreak of COVID-19, and carried out ongoing technical exchanges and cooperation with the IAEA, the Nuclear Energy Agency of the Organisation for Economic Co-operation and Development (OECD/NEA) and other international organizations, as well as countries such as Switzerland and Russia. Since the last Review Meeting, three international technical exchanges have been held at the Beishan URL site, and one international technical cooperation project has been launched. From July 10th to 14th, 2023, an international workshop was held on the site of Beishan URL, and the IAEA project officers and specially appointed experts shared international experience and latest progress in the field of geological disposal of HLW. From July 27th to 29th, 2023, the International Conference on Geological Disposal of High-Level Radioactive Waste was held on the site of Beishan URL by the CAEA Innovation Center for Geological Disposal of High-Level Radioactive Waste and the OECD NEA.

K.1.3 Near Surface Disposal for Types of Disused Sealed Sources

K-12 Since the last Review Meeting, China has persisted in advancing the development of relevant standards for the near surface disposal of disused sealed sources, and carrying out the retrieval, conditioning and disposal of disused sealed sources in long-term storage.

K-13 The *Safety requirements for near surface disposal of disused radioactive sources* (HJ 1336-2023) was issued, which specifies the safety requirements for the disposal of disused sealed sources in near surface disposal facilities, including basic requirements and requirements for characteristics, conditioning, waste packages, disposal and QA of disused sealed sources for near surface disposal.

K-14 China has been investigating special conditioning equipment for the near surface disposal of disused sealed sources, which can perform multiple functions such as retrieval, conditioning, detection, and transfer prior to the near surface disposal of specific disused sealed sources, thus laying the foundation for the disposal of disused sealed sources.

K-15 China has promoted the disposal of some disused sealed sources with low activity levels, and has disposed of nearly 30,000 disused ^{192}Ir and ^{75}Se sources stored by radioactive source manufacturers in three batches at the Northwest Disposal Facility.

K-16 China has sorted out the disused sealed sources accumulated in the National Centralized Disused Sealed Sources Storage Facility, carried out segregation and characterization based on the expected conditioning and disposal methods, and planned to dispose of more than 100,000 disused sealed sources in storage in three stages. In August 2023, the NNSA agreed to retrieve and condition more than 1,100 disused sealed sources and implement near surface disposal at the Northwest Disposal Facility. As of the end of 2023, the conditioning of this batch of disused sealed sources has been completed.

K-17 Details are given in J.2.4.

K.2 Response to the Requests of the Review Meeting

K.2.1 Competence and Staffing Linked to Timetable for Spent Fuel Management and Radioactive Waste Management Programmes

K-18 China has made efforts at various levels, including regulatory standards, talent development strategies, training and qualification management for regulators, organizational construction and staffing for spent fuel and radioactive waste management at nuclear facilities, to provide competence and staffing that meet the actual needs of spent fuel and radioactive waste management.

K-19 China has specified regulatory requirements for the qualification management of personnel involved in spent fuel and radioactive waste management. These requirements are clearly defined in regulations and standards such as the *Nuclear Safety Law of the People's Republic of China*, the *Safety Rules on Commissioning and Operation of Nuclear Power Plants* (HAF 103), the *Regulations on the Safety of Radioactive Waste Management* and the *Management Measures for the Licencing of Solid Radioactive Waste Storage and Disposal.* Details are given in F.2.1.

K-20 China has made efforts to develop education and training programmes that will help enhance talent reserve in this field. Employing government support and cooperation between higher education institutions and enterprises, professional programmes, including nuclear engineering, nuclear technology, and radiation protection, have been established in some higher education institutions, enabling more professionals to be enrolled for the nuclear industry and optimizing the structure of academic disciplines. CNNP and other related companies have conducted joint training with universities to attract talents to join the nuclear industry. Details are given in F.2.1.

K-21 China attaches great importance to the training and qualification management of personnel involved in the inspection of spent fuel and radioactive waste management, and all the regulatory inspection personnel have been properly certified. Under the *Management Measures on Administrative Law Enforcement Certificates of the Ministry of Ecology and Environment*, the MEE/NNSA verifies the qualifications of the personnel applying for administrative law enforcement certificates for nuclear and radiation safety regulatory inspection and provides training and examination for them. Only those who pass the examination and meet the relevant conditions can be granted such certificates. China has developed and issued documents such as the *Guiding Opinions on Operational Training for Nuclear and Radiation Safety Supervisors*, the *Operational Training Guide for Nuclear and Radiation Safety Supervisors*, and the *Outline of Operational Training for Nuclear and Radiation Safety Supervisors*, further improving the training system with the initial, intermediate, advanced and on-the-job training of nuclear and radiation safety supervision as the main framework, and providing professional training for supervisors. From 2020 to 2023, China organized a total of 69 training sessions for nuclear and radiation safety supervision and inspection personnel, involving about 4,700 participants. In addition, it has improved the operational competence of supervisory personnel in all aspects by cooperating with universities to carry out degree education and by dispatching personnel to participate in international exchanges and seminars. Since the last Review Meeting, another 102 officially budgeted posts have been allocated to the six regional offices under the NNSA, and 92 new employees have been recruited, further strengthening the inspection workforce.

K-22 All NPPs in China are staffed with specialized personnel for spent fuel management, ensuring that the establishment and staffing of positions are in line with the standard organizational structure. The management of spent fuel under at-reactor storage at NPPs is generally the responsibility of the technical staff of the fuel management department of each NPP, which usually consists of 10–20 professionals (depending on the number of units in operation). Each NPP has developed a training programme for spent fuel management personnel to acquire the necessary expertise through training and assessment, and has implemented a structured system of "training, authorization, assessment and employment". Only those who have successfully completed the training are authorized to assume their roles.

K-23 Operating nuclear facilities, such as NPPs and waste disposal facilities, have established organizations with clearly defined responsibilities for radioactive waste management, and are staffed with professional personnel for radioactive waste management, including a number of certified nuclear safety engineers. For example, most NPPs have set up a special department responsible for radioactive waste management, such as the Protection Support Section under the Health Physics Division. In addition, the requirements for training and assessment of personnel in the professional contractor team responsible for on-site work such as radioactive waste collection and processing are the same as those of personnel working in NPPs. Generally, 25–50 people are required for solid radioactive waste management in each NPP (depending on the number of units in operation). Personnel for radioactive waste management is required to meet the requirements of the on-the-job training programmes and procedures. They are only authorized to take up their duties after they have been trained in safety and qualified for the job, and are retrained regularly.

K.2.2 Inclusive Public Engagement in Radioactive Waste Management and Spent Fuel Management Programmes

K-24 China has established laws and regulations governing information disclosure, public communication and public engagement for nuclear-related projects. Relevant requirements are specified in laws and regulations such as the *Nuclear Safety Law of the People's Republic of China*, the *Measures for Disclosure of Nuclear Safety Information*, and the *Measures for Public Participation in Environmental Impact Assessments*. Details are given in H.3.2.

K-25 China has established a public communication mechanism for nuclear safety, which encompasses central government oversight, local government leadership, enterprise initiative, and public engagement. Guidelines have been developed for various sectors including nuclear power, nuclear technology application, and electromagnetic radiation to ensure the standardized development of public communication.

K-26 China has actively promoted the popularization of nuclear science. Extensive public awareness and education campaigns have been carried out on nuclear safety. Several national nuclear science education centers have been established. A number of public communication facilities and industrial tourism projects have been developed. Nuclear safety communication and education have been integrated into the training programs for leadership cadres and the educational curriculum for young people. A public communication conference on nuclear energy was organized, and extensive publicity was conducted through platforms such as the "4·15" National Security Education Day, the World Environment Day, and the "8·7" Public Open Day (Week). Initiatives such as "A Media Tour to Nuclear Power Plants" , the "Charm Light" National Nuclear Power Popular Science Knowledge Contest for Middle School Students, the "Nuclear + X" Creative Competition for National Universities, and Interview with Academicians on Nuclear Energy Science Popularization have been promoted to introduce nuclear safety science to schools and communities. A science popularization network and new media platforms have been developed, and innovative publicity methods such as nuclear science and technology exhibitions, nuclear power-themed wedding photography, and science popularization robots have been introduced to enhance public engagement and create an emotional connection with the public.

K-27 China has adopted a variety of public communication channels in line with the principles of equality, inclusiveness, and convenience. Local governments and nuclear facility licencees have actively sought public input on significant nuclear safety issues of public interest through various means such as questionnaires, online surveys, public hearings, deliberation meetings and symposiums. This approach ensures that the public's rights to information, participation, expression and scrutiny are upheld, particularly in the context of the construction of spent fuel and radioactive waste management facilities.

K-28 During the construction of the spent fuel temporary dry storage facility at Qinshan NPP Phase III, public participation activities were conducted in compliance with the *Law of the People's Republic of China on Environmental Impact Assessment* and the *Tentative Methods on Public Participation in Environmental Impact Assessment*. Information disclosure, questionnaire surveys and public symposiums were used to seek public comments on the construction of the spent fuel temporary dry storage facility.

K-29 During the construction of the Longhe Disposal Facility, the MEE publicized the EIS for the Longhe Disposal Facility on its official website. The project undertaker announced its environmental impact information on the official website of the local people's government where the project is located, and synchronously announced the environmental impact information through various channels, including online platforms, newspapers and public notices. Moreover, the project undertaker engaged with local residents and government officials to disseminate knowledge about radioactive waste management and enhance public understanding of radioactive waste management facilities.

K-30 A total of three information announcements (via online platforms, newspapers and public notices) and one questionnaire survey were conducted during the execution of the Beishan URL Project. The project undertaker maintained regular engagement with local residents, securing their support for the associated engineering and scientific research activities. In December 2021, “A Fu’s Family”, a science popularization cartoon about China’s HLW disposal programme, was launched at the Beishan URL to further enhance public outreach efforts. Since the official commencement of construction in 2021, the Beishan URL has hosted more than 100 tours and visits from government departments, colleges and universities, relevant scientific research institutions and other social groups.

K.2.3 Ageing Management of Packages and Facilities for Radioactive Waste and Spent Fuel, Considering Extended Storage Periods

K-31 China attaches great importance to the long-term safety of spent fuel and radioactive waste management. The *Nuclear Safety Law of the People’s Republic of China* stipulates that organizations producing, storing, transporting or reprocessing spent fuel shall take measures to ensure the safety of spent fuel, and shall be responsible for the safety of spent fuel; nuclear facility licencees and organizations engaged in treatment and disposal of radioactive waste shall treat and dispose of radioactive waste by minimization and decontamination to ensure permanent safety. The *Regulations for environmental radiation protection of nuclear power plant* (GB 6249-2011) stipulates that the temporary storage of radioactive waste in the temporary storage facilities shall not exceed five years. Details are given in G.1 and H.1.

K-32 China has made overall planning for national spent fuel management capacity building, developed the plan for enhancing the storage system for spent fuel from NPPs, and promoted projects on spent fuel storage facilities and large commercial reprocessing facilities, to ensure the long-term safety of spent fuel management. By the end of December 2023, there are 55 nuclear power units in operation in China, of which only eight units have operated for more than 20 years, among which, one has operated for 32 years. Spent fuel has not yet been stored for an extended period. Additionally, to supplement the storage capability of spent fuel pools, some Chinese NPPs have built spent fuel dry storage facilities/systems, including the spent fuel temporary dry storage facility in Qinshan NPP Phase III, spent fuel storage system in Tianwan NPP, spent fuel storage system in Qinshan NPP Phase II, and spent fuel dry storage facilities in Daya Bay NPP.

K-33 China has considered the safety of radioactive waste across the nation during the storage period and disposal capacity building, and promoted the construction of LLW disposal facilities to ensure long-term safety of radioactive waste. The Longhe Disposal Facility was constructed and put into operation in 2022. It is expected that there will be no overdue storage of radioactive waste in NPPs in the next few decades.

K-34 China focuses on the ageing management of radioactive waste packages and storage facilities. For storage facilities, the relevant facilities and structures of radioactive waste storage buildings are regularly inspected and maintained to prevent performance degradation due to ageing. For waste packages, each NPP has developed a special regular random inspection system, and developed inspection methods such as endoscopes to ensure the safety of waste packages during the storage period. Personnel for radioactive waste management conduct regular inspections of the waste facilities and prepare an assessment report on the safety of solid radioactive waste every year. At present, the waste storage facilities are operating normally and the waste packages are in a safe state.

K-35 China focuses on the ageing management of spent fuel storage facilities. For spent fuel pools, the focus is placed on steel lining and spent fuel storage frames. Through water chemistry management and monitoring, the levels of harmful elemental ions in the cooling water are strictly controlled to reduce corrosion of steel lining and storage frames. The ageing condition of the neutron absorbing materials in the storage frames is assessed by periodic detection of the monitoring samples of neutron absorbing materials. The impact of ageing on neutron absorbing capacity is evaluated by direct detection of neutron absorbing materials.

K-36 China focuses on the ageing of facilities and equipment in the regulatory inspections of nuclear facilities, which is taken as one of the safety elements of periodic safety review (PSR) of nuclear facilities. The *Periodic Safety Review for NPPs* (HAD 103/11-2006) stipulates that thematic evaluation needs to be performed for 14 safety elements including “ageing” for PSR of NPPs. The *Regular Safety Review of Research Reactors* (HAD 202/02-2017) stipulates that thematic evaluation needs to be performed for five safety elements, including “actual state and ageing management of structures, systems and components”, in the PSR of research reactors.

K-37 Since the last Review Meeting, PSRs have been conducted for nuclear facilities, including Fangchenggang Units 1 and 2, Ningde Units 1–4, Hongyanhe Units 1–4, and Northwest Disposal Facility. These assessments have incorporated a thematic review of ageing management as a critical safety element. In 2021, the NNSA organized the review of the *First periodic safety review program for the spent fuel temporary dry storage facility in Qinshan NPP Phase III.* This marks the first instance of China conducting a PSR specifically for spent fuel dry storage facilities. The PSR programme, based on the *Periodic Safety Review for NPPs* (HAD 103/11-2006), identifies 13 safety elements requiring thematic evaluations, with aspects related to “ageing” including a thematic review of ageing elements, methods for identifying ageing effects, an assessment of effectiveness of the ageing management programme, and the establishment of an ageing database.

K.2.4 Long-Term Management of Disused Sealed Sources, Including Sustainable Management Options for Regional as Well as Multinational Solutions

K-38 China attaches importance to and strengthens the safe management of radioactive sources throughout their life cycle. A robust legal and regulatory framework has been established, which defines management requirements for processes such as the storage and disposal of radioactive sources. The implementation of a nationwide networked information system, the National Radiation Safety Management System for Nuclear Technology Application, facilitates full-process dynamic tracking and management of radioactive sources. In some provinces, temporary storage facilities for the radioactive waste from nuclear applications and producers of radioactive sources have developed radioactive source safety management systems, further enhancing the information-based management of disused sealed sources.

K-39 According to Chinese regulations, Category I, II, and III disused sealed sources shall be returned to the producers or the original exporters as per the agreement on return of disused sealed sources. In compliance with the IAEA *Code of Conduct on the Safety and Security of Radioactive Sources* and its supplementary *Guidance on the Import and Export of Radioactive Sources*, China is committed to actively assisting in the return of exported Category I, II, and III radioactive sources to China once they are decommissioned.

K-40 China operates 31 provincial radioactive waste temporary storage facilities for nuclear technology application and one national centralized disused sealed sources storage facility, which follow the strategy of "dispersed provincial storage before national centralized storage" for disused sealed sources. Depending on the availability of storage capacity in provincial temporary storage facilities for the radioactive waste from nuclear applications, the Chinese government invests in regular transfer of disused sealed sources from the temporary storage facilities to the National Centralized Disused Sealed Sources Storage Facility.

K-41 China encourages and actively practices recycling and reuse of disused sealed sources to promote resource conservation and minimize radioactive waste. From 2020 to 2023, approximately 2,000 disused sealed sources, including ^{241}Am, ^{137}Cs, Pu-Be, ^{60}Co and ^{252}Cf, were reused in China. In addition, China continuously expands the scope of disused sealed sources for reuse, and actively explores the screening of disused sealed sources in provincial temporary storage facilities for the radioactive waste from nuclear technology applications to return valuable disused sealed sources to manufacturers for reuse.

K-42 China has established clear regulations on the management and recovery control of orphan sources, which require entities and individuals to immediately report the discovery of disused sealed sources or radioactively contaminated items and hand them over to the designated storage facilities. In practice, measures such as reducing or exempting recovery and storage fees, and door-to-door collection for orphan sources discovered and radioactive sources from bankrupt organizations, have been taken.

