English Version

THE PEOPLE'S REPUBLIC OF CHINA

Third National Report
for the
Joint Convention
on the Safety of Spent Fuel Management and
on the Safety of Radioactive Waste Management

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Beijing, China

Preface

Chinese Government has consistently accorded high priority to the safety of spent fuel management and the safety of radioactive waste management. The 21st Session of the Standing Committee of the 10th National People's Congress, the People's Republic of China, decided to access to the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (hereinafter referred to as Joint Convention), which was adopted on 5 September 1997 by a Diplomatic Conference convened by the International Atomic Energy Agency and，at the same time, stated that the Joint Convention is not, for the time being, applicable to the Marco Special Administration Region of the People's Republic of China, unless otherwise stated by Chinese Government. On 13 September 2006, China sent its submission of accession instrument to the Depositary. The Joint Convention entered into force to China from the day of 12 December 2006 on.

The 1st and 2nd National Reports of the People's Republic of China on the fulfillment of the obligations of the Joint Convention were submitted, in October 2008 and October 2011, respectively, to the 3rd and 4th Review Meetings of the Contracting Parties.

This report is provided, according to the Article 32 of the Joint Convention, as the 3rd National Report of the People's Republic of China to the 5th Review Meeting of the Contracting Parties. This Report describes the situation of how the obligations of the Joint Convention is implemented in China, and is composed of two parts. The Part 1 is the status report of Joint Convention fulfillment by the Central Government of the People's Republic of China, and the part 2 is the status report of Joint Convention fulfillment by the Hong Kong Special Administrative Region of the People's Republic of China. The data on the inventory and checklist provided in the present report was gathered as of December 31, 2013.

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

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PART 1

A. INTRODUCTION

A.1 Theme of the Report

A-1 This report provides a description of the Chinese fundamental policies on, and practices of, the safety of spent fuel management and the safety of radioactive waste management.

A-2 The aim of spent fuel management and radioactive waste management in China is to achieve and maintain the high level safety and, at present and in future, to protect individuals, society and the environment against the harmful impacts of ionization radiation and promote the sustainable development and peaceful use of nuclear energy and nuclear technology. Chinese government has been adhering the basic principles of ionizing radiation protection, radiation source safety, spent fuel management safety and radioactive waste management safety. Chinese government has been making efforts to establish well and improve legislative system, clarify and allocate safety management responsibilities, enhance and raising regulatory capabilities, attach importance to and actively participate with international cooperation, so as to ensure the safety of spent fuel management and the safety of radioactive waste management.

A.2 Concerned Facilities

A-3 In accordance with the Joint Convention, the Part 1 of this report is focused on a wide range of management facilities, such as at-reactor and/or away-from-reactor storage facilities erected for the spent fuel generated from nuclear power plants (NPPs) and research reactors, radioactive waste treatment and storage facilities for nuclear facilities, radioactive waste storage facilities for nuclear technology applications, and radioactive waste disposal facilities.

A.3 Structure

A-4 As required by the *Guidelines regarding the Form and Structure of National Reports* (INFCIRC/604/Rev.2), the Part 1 of this report explains China's fulfillment of the obligations of the Joint Convention in terms of chapters corresponding to the Articles. Each chapter begins with the corresponding Articles, given in the Joint Convention, enclosed with a box and underlying dark lines. The contents, in addition to the Introduction, are as

follows:

Section B. Polices and Practices (article 32-1)

Section C. Scope of Application (article 3)

Section D. Inventories and Lists (article 32-2)

Section E. Legislative and Regulatory System (articles 18 to 20)

Section F. Other General Safety Provisions (articles 21 to 26)

Section G. Safety of Spent Fuel Management (articles 4 to 10)

Section H. Safety of Radioactive Waste Management (articles 11 to 17)

Section I. Transboundary Movement (article 27)

Section J. Disused Sealed Sources (article 28)

Section K. Planned Activities to Improve Safety

Section L. Annexes

A-5 To avoid the overlapping of the relevant parts in Chapters G and H, the general laws and regulations governing the safety of spent fuel management and the safety of radioactive waste management are addressed in Chapter E, as required in the INFCIRC/604/Rev.2.

A.4 Summary of the Fourth Review Meeting

A-6 Chinese government attaches great importance on its commitment for fulfilling the obligations under Joint Convention by actively taking measures to address the issues concerned by the last Review Meeting. The results will be presented in this report.