K-43 For disused sealed sources that lack reuse potential, China stores them in the National Centralized Disused Sealed Sources Storage Facility or provincial temporary storage facilities for the radioactive waste of nuclear technology applications, or returns them to the manufacturers for storage, and meanwhile, considers their disposal by grade and category. Since the last Review Meeting, China has issued the *Safety requirements for near surface disposal of disused radioactive sources* (HJ 1336-2023), and retrieved and conditioned more than 1,100 disused sealed sources in the National Centralized Disused Sealed Sources Storage Facility. In the future, the phased disposal of more than 100,000 disused sealed sources currently in storage is planned.

K-44 China's management approach to disused sealed sources is a balanced decision that takes considers safety, cost, and the needs of social sustainability. As the demand for radioactive sources increases in the pursuit of social sustainability, China aims to improve regulatory efficiency and reduce regulatory costs by leveraging more information technologies for full-process regulation. The conditions for reuse are determined and regulation is enforced based on the reuse value of disused sealed sources. The methods for disposal of disused sealed sources are determined based on their decay properties and long-term radiation safety risks.

K-45 Details are given in J.1 and J.2.

K.3 Existing Safety Issues and, Challenges and Proposed Actions for the Current Stage and Proposed Actions

K.3.1 Safety of Spent Fuel Management

K-46 China will continuously strengthen the safety of spent fuel management.

K-47 China will steadily foster diversified spent fuel intermediate storage systems for AP1000, European Pressurized Reactor (EPR), Hualong One (HPR1000) and Water-Water Energetic Reactor (VVER), and accelerate capacity building to support intermediate storage of spent fuel. China will fully demonstrate the principles for allocation of spent fuel in case of dispersed and centralized storage, the technical route for spent fuel storage, site layout, transport, facility storage capacity and other factors, and provide an optimal solution for multi-reactor type spent fuel management from the perspectives of safety and economy.

K.3.2 Safe Disposal of HLW

K-48 China will strengthen the research on geological disposal of HLW.

K-49 China will steadily promote the construction of the URL for the geological disposal of HLW and experimental studies in the sites of the URL, and during the URL construction, continuously carry out researches on deep geological environment, hydrogeological characteristics, mechanical and long-term properties of host rock, performance testing and evaluation of potential materials for disposal containers, and methods for evaluating long-term safety of geological disposal. China will continuously promote the siting and research of HLW geological repositories, carrying out screening and assessment of candidate sites for HLW geological disposal of clay rocks in Northwest China; carrying out research on deep borehole disposal technology; and carrying out research on big data integration of disposal systems and on large-scale scientific computing methods.

K.3.3 Processing of Complex Radioactive Waste

K-50 China needs to start and speed up the processing of complex radioactive waste.

K-51 China will continuously promote the R&D and engineering application of key technologies for treatment of complex radioactive waste. It aims to master sludge treatment technologies and other complex waste treatment technologies, build mobile treatment facilities or modular treatment facilities; and carry out demonstrative application of technologies such as mobile incineration of combustible nuclear power waste, plasma melting incineration, inorganic treatment of radioactive waste resin, and in-drum drying of radioactive sludge.

K.4 Good Practices

K-52 With regard to the safety of spent fuel management and the safety of radioactive waste management, China would like to share four good practices with the Contracting Parties to the Joint Convention.

K.4.1 Management of Disused Sealed Sources Combining Sustainable Development and Safety Throughout the Life Cycle

K-53 Considering factors such as safety, cost, and sustainable social development, priority is given to the safety of radioactive sources throughout their life cycle. Based on the current situation of China, efforts have been made to improve the safety, security, and information-based management during long-term storage of disused sealed sources. Additionally, channels for the recovery and reuse of disused sealed sources have been expanded. The strategy for disposal has been clarified, and the storage and subsequent disposal processes has been effectively integrated. Furthermore, disposal of disused sealed sources is advancing by grade and category to promote the final disposal of all categories of disused sealed sources.

(1) Formulating a national standard for the near surface disposal of disused sealed sources, improving the strategy for the disposal of such sources, and promoting disposal practices

K-54 The *Safety requirements for near surface disposal of disused radioactive sources* (HJ 1336-2023) was issued in 2023. This standard clearly defines the requirements for the characteristics, conditioning, packaging, and acceptance of the disused sources intended for near surface disposal, providing guidance for the systematic advancement of the disposal of certain disused sealed sources.

K-55 After the issuance of this standard, the strategy for the final disposal of disused sealed sources in China has been further clarified. Depending on their nuclide type, activity level, and corresponding risk level, disused sealed sources are classified into four categories: disused sealed sources with a short half-life that can be cleared (e.g., ^{192}Ir), disused sealed sources with a half-life of up to five years (e.g., ^{60}Co), disused sealed sources with a half-life ranging from five to thirty years (e.g., ^{137}Cs), and disused sources with a half-life exceeding thirty years (e.g., ^{241}Am), for which the disposal methods are determined separately. Near surface disposal is recommended for the majority of the disused sealed sources in the first three categories, while geological disposal for the last category.

K-56 Effective interfacing and compatibility with the subsequent disposal processes have been considered at the storage stage of disused sealed sources. The National Centralized Disused Sealed Sources Storage Facility is located within the Northwest Disposal Facility. Since the last Review Meeting, the disposal practices for the first three categories of disused sealed sources have been implemented, involving approximately 30,000 ^{192}Ir and ^{75}Se sources containing a limited number of impurity nuclides, as well as over 1,100 ^{90}Sr, ^{137}Cs, and ^{60}Co sources with low activity levels. In the future, China will also explore the potential use of existing hot cells owned by domestic producers, or alternatively, the establishment of specialized conditioning hot cells for conditioning and disposing ^{60}Co and other radioactive sources which possess a high level of activity. Details are given in J.2.4.

(2) Strengthening the safety management of disused sealed sources during long-term storage

K-57 Since the last Review Meeting, China has upgraded the security systems of both provincial radioactive waste temporary storage facilities for nuclear technology application and the National Centralized Disused Sealed Sources Storage Facility respectively. This has effectively reduced the security risks associated with long-term storage of radioactive sources. Additionally, China has issued *Technical specifications for siting, design and construction of radioactive waste repository for nuclear technology application* (HJ 1258-2022), a national standard that incorporates the security requirements. Details are given in J.2.2.

(3) Continuously enhancing the safety management of disused sealed sources

K-58 The safety management of disused sealed sources has been continuously enhanced by means of informatization and capacity building for emergency response.

K-59 The Chinese government and relevant enterprises have established an information system that extends the full-process dynamic tracking and management of radioactive sources to include long-term storage and final disposal of disused sealed sources. By leveraging the National Radiation Safety Management System for Nuclear Technology Application and the Radioactive Source Coding System, “one source, one archive” and “data accompanying the sources” have been achieved for both disused sealed sources and in-use sources to guarantee information traceability. In recent years, the regulatory authorities for radioactive sources have persistently encouraged provincial radioactive waste temporary storage facilities for nuclear technology application and producers of radioactive sources to supplement the information on disused sealed sources for better completeness and accuracy. The tracking of radioactive sources in the information system encompasses the stages of reuse and final disposal. For instance, when a disused gamma knife source is utilized to generate a ^{60}Co source for irradiation purposes, the ^{60}Co source can be traced back to the original gamma knife source through the new source code. This ensures the full life-cycle management of the radioactive source. The information system for the management of disused sealed sources for the National Centralized Disused Sealed Sources Storage Facility of China enables statistical analysis of nuclides, activity levels, morphology, container types, and other relevant data pertaining to the stored disused sealed sources. Additionally, it records the location of containers holding disused sealed sources to facilitate two-dimensional visualization.

K-60 In terms of developing emergency response capacity for disused sealed sources, provincial ecological and environmental authorities have included the dropping of disused sealed sources during transport and the discovery of orphan sources have been included in scenarios requiring radiation accident emergency response. To address concerns regarding accidents involving the dropping of radioactive sources during long-distance transport that have actually occurred in recent years, China has utilized actual disused sealed sources in provincial radioactive waste temporary storage facilities for nuclear technology application to conduct on-site drills about this scenario to test emergence response capability, in which case, the location of the accident is randomly selected, without prior notification of such drills.

(4) Continuously promoting the reuse of disused sealed sources

K-61 Since the last Review Meeting, China's three producers of radioactive sources reused about 2,000 disused sealed sources such as ^{241}Am, ^{137}Cs, Pu-Be, ^{60}Co, and ^{252}Cf. New radioactive sources meeting corresponding safety standards were given new codes and applied to fields such as cement processing, oilfield exploration logging, nuclear power, coal mining, petrochemical industry, reactor start-up source, fuel rod clearance detection, industrial automation measurement and control, and iron and steel smelting. In particular, the batch reuse of ^{60}Co gamma knife source with high radioactivity has been realized. Details are given in J.2.3.

K-62 The long-term storage management and final disposal of disused sealed sources is a global challenge and has also been the focus of previous Review Meetings. The policies and practices that emphasize enhancing long-term storage safety, implementing informatization management tools, strengthening emergency response capacity, broadening reuse channels, integrating the layout of disused sealed sources for storage and disposal, and disposing of such sources in a step by step manner, from the easy to the difficult, have been proven to be both feasible and effective in China.

K.4.2 Developing a Multi-Stakeholder Collaborative Framework for Development of a Centralized Disposal Facility for LLW from NPPs, Ensuring Effective Benefit Compensation and Public Engagement

K-63 Since the last Review Meeting, Chinese stakeholders have collaborated closely, fostered innovative concepts, and established a collaborative and cooperation mechanism among industry players, government bodies, regulators, and shareholders. The mechanism has facilitated the siting and construction of a centralized disposal facility for LLW from NPPs (the Longhe Disposal Facility), so as to align nuclear power development with waste disposal capacity.

(1) The central government has underscored the importance of establishing a centralized disposal facility for LLW from NPPs, while local governments have provided strong support. Extensive research and careful evaluation have led to the formulation of a comprehensive strategy by key stakeholders, including the NDRC/NEA, MEE/NNSA, CAEA, the State-owned Assets Supervision and Administration Commission of the State Council (SASAC), along with the Gansu Provincial People's Government and other governmental agencies. Once the preferred site for the facility was selected, the provincial and local governments in Gansu Province, where the facility is located, have provided their unwavering support and actively assisted in public communication and other related tasks to ensure the successful implementation of the project.

(2) The competent authorities and regulatory bodies have coordinated efforts to address the challenge of the Not in My Backyard (NIMBY) phenomenon. The NEA, the NNSA, the CAEA, the SASAC and other governmental agencies have united efforts to finalize the overall model, clarifying the responsibilities and the way forward for the construction and operation of the centralized disposal facility, so as to address the concerns of all interested parties. To address the challenge of the "NIMBY phenomenon" arising from cross-regional disposal, a certain percentage of the disposal fee was withdrawn to serve as "institutional control and management fee", which will be used for post-closure institutional control and management of the disposal facility and support the construction of the infrastructures and public service facilities in the disposal facility; besides, local SOEs in Gansu Province were included into the construction and operation subjects of the Longhe Disposal Facility.

(3) The community of shared interests collaborated to achieve mutually beneficial outcomes, and the disposal facility was completed and put into operation timely. China's major nuclear power group companies and SOEs in Gansu Province have collaborated as shareholders to establish Gansu Longhe Environmental Protection Technology Co., Ltd., aiming to invest, develop, and operate the Longhe Disposal Facility. Adhering to the strategy of "commercial operation, intensive construction, and professional management", the facility is poised to support the sustainable development of the nuclear power industry and invigorate local economic and social development. After being put into operation, the Longhe Disposal Facility has emerged as a pivotal component in China's endeavors to establish an efficient nuclear energy system.

(4) Extensive public communication has been conducted to fully protect the rights and interests of the public. The local governments at all levels, where the disposal facility is located, have played a crucial role in facilitating public participation and communication, e.g. actively engaging relevant nuclear experts to deliver lectures

on nuclear science. The MEE published the EIS of the Longhe Disposal Facility on its official website. The project undertaker disseminated information on environmental impact and nuclear science through various channels, including the internet, newspapers, public notices, and nuclear safety brochures.

K-64 In the process of siting and construction of the Longhe Disposal Facility, China respected the needs of various stakeholders, innovated mechanisms, and coordinated various stakeholders for full involvement, and effectively addressed the concerns of all stakeholders, including local governments, nuclear power group companies, and the public. This approach has facilitated progress in the siting, construction, and operation of the Longhe Disposal Facility. As of the end of 2023, the Longhe Disposal Facility has received 2,989 m^3 of solid radioactive waste. The operation of this site is of great significance in advancing the timely delivery and disposal of radioactive waste from NPPs throughout China, as well as ensuring the safety of radioactive waste management.

K-65 Globally, the LILW disposal projects in many countries are advancing slowly due to, for example, the “NIMBY Phenomenon”. The mechanism of “coordination across the nuclear industry and close collaboration among all stakeholders”, which China has developed during the siting and construction process of the Longhe Disposal Facility, has proven to be both feasible and effective.

K.4.3 Construction of URL for Geological Disposal of HLW with Advanced Engineering Technologies

K-66 Drawing extensively from international experience, China has pioneered and implemented state-of-the-art engineering construction technologies in the development of the Beishan URL. These advancements significantly reduce the excavation damaged zones (EDZs) in the host rock, thereby enhancing the long-term safety of the geological disposal repository.

K-67 Constructing a URL in crystalline rock will inevitably result in EDZs in host rock. Conventional excavation techniques, such as the drilling and blast method, generally produces EDZs of up to tens of centimeters in the host rock, which can compromise the repository's long-term safety. In order to reduce EDZs in the host rock, China proposed a technical solution by utilizing the full-face tunnel boring machine (TBM) technology to excavate the URL spiral ramp. China has developed “Beishan No. 1”, the first TBM capable of excavating with a small turning radius and a high inclined angle.

K-68 At present, the “Beishan No. 1” has been successfully used in the excavation of the ramp of Beishan URL, with a maximum tunneling rate of 22 m/day, and the EDZs in the wall have been found to be only several centimeters in thickness. It ensures the safety function of the natural barrier and will help maintain the feasibility of transforming the URL into the final repository in the future.

K-69 Currently, there are 26 URLs worldwide; however, only the United States, Switzerland, and Sweden are the only countries that have experimented with TBMs in constructing such facilities. However, these trials have mainly been limited to straight sections of ramp and have not fully embraced a “small-damage and high-efficiency” excavation technology. This excavation technology developed by China, proven to be feasible and effective for small turning radius and hard granite conditions, can be applied to the construction of URLs and even future repositories at crystalline rock sites.

K.4.4 Continuously Advancing the R&D of New Technologies on Waste Management and Decommissioning

K-70 Since the last Review Meeting, China has actively advanced the R&D of new technologies, including laser decontamination, AI and digital twins, as well as reuse of NPP ventilation filter frames, and radioactive organic liquid waste treatment. These continuous efforts are aimed at enhancing decommissioning efficiency, minimizing radiation exposure to individuals, minimizing the volume of radioactive waste, to ensure the safety in decommissioning activities as well as radioactive waste management.

(1) China has successfully developed and realized the engineering application of radioactive laser decontamination technology, with the relevant technology patented by China, United Kingdom, and Argentina. Considering excessive secondary waste liquid, vulnerable materials, and inadequate decontamination effect, and other problems of the original decontamination process used by NPPs, China has proposed and designed an innovative composite laser decontamination module, which integrates a signal acquisition & detection system and a real-time feedback & control system. It successfully overcomes key challenges such as balancing decontamination effect and damage to in-service components, as well as decontamination and clearance of contaminated metals from decommissioning of nuclear facilities. The module can meet requirements for decontaminating the main body and surface of various contaminated components while identifying the types of contaminants on surfaces of the contaminated substrate online for real-time feedback and adjustments to improve overall quality.

K-71 Specialized laser decontamination equipment for the inner walls of radioactive pipelines has been developed and applied to the laser decontamination of the contaminated pipelines in the primary circuit of nuclear power reactors, marking the world’s first practice of using lasers for such radioactive decontamination. After laser decontamination, the surface dose rate of the pipeline was reduced to below 100 μSv/h, which met the standards on smelting of contaminated metals.

(2) China has applied intelligent technologies such as AI and digital twins to the decommissioning process of the 101 HWRR. The parametric 3D model of 101 HWRR and a decommissioning project database have been established using intelligent technologies. The decommissioning simulation platform enables the direct design of the cutting scheme and the planning of equipment cutting route based on the 3D model, as well as the transmission of such route to the manipulator, robots and other equipment to complete the task intelligently. In the future, digital twins of reactor dismantling platform and equipment will be developed for the decommissioning of 101 HWRR to establish a complete digital

twin of the 101 HWRR decommissioning project.

(3) China has developed ventilation filter holding frame recycling technology and supporting equipment and radioactive organic liquid waste purification technology and device, which have been put into engineering application in NPPs. Compared to traditional treatment technologies for ventilation filter frames, the reuse of these frames in nuclear power plants can be achieved through self-developed reusable ventilation filter frames and mobile production line. The dismantling equipment results in secondary waste 20% less than that generated by traditional technologies, while frame reuse reduces the amount of cleared waste by 80% compared to the direct smelting process. The technology effectively solves the long-term temporary storage problem of the ventilation filter frames and reduces the amount of radioactive waste from NPPs. In response to the physical and chemical properties of radioactive waste oil and waste bolt cleaning agent, a set of treatment methods and mobile specialized treatment devices have been developed. These devices feature a streamlined technological process, ensuring safe and reliable operation with low costs. They are capable of effectively removing radionuclides from waste oil and waste bolt cleaning agent, achieving the clearance of radioactive organic liquid waste.

K-72 Compared to conventional technologies, the aforementioned new technologies exhibit high efficiency, precision, environmental friendliness, effectiveness in waste minimization, remote control capabilities, etc., and have significant advantages in enhancing decommissioning efficiency, promoting radioactive waste minimization efforts, and reducing individual exposure dose. The aforementioned technologies for radioactive waste management and decommissioning have been implemented in China, yielding superior outcomes and demonstrating their feasibility and effectiveness.

K.5 Good Performances

K-73 Five good performances have been achieved in China in the safety of spent fuel management and the safety of radioactive waste management.

K.5.1 Achieving Positive Progress in the Recovery and Reuse of Scrap Metals

K-74 Since the last Review Meeting, the NNSA granted an operating licence to Hunan Nuclear Industry Honghua Machinery Co., Ltd. for the demonstration project on smelting of scrap metals from NPPs in April 2023. This project is China’s first production line specialized for the recycling and reuse of radioactive scrap metals from NPPs, with an annual processing capacity of 300 tons.

K-75 The project realizes resource reuse through the smelting of radioactive scrap metals from NPPs, transforming them into recyclable radioactive waste steel boxes and shielding sleeves that can be utilized within the nuclear industry system.

K.5.2 Promoting NPP Decommissioning by Government-Guided, Industry-Led and Systematic Planning

K-76 Since the last Review Meeting, the National Energy Administration (NEA) and the relevant departments have made overall deployment and arrangements to prepare for NPP decommissioning. Specifically, they have designated Qinshan NPP and Daya Bay NPP as demonstration projects for decommissioning, while also requesting the nuclear power group companies to build decommissioning R&D platforms and focus on scientific research bottlenecks.

77 CNNC took the lead in establishing a research center integrating enterprises, universities, research institutes and end-users. By pooling the resources of its subsidiaries, CNNC has continuously strengthened the training for nuclear decommissioning personnel and developed professional platforms. On the one hand, it promoted the establishment of a specialized operation and maintenance company to coordinate and manage the decommissioning work of all NPPs controlled by CNNC. It also established a management system for the preparation of NPP decommissioning. On the other hand, in January 2023, it set up the "CNNC Technology Research Center for NPP Decommissioning Projects", with the aim of comprehensively developing an NPP decommissioning management system, technological system, and technology capacity for application in projects in line with China's nuclear industry development by 2035. Additionally, it actively made preparation for the demonstration project for first reactor decommissioning of NPPs.

K-78 Relying on the Center, CNNC has organized and carried out a large amount of research on the management and technology of NPP decommissioning. For example, it has conducted research on the overall route and development planning for NPP decommissioning, with a decommissioning plan for the entire lifetime of NPPs formulated; it has carried out research on the establishment of an NPP decommissioning standard system, with the overall framework formulated, a set of relevant standards under development, and three new industry standards issued; based on the principle of "necessary for decommissioning and usable for operation", it has actively carried out pre-studies on NPP decommissioning technologies, such as the R&D of high-efficiency laser decontamination devices for radioactive metal wastes and mobile waste incineration devices, and the research on steam reforming technologies.

K.5.3 Promoting the Informatization of Radioactive Waste Management Step by Step

K-79 The national radioactive waste management information system was launched in 2023. By collecting and summarizing national spent fuel and radioactive waste management data, the system realized the unified management of national radioactive waste information and permanent preservation of waste disposal information. It has provided data support for the development of policies, regulations and standards for radioactive waste management, and the safety of spent fuel and radioactive waste management.

K-80 Since the last Review Meeting, CNNC Everclean has developed an information system that encompasses radioactive waste origin verification and identification until disposal based on disposal projects. It has carried out R&D work on the Quick response code (QR code) for waste packages, and has now commissioned a specialized company to design and develop QR codes that are integrated with waste containers., These QR codes are expected to be promoted and applied to newly generated waste packages in 2024.

K.5.4 Tailoring Radioactive Waste Management Strategies for the Design Features of New Reactors

K-81 For new reactors such as SMRs, HTGRs, and MSRs, China encourages the consideration of radioactive waste treatment, disposal, and facilitation of decommissioning from the reactor design stage. It mandates the promotion of waste minimization through source control and rational selection of waste treatment processes. Furthermore, it allows and encourages licencees to tailor the design of waste treatment systems and operations based on the characteristics of the site and the reactor type while considering facilitating decommissioning at the earliest stage.

K-82 It is planned to adopt off-site waste disposal for some of the small reactors. Based on the premise of ensuring proper and safe treatment and disposal of solid radioactive waste, it is proposed to adopt a combination of temporary storage after in-plant pretreatment and off-site treatment and disposal for solid waste generated in some of the new reactors. For some small reactors, sharing waste management facilities with large PWRs have been considered based on the characteristics of their sites. An example is the Changjiang Multipurpose Small Modular Reactor Science and Technology Demonstration Project in Hainan Province, which is located at the Hainan Changjiang Nuclear Power Base and benefits from integrated management radioactive waste.

K.5.5 Achieving Continuous Improvement in Radioactive Waste Reduction of Multi-Facility Sites Through Goal-Oriented, Step-by-Step Roadmap Formulation

K-83 China continues to promote radioactive waste minimization in various nuclear facilities, and enterprises have achieved the radioactive waste minimization through technical and management measures. Taking CGN as an example, by adhering to the goal-oriented, step-by-step formulation of roadmaps and timetables, it has developed the first five-year plan for radioactive waste around the medium-and long-term goals for its multi-facility site, established a special team for solid waste management, built a platform for coordinating radioactive waste management, and optimized the whole process of waste management (design, R&D, operation, and application) of radioactive waste. Moreover, it advanced the implementation, thus promoting continuous improvement in the radioactive waste reduction for its multi-facility site and achieving positive progress. Since the last Review Meeting, CGN has taken combustible waste incineration treatment as a breakthrough point and achieved the annual planning goal of reducing solid waste output of its multi-facility site to less than 30 m^3 per unit.

K.6 Policy, Practice and Plan in Response to IRRS Mission to China

K-84 China recognizes the importance of international peer review in the fields of nuclear and radiation safety, including the safety of spent fuel management and the safety of radioactive waste management. China welcomes the IRRS mission for exchanges.

K-85 As pointed out clearly in the *Nuclear Safety Culture Policy Statement* issued in 2014, China pursues the international peer review and encourages third-party review activities in developing nuclear safety culture education and practice, learning from successful experience, and identifying potential weakness and problems for timely correction and improvement. In the white paper *Nuclear Safety in China* issued in 2019, China clearly stated that it "has strengthened exchanges and cooperation with the Nuclear Energy Agency of the Organization for Economic Cooperation and Development, the European Union, the World Association of Nuclear Operators (WANO), and other international organizations. It is an active participant in international peer reviews of nuclear safety directed to common progress against global standards. In order to expand participation in global cooperation platforms and enhance its nuclear safety capabilities, China continues to take part in activities under the frameworks of the Global Nuclear Safety and Security Network (GNSSN) and the Asian Nuclear Safety Network (ANSN)".

K-86 The IAEA conducted Integrated Regulatory Review Services (IRRS) Missions on China's nuclear and radiation safety regulation in 2000, 2004, 2010, and 2016, respectively, fully recognizing China's good practices and experiences. Meanwhile, China plans to invite the IAEA to conduct an IRRS mission on China's national nuclear and radiation safety in 2025.

K.7 Openness and Transparency of Joint Convention Implementation

K-87 China attaches great importance to and strengthens the openness and transparency of various activities taken throughout the implementation of the Joint Convention. For this purpose, an NRCG and an NRRC were established. The NRRC consists of experts from multiple agencies and organizations, such as the MEE/NNSA, the CAEA, the MFA, the MPS, the NHC, the NEA, nuclear power group companies, licencees of some nuclear facilities, and relevant research institutions. In preparing the National Report, the NRCG collects information/data from the NRRC's member organizations. Upon completion of the initial draft, the NRRC conducts a thorough review and provides recommendations and suggestions for revision. The NRCG then refines the draft, incorporating these suggestions to produce the final National Report. In responding to written inquiries from other Contracting Parties, the NRCG provides preliminary answers to the questions and subsequently finalizes the revisions to the written responses according to the recommendations and suggestions of the NRRC provided after a thorough review. During the preparation of and question answering for the National Report, the report contents and discussion process are open and transparent to all agencies and organizations involved in these processes. On the website of MEE/NNSA (http://nnsa.mee.gov.cn), the full text of China's National Reports (both Chinese and English versions) submitted at each Review Meeting of the Contracting Parties to the Joint Convention is available to the public. Therefore, the text of the National Reports is open and transparent to the public.

K-88 Furthermore, the information related to China's participation in Organizational Meetings, Review Meetings and Extraordinary Meetings of Contracting Parties to the Joint Convention was made available to the public on MEE/NNSA website, CAEA website and *Annual Reports of NNSA*.

K.8 International Cooperation Measures

K- 89 China will continue to pay attention to the role that the IAEA plays in providing a platform for promoting international cooperation regarding spent fuel and radioactive waste management. China actively participates in IAEA sponsored technical cooperation projects, international and regional training courses, and meetings. Additionally, China will continue to diligently fulfill its obligations under the Joint Convention, contribute to the development of international standards, conduct prospective studies and discussions, and promote international cooperation and exchange. From 2020 to 2023, China has participated in and hosted many IAEA meetings and international conferences, including the International Conference on Radioactive Waste Management, the Interregional Workshop on Safety Assessment of Remediation, the Regional Workshop on the Development of National Strategies and Regulatory Requirements for Spent Fuel Management, and the Meeting of IAEA Underground Research Facilities Network for Geological Disposal as well as the International Conference on Nuclear Decommissioning, and the Workshop on Characterization and Minimization of Radioactive Waste.

K-90 China has steadily pushed forward cooperation with the United States, France, Britain, Japan, Russia, Spain, the European Union countries and relevant regional organizations in the area of the safety of spent fuel and radioactive waste management, including signing cooperative agreements or memorandums in this regard with relevant countries. China has also increased the frequency of international peer reviews, enhanced transparency in these reviews, emphasized emergency response and assistance, and strengthened bilateral and multilateral cooperation in technology introduction and joint research. Since the last Review Meeting, the French Nuclear Safety Authority (L'Autorité de sûreté nucléaire, ASN) came to China to participate in the meeting of the China-France Steering Committee for Nuclear Safety Cooperation and to renew the cooperation agreement between the two countries. The Scientific and Engineering Centre for Nuclear and Radiation Safety (SEC), Russia's regulatory technical support agency, came to China to conduct technical exchanges on spent fuel and radioactive waste management. The Rostechnadzor (Federal Environmental, Industrial and Nuclear Supervision Service of Russia) delegation visited China's National Nuclear and Radiation Safety Technology R&D Base for the purpose of technical exchanges. The National Operator for Radioactive Waste Management (NO RWM) of Russia, the Institute for Nuclear Research (INR) of the Russian Academy of Sciences and other organizations came to China for cooperation and exchanges on the research of geological disposal technology of HLW and the development of URLs. China has actively participated in regional nuclear safety cooperation. This includes the China-Japan-Korea Top Regulators' Meeting (TRM) on Nuclear Safety Regulation, the GNSSN, the ANSN, the Forum for Nuclear Cooperation in Asia (FNCA), and the Regulatory Cooperation Forum (RCF). Through these platforms, China has shared its experiences and lessons learned regarding the safety of spent fuel management and the safety of radioactive waste management with relevant member states, helping them maintain and achieve a high level of safety in both aspects. Building upon the "Belt and Road" initiative, China has made unremitting efforts to achieve the goals of the Joint Convention by extending capacity building, information exchange and experience feedback with the countries along the "Belt and Road" in the field of the safety of spent fuel management and the safety of radioactive waste management. Since the last Review Meeting, the Eleventh Meeting of China-Pakistan Steering Committee on Nuclear Safety Cooperation was held as scheduled. At the meeting, the two sides exchanged views on the licencing of near surface disposal facilities. The third specialized training on waste management, under the framework of the Programme on Environmental Management and Sustainable Development, a cooperation programme of China's MEE and Italy's Ministry of the Environment, was successfully organized online.

L. APPENDICES

L.1 List of Spent Fuel Management Facilities

L.1.1 Spent Fuel Storage Facilities at NPPs

No.	Facility	Affiliation	Design Capacity (tHM)	Time put into operation
1	Spent fuel storage pool 1#	Qinshan NPP	192	1991
2	Spent fuel storage pool 2#	Qinshan NPP	146	1991
3	Spent fuel storage pool 1#	Fangjiashan NPP	549	2014
4	Spent fuel storage pool 2#	Fangjiashan NPP	549	2015
5	Spent fuel storage pool 1#	Qinshan NPP Phase II	317	2002
6	Spent fuel storage pool 2#	Qinshan NPP Phase II	317	2004
7	Spent fuel storage pool 3#	Qinshan NPP Phase II	474	2010
8	Spent fuel storage pool 4#	Qinshan NPP Phase II	474	2011
9	SFDSS (Modules 1#-5#)	Qinshan NPP Phase II	73.5	2023
10	Spent fuel storage pool 1#	Qinshan NPP Phase III	946	2002
11	Spent fuel storage pool 2#	Qinshan NPP Phase III	946	2003
12	SFDSS (Modules 1#-6#)	Qinshan NPP Phase III	2,764.8	2009
13	Spent fuel storage pool 1#	Fuqing NPP	554	2014
14	Spent fuel storage pool 2#	Fuqing NPP	554	2015
15	Spent fuel storage pool 3#	Fuqing NPP	554	2016
16	Spent fuel storage pool 4#	Fuqing NPP	554	2017
17	Spent fuel storage pool 5#	Fuqing NPP	539	2021
18	Spent fuel storage pool 6#	Fuqing NPP	557	2022
19	Spent fuel storage pool 1#	Daya Bay NPP	427	1992
20	Spent fuel storage pool 2#	Daya Bay NPP	427	1993
21	SFDSS (Modules 1#-3#)	Daya Bay NPP	44.1	2020
22	Spent fuel storage pool 1#	Ling'ao NPP Phase I	554	2001
23	Spent fuel storage pool 2#	Ling'ao NPP Phase I	554	2002
24	Spent fuel storage pool 3#	Ling'ao NPP Phase II	554	2010
25	Spent fuel storage pool 4#	Ling'ao NPP Phase II	554	2010
26	Spent fuel storage pool of Unit 1	Tianwan NPP	327	2007
27	Spent fuel storage pool of Unit 2	Tianwan NPP	327	2007
28	Spent fuel storage pool of Unit 3	Tianwan NPP	327	2018
29	Spent fuel storage pool of Unit 4	Tianwan NPP	327	2018
30	Spent fuel storage pool of Unit 5	Tianwan NPP	554	2020
31	Spent fuel storage pool of Unit 6	Tianwan NPP	554	2020
32	SFDSS (Modules 1#-15#)	Tianwan NPP	215.3	2019
33	Spent fuel storage pool 1#	Hainan Changjiang NPP	316	2015

No.	Facility	Affiliation	Design Capacity (tHM)	Time put into operation
34	Spent fuel storage pool 2#	Hainan Changjiang NPP	316	2016
35	Spent fuel storage pool 1#	Hongyanhe NPP	554	2012
36	Spent fuel storage pool 2#	Hongyanhe NPP	554	2013
37	Spent fuel storage pool 3#	Hongyanhe NPP	554	2014
38	Spent fuel storage pool 4#	Hongyanhe NPP	554	2015
39	Spent fuel storage pool 5#	Hongyanhe NPP	554	2020
40	Spent fuel storage pool 6#	Hongyanhe NPP	554	2021
41	Spent fuel storage pool 1#	Ningde NPP	554	2012
42	Spent fuel storage pool 2#	Ningde NPP	554	2013
43	Spent fuel storage pool 3#	Ningde NPP	554	2015
44	Spent fuel storage pool 4#	Ningde NPP	554	2016
45	Spent fuel storage pool 1#	Yangjiang NPP	554	2014
46	Spent fuel storage pool 2#	Yangjiang NPP	554	2015
47	Spent fuel storage pool 3#	Yangjiang NPP	554	2016
48	Spent fuel storage pool 4#	Yangjiang NPP	554	2017
49	Spent fuel storage pool 5#	Yangjiang NPP	554	2018
50	Spent fuel storage pool 6#	Yangjiang NPP	554	2019
51	Spent fuel storage pool 1#	Fangchenggang NPP	554	2015
52	Spent fuel storage pool 2#	Fangchenggang NPP	554	2016
53	Spent fuel storage pool 3#	Fangchenggang NPP	580	2022
54	Spent fuel storage pool 1#	Haiyang NPP	476.5	2018
55	Spent fuel storage pool 2#	Haiyang NPP	476.5	2019
56	Spent fuel storage pool 1#	Taishan NPP	641	2017
57	Spent fuel storage pool 2#	Taishan NPP	641	2019
58	SFDSS (Modules 1#-2#)	Taishan NPP	12.7	2017
59	Spent fuel storage pool 1#	Sanmen NPP	386	2018
60	Spent fuel storage pool 2#	Sanmen NPP	386	2018
61	Spent fuel buffer storage area	Shidao Bay NPP	1,600,000 (places)	2023
62	Phase I intermediate spent fuel storage area	Shidao Bay NPP	3,200,000 (places)	2021

Note: As of December 31, 2023.