A-7 The Fourth Review Meeting of Joint Convention convened in May 2012 presented its review comments on the China's National Report, to which attention should be given by China as follows:

(1) effective implementation of measures for covering the decommissioning and LILW liability should be completed (see F.2.2 and F.6);

(2) reassessment of current management practices at SNF and RW facilities (external site risks from natural origin) should be conducted (see G.2 and H.2);

(3) consideration should to be given to define a long-term management route for those LILW-LL than cannot be accepted at Near Surface repository type (see B.5); and

(4) development of solidification plant for liquid HLW arisen from reprocessing (see B.2, B.5 and G.1).

A-8 Meanwhile, the Contracting Parties agreed that National Reports to the 5th Review Meeting should include the following issues:

(1) management of disused sealed sources (see B.5 and J);

(2) safety implications of very long storage periods and delayed disposal of spent fuel and radioactive waste (see G.2 and H.2);

(3) international cooperation in finding solutions for the long term management and disposal of different types of radioactive waste and/or spent fuel (see B.5); and

(4) progress on lessons learned from the Fukushima accident, in particular regarding strategies for spent fuel management (see G.2).

A.5 Updating of the previous report

A-9 The present report updates and supplements the following main activities and progress made in China since January 1, 2011 until December 31, 2013 on the safety of spent fuel management and on the safety of radioactive waste management.

Newly issued and revised laws, regulations and rules:

(1) *Management Measures on Safety and Protection against Radioisotope and Ray-generating Installation* (MMSPRRI), issued by the MEP/NNSA in April 2011, issued (see J.2);

(2) *Law of the People's Republic of China on Prevention and Control of Occupational Disease* (LPCOD), revised in December 2011 by the Standing Committee of the National People's Congress of the People's Republic of China;

(3) *Regulations on Safety of Radioactive Waste Management*, issued in December 2011 by the State Council of the People's Republic of China (hereafter State Council) (see E.2.2，F.1.3 and F.2.2);

(4) *Regulations on Nuclear Accident Emergency Management at Nuclear Power Plant* (RNAEMN), issued in January 2012 by the State Council (see F.5.1); and

(5) *Management Measures for Licensing the Storage and Disposal of Solid Radioactive Waste*, issued by the MEP/NNSA in December 2013 (see E.2.2，

F.1.3，F.2.2);

Newly issued programs and action plans

(1) The *"Twelfth-Five Year Plan" and the 2020 Future Vision on Nuclear Safety and Radioactive Pollution Protection and Control,* issued in 2012 by the MEP/NNSA in collaboration with National Development and Reform Commission (NDRC), Ministry of Finance (MoF), National Energy Administration (NEA) and China Atomic Energy Authority (CAEA) (see K.1.2);

(2) *National Twelfth Five-year Plan for Nuclear Accident Emergency* issued in April 2012 by National Nuclear Accident Emergency Coordination Committee (NNAECC);

(3) *General Technical Requirements for Modification Action of Nuclear Power Plants after Fukushima Daiichi Nuclear Power Station Accident (trial)*, issued in June 2012 by the NNSA (see F.2.1 and G.2.2);

(4) *National Nuclear Emergency Plan* (revised), issued by the State Council in June 2013 (see F.5);

(5) *Action Plan for Air Pollution Prevention and Control*, issued by the State Council in September 2013; and

(6) *Guides of Government Information Publicity for Construction Project Environmental Impact Assessment*, issued by the MEP/NNSA in November 2013 (see G.3.1 and H.3.2).

Changes in regulatory bodies

(1) Organizational structure was adjusted to the MEP/NNSA in 2011, with its original Nuclear and Radiation Safety Department subdivided into three departments (see E.3.2);

(2) Organizational structure adjustment took place in the CAEA in 2011, with the Nuclear Emergency Safety Department added (see E.4.1);

(3) Institutional reform of the State Council was implemented in 2013, with the former Ministry of Health and the original National Population and Family Planning Commission merged into the National Health and Family Planning Commission (NHFPC) (see E.3.3); and

(4) Institutional structure adjustment was implemented in the NEA in 2013, newly set up Nuclear Power Department (see E.4.2);