L.1.2 Spent Fuel Storage Facilities at Research Reactors

No.	Facility	Licencee	Location
1	Spent fuel storage pool of CIAE	CIAE	Beijing

No.	Facility	Licencee	Location
2	Spent fuel storage pool of Tsinghua University	Tsinghua University	Beijing
3	Spent fuel storage pool of Nuclear Power Institute of China (NPIC)	NPIC	Sichuan Province

Note: As of December 31, 2023.

L.2 Inventory List of Spent Fuel

L.2.1 Inventory List of Spent Fuel at NPPs

No.	Facility	Affiliation	Existing spent fuel (tHM)
1	Spent fuel storage pool 1#	Qinshan NPP	130.0
2	Spent fuel storage pool 2#	Qinshan NPP	131.6
3	Spent fuel storage pool 1#	Fangjiashan NPP	207.7
4	Spent fuel storage pool 2#	Fangjiashan NPP	176.4
5	Spent fuel storage pool 1#	Qinshan NPP Phase II	210.0
6	Spent fuel storage pool 2#	Qinshan NPP Phase II	247.7
7	Spent fuel storage pool 3#	Qinshan NPP Phase II	215.0
8	Spent fuel storage pool 4#	Qinshan NPP Phase II	204.9
9	SFDSS (Modules 1#-5#)	Qinshan NPP Phase II	73.5
10	Spent fuel storage pool 1#	Qinshan NPP Phase III	687.1
11	Spent fuel storage pool 2#	Qinshan NPP Phase III	686.3
12	SFDSS (Modules 1#-6#)	Qinshan NPP Phase III	2,753.3
13	Spent fuel storage pool 1#	Fuqing NPP	179.2
14	Spent fuel storage pool 2#	Fuqing NPP	174.6
15	Spent fuel storage pool 3#	Fuqing NPP	161.7
16	Spent fuel storage pool 4#	Fuqing NPP	145.2
17	Spent fuel storage pool 5#	Fuqing NPP	62.5
18	Spent fuel storage pool 6#	Fuqing NPP	31.2
19	Spent fuel storage pool 1#	Daya Bay NPP	270.2
20	Spent fuel storage pool 2#	Daya Bay NPP	310.6
21	SFDSS (Modules 1#-3#)	Daya Bay NPP	44.1
22	Spent fuel storage pool 1#	Ling'ao NPP Phase I	428.3
23	Spent fuel storage pool 2#	Ling'ao NPP Phase I	312.5
24	Spent fuel storage pool 1#	Ling'ao NPP Phase II	309.7
25	Spent fuel storage pool 2#	Ling'ao NPP Phase II	309.7
26	Spent fuel storage pool 1#	Tianwan NPP	249.1
27	Spent fuel storage pool 2#	Tianwan NPP	178.3
28	Spent fuel storage pool 3#	Tianwan NPP	200.9
29	Spent fuel storage pool 4#	Tianwan NPP	117.6

No.	Facility	Affiliation	Existing spent fuel (tHM)
30	Spent fuel storage pool 5#	Tianwan NPP	62.5
31	Spent fuel storage pool 6#	Tianwan NPP	62.5
32	SFDSS (Modules 1#-15#)	Tianwan NPP	215.3
33	Spent fuel storage pool 1#	Hainan Changjiang NPP	244
34	Spent fuel storage pool 2#	Hainan Changjiang NPP	208
35	Spent fuel storage pool 1#	Hongyanhe NPP	235.3
36	Spent fuel storage pool 2#	Hongyanhe NPP	193.0
37	Spent fuel storage pool 3#	Hongyanhe NPP	178.3
38	Spent fuel storage pool 4#	Hongyanhe NPP	159.9
39	Spent fuel storage pool 5#	Hongyanhe NPP	31.2
40	Spent fuel storage pool 6#	Hongyanhe NPP	31.2
41	Spent fuel storage pool 1#	Ningde NPP	215.0
42	Spent fuel storage pool 2#	Ningde NPP	180.1
43	Spent fuel storage pool 3#	Ningde NPP	187.5
44	Spent fuel storage pool 4#	Ningde NPP	158.1
45	Spent fuel storage pool 1#	Yangjiang NPP	193.0
46	Spent fuel storage pool 2#	Yangjiang NPP	187.5
47	Spent fuel storage pool 3#	Yangjiang NPP	165.4
48	Spent fuel storage pool 4#	Yangjiang NPP	121.3
49	Spent fuel storage pool 5#	Yangjiang NPP	119.5
50	Spent fuel storage pool 6#	Yangjiang NPP	93.7
51	Spent fuel storage pool 1#	Fangchenggang NPP	159.9
52	Spent fuel storage pool 2#	Fangchenggang NPP	158.0
53	Spent fuel storage pool 3#	Fangchenggang NPP	0
54	Spent fuel storage pool 1#	Haiyang NPP	105.1
55	Spent fuel storage pool 2#	Haiyang NPP	102.9
56	Spent fuel storage pool 1#	Taishan NPP	102
57	Spent fuel storage pool 2#	Taishan NPP	78
58	SFDSS (Modules 1#-2#)	Taishan NPP	0
59	Spent fuel storage pool 1#	Sanmen NPP	103.7
60	Spent fuel storage pool 2#	Sanmen NPP	110.2
61	Spent fuel buffer storage area	Shidao Bay NPP	0.0
62	Phase I intermediate spent fuel storage area	Shidao Bay NPP	0
Total amount under at-reactor pool storage			10,284.8
Total amount under dry storage			3,086.2
Total			13,371.0

Note: As of December 31, 2023.

L.2.2 Inventory List of Spent Fuel at Research Reactors

No.	Facility	Licencee	Existing Spent fuel (tU)
1	Spent fuel storage pool of CIAE	CIAE	0
2	Spent fuel storage pool of Tsinghua University	Tsinghua University	0
3	Spent fuel storage pool of NPIC	NPIC	0.226

Note: As of December 31, 2023.

L.3 List of Radioactive Waste Management Facilities

L.3.1 Radioactive Waste Treatment and Storage Facilities at NPPs

No.	Facility	Affiliation	Time put into operation
1	21# LILW storeroom	Qinshan NPP	1994
2	22# solidification workshop	Qinshan NPP	1994
3	24# solid waste storeroom	Qinshan NPP	1994
4	9TES cement solidification system	Fangjiashan NPP	2014
5	Waste treatment auxiliary workshop (QS)	Fangjiashan NPP	2014
6	Waste temporary storage facility (QT)	Fangjiashan NPP	2014
7	Radioactive waste oil storeroom (QR)	Fangjiashan NPP	2014
8	8TES cement solidification system	Qinshan NPP Phase II	2002
9	Waste segregation and measurement plant (QS)	Qinshan NPP Phase II	2002
10	Solid radioactive waste temporary storage facility (QT)	Qinshan NPP Phase II	2002
11	New solid radioactive waste temporary storage facility (5QT)	Qinshan NPP Phase II	2010
12	Radioactive waste oil temporary storage facility (5QT2)	Qinshan NPP Phase II	2010
13	9TES cement solidification system	Qinshan NPP Phase II	2010
14	Temporary storage facilities for radioactive waste	Qinshan NPP Phase III	2002
15	Radioactive waste packing room	Qinshan NPP Phase III	2002
16	Solid waste temporary storage facility (QT)	Fuqing NPP	2014
17	Waste treatment auxiliary workshop (QS)	Fuqing NPP	2014
18	Radioactive waste oil temporary storage facility (QR)	Fuqing NPP	2014
19	Solid waste treatment system (TES)	Fuqing NPP	2014

No.	Facility	Affiliation	Time put into operation
20	11UKT technical waste temporary storage facility	Tianwan NPP	2007
21	21UKT technical waste temporary storage facility	Tianwan NPP	2007
22	91UKT cement solidified waste temporary storage facility	Tianwan NPP	2007
23	31UKT radioactive waste storage facility	Tianwan NPP	2018
24	41UKT radioactive waste storage facility	Tianwan NPP	2018
25	T1UKT radioactive waste storage facility	Tianwan NPP	2018
26	T2UKT waste neutron flux and temperature measurement channel temporary storage facility	Tianwan NPP	2018
27	QT building	Tianwan NPP	2020
28	QR building	Tianwan NPP	2020
29	Solid radioactive waste treatment system of Unit 1 (1KPA)	Tianwan NPP	2007
30	Solid radioactive waste treatment system of Unit 2 (2KPA)	Tianwan NPP	2007
31	Liquid waste cement solidification system of Unit 1 (1KPC)	Tianwan NPP	2007
32	Liquid waste cement solidification system of Unit 2 (2KPC)	Tianwan NPP	2007
33	Radioactive waste treatment center (T4UKT)	Tianwan NPP	2018
34	Solid waste treatment system of Units 5 and 6 (TES)	Tianwan NPP	2020
35	Compaction and packing device of QS building	Changjiang NPP	2015
36	Solid radioactive waste temporary storage facility in QT building	Changjiang NPP	2015
37	NX building (9TES cement solidification system)	Changjiang NPP	2015
38	TES (NX)	Daya Bay NPP	1994
39	TES (DQS)	Daya Bay NPP	1994
40	Solid radioactive waste storage facility (DQT)	Daya Bay NPP	1994
41	TES (NX)	Ling'ao NPP Phase I	2002
42	TES (LQS)	Ling'ao NPP Phase I	2002
43	TES (NX)	Ling'ao NPP Phase II	2013
44	Solid radioactive waste storage facility (KQT)	Ling'ao NPP Phase II	2011
45	TES solidified system of 8NX building	Hongyanhe NPP	2014

No.	Facility	Affiliation	Time put into operation
46	TES solidified system of 9NX building	Hongyanhe NPP	2012
47	HQS building	Hongyanhe NPP	2014
48	HQT building	Hongyanhe NPP	2014
49	TES solidified system of 7NX building	Hongyanhe NPP	2021
50	9 TES cement solidification facility	Ningde NPP	2013
51	8TES cement solidification facility	Ningde NPP	2014
52	QS building (0TES compression packing facility)	Ningde NPP	2013
53	QT building	Ningde NPP	2013
54	QR building	Ningde NPP	2013
55	QV building	Ningde NPP	2020
56	TES system (9NX)	Yangjiang NPP	2013
57	TES system (8NX)	Yangjiang NPP	2015
58	TES system (7NX)	Yangjiang NPP	2018
59	QS building	Yangjiang NPP	2013
60	QT building	Yangjiang NPP	2014
61	QR building	Yangjiang NPP	2014
62	QV building	Yangjiang NPP	2013
63	Solid radioactive waste treatment system 9TES (NX)	Fangchenggang NPP	2015
64	Solid radioactive waste treatment system 0TES (QS)	Fangchenggang NPP	2015
65	Solid radioactive waste storage facility (QT)	Fangchenggang NPP	2016
66	Solid radioactive waste treatment system 8TES (BWX)	Fangchenggang NPP	2022
67	Solid radioactive waste treatment system 3TES (BNX)	Fangchenggang NPP	2022
68	Site radioactive waste treatment facility (SRTF)	Haiyang NPP	2016
69	9HQS building (solid radioactive waste storeroom)	Taishan NPP	2018
70	9HQB building (radioactive waste treatment building)	Taishan NPP	2017
71	9HQR building (radioactive waste oil storage facility)	Taishan NPP	2018
72	9HQV building (radioactive waste solvent storage facility)	Taishan NPP	2018

No.	Facility	Affiliation	Time put into operation
73	1/2HNX building (nuclear auxiliary building)	Taishan NPP	2017
74	Site radioactive waste treatment facility (SRTF)	Sanmen NPP	2018
75	Radioactive waste building of Unit 1	Sanmen NPP	2018
76	Radioactive waste building of Unit 2	Sanmen NPP	2018
77	Facilities related to radioactive waste treatment in nuclear auxiliary plants (UKA)	Shidao Bay NPP	2021
78	Solid radioactive waste repository (UKT)	Shidao Bay NPP	2021

Note: As of December 31, 2023.

L.3.2 Radioactive Waste Treatment and Storage Facilities at Research Reactors

No.	Facility	Licencee
1	Liquid waste temporary storage facility	CIAE
2	Liquid waste treatment workshop	CIAE
3	Solid waste temporary storage facility	CIAE
4	Solid waste conditioning facility	CIAE
5	Liquid waste treatment system	Tsinghua University
6	Cement solidification system	Tsinghua University
7	Compressing and packing machine	Tsinghua University
8	Waste temporary storage facility	Tsinghua University
9	Liquid radioactive waste treatment workshop	NPIC
10	Cement solidification workshop	NPIC
11	Temporary storage facility	NPIC
11-1	Temporary storage section	NPIC
11-2	Conditioning section	NPIC
11-3	Compression section	NPIC

Note: As of December 31, 2023.

L.3.3 Radioactive Waste Treatment and Storage Facilities at Nuclear Fuel Cycle Facilities

No.	Facility	Licencee
1	Liquid waste pool	CNNC Shaanxi Uranium Enrichment Co., Ltd.
2	Liquid waste treatment facility	CNNC Shaanxi Uranium Enrichment Co., Ltd.
3	Solid radioactive waste temporary storage facility	CNNC Shaanxi Uranium Enrichment Co., Ltd.
4	Ventilation system	CNNC Shaanxi Uranium Enrichment Co., Ltd.
5	Liquid waste treatment facility	CNNC Lanzhou Uranium Enrichment Co., Ltd.

No.	Facility	Licencee
6	Solid radioactive waste temporary storage facility	CNNC Lanzhou Uranium Enrichment Co., Ltd.
7	Ventilation system	CNNC Lanzhou Uranium Enrichment Co., Ltd.
8	Liquid waste treatment facility	China North Nuclear Fuel Co., Ltd.
9	Temporary storage facility for waste containing uranium	China North Nuclear Fuel Co., Ltd.
10	Ventilation center	China North Nuclear Fuel Co., Ltd.
11	Liquid waste treatment facility	CNNC Jianzhong Nuclear Fuel Co., Ltd.
12	Temporary storage facility for waste containing uranium	CNNC Jianzhong Nuclear Fuel Co., Ltd.
13	Waste treatment and conditioning facilities	CNNC Jianzhong Nuclear Fuel Co., Ltd.
14	Ventilation center	CNNC Jianzhong Nuclear Fuel Co., Ltd.

Note: As of December 31, 2023.

L.3.4 Radioactive Waste Storage Facilities

No.	Facility	Location	Time put into operation
1	Low level waste storage facility of Gansu Dongfang Ruilong Environmental Control Co., Ltd.	Gansu Province	December 2019
2	Low level waste reception and storage building at Longhe Disposal Facility	Gansu Province	November 2022

Note: As of December 31, 2023.

L.3.5 Radioactive Waste Treatment Facilities

No.	Facility	Location	Time put into operation
1	Treatment facilities of CNNC Sichuan Environmental Protection Engineering Co., Ltd.	Sichuan Province	May 2020
2	Treatment facilities of Hunan Nuclear Industry Honghua Machinery Co., Ltd.	Hunan Province	April 2023

Note: As of December 31, 2023.

L.3.6 Radioactive Waste Storage Facilities for Nuclear Technology Application

No.	Facility	Location	Design capacity (m^3)	Time put into operation
1	Anhui Provincial Radioactive Waste Temporary Storage Facility for Nuclear Technology Application	Anhui	800	2007
2	Beijing Radioactive Waste Temporary Storage Facility for Nuclear Technology Application	Beijing	2,460	2008
3	Fujian Provincial Radioactive Waste Temporary Storage Facility for Nuclear Technology Application	Fujian	600	2010

No.	Facility	Location	Design capacity (m^3)	Time put into operation
4	Gansu Provincial Radioactive Waste Temporary Storage Facility for Nuclear Technology Application	Gansu	800	2009
5	Guangdong Provincial Radioactive Waste Temporary Storage Facility for Nuclear Technology Application	Guangdong	600	2001
6	Guangxi Provincial Radioactive Waste Temporary Storage Facility for Nuclear Technology Application	Guangxi	800	2013
7	Guizhou Provincial Radioactive Waste Temporary Storage Facility for Nuclear Technology Application	Guizhou	600	2009
8	Hainan Provincial Radioactive Waste Temporary Storage Facility for Nuclear Technology Application	Hainan	400	2010
9	Hebei Provincial Radioactive Waste Temporary Storage Facility for Nuclear Technology Application	Hebei	800	2012
10	Henan Provincial Radioactive Waste Temporary Storage Facility for Nuclear Technology Application	Henan	800	2008
11	Heilongjiang Provincial Radioactive Waste Temporary Storage Facility for Nuclear Technology Application	Heilongjiang	800	2008
12	Hubei Provincial Radioactive Waste Temporary Storage Facility for Nuclear Technology Application	Hubei	1,000	2022
13	Hunan Provincial Radioactive Waste Temporary Storage Facility for Nuclear Technology Application	Hunan	800	2003
14	Jilin Provincial Radioactive Waste Temporary Storage Facility for Nuclear Technology Application	Jilin	1,200	1998
15	Jiangsu Provincial Radioactive Waste Temporary Storage Facility for Nuclear Technology Application	Jiangsu	1,200	2010
16	Jiangxi Provincial Radioactive Waste Temporary Storage Facility for Nuclear Technology Application	Jiangxi	600	2012
17	Liaoning Provincial Radioactive Waste Temporary Storage Facility for Nuclear Technology Application	Liaoning	800	2012
18	Inner Mongolia Radioactive Waste Temporary Storage Facility for Nuclear Technology Application	Inner Mongolia	800	2010

No.	Facility	Location	Design capacity (m^3)	Time put into operation
19	Ningxia Radioactive Waste Temporary Storage Facility for Nuclear Technology Application	Ningxia	400	2009
20	Qinghai Provincial Radioactive Waste Temporary Storage Facility for Nuclear Technology Application	Qinghai	400	2012
21	Shandong Provincial Radioactive Waste Temporary Storage Facility for Nuclear Technology Application	Shandong	900	2005
22	Shanxi Provincial Radioactive Waste Temporary Storage Facility for Nuclear Technology Application	Shanxi	800	1990
23	Shaanxi Provincial Radioactive Waste Temporary Storage Facility for Nuclear Technology Application	Shaanxi	800	2012
24	Shanghai Radioactive Waste Temporary Storage Facility for Nuclear Technology Application	Shanghai	1,785	1989
25	Sichuan Provincial Radioactive Waste Temporary Storage Facility for Nuclear Technology Application	Sichuan	700	1993
26	Tianjin Radioactive Waste Temporary Storage Facility for Nuclear Technology Application	Tianjin	800	2004
27	Tibet Radioactive Waste Temporary Storage Facility for Nuclear Technology Application	Tibet	200	2010
28	Xinjiang Radioactive Waste Temporary Storage Facility for Nuclear Technology Application	Xinjiang	600	2008
29	Yunnan Provincial Radioactive Waste Temporary Storage Facility for Nuclear Technology Application	Yunnan	800	2012
30	Zhejiang Provincial Radioactive Waste Temporary Storage Facility for Nuclear Technology Application	Zhejiang	800	2009
31	Chongqing Radioactive Waste Temporary Storage Facility for Nuclear Technology Application	Chongqing	600	2021
32	National Centralized Disused Sealed Sources Storage Facility	Gansu	2600	2011

Note: As of December 31, 2023.

L.3.7 Radioactive Waste Disposal Facilities

No.	Facility	Location	Time put into operation
1	Northwest Disposal Facility	Gansu Province	January 2011
2	Longhe Disposal Facility	Gansu Province	November 2022
3	Beilong Disposal Facility	Guangdong Province	January 2011
4	Feifengshan Disposal Facility	Sichuan Province	May 2016
5	Jinta Very Low Level Waste Landfill of CNNC Everclean Environmental Technology Engineering Co., Ltd.	Gansu Province	December 2021
6	Very Low Level Solid Radioactive Waste Landfill of CNNC Sichuan Environmental Protection Engineering Co., Ltd.	Sichuan Province	May 2020

Note: As of December 31, 2023.

L.4 Inventory of Radioactive Waste

L.4.1 Inventory of Conditioned Radioactive Waste in NPPs

(m^3)

No.	Nuclear power plant	Waste volume					
		Distillation residue	Spent resin	Sludge	Water filter	Technical waste	Subtotal
1	Qinshan NPP	162.6	0.0	0.0	17.6	404.1	584.3
2	Qinshan NPP Phase II	316.4	366	11.6	168.3	1,412.1	2,274.4
3	Qinshan NPP Phase III	0.0	0.0	0.0	0.0	0.0	0.0
4	Daya Bay NPP	29.5	210.0	2.0	79.1	782.3	1,102.9
5	Ling'ao NPP Phase I	45.4	180.0	2.0	126.5	441.8	795.7
6	Ling'ao NPP Phase II	36.8	174.8	0.0	47.2	490.8	749.6
7	Tianwan NPP in Jiangsu Province	0	0	0.0	0.0	299.6	299.6
8	Hongyanhe NPP	49.2	256.4	0.0	129.6	724.4	1,159.6
9	Ningde NPP	44.4	187.2	0.0	94.4	248.8	574.8
10	Yangjiang NPP	152.4	260.2	0.0	76.8	116.4	605.8
11	Fuqing NPP	164.4	246.4	0.0	8.8	511.6	931.2
12	Fangjiashan NPP	99.6	173.6	0.0	33.2	410.1	716.5
13	Changjiang NPP	65.6	100	0.0	2.0	220	387.6
14	Fangchenggang NPP	23.6	126.0	0.0	29.6	2.4	181.6
15	Haiyang NPP	0.0	78.4	0.0	0.0	160	238.4
16	Taishan NPP	0.0	0.0	0.0	0.0	0.0	0.0
17	Sanmen NPP	0.0	37.2	0.0	0.2	90.2	127.6
18	Shidao Bay NPP	0.0	0.0	0.0	0.0	7.0	7.0
Total		1,189.9	2,396.2	15.6	813.3	6,321.6	10,736.6

Note: As of December 31, 2023.

L.4.2 Inventory of Conditioned Radioactive Waste in Research Reactors and Nuclear Fuel Cycle Facilities

(m^3)

No.	Type	Waste volume				
		Intermediate level liquid waste	Intermediate level solid waste	Low level liquid waste	Low level solid waste	Subtotal
1	Research reactors	0.0	0.0	0.0	831.8	831.8
2	Uranium Enrichment Facilities	0.0	0.0	0.0	0.0	0.0
3	Fuel Element Fabrication Facilities	0.0	0.0	0.0	0.0	0.0
Total		0.0	0.0	0.0	831.8	831.8

Note: As of December 31, 2023.

L.4.3 Inventory List of Disused Sealed Sources in Provincial Radioactive Waste Temporary Storage Facilities for Nuclear Technology Application

(Pcs.)

No.	Province	Disused sealed sources
1	Anhui	2,352
2	Beijing	10,205
3	Fujian	1,069
4	Gansu	1,952
5	Guangdong	2,630
6	Guangxi	1,139
7	Guizhou	79
8	Hainan	378
9	Hebei	2,949
10	Henan	5,102
11	Heilongjiang	74
12	Hubei	414
13	Hunan	2,008
14	Jilin	35
15	Jiangsu	1,084
16	Jiangxi	1,156
17	Liaoning	414
18	Inner Mongolia	2,973
19	Ningxia	547
20	Qinghai	45
21	Shandong	5,082
22	Shanxi	710

No.	Province	Disused sealed sources
23	Shaanxi	1,730
24	Shanghai	1,835
25	Sichuan	296
26	Tianjin	1,672
27	Tibet	6
28	Xinjiang	821
29	Yunnan	97
30	Zhejiang	417
31	Chongqing	473
32	National Centralized Disused Sealed Sources Storage Facility	171,086
Total		220,830

Note: As of December 31, 2023.

L.4.4 Inventory of Waste Received by Storage Facilities

No.	Facility	Volume of waste received (m^3)	Total activity (Bq)
1	Low level waste storage facility of Gansu Dongfang Ruilong Environmental Control Co., Ltd.	4992.3	4.44E+11
2	Low level waste reception and storage building at Longhe Disposal Facility	1,995.3	2.05E+11
Total		6,987.6	6.16E+11

Note: As of December 31, 2023.

L.4.5 Inventory of Waste Received by Treatment Facilities

No.	Facility	Volume/Mass of waste received
1	Treatment facilities of CNNC Sichuan Environmental Protection Engineering Co., Ltd.	137 m^3 (combustible waste)
2	Treatment facilities of Hunan Nuclear Industry Honghua Machinery Co., Ltd.	289 kg (metal)

Note: As of December 31, 2023.

L.4.6 Inventory of Waste Received by Near Surface Disposal Facilities

No.	Facility	Volume of waste received (m^3)	Total activity (Bq)
1	Northwest Disposal Facility	31,068.65	6.65E+14
2	Longhe Disposal Facility	2,989.3	6.96E+13
3	Beilong Disposal Facility	2,526.44	7.95E+13
4	Feifengshan Disposal Facility	47,856.88	3.05E+15
Total		84,441.27	3.86E+15

Note: As of December 31, 2023.

L.4.7 Inventory of Waste Received by VLLW Landfills

No.	Facility	Volume of waste received (m^3)	Total activity (Bq)
1	Jinta Very Low Level Waste Landfill of CNNC Everclean Environmental Technology Engineering Co., Ltd.	3,835.29	6.88E+10
2	Very Low Level Solid Radioactive Waste Landfill of CNNC Sichuan Environmental Protection Engineering Co., Ltd.	8,046.08	1.02E+11
Total		11,881.37	1.71E+11

Note: As of December 31, 2023.

L.5 Facilities Decommissioned or in the Process of Being Decommissioned

Facility	Location	Rector type	Operation date	Closure date	Thermal power (MW)
Heavy Water Research Reactor of CIAE	Fangshan District, Beijing	HWR	September 1958	December 2007	15
Bulk Shielding Reactor of Tsinghua University	Changping District, Beijing	LWR	September 1964	July 2009	4.8

Note: As of December 31, 2023.

L.6 Relevant Laws, Regulations, Rules, Guides and Standards

L.6.1 Relevant Laws

Title	Issued by	Entry into force
Law of the People's Republic of China on Environmental Protection	The Standing Committee of the NPC	Revised, 2015
Law of the People's Republic of China on Prevention and Control of Water Pollution	The Standing Committee of the NPC	Revised, 2017
Law of the People's Republic of China on the Prevention and Control of Air Pollution	The Standing Committee of the NPC	Revised, 2018
Law of the People's Republic of China on Marine Environment Protection	The Standing Committee of the NPC	Revised, 2017
Law of the People's Republic of China on Safety of Operation	The Standing Committee of the NPC	Revised, 2014
Law of the People's Republic of China on Environmental Impact Assessment	The Standing Committee of the NPC	Revised, 2018
Law of the People's Republic of China on Prevention and Control of Radioactive Pollution	The Standing Committee of the NPC	2003
Law of the People's Republic of China on Prevention and Control of Environmental Pollution by Solid Waste	The Standing Committee of the NPC	Revised, 2020
Law of the People's Republic of China on Prevention and Control of Occupational Diseases	The Standing Committee of the NPC	Revised, 2018
Nuclear Safety Law of the People's Republic of China	The Standing Committee of the NPC	2018

L.6.2 Relevant Administrative Regulations

Title	Issued by	Entry into force
Regulations of the People's Republic of China on the Safety Supervision and Management of Civilian Nuclear Installations	State Council	1986
Regulations of the People's Republic of China on Nuclear Material Control	State Council	1987
Regulations of the People's Republic of China on Emergency Management of Nuclear Accident at Nuclear Power Plants	State Council	Revised, 2011
Regulations of the People's Republic of China on the Control of Nuclear Export	State Council	Revised, 2006
Regulations of the People's Republic of China on Control of Nuclear Dual-Use Items and Related Technologies Export	State Council	Revised, 2007
Regulations on the Safety and Protection of Radioisotopes and Radiation-Emitting Devices	State Council	Revised, 2019
Regulations on the Supervision and Management for Civilian Nuclear Safety Equipment	State Council	Revised, 2019
Regulations on the Safe Transportation of Radioactive Materials	State Council	2010
Regulations on the Safe Management of Dangerous Chemical Materials	State Council	Revised, 2013
Regulations on the Safety of Radioactive Waste Management	State Council	2012

L.6.3 Relevant Rules and Provisions

Title	Issued by	Entry into force
1 Generic Series		
Rules on the Qualification of Operators of Civil Nuclear Facilities	MEE, NDRC	2021
Implementation Details (II) of the Regulations of the People's Republic of China on the Safety Supervision and Management of Civilian Nuclear Installations - Regulation of Nuclear Facility Safety	NNSA	1995
Annex I of the Implementation Details (II) of the Regulations of the People's Republic of China on the safety supervision and management of Civilian Nuclear Installations - Reporting System of NPP Licencees	NNSA	1995
Annex II of the Implementation Details (II) of the Regulations of the People's Republic of China on the Safety Supervision and Management of Civilian Nuclear Installations - Reporting System of Research Reactor Licencees	NNSA	1995
Annex III of the Implementation Details (II) of the Regulations of the People's Republic of China on the Safety Supervision and Management of Civilian Nuclear Installations - Reporting System of Nuclear Fuel Cycle Facility Licencees	NNSA	1995
Implementation Details (I) of the Regulations on Emergency Management of Nuclear Accidents at Nuclear Power Plants – Emergency Preparedness and Response of NPP Licencees	NNSA	1998

Title	Issued by	Entry into force
Rules on Quality Assurance for Safety in Nuclear Power Plants	NNSA	1991
Temporary Regulations on Road Transport of NPP Spent Fuel	CAEA, MPS, Ministry of Transport (MOT), and Ministry of Health (MOH)	2003
Regulatory Procedures on Transfer and Transboundary Movement of Nuclear Products (Trial)	CAEA	2000
Management Measures on Administrative Law Enforcement Certificates of the Ministry of Ecology and Environment	MEE	2021
Safety Licencing Procedures for Nuclear Power Plants, Research Reactors and nuclear Fuel Cycle Facilities	MEE	2019
2 Nuclear Power Plant Series		
Rules on the Safety of Nuclear Power Plant Siting	NNSA	Revised, 2023
Rules on the Safety of Nuclear Power Plant Design	NNSA	Revised, 2016
Safety Rules on Commissioning and Operation of Nuclear Power Plants	NNSA	2022
Management Measures on Experience Feedback about Operating NPPs	NNSA	2012
General Technical Requirements for Nuclear Power Plant Modification following Fukushima Accident	NNSA	2012
3 Research Reactor Series		
Rules on the Safety of Research Reactor Design	NNSA	1995
Rules on the Safety of Research Reactor Operation	NNSA	1995
4 Non-reactor Nuclear Fuel Cycle Facilities Series		
Rule on the Safety of Civilian Nuclear Fuel Cycle	NNSA	1993
5 Spent Fuel and Radioactive Waste Management Series		
Assumptions on the Potential Accident at Spent Fuel Reprocessing Plant	NNSA	1995
Design Safety Guidelines on Spent Fuel Reprocessing Plant	NNSA	1995
Rules on Radioactive Waste Safety	NNSA	1997
Rules for Categorization of Radioactive Sources	SEPA	2005
Technical Requirements on Siting, Design and Construction of Nuclear Technology Application Radioactive Waste Storage Facility (Trial)	SEPA	2004
Regulations on Decommissioning of Nuclear Facilities and Management of Radioactive Waste	CAEA, MOF	2010
Interim Procedures on Collection, Utilization and Management of the Fund for Treatment and Disposal of Spent Fuel from Nuclear Power Plants	MOF, NDRC, CAEA	2010
Management Measures for Projects Supported by the Fund for Treatment and Disposal of Spent Fuel from Nuclear Power Plants	CAEA	2014
Management Measures for the Licencing of Solid Radioactive Waste Storage and Disposal	MEP	2014
Classification of Radioactive Waste	MEP, MIIT, CAEA	2018