Newly constructed facilities

(1) Both at-reactor spent fuel storage facilities and radioactive waste treatment and storage facilities were constructed for the newly constructed six nuclear units (see L.1.1 and L.3.1): and

(2) Two additional modules were manufactured in 2013, in addition to the existing two in operation, for interim storage of QNPP III CANDU reactor spent fuel (see B.2);

Licensing of radioactive waste disposal site

(1) The MEP/NNSA granted, in 2011, operation license to both Guangdong Beilong Disposal Site and Northwest China Disposal Site, respectively (see H.2 and H.6.3); and

(2) The MEP/NNSA granted, in 2012, construction license to Southwest China Disposal Site. (see H.3.1 and H.4.3).

Conducted safety inspections

(1) A comprehensive safety inspection campaign was launched to civil nuclear facilities countrywide in 2011 (see G.2). Such an inspection campaign was initiated during March to December of 2011 following Fukushima accident. By the end of 2013, the short and intermediate term modification requirements were entirely met in all civil nuclear facilities.

(2) A full range of countrywide radiation safety inspection was conducted in 2012 for nuclear technology applications, uranium mining and milling, and radioactive material transportation (see H.2). The inspection was sponsored by the MEP/NNSA, which resulted in license administration to be standardized, environmental impact assessment documents verified, radioactive waste management facilities “three simultaneous” demonstrated, potential safety hazards identified, and safety management level escalated.

(3) An overall nuclear and radiation safety inspection was conducted in period July to December, 2013 (see H.2). This was organized by the MEP/NNSA, resulted in follow-up inspection and re-evaluation of modification projects implementation. As conducted through this inspection, China continues to keep its operational nuclear facilities in safe operation and under-construction nuclear facilities in controlled conditions and radiation environmental quality in good order.

A-10 Apart from these, the inventories and lists are updated (see D and L).

A.6 Good practices and challenges

A-11 The major good practices implemented in China for the safety of spent fuel management and the safety of radioactive waste management are as follows:

(1) development of the Plan for Nuclear Safety and Radioactive Contamination Control;

(2) conducting of comprehensive safety inspection at NPPs and research reactors against extreme external event and evaluating safety margin at operating NPPs against external accidents after Fukushima accident;

(3) initiation of survey and evaluation of environmental radiation situations surrounding nuclear facilities;

(4) building of nuclear waste treatment facility shared by multiple units at newly constructed nuclear power bases;

(5) establishment of monitoring system of radioactive effluents from NPPs;

(6) construction of radioactive waste storage repositories for nuclear technology application in every province of China;

(7) standardization of information publicity of nuclear and radiation safety in a step by step base;

(8) sustainable development of radioactive waste minimization; and

(9) after Fukushima accident, two nuclear emergency forces in response to nuclear power emergency are established, separately, by the China National Nuclear Corporation (CNNC) and China General Nuclear Power Group (CGN) to improve the emergency capability at NPPs.

A-12 The challenges to be faced with in China in aspects of the safety of spent fuel management and the safety of radioactive waste management are as follows:

(1) updating of legislations and regulations on radioactive waste management;

(2) building of nuclear safety capability including regulatory control capability;

(3) development and implementation of technology route for disposal long-lived intermediate-level radioactive waste;

(4) siting of HLW geological repository and construction of underground

laboratory;

(5) long-term storage of spent fuel; and

(6) public acceptance of radioactive waste disposal site.

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 Contraction 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's spent fuel management policy is to implement the reprocessing of spent fuel and to extract and recover uranium and plutonium materials, so as to achieve maximum use of resources, reduce the generation of high level radioactive wastes (HLW) and to ensure the safety of spent fuel management and the public safety, and to lower the risks to the future generations.

B-2 On the basis of the demands of nuclear power expansion in the near and long-term future, China is making efforts to develop overall planning for spent fuel management capability building, encourage enterprises to participate in capability building and scientific research, improve the regulatory system, and train high quality talent team, so as to ensure the smooth implementation of the spent fuel management policy.

B.2 Spent Fuel Management Practices

B-3 At present, the spent fuels generated from NPPs and research reactors are stored at reactors. The operators of NPPs and research reactors shall have the overall responsibility over the safety of management of the spent fuels generated by them.