Title	Issued by	Entry into force
6 Emergency Series		
Rules on Transboundary Emergency Management for Radiation Impacts of Nuclear Accident	CAEA	2002
Intervention Principle and Level for the Public Radiation Protection in an Event of Nuclear Emergency	NNSA, National Environmental Protection Agency (NEPA)	1991
Derived Intervention Principle for the Public Radiation Protection in an Event of Nuclear Emergency	NNSA, NEPA	1991
Emergency Preparedness and Response for Radioactive Sources and Radiation Technology Applications	CAEA, MOH	2003
Rules on Management of Special Revenue for NPP Accident Emergency Preparedness	MOF, CAEA	2007
Decision-making on Protection Measures and Rehabilitation Against Severe Accident in Later Stage	CAEA	2000
Emergency Preparedness and Response to Transport Accidents Involving Radioactive Material	CAEA	2000
Rules on the Management of Nuclear Emergency Exercises	NNAECC	2015
Management Measures on Nuclear Emergency Training	NNAECC	2015
Management Measures on Nuclear Accident Information Release	NNAECC	2015
Management Measures on National Nuclear Emergency on-Shift Network Operation	National Nuclear Accident Emergency Office (NNAERO)	2015
Management Measures on Nuclear Accident Emergency Reporting	NNAECC	2016
Management Measures on National Nuclear Emergency Technical Support Center and Rescue Team	NNAECC	2016
Code of Building National Radiation Monitoring Technical Support Team for On-site Nuclear Emergency Rescue	NNAECC	2016
Code of Building National Air Radiation Monitoring Team for Nuclear Emergency Rescue	NNAECC	2016
Code of Building National Maritime Radiation Monitoring Technical Support Center for Nuclear Emergency and National Maritime Radiation Monitoring Team for Nuclear Emergency Rescue	NNAECC	2016
Code of Building National Radiation Protection Technical Support Team for On-site Nuclear Emergency Rescue	NNAECC	2016
Code of Building National Medical Rescue Team for Nuclear Emergency	NNAECC	2016
Summarized Principles on Developing Nuclear Emergency Assistance Programme	NNAERO	2016
7 Nuclear Material Control Series		
Detailed Rules for the Regulations of the People's Republic of China on Regulating Nuclear Materials	NNSA, NEA, CAEA	1990
8 Civilian Nuclear Safety Equipment Regulatory Management Series		
Rules on Oversight of Design, Manufacture, Installation and Non-Destructive Detection of Civilian Nuclear Safety Equipment	SEPA	2007
Rules on Qualification Management of Non-Destructive Detection Staff of Civilian Nuclear Safety Equipment	MEE	Revised, 2019

Title	Issued by	Entry into force
Rules on Qualification Management of Welding Workers of Civilian Nuclear Safety Equipment	MEE	Revised, 2020
Rules on Oversight of Imported Civil Nuclear Safety Equipment	SEPA	2008
9 Radioactive Materials Transportation Management Series		
Management Measures on Licensing Radioactive Article Transportation Safety	MEE	Revised, 2019
Management Measures on Oversight of radioactive Article Transportation Safety	MEP	2016
10 Radioisotopes and Radiation-Emitting Devices Regulatory Series		
Management Measures on Safety Licencing for Radioisotopes and Radiation-Emitting Devices	MEE	Revised, 2019
Management Measures on Safety and Protection for Radioisotopes and Radiation-Emitting Devices	MEP	2011
11 Others		
Management Measures on Occupational Health for Radiation Workers	MOH	2007
Measures for Public Participation in Environmental Protection	MEP	2015
Measures for Public Participation in Environmental Impact Assessment	MEE	2019

L.6.4 Relevant Guides

Title	Issued by	Entry into force
1 Generic Series		
Emergency Preparedness and Response of NPP Licencees, HAD 002/01	NNSA	Revised, 2019
Emergency Preparedness by Local Government for Nuclear Power Plant, HAD 002/02	NNSA, SEPA, MOH	1990
Intervention Principle and Level for the Public Radiation Protection in an Event of Nuclear Emergency, HAD 002/03	NNSA,SEPA	1991
Derived Intervention Principle for the Public Radiation Protection in an Event of Nuclear Emergency, HAD 002/04	NNSA,SEPA	1991
Medical Emergency Preparedness and Response in an Event of Nuclear Accident, HAD 002/05	NNSA, MOH	1992
Emergency Preparedness and Response by Research Reactor Licencees, HAD 002/06	NNSA	Revised, 2019
Emergency Planning for Licencees of Civilian Nuclear Facilities, HAD 002/07	NNSA	Revised, 2019
Development of Emergency Action Levels for PWR Nuclear Power Plants, HAD 002/08	NNSA	2022
Emergency Preparedness and Response of Licensees of Near Surface Disposal Facilities for Radioactive Waste, HAD 002/09	NNSA	2023
Quality Assurance Programme for NPPs, HAD 003/01	NNSA	1988
Quality Assurance Organization of NPPs, HAD 003/02	NNSA	1989
Quality Assurance in the Procurement of Items and Services for Nuclear Power Plants, HAD 003/03	NNSA	1986
Quality Assurance Record System for NPPs, HAD 003/04	NNSA	1986
Oversight and Inspection of Quality Assurance for NPPs, HAD	NNSA	1988

Title	Issued by	Entry into force
003/05		
Quality Assurance in the Design of NPPs, HAD 003/06	NNSA	1986
Quality Assurance in the Construction of NPPs, HAD 003/07	NNSA	1987
Quality Assurance in the Items Manufacture for NPPs, HAD 003/08	NNSA	1986
Quality assurance in the commissioning and operation of NPPs, HAD 003/09	NNSA	1988
Quality Assurance in the Procurement, Design and Construction of Nuclear Fuel Elements, HAD 003/10	NNSA	1989
2 Nuclear Power Plant Series		
Seismic Issues in Siting NPPs, HAD 101/01	NNSA, National Earthquake Administration	1994
Atmospheric Dispersion Problems in Siting NPPs, HAD 101/02	NNSA	1987
Population Distribution Problems in Siting and Assessment of NPPs, HAD101/03	NNSA	1987
External Human-Made Event in Siting NPPs, HAD 101/04	NNSA	1989
Hydrological Dispersion Problems of Radioactive Materials in Siting NPPs, HAD 101/05	NNSA	1991
Relevance of NPPs Siting to Hydrology, HAD 101/06	NNSA	1991
Site Survey of NPPS, HAD 101/07	NNSA	1989
Design Basis Flood for Nuclear Power Plants on River Sites, HAD 101/08	NNSA	1989
Design Basis Flood for Nuclear Power Plants on Coastal Sites, HAD 101/09	NNSA	1990
Extreme Meteorological Event Related to NPP Siting, HAD 101/10	NNSA	1991
Design Basis Tropical Cyclone for NPPs, HAD 101/11	NNSA	1991
Issues Relating to Safety of NPP Base, HAD 101/12	NNSA	1990
Safety Principle of NPPs Design, HAD 102/01	NNSA	1989
Seismic Design and Qualification for Nuclear Power Plants , HAD 102/02	NNSA	2019
Safety Function and Component Classification for BWR, PWR and PTR, HAD 102/03	NNSA	1986
Protection Against Internal Hazards other than Fires and Explosions in the Design of Nuclear Power Plants, HAD 102/04	NNSA	2019
External Human-Made Event Relating to Design of NPPs, HAD 102/05	NNSA	1989
Design of the Reactor Containment and Associated Systems for Nuclear Power Plants, HAD 102/06	NNSA	2020
Design for Reactor Core Safety in Nuclear Power Plants, HAD 102/07	NNSA	2020
Design of the Reactor Coolant System and Associated Systems for Nuclear Power Plants, HAD 102/08	NNSA	2020
Design of Instrumentation and Control Systems for Nuclear Power Plants, HAD 102/10	NNSA	2021
Protection Against Internal Fires and Explosions in the Design of Nuclear Power Plants, HAD 102/11	NNSA	2019
Radiation Protection Design of NPPs, HAD 102/12	NNSA	2019

Title	Issued by	Entry into force
Electrical Power System Design for Nuclear Power Plants, HAD 102/13	NNSA	2021
Design of Fuel Handling and Storage Systems for NPPs, HAD 102/15	NNSA	2007
Safety Assessment and Verification for Nuclear Power Plants, HAD 102/17	NNSA	2006
Human Factors Engineering in the Design of Nuclear Power Plants, HAD 102/21	NNSA	2021
Design of Auxiliary Systems and Supporting Systems for Nuclear Power Plants, HAD 102/22	NNSA	2022
Deterministic Safety Analysis for nuclear Power Plants	NNSA	2021
Level 1 Probabilistic Safety Assessment for Nuclear Power Plants	NNSA	2021
Level 2 Probabilistic Safety Assessment for Nuclear Power Plants	NNSA	2022
OL&C and Operational Procedure for Nuclear Power Plant, HAD 103/01	NNSA	2005
NPP Commissioning Procedures, HAD 103/02	NNSA	1987
Management of Core and Fuel at NPPs, HAD 103/03	NNSA	1989
Radiation Protection During Operation of NPP, HAD 103/04	NNSA	1990
Staffing, Recruitment, Training and Delegation at NPPs, HAD 103/05	NNSA	2013
Organization and Operational Management of Licencees of NPPs, HAD 103/06	NNSA	2006
In-Commissioning Examination of NPPs, HAD 103/07	NNSA	1988
Repair and Maintenance of NPPs, HAD 103/08	NNSA	1993
Oversight of Items Important to Safety at NPPs, HAD 103/09	NNSA	1993
Fire Protection for NPPs, HAD 103/10	NNSA	2005
Periodic Safety Review for NPPs, HAD 103/11	NNSA	2006
Aging Management for NPPs, HAD 103/12	NNSA	2012
Operating Experience Feedback for Nuclear Installations, HAD 103/13	NNSA	2022
Management of Modifications to Nuclear Power Plants, HAD 103/14	NNSA	2023
3 Research Reactor Series		
Format and Contents of Research Reactor Safety Analysis Report, HAD 201/01	NNSA	1996
Research Reactor Operation Management, HAD 202/01	NNSA	1989
Management of Criticality Installation Operation and Experiment, HAD 202/02	NNSA	1989
Regular Safety Review of Research Reactors, HAD 202/02	MEP/NNSA	2017
Application and Modification of Research Reactors, HAD 202/03	NNSA	1996
Safety Management of Research Reactors after Long-Term Shutdown, HAD 202/03	MEP/NNSA	2017
Decommissioning of Research Reactor and Criticality Installation, HAD 202/04	NNSA	1992
Commissioning of Research Reactor, HAD 202/05	NNSA	2010
Research Reactor Maintenance, Regular Testing and Inspection, HAD 202/06	NNSA	2010

Title	Issued by	Entry into force
Core Management and Fuel Handling for Research Reactors, HAD 202/07	NNSA	2012
4 Non-Reactor Nuclear Fuel Cycle Installation Series		
Standard Format and Content of the Safety Analysis Report for Front-End Nuclear Fuel Cycle Facilities, HAD 301/01	NNSA	2021
Design of Spent Fuel Storage Installation, HAD 301/02	NNSA	1998
Operation of Spent Fuel Storage Installation, HAD 301/03	NNSA	1998
Safety Assessment of Spent Fuel Storage Installation, HAD 301/04	NNSA	1998
Safety of the Nuclear Fuel Reprocessing Facilities, HAD 301/05	NNSA	2021
Safety of Conversion Facilities and Uranium Enrichment Facilities, HAD 301/06	NNSA	2021
5 Radioactive Waste Management Series		
Management of Radioactive Effluents and Waste Arising from Nuclear Power Plant, HAD 401/01	NNSA	1990
Design of Radioactive Waste Management System for Nuclear Power Plant, HAD 401/02	NNSA	1997
Design and Operation of Radioactive Waste Incineration Installation, HAD 401/03	NNSA	1997
Siting of Radioactive Waste Near Surface Disposal Facility, HAD401/05	NNSA	1998
Siting of High Level Radioactive Waste Geological Facility, HAD 401/06	NNSA	2013
Radioactive Waste Minimization at Nuclear Facilities HAD 401/08	NNSA	2016
Monitoring and inspection of Radioactive Waste Disposal Facilities, HAD 401/09	MEE/NNSA	2019
Geological Disposal Facilities for Radioactive Waste, HAD 401/10	NNSA	2020
Minimization of Radioactive Waste in Nuclear Technology Application Projects, HAD 401/11	NNSA	2020
Predisposal Management of Radioactive Waste at Nuclear Facilities, HAD 401/12	NNSA	2020
Safety of Low Level Solid Radioactive Waste Storage Facilities, HAD 401/13	NNSA	2021
Decommissioning of Nuclear Technology Application Facilities, HAD 401/14	NNSA	2021
Safety Assessment for Decommissioning of Nuclear Facilities, HAD 401/15	NNSA	2021
Management of Radioactive Waste from the Use of Radioactive Material in Medicine, Industry, Agriculture, Research and Education, HAD 401/16	NNSA	2023
6 Nuclear Material Control Series		
Nuclear Fuel Balance Budget for Low Enriched Uranium Conversion and Element Fabrication Plant, HAD 501/01	NNSA	2008
Physical Protection for Nuclear Installations, HAD 501/02	MEE/NNSA	2018
Alarming System Against Intrusion to Nuclear Facility, HAD 501/03	NNSA	2005
Access Control of Nuclear Facility, HAD 501/04	NNSA	2008
Physical Protection of Nuclear Materials Transport, HAD 501/05	NNSA	2008

Title	Issued by	Entry into force
Format and Content of Safety Analysis Report of Physical Protection and Nuclear Materials Accountancy and Control, HAD 501/06	NNSA	2008
Nuclear Materials Accountability for Nuclear Power Plant, HAD 501/07	NNSA	2008
Video Monitoring System for Physical Protection of Nuclear Power Plant, HAD 501/08	NNSA	2020
Nuclear Material Accounting for Nuclear Fuel Reprocessing Plants, HAD 501/09	NNSA	2022
7 Civilian Nuclear Safety Equipment Regulatory Management Series		
Civilian Nuclear Safety Simulated Machinery and Equipment Parts Production (Trial), HAD 601/01	NNSA	2013
Technical Requirements on Civilian Nuclear Safety Equipment Installation and Licence Applicant (Trial), HAD 601/02-2013	NNSA	2013
8 Radioactive Article Transport Management Series		
Standard Format and Content of Safety Assessment (Analysis) Report of Radioactive Article Transport Container Design, HAD 701/01	NNSA	2010
Standard Format and Content of Nuclear and Radiation Safety Analysis Report of Radioactive Article Transport, HAD 701/02	NNSA	2021

L.6.5 Relevant Standards

Name	Issued by	Entry into force
1 Generic Series		
Basic standards for protection against ionizing radiation and for the safety of radiation sources, GB 18871-2002	General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China (AQSIQ)	2002
Radiation protection regulations for handling unsealed source, GB 11930-2010	AQSIQ, Standardization Administration of the People's Republic of China (SAC)	2011
General regulation of quality assurance for ionizing radiation monitoring, GB 8999-2021	MEE, SAMR	2021
Glossary of nuclear science and technology terms - Part 3: Nuclear fuel and nuclear fuel cycle, GB/T 4960.3-2010	AQSIQ, SAC	2011
Glossary of terms: Nuclear science and technology -Radiation protection and safety of radiation sources, GB/T 4960.5-1996	China State Bureau of Quality and Technical Supervision (CSBTS)	1996
Glossary of nuclear science and technology terms - Part 7: Nuclear materials control and safeguards, GB/T 4960.7-2010	AQSIQ, SAC	2011
Glossary of term: nuclear science and technology - Part 8: Radioactive waste management, GB/T 4960.8-2008	AQSIQ, SAC	2008
Regulations for the safe transport of radioactive material, GB 11806-2019	MEE, SAMR	2019
Quality assurance for packaging used in transport of radioactive material, GB/T 15219-2009	AQSIQ, SAC	2009

Name	Issued by	Entry into force
Activity concentration for material not requiring radiological regulation, GB 27742-2011	AQSIQ, SAC	2012
Guidelines for the safe design of packaging for radioactive material against brittle fracture, HJ 1201-2021	MEE	2021
Format and content of nuclear and radiation safety analysis report for transport of radioactive articles, HJ 1187-2021	MEE	2021
Technical specification for the measurement of environmental gamma radiation dose rate, HJ 1157-2021	MEE	2021
Technical specification for radiation environmental monitoring, HJ 61-2021	MEE	2021
Technical specifications for emergency monitoring in radiation accidents, HJ 1155-2020	MEE	2020
Ambient air - Determination of gamma-ray emitting radionuclides in aerosol - Filter compression /gamma spectrometry, HJ 1149-2020	MEE	2020
Format and content of acceptance monitoring report of radiation environmental protection for completion of development and utilization project of other radioactive mines, HJ 1148-2020	MEE	2020
Technical specifications on determination of gamma-ray emitting radionuclides in environmental samples for emergency monitoring, HJ 1127-2020	MEE	2020
Analysis method for tritium in water, HJ 1126-2020	MEE	2020
General technical requirements for fabrication of steel spent fuel transport cask, HJ 1202-2021	MEE	2021
2 Nuclear Power Plant Series		
Regulations for environmental radiation protection of nuclear power plant, GB 6249-2011	MEP, AQSIQ	2011
Analysis and control specifications for airborne radioactive source term of pressurized water reactor nuclear power plant, GB/T 42290-2022	SAMR, SAC	2023
Safety design rule for spent fuel dissolving system of nuclear fuel reprocessing plant, EJ/T 1142-2002	CAEA	2003
Design criteria for pressurized water reactor spent fuel storage facilities at nuclear power plant, EJ/T 883-2006	CAEA	2007
Design criteria for independent spent fuel storage installation (water pool type), EJ/T 878-2011	CAEA	2011
Technical specification to thermal discharge monitoring for coastal nuclear power plants based on satellite remote sensing (on trial), HJ 1213-2021	MEE	2021
Technical specification for environmental emergency monitoring in nuclear power plant accidents, HJ 1128-2020	MEE	2020
3 Radioactive Waste Management Series		
3.1 Fundamental Document		
Regulations for radioactive waste management, GB 14500-2002	AQSIQ	2003
3.2 Generation, Pretreatment, Treatment and Discharge of Waste		

Name	Issued by	Entry into force
Authorized limits for normalized releases of radioactive effluents from nuclear fuel cycle, GB 13695-1992	CSBTS	1993
The general regulation for environmental radiological assessment, GB 11215-1989	NEPA	1990
General requirements of quality assurance program for effluent and environmental radioactivity monitoring at nuclear facilities, GB 11216-1989	NEPA	1990
Graphical signs for environmental protection - Discharge outlet (source), GB 15562.1-1995	NEPA	1997
Radiological protection management for medical radioactive waste, GBZ 133-2009	MOH	2009
Radioactive source term of pressurized water reactor nuclear power plant for operation states, GB/T 13976-2021	AQSIQ, SAC	2021
Decontamination of radioactively contaminated surfaces - Part 1: Method for testing and assessing the ease of decontamination, GB/T 14057.1-2008	AQSIQ, SAC	2009
Decontamination of radioactively contaminated surface - Part 2: Testing method of decontamination agents for textiles, GB/T 14057.2-2011	AQSIQ, SAC	2011
Characterization of radioactive waste forms and packages, EJ 1186-2005	Commission of Science, Technology and Industry for National Defence (COSTIND)	2005
Regulations for low and intermediate level radioactive waste volume reduction system, EJ/T 795-1993	CNNC	1994
3.3 Waste Conditioning		
Standard test method for leachability of low and intermediate level solidified radioactive waste forms, GB/T 7023-2011	AQSIQ, SAC	2012
Standard of safety for low and intermediate level solid radioactive waste packages, GB 12711-2018	MEE, SAMR	2019
Performance requirements for low and intermediate level radioactive waste form - Cemented waste form, GB 14569.1-2011	MEP, AQSIQ	2011
Characteristic requirements for solidified waste of low-and intermediate-level radioactive waste - Bitumen solidified waste, GB 14569.3-1995	CSBTS	1996
Ductile cast iron high integrity container for low-and-intermediate level radioactive solid wastes, GB 36900.1-2018	MEE, SAMR	2019
Concrete high integrity container for low-and-intermediate level radioactive solid wastes, GB 36900.2-2018	MEE, SAMR	2019
Cross linked high density polyethene high integrity container for low-and-intermediate level radioactive solid wastes, GB 36900.3-2018	MEE, SAMR	2019
Containers for low-and intermediate-level radioactive solid waste Steel drum, EJ 1042-2014	State Administration of Science, Technology and Industry for National Defense (SASTIND)	2014
Container for low-and intermediate-level radioactive solid waste Steel box, EJ 1076-2014	SASTIND	2014

Name	Issued by	Entry into force
Concrete container for low- and intermediate-level radioactive solid wastes, EJ/T 914-2000	COSTIND	2001
Characterization of low level radioactive waste packages - Cemented waste form, GB 41930-2022	MEE, SAMR	2023
3.4 Waste Storage		
Regulations for interim storage of low-and intermediate-level radioactive solid wastes, GB 11928-1989	CSBTS	1990
Regulations for designing storage building of high level radioactive liquid waste, GB 11929-2011	AQSIQ, SAC	2012
Technical rules for interim storage of low and intermediate level solid radioactive waste from nuclear power plant, GB 14589-1993	CSBTS	1993
Requirements on safety analysis report for solid LILW interim storage, EJ/T 532-1990	CNNC	1990
Technical specifications of radiation environmental protection for other radioactive material's storage and solid waste's landfill (Trial), HJ 1114-2020	MEE	2020
Technical specifications for siting, design and construction of radioactive waste repository for nuclear technology application, HJ 1258-2022	MEE	2022
3.5 Waste Disposal		
Safety requirements for near surface disposal of low and medium level radioactive solid waste, GB 9132-2018	MEE, SAMR	2019
Regulations for disposal of solid low- and intermediate level radioactive waste in rock cavities, GB 13600-1992	CSBTS	1993
Graphical signs for environmental protection solid waste storage (disposal) site, GB 15562.2-1995	NEPA	1995
Requirements for environmental radiation monitoring around near surface disposal site of radioactive solid waste, GB/T 15950-2023	MEE, SAMR	2023
Safety requirements for near surface disposal of disused radioactive sources, HJ 1336-2023	MEE	2024
Regulations for design of near surface disposal facilities of low and intermediate level radioactive waste - Disposal except in rock caverns, EJ/T 1109.1-2000	COSTIND	2000
Regulations for design of near surface disposal facilities of low and intermediate level radioactive waste - Disposal in rock caverns, EJ/T 1109.2-2002	COSTIND	2003
Environmental protection regulation guidelines for nuclear facilities - Standard format and content of environmental impact reports for shallow ground disposal of solid radioactive waste, HJ/T 5.2-1993	NEPA	1993
Siting of near surface disposal facilities of low- and intermediate-level radioactive waste, HJ/T 23-1998	NEPA	1998
Landfill disposal of very low level radioactive waste, GB/T 28178-2011	AQSIQ, SAC	2012
Activity measurements of solid materials considered for recycling, re-use, or disposal as non-radioactive waste, GB/T 17947-2008	AQSIQ, SAC	2009

Name	Issued by	Entry into force
3.6 Nuclear Facility Decommissioning and Environmental Reclamation		
Technical regulations for environmental management of reactor decommissioning, GB 14588-2009	AQSIQ	2009
Clearance levels for recycle and reuse of steel, aluminum, nickel and copper from nuclear facilities, GB 17567-2009	AQSIQ, SAC	2009
Safety requirements for decommissioning of nuclear facilities, GB/T 19597-2004	AQSIQ, SAC	2005
Provisions of decommissioning nuclear fuel reprocessing radiation protection, EJ 588-1991	CNNC	1992
Technical guidelines on decontamination during reactor decommissioning, EJ/T 941-1995	CNNC	1995
Standard format and content for the decommissioning environmental impact report of uranium processing and fuel fabrication facilities, EJ/T 1037-1996	CNNC	1997
Interim regulation for acceptable levels of residual radionuclides in soil of site considered for release, HJ 53-2000	SEPA	2000
3.7 Management of Radioactive Waste from Uranium Mining and Milling		
Regulations for safe management of radioactive waste from the mining and milling of uranium and thorium ores, GB 14585-1993	NEPA, CSBTS	1994
Technical regulations for the environmental management of decommissioning of uranium mining and milling facilities, GB 14586-1993	NEPA, CSBTS	1994
Regulation for radiation environmental monitoring in uranium mine and mill, GB 23726-2009	MEP, AQSIQ	2010
Regulations for radiation protection and radiation environment protection in uranium mining and milling, GB 23727-2020	MEE, SAMR	2020
Regulations on radiation protection technique for uranium heap leaching and in-suit leach mining, EJ 1007-1996	CNNC	1996
Regulations for uranium mine and processing plant site selection, EJ/T 1171-2004	CAEA	2004

L.7 References

L.7.1 Documents

No.	References
1	The Eighth National Report of the People's Republic of China to the Convention on Nuclear Safety, 2019
2	The Ninth National Report of the People's Republic of China to the Convention on Nuclear Safety, 2022
3	Nuclear Safety in China, 2019
4	Annual report of nuclear safety, MEP/NNSA, 2020
5	Annual report of nuclear safety, MEP/NNSA, 2021
6	Annual report of nuclear safety, MEP/NNSA, 2022
7	Annual report of nuclear safety, MEP/NNSA, 2023

L.7.2 Websites

More Information can be available at the following websites:

No.	Agency Name	Website
1	MEE	www.mee.gov.cn
2	NNSA	nnsa.mee.gov.cn
3	CAEA	www.caea.gov.cn
4	NHC	www.nhc.gov.cn
5	NEA	www.nea.gov.cn
6	MPS	www.mps.gov.cn
7	CNNC	www.cnnc.com.cn
8	CGN	www.cgnpc.com.cn
9	SPIC	www.spic.com.cn
10	CHNG	www.chng.com.cn

L.8 Abbreviation

No.	Abbreviation	Full name
1	101 HWRR	the 101 Heavy Water Research Reactor
2	3D	Three Dimensional
3	AI	Artificial Intelligence
4	ALARA	As Low As Reasonably Achievable
5	ANSN	Asian Nuclear Safety Network
6	AQSIQ	the General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China
7	ASN	L'Autorité de sûreté nucléaire
8	Beilong Disposal Facility	Guangdong Beilong Low Level Solid Waste Disposal Facility
9	Beishan URL	Beishan Underground Research Laboratory
10	BRIUG	Beijing Research Institute of Uranium Geology
11	CAEA	China Atomic Energy Authority
12	CEA	China Earthquake Administration
13	CGN	China General Nuclear Power Corporation
14	CHNG	China Huaneng Group Co., Ltd.
15	CIAE	China Institute of Atomic Energy
16	CNEA	China Nuclear Energy Association
17	CNNC	China National Nuclear Corporation
18	CNNC Everclean	CNNC Everclean Environmental Technology Engineering Co., Ltd.
19	CNNP	China National Nuclear Power Co., Ltd.
20	COSTIND	Commission of Science, Technology and Industry for National Defence
21	CSBTS	China State Bureau of Quality and Technical Supervision

22	EIA	Environmental Impact Assessment
23	EIS	Environmental Impact Statement
24	EPR	European Pressurized Reactor
25	Feifengshan Disposal Facility	Feifengshan Low and Intermediate Level Solid Waste Disposal Facility
26	FNCA	Forum for Nuclear Cooperation in Asia
27	GNSSN	Global Nuclear Safety and Security Network
28	HLW	High Level Waste
29	HTGR	High-Temperature Gas-Cooled Reactor
30	HWR	Heavy Water Reactor
31	IAEA	International Atomic Energy Agency
32	ILW	Intermediate Level Waste
33	INR	Institute for Nuclear Research
34	Joint Convention	Joint Convention on the Safety of Spent Fuel Management and the Safety of Radioactive Waste Management
35	LILW	Low and Intermediate Level Waste
36	LLW	Low Level Waste
37	Longhe Disposal Facility	Longhe Near Surface Disposal Facility
38	LWR	Light Water Reactor
39	MEE	Ministry of Ecology Environment
40	MEE/NNSA	the Ministry of Ecology and Environment (National Nuclear Safety Administration)
41	MEP	Ministry of Environmental Protection
42	MFA	Ministry of Foreign Affairs
43	MIIT	Ministry of Industry and Information Technology
44	MOF	Ministry of Finance
45	MOH	Ministry of Health
46	MOST	Ministry of Science and Technology
47	MOT	Ministry of Transport
48	MPS	Ministry of Public Security
49	MSR	Molten Salt Reactor
50	NDRC	National Development and Reform Commission
51	NEA	National Energy Administration
52	NEPA	National Environmental Protection Agency
53	NHC	National Health Commission
54	NIMBY	Not in My Backyard
55	NNAECC	National Nuclear Accident Emergency Coordination Committee
56	NNAERO	National Nuclear Accident Emergency Office

57	NO RWM	National Operator for Radioactive Waste Management
58	NORM	Naturally Occurring Radioactive Materials
59	Northwest Disposal Facility	Northwest Low Level Solid Waste Disposal Facility
60	NPC	National People’s Congress
61	NPIC	Nuclear Power Institute of China
62	NPP	Nuclear Power Plant
63	NRRC	National Report Review Committee
64	NRCG	National Report Compiling Group
65	OECD	Organisation for Economic Co-operation and Development
66	PSR	Periodic Safety Review
67	PWR	Pressurized Water Reactor
68	QA	Quality Assurance
69	QR Code	Quick Response Code
70	R&D	Research and Development
71	RCF	Regulatory Cooperation Forum
72	SAC	Standardization Administration of the People’s Republic of China
73	SAMR	State Administration for Market Regulation
74	SASAC	State-owned Assets Supervision and Administration Commission of the State Council
75	SASTIND	State Administration of Science, Technology and Industry for National Defense
76	SEC	Scientific and Engineering Centre for Nuclear and Radiation Safety
77	SEPA	State Environmental Protection Administration
78	SFDSS	Spent Fuel Dry Storage System
79	SMR	Small Modular Reactor
80	SOEs	State-Owned Enterprises
81	SPIC	State Power Investment Corporation
82	SRTF	Site Radioactive Waste Treatment Facility
83	TBM	Tunnel Boring Machine
84	URL	Underground Research Laboratory
85	VLLW	Very Low Level Waste
86	VSLW	Very Short Lived Waste
87	VVER	Water-Water Energetic Reactor
88	WANO	World Association of Nuclear Operators

PART 2
REPORT BY THE HONG KONG SPECIAL ADMINISTRATIVE REGION GOVERNMENT

A. INTRODUCTION

A.1 Overview

Hong Kong Special Administrative Region (HKSAR) does not produce spent fuel. There are also no facilities related to spent fuel management. Hence, the articles under Chapter 2 of the *Joint Convention* concerning the safety of spent fuel management are not applicable to HKSAR.

To realise and maintain a high standard of radiation protection so as to safeguard the health of the public and workers as well as the safety of the society and environment, HKSAR has established a proper and effective radiation protection system and regulatory regime to manage the use of radioactive substances and to deal with the resultant wastes. In HKSAR, radioactive substances are primarily used in medical services, industry, education and scientific research, etc. All radioactive wastes arising from such uses belong to the class of low level or low to intermediate level radioactive wastes.

The management of radioactive substances in HKSAR is founded on the basis of international principles of radiation protection, with legislation and a licensing system as the regulatory instruments. A permanent statutory regulatory authority is established as the policy formulation and law enforcement agency. The entire system is complemented by collaboration amongst the various professional bodies that provide advice and services on radiation protection and practical radiation protection technology and instrumentations. In formulating and reviewing the policies on radiation protection, the regulatory authority has made extensive reference to national and international standards and recommendations to facilitate the application and development of radiation technology.

A.2 Waste Facility

In addition, a purpose-built Low-level Radioactive Waste Storage Facility ("Storage Facility") was commissioned in HKSAR in mid-2005. It is a crucial facility to enable a holistic and effective management of radioactive wastes in conformance to the high standard of management culture on radiation safety.

B. POLICIES AND PRACTICES

B.1 Definition of Radioactive Wastes

The *Radiation Ordinance* (Cap. 303 of the Laws of Hong Kong) (please refer to Appendix I.2 Reference[1]) and the associated licensing system form the legal basis for the control of radioactive substances and radioactive wastes in HKSAR. The Hong Kong Radiation Board ("the Board") is established as the regulatory authority under the *Radiation Ordinance*.

As defined in the *Radiation Ordinance*, all disused radioactive substances or wastes contaminated by radioactive substances should be regarded as radioactive wastes. Any person who works and undertake activities involving radioactive substances (including radioactive wastes) are required to be covered by a valid licence issued by the Board.

Any premises where radioactive substances are handled are subject to radiation safety assessment and on-site inspection of the Board to ensure that legal requirements and conditions of licence are fully met before a licence is granted. The Board will also conduct review assessment at such premises during the licence period and before the renewal of licence to ensure that requirements on radiation safety are effectively maintained.

B.2 Criteria for the Categorization of Radioactive Wastes

Radioactive wastes produced in HKSAR are classified into the following basic categories according to their properties –

i) solid waste;

ii) liquid waste;

iii) gaseous waste; and

iv) exempt waste.

Solid radioactive waste mainly includes disused sealed sources and solid wastes contaminated by radioactive substances, etc. Sealed sources are used primarily in medical and industrial sectors. Sealed sources in medical applications include the higher activity Category 1 and Category 2 sources under the *Categorization of Radioactive Sources* of the International Atomic Energy Agency (IAEA), such as caesium-137 in blood irradiator systems and cobalt-60 in gamma knife radiosurgery system, as well as Category 3 or lower category sources that are used in brachytherapy and calibration of radiation detectors. Sealed sources for industrial applications include Category 2 and Category 3 sources such as iridium-192 and selenium-75, etc., that are used in non-destructive testing, as well as sealed sources of lower categories that are used in quality inspection instruments, such as americium-241/beryllium neutron sources in the measurement of moisture and density in concrete, americium-241 γ-source in the analysis of material contents as well as nickel-63 -sources in electron capture devices.

Sealed sources for scientific research and educational purposes primarily belong to the lower radioactivity Category 5. Radioactive substances used in other products include americium-241 in lightning conductors and smoke detectors as well as tritium in luminous watches and directional signs, etc.