B-4 The 2013-2030 plan for the transportation, storage and reprocessing of spent fuel generated from NPPs is under development by CAEA. This plan will define China's policy and vision on building spent fuel reprocessing ability, and put forward the development ideas towards spent fuel reprocessing compatible with its nuclear power expansion.

B-5 The spent fuel storage facilities have been established to variable extent at NPPs to accommodate the spent fuel arising from NPPs within a certain period of time and ensure storage safety. The spent fuel storage facility was built at each of NPPs, with more information found in section L.1.1

B-6 A dry storage facility of spent fuel has been erected at QNPP III site, consisting mainly of spent fuel preparation zone, transport zone, and dry storage zone. The first two modules were put into operation in September 2009; the second two began in operation since the end of 2013, as described in Chapter G.

B-7 Under the *Regulations on NPP operation safety* (HAF103) and the *Research reactor operation management* (HAD202/01), the operators of both NPPs and research reactors have responsibilities for all activities of managing reactor core and fuel, including spent fuel. The management procedures for nuclear fuel and reactor-core components are prepared, including handling of irradiated fuel, storage in plant area, and preparatory work for delivery of spent fuel to the outside. This can ensure the safety of fuel using in a reactor and the safety of fuel during the transfer and storage in the plant area. Spent fuel withdrawn from Daya Bay Nuclear Power Plant was partly delivered to centralized storage facility at a reprocessing pilot plant for purpose of away-from-reactor storage and reprocessing.

B-8 Under the HAF103 and the HAD 202/01, the operators of NPPs and research reactors prepare the operational procedures for various steps of spent fuel management and implement wide variety of activities, such as spent fuel withdrawing operation, radiation measurement, radiation protection supervision, spent fuel storage, management and surveillance of plant building and installations, documentation, water chemistry analysis and quality assurance.

B-9 China has set up the funds for treatment of spent fuel from NPPs available for the transportation, storage and reprocessing of spent fuel and the disposal of HLW. The CAEA, in collaboration with the relevant departments, has developed the *Projects Management Methods of the Funds for Treatment and Disposal of Spent Fuel from Nuclear Power Plants* governing the management of the funded-projects, so as to improve the efficient use of the funds.

B-10 To meet the demands of nuclear power expansion, China makes effort, based on an overall planning, to construct the facilities for storage and reprocessing of spent fuel. The ongoing efforts involve the extension of spent fuel centralized storage facility, the research and development of spent fuel reprocessing technology, the construction of spent fuel reprocessing pilot plant

for power reactors, the construction of national-level radiochemistry laboratory for spent fuel reprocessing, the structuring of research and development platform for reprocessing technology and the initiation of large scale commercial reprocessing-recycle plant. The vitrification facilities of liquid HLW shall be constructed and the capacity of the storage and reprocessing of spent fuel shall be constantly improved as needed.

B.3 Criteria Used to Define and Categorize Radioactive Waste

B-11 As specified in the *Law of the People's Republic of China on Prevention and Control of Radioactive Pollution* (LPCRP), radioactive waste is those that contain, or are contaminated with, radionuclides at activity concentrations or specific radioactivity greater than the clearance level as established by the regulatory body without foreseen further use.

B-12 In China, radioactive wastes arise mainly from NPPs, research reactors, nuclear fuel cycle, nuclear technology applications, and mining and uses of uranium (thorium) resources. The current Chinese radioactive waste categorization standards, as shown in Table1, were developed on the basis of the equivalent adoption of the *Classification of Radioactive Waste* (111-G-1.1) developed by IAEA in 1994. In the process of establishing such standards, account was taken of the radioactivity level and physical properties of waste and the half life and radiation types of radionuclides among others. According to their activity level, wastes are classified into exempt waste, low-level radioactive waste, immediate-level radioactive waste and high level radioactive waste. However, such classification is not applicable to the waste generated in the process of mining and milling of uranium (thorium) ores.

Table 1 Classification of Radioactive Waste

Physics condition	Waste categorization	Waste characteristics/index
Gaseous	Low level waste (LLW)	Concentrations not exceeding 4×10^{7} Bq/m^{3}
	Intermediate level waste (ILW)	Concentrations higher than 4×10^{7} Bq/m^{3}
Liquid	Low level waste (LLW)	Concentrations not exceeding 4×10^{6} Bq/L
	Intermediate level waste (ILW)	Concentrations higher than 4×10^{6} Bq/L but not exceeding 4×10^{10} Bq/L
	High level waste (HLW)	Concentrations higher than 4×10^{10} Bq/L
Solid	Low level waste (LLW)	Specific activity not exceeding 4×10^{6} Bq/kg
	Intermediate level waste (ILW)	(1) Half-life longer than 60 d but shorter than or equal to 5 a, specific activity higher than 4×10^{6} Bq/kg (2) Half-life longer than 5a,but shorter than or equal to 30 a, with specific activity higher than 4×10^{6} Bq/kg but not exceeding 4×10^{11} Bq/kg (3) Half-life longer than 30 a, specific activity higher than 4×10^{6} Bq/kg, and heat release rate not exceeding 2 kW/m^{3}
	High level waste (HLW)	(1) Half-life longer than 5a, but shorter than or equal to 30 a, with heat release rate more than 2 kW/m^{3} or specific activity higher than 4×10^{11} Bq/kg, (2) Half-life longer than 30a, specific activity higher than 4×10^{10} Bq/kg, or heat release rate more than 2 kW/m^{3}
	Alpha radioactive waste	Alpha nuclides with half-life longer than 30 a, specific activity in a single container higher than 4×10^{6} Bq/kg

B.3.1 Low and Intermediate Level Radioactive Waste

B-13 Low- and intermediate-level radioactive waste is mainly generated from reactor operation and nuclear technology application.

B-14 The radioactive waste generated from the reactor operation can be divided into airborne waste, liquid waste and solid waste in their physical forms. Airborne radioactive waste can be divided, by source and components, into the process waste gas and nuclear island building exhaust. Process waste gas can be

divided usually into hydrogen-containing waste gas and oxygen-containing waste gas. In terms of activity concentration and chemical content, the liquid waste can be divided into process liquid waste, chemical liquid waste, equipment drainage water, detergent liquid waste. Solid waste can be divided, by source, into technology waste, process waste and other waste. Technology waste is all sorts of waste generated during the NPP operation and maintenance; process waste is generated from the process system under the normal condition; other waste is organic waste generated from radioactive system or equipment.

B-15 The wastes arising from nuclear technology applications refers to those generated from the applications of radioisotopes and irradiation technology used in industry, agriculture, medicine, research and education fields.

B.3.2 High-Level Radioactive Waste

B-16 High level radioactive waste (HLW) includes the high-level liquid waste generated from the reprocessing of spent nuclear fuel, and the solidified form of such waste, as well as spent fuel generated from nuclear power reactors or research reactors pending direct disposal.

B.3.3 Uranium (Thorium) Mining and Milling Waste

B-17 Uranium (Thorium) mining and milling waste means those with radioactive levels exceeding the relevant regulatory levels, which was generated from exploration, mining, milling and closure, mainly covering barren rocks and tailings.

B.4 Radioactive Waste Management Policy

B-18 The generators of radioactive wastes shall bear overall safety responsibility and implement management of radioactive wastes in terms of their classifications.

B-19 Relevant radioactive waste management facilities should be simultaneously established together with their main technological process facilities in their design, construction and operation. Both gaseous and liquid radioactive wastes shall be treated and released on the up-to-standard basis.

B-20 Radioactive waste generated from nuclear technology applications shall be stored in the provincial centralized radioactive waste storage facilities.

B-21 Solid radioactive waste shall be disposed of in accordance with their classification. Solid LILW shall be disposed of in regional near-surface disposal

facilities. Solid HLW waste shall be disposed of in a centralized deep geological disposal repository. Wastes arising form uranium (thorium) mining and milling tend to be in relatively-centralized in-situ landfill.

B.5 Radioactive Waste Management Practices

B-22 In accordance with the requirements of "three simultaneous" to radioactive waste management facilities, the liquid and/or gaseous waste treatment facilities and the solid radioactive waste storage facilities are erected for NPPs and research reactors. Radioactive waste management programs are developed by the operators of various NPPs, along with radioactive waste management procedures, to manage radioactive wastes in accordance with their classifications.

B-23 Usually, at NPPs and research reactor facilities, gaseous radioactive waste undergoes filtration, absorption, storage for decay and then is released when met relevant standards; liquid radioactive waste undergoes filtration, evaporation and ion-exchange etc. and then is released when met relevant standards; concentrated liquid waste and spent resin are cement solidified; technology waste experiences sorting, compression and immobilization; spent filter cartridge is cemented for treatment. The waste packages, meeting acceptance criteria for near surface disposal of radioactive waste, formed following treatment are in safe storage. At other nuclear fuel cycle facilities, waste generated is under the effective management in a manner similar to those mentioned above.

B-24 Radioactive waste minimization is implemented at the operating NPPs. The training and publicity on waste minimization have brought about enhanced awareness to personnel and contractors in this issue. Wide varieties of minimization technologies are employed, such as pre-compression and super-compression as volume reduction technology, trial of paper garment and shoe covers made from biodegradable materials and other protective articles, and changing cement barrels to metal drum as the cement solidified packaging container. Novel waste treatment technologies and operational models are incorporated into the design of newly constructed NPPs, such as drum drying, waste resin static hot pressing processor, High Integrity Containers (HIC), mobile liquid waste processing installation, Site Radioactive Treatment Facility (SRTF), and so on. Under the joint effort of the CAEA and the MEP/NNSA, the project "study on strategy and top-level design of waste minimization" was sponsored in June 2009 by the NPP companies concerned. Based on this result

achieved, the corresponding management guides on radioactive waste minimization is under development.

B-25 In China, for long-lived intermediate-level radioactive waste, the storage-approach management is currently implemented. The revision work has been initiated for both the *Regulations on Near Surface Disposal of LIIW* (GB 9132-1988) and the *Regulations on Categorization of Radioactive Waste,* GB 9133-1995*)*, with account taken of the characterization and disposal approach of intermediate-level radioactive waste.

B-26 China has attached importance to the safety of liquid HLW management. The research and development of vitrification technology and the relevant international cooperation have been actively conducted by CAEA. On the basis of ensuring the safety of liquid HLW storage, the vitrification technology was finalized and cool branch operation was completed. Vitrification-related research efforts were initiated for liquid HLW arising from NPPs, involving prescription, performance, cold crucible vitrification and rock solidification technologies. International efforts to study vitrification technology were conducted in collaboration with Germany and the United States.

B-27 CAEA has been developing siting and relevant research efforts for geological repository of HLW. Screening survey was conducted in six pre-selected regions of Eastern China, Southern China, Southeastern China, Inner Mongolia, Xinjiang and Gansu, with emphasis on the study of site characteristics in Beishan pre-selected region. Early-phase preparatory work of underground laboratory construction is in progress.

B-28 Chinese government attaches importance to, and push forward, international cooperation in respect to HLW geological disposal. The CAEA has launched varieties of international cooperation in the area of HLW geological disposal in collaboration with IAEA, EU, France, the United States, Germany and the United Kingdom in diverse form of participation, jointly cooperative laboratories, cooperative studies and seminars. The scope of concern covers a large number of areas, such as engineering barrier, engineering technology, engineering design, repository siting, radionuclide migration, site assessment, performance assessment, safety assessment and so on. Since 2004, for example, China has participated with IAEA-organized cooperative project of buffer/backfilled materials. In 2009, a HLW geological disposal cooperative laboratory was set up jointly between China and France. Beginning in 2010, Performance Engineering Barrier System (PEBS) spanning four years was initiated under the joint effort between China and EU. China and the United

States are determined in 2013 to carry out underground laboratory-based study for HLW geological disposal.

B-29 Nuclear technology application radioactive wastes repositories are constructed in 31 provinces, autonomous regions or municipalities countrywide to store the disused sealed sources arising, within their respective scope, from industry, agriculture, medicine, education and research fields. Provincial environmental protection agencies have set up special-purpose organizations staffed with specialists or professionals who are responsible for oversight disused sealed sources and environmental monitoring. Since June 2007 to March 2011, the disused sealed sources stored previously are conditioned and removed, totaling 72,433 disused sealed sources with total activity of 1.18E+16 Bq. These disused sealed sources have been sent in a safe manner to the national centralized storage facility of disused sealed sources for long term storage.

B-30 In China, there have been two solid LILW disposal sites in operation and one under construction. Siting of solid LILW disposal repositories are being conducted in provinces where multiple NPPs are located organized by CAEA.

B-31 Since 1990, special projects have been activated for the decommissioning of nuclear facilities and associated radioactive waste