Liquid radioactive waste mainly refers to disused liquid or solution containing radioactive substances. Liquid radioactive substances include radio-pharmaceuticals used in nuclear medicine for the treatment and diagnosis of diseases, such as iodine-131, technetium-99m, thallium-201, gallium-67, fluorine-18, and phosphorus-32; as well as radioactive compounds used in clinical tests and scientific research, such as iodine-125, phosphorus-32, carbon-14 and uranium-238, etc.

Gaseous radioactive waste mainly refers to waste radioactive gases, vaporised radioactive liquid and radioactive aerosols, such as krypton-85 and technetium-99m vapour, etc.

Exempt waste refers to waste that is exempted from regulatory control in accordance with exemption principles.

C. RADIOACTIVE WASTE MANAGEMENT POLICIES AND ITS PRACTICES

C.1 Radioactive Waste Management Policies

The fundamental principle of HKSAR's radioactive waste management policy is to minimise the waste arising at source. The Board adopts the following management policies commensurate with the properties and categories of radioactive wastes –

i) **Sealed sources**: the licensed user is required to return disused sealed sources to their original manufacturer. With prior approval from the Board, the licenced user could also return disused sealed sources to alternative suppliers or manufacturers of the same type of sealed sources outside Hong Kong. In case that there are justifiable reasons proving that the foregoing measures are impracticable, the licensed user may seek approval from the Board for transferring the waste sources to the Storage Facility;

ii) **Solid contaminated wastes**: the licensed user is required to store such wastes to allow for radioactive decay for a period of time as specified in the conditions of licence, after which the wastes should be disposed of as exempt wastes. Subject to the conditions of licence, some wastes that present biological hazards may be disposed of by incineration. Subject to the approval of the Board, wastes exceeding the permitted discharge level after delay storage may be transferred to the Storage Facility;

iii) **Liquid wastes**: the licensed user is required to store such wastes to allow for radioactive decay for a period as specified in the conditions of licence, after which the wastes should be disposed of as exempt liquid wastes. Subject to the approval of the Board, wastes exceeding the permitted discharge level after delay storage may be solidified and transferred to the Storage Facility for suitable processing and storage; and

iv) **Gaseous wastes**: the licensed user is required to collect such wastes or discharge them through a purpose-designed exhaust system according to the principles specified in the conditions of licence.

C.2 Discharge of Effluents

The permitted discharge level of different wastes is determined with reference to the Annual Limit on Intake of the individual radionuclide. The user concerned should record in detail the date on which the waste is produced, its activity, storage duration and the date of discharge. Any disposal of wastes exceeding the limit permitted by the licence shall only be carried out after satisfactory assessment of the impact on the public and environment caused by the proposed disposal method in conjunction with the radioactivity and the radiation level of such wastes and subject to the approval of the Board.

D. SAFETY OF RADIOACTIVE WASTE MANAGEMENT (Articles 11-17)

D.1 Safety Management Practices of the Storage Facility

As stated in paragraph C.1, the basic principle for the management of radioactive wastes of HKSAR is to proactively minimise the quantity of wastes at the source of waste arising. This is further complemented by the formulation and implementation of relevant disposal policies and regulations commensurate with the properties of various categories of wastes so as to minimize the risks caused by such wastes on humans, society and the environment.

The Storage Facility, with a designed storage capacity of $140m^3$, has been commissioned in HKSAR since mid-2005. Presently the total volume of waste in store is about $80m^3$. It is estimated that the storage capacity will meet the waste storage requirement of HKSAR in the coming 100 years. Apart from this facility, HKSAR does not have any other proposed radioactive waste facilities.

The siting and planning of the Storage Facility were studied and examined in detail by the Environmental Protection Department ("EPD") of the HKSAR Government, which included risk and environmental assessment. The Storage Facility was designed and constructed under the supervision of independent professional consultants according to high standards and advanced technology in radiation safety design specified by EPD. Having satisfactorily passed the Board's in-depth licensing assessments to confirm that legal requirements and terms of licence are met, the Storage Facility is now operated by EPD's contractor.

The Storage Facility is located at Siu A Chau, a small remote island located at the southwest of Lantau, which is far away from residential areas. Its core design comprises a central waste storage vault, a waste processing area equipped with glove boxes and fume cupboard, a radiation laboratory which provides various radioactivity analysis and measurement equipment, a continuous radiological surveillance system which monitors the gaseous discharge as well as the radiation level inside and outside the facility and a central control room for overall management of the facility, etc. The Storage Facility is also equipped with an all-round weather-proof security surveillance system, which is directly connected to a 24-hour monitoring centre located at the urban area through a dedicated data network. The safe operation of the Storage Facility is therefore stringently ensured.

The radiation levels inside and outside the Storage Facility are continuously monitored and controlled to be within the range specified by the licence and in accordance with the operation manual, with due regard to the principle of optimisation of radiological protection. The contractor is also required to conduct regular analysis and assessment on the impact of the Storage Facility to its surrounding environment, so as to ensure that high standards of radiation protection are effectively maintained. Radioactive wastes generated during the operation of the Storage Facility are required to be properly disposed of in accordance with the methods and discharge limits approved under the relevant policies of the Board.

D.2 Inventory of Wastes

At present, the majority of the low-level radioactive wastes produced in HKSAR, including those arising from medical, industrial and educational origins, has already been transferred to the Storage Facility. An inventory list of these wastes is given in Appendix I.1.

E. LEGISLATIVE AND REGULATORY FRAMEWORK (Articles 18-20)

E.1 Regulatory Framework

The *Radiation Ordinance* establishes the Board as the statutory authority to exercise the powers conferred by the *Ordinance*, which include granting of licence and imposing conditions of licence. Section 3 of the *Radiation Ordinance* provides that the Board shall consist of three *ex-officio* members (the Director of Health being the *ex-officio* Chairman) and such persons not exceeding 10 in number as the Chief Executive may appoint from time to time. Under section 13 of the *Radiation Ordinance* and subject to the approval of the Legislative Council, the Board may by regulation provide for a series of matters related to radiation safety that comes under the jurisdiction of the *Ordinance*. In addition, the Board may from time to time appoint persons by name or office to be inspectors to exercise the powers of inspection stipulated under section 16 of the *Ordinance*.

The Board has established an effective licensing system according to the regulatory framework. It has also formulated policies and corresponding conditions of licence in accordance with principles and requirements of radiation protection for different practices involving the use of radioactive substances. Any person who is engaged in work or activity relating to radioactive substances or wastes should obtain a valid licence issued by the Board. During the evaluation of licence application, appropriate and comprehensive radiation safety assessment will be conducted on the applicant, premises and equipment, etc. to confirm the compliance of the requirements stipulated in relevant legislations and licence conditions.

E.2 Licensing System

Licence applicants are required to submit detailed technical specifications of the radioactive source or irradiating apparatus, the applicable safety standards, certification and record of safety tests, radiation safety design of the premises and equipment, etc. to facilitate the assessment of the Board. All radioactive substance licences will have specific prescriptions about the concerned radioactive nuclides and the approved purposes of use and activity limits. Inspectors of the Board, as part of the assessments of the application, will conduct on-site inspection of the concerned premises. The inspection assessment will cover the following aspects –

i) radiation level surveys;

ii) radiological protection facilities and equipment;

iii) effective operation of monitoring equipment;

iv) contamination control facilities and procedures;

v) records of purchase and storage of radioactive substances;

vi) records of disposal of radioactive wastes;

vii) inventory list and safety management of sealed sources;

viii) radiation monitoring programme and working instructions;

ix) appointment of supervising persons;

x) health surveillance of radiation workers; and

xi) contingency plan, etc.

The licensee is required to report any changes in the licence particulars to the Board for approval and updating and to submit regular reports on testing of sealed sources and radiation monitoring equipment, as well as sale and purchase records of sealed sources, etc. Inspectors of the Board will conduct on-site audit visit at the premises to ensure that radiological safety is effectively maintained. The Board will proactively initiate investigation into any suspected irregularities and, if such irregularities are substantiated, the parties concerned could be prosecuted or warned according to the provisions of the *Ordinance* and licence conditions. Review and follow-up on the improvement measures will also be conducted.

E.3 Radioactive Sources Information Management

To facilitate the effective implementation of the *Code of Conduct on the Safety and Security of Radioactive Sources* issued by the IAEA, the Board has set up a comprehensive information management system to maintain the register of sealed sources in HKSAR. The licensing system has been accredited with *ISO 9001:2000 Quality Management System* certification since 2004 and successfully upgraded to conform to the *ISO 9001:2008* quality management standards in 2009 and subsequently to the latest ISO 9001:2015 quality management standards in early 2018, which reflects the quality of the management system and the commitment to continual improvement. The entire licensing system and the associated radioactive sources database information system have been successfully converted to a fully electronic work flow system in 2010 to enhance the information analysis and data handling capability and to facilitate a “cradle to grave” lifecycle management of radioactive sources. The electronic work flow system is successfully upgraded in 2020 with enhanced performance and capacity.

E.4 Emergency Response

In the event of radiological incidents, inspectors of the Board will, depending on the nature and category of the incident and in accordance with established emergency procedures, take appropriate response actions in collaboration with relevant departments such as the Security Bureau, Fire Services Department and the Police, etc. The response actions will consist of evaluating the risks of the radiation hazards, carrying out emergency countermeasures including decontamination, as well as managing radioactive wastes arising from the incident, so as to limit the impact arising from possible radiation exposure and contamination on individuals, society and the environment.

F. GENERAL SAFETY PROVISIONS (Articles 21-26)

F.1 Responsibility of the licence holder (Article 21)

According to the *Radiation Ordinance*, the licensees who are authorized to handle radioactive substances are required to manage and dispose of their radioactive wastes properly in accordance with the requirements stipulated in the *Radiation Ordinance* and the relevant conditions of licence. Such requirements include method of storage, radiation level at the storage site, method of waste management, record of waste discharge and safety standards of transport, etc. Inspectors of the Board will regularly inspect the premises at which radioactive substances are used to ensure that requirements of the law and conditions of licence are met. The licensees are liable for contraventions to the *Radiation Ordinance*, and may be subject to the prescribed penalties upon conviction by the court.

F.2 Human and Financial Resources (Article 22)

Any licensee who is engaged in work involving the handling of radioactive substances is required to employ qualified supervising persons who have received proper training on radiation protection to supervise the work. The approved supervising persons are listed in the licence.

The Storage Facility is the property of and fully funded by the HKSAR Government. Hence, human and financial resources required for the operation of the Storage Facility, including staff training and management, can be reliably maintained. Every staff working at the Storage Facility has completed proper training and professional assessments as required by the work.

F.3 Quality Assurance (Article 23)

The contractor of the Storage Facility is required, according to the conditions of licence, to set up and maintain an effective quality management system, so as to ensure the safety and security of radioactive substances.

The Storage Facility is operated and managed in accordance with *ISO 14000 Environmental Management Standards*, which reflects the Government's commitment to management quality and environmental protection.

F.4 Operational Radiation Protection (Article 24)

The conditions of licence of the Storage Facility require the radiation level inside and outside the facility to be controlled within the specified range commensurate with the principle of optimisation. Under normal operation of the Storage Facility, the radiation exposure of workers and the public are required to be controlled within the relevant dose limits applicable to occupational exposure and public exposure stipulated in the *Radiation Ordinance*, i.e. no more than 20mSv and 1mSv in any one year respectively.

The Storage Facility is equipped with high standard radiation safety design: the structure of the storage vault provides shielding of radiation and prevents the release of radioactive substances from the Facility. The specially designed wastewater treatment system and high performance air filtration system can effectively reduce the discharge of liquid and gaseous radioactive substances. Data from the continuous radiation monitoring systems inside and outside the Storage Facility are directly transferred to a 24-hour monitoring centre located in the urban area through dedicated network to ensure that these radiation levels are controlled within the regulatory requirements. Furthermore, environmental monitoring with the collection of relevant environmental samples for radiation monitoring and radioactivity analysis is conducted regularly to ensure that the operation of the Storage Facility will not result in any adverse impact on the environment.

F.5 Facility Emergency Preparedness (Article 25)

The contractor of the Storage Facility has, as required by the Board, set up corresponding contingency plans and mechanisms for the various foreseeable emergency scenarios. Under such mechanisms, the contractor should carry out appropriate response measures jointly with relevant government departments for the various emergency scenarios, so as to safeguard the safety of workers and the public as well as protecting the environment. The contractor is required to conduct regular exercises to test the contingency plans under the supervision of the EPD.

F.6 Decommissioning (Article 26)

At the planning stage of the Storage Facility, the HKSAR Government has given serious considerations to its decommissioning requirements. As there remains a long period of time to go before decommissioning of the Storage Facility takes effect, the HKSAR Government will formulate detailed plans, provide the funds and take charge of the decommissioning work at an appropriate time.

G. TRANSBOUNDARY MOVEMENT (Article 27)

G.1 Import and Export Control

HKSAR does not produce any sealed sources or radioactive substances and, therefore, the transboundary movement of radioactive substances, in general, is confined to transhipment operations, import of radioactive substances for local use and return of disused sealed sources to their places of origin. According to the existing regulations, any import of radioactive substances into HKSAR is required to be covered by a valid import licence issued under the *Import (Radiation) (Prohibition) Regulations* (Cap. 60K of the Laws of Hong Kong) (please refer to Appendix I.2 Reference[2]) and a radioactive substance licence issued by the Board under the *Radiation Ordinance*. The assessment of import licence application will include a comprehensive evaluation of the export and transport approvals for the particular radioactive substances or sealed sources, their categories and properties, radioactivity, safety tests, the radiation safety of the proposed stowage or storage sites, etc. The licensee is required to regularly submit their records of import and sale activities to the Board for auditing.

G.2 Transport Management

The transport of radioactive substances in HKSAR should comply with the *Regulations for the Safe Transport of Radioactive Material* and the *Guidance on the Import and Export of Radioactive Sources* issued by the IAEA and is required to be covered by a valid licence and conveyance permit issued by the Board. The transport should be conducted under the personal supervision of the approved supervising persons prescribed by the licence. The licensee is required to submit to the Board the reports and records of the transport activities after they have been completed.

H. DISUSED SEALED SOURCES (Article 28)

H.1 Disused Sealed Sources

As stated in paragraph G.1, HKSAR does not produce any sealed sources or radioactive substances. Therefore, article 28 “Disused sealed sources” of the *Joint Convention* does not apply to HKSAR.

I. APPENDICES

I.1 Inventory of Wastes Stored in the Storage Facility

Appendix I.1 Low-level Radioactive Waste Storage Facility of Hong Kong

List of Major Isotopes in Store

Isotope	**Total Activity (MBq)**	**Weight (kg)**	**Major Sources of Wastes**
Caesium-137	6.2×10^5	9.6×10^2	Medical radiation sources
Radium-226	7.1×10^4	1.0×10^4	Lightning conductor heads, luminous watch dials and hands, medical radiation sources
Cobalt-60	4.7×10^4	6.4×10^2	Radioactive check sources
Promethium-147	4.0×10^4	8.3×10^3	Luminous watch dials and hands
Strontium-90	3.3×10^4	4.1×10^2	Medical radiation sources
Gadolinium-153	1.1×10^4	1.0	Medical radiation sources
Americium-241	1.9×10^4	5.1×10^2	Radioactive check sources, smoke detectors, nucleonic gauges
Thorium-232	1.2×10^3	8.0×10^3	Rayon mantles for kerosene lanterns

Total volume of waste in store = $80m^3$ (as at March 2024)

I.2 References

1. Radiation Ordinance (Cap. 303 of the Laws of Hong Kong)

2. Import (Radiation) (Prohibition) Regulations (Cap. 60K of the Laws of Hong Kong)

3. INTERNATIONAL ATOMIC ENERGY AGENCY, Guidance on the Import and Export of Radioactive Sources, IAEA, Vienna (2012)

4. INTERNATIONAL ATOMIC ENERGY AGENCY, Code of Conduct on the Safety and Security of Radioactive Sources, IAEA, Vienna (2004)

5. INTERNATIONAL ATOMIC ENERGY AGENCY, Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, INFCIRC/546, Vienna (1997)

6. INTERNATIONAL ATOMIC ENERGY AGENCY, Categorization of Radioactive Sources, IAEA Safety Standards Series No. RS-G-1.9, IAEA, Vienna (2005)

7. INTERNATIONAL ATOMIC ENERGY AGENCY, Radiation Protection & Safety of Radiation Sources: International Basic Safety Standards, IAEA Safety Standards Series No. GSR Part 3, IAEA, Vienna (2014)

8. INTERNATIONAL ATOMIC ENERGY AGENCY, Regulations for the Safe Transport of Radioactive Material, 2018 Edition, Specific Safety Requirements No. SSR-6 (Rev. 1), IAEA, Vienna (2018)

9. INTERNATIONAL ATOMIC ENERGY AGENCY, IAEA Nuclear Safety and Security Glossary, 2022 (Interim) Edition, IAEA, Vienna (2022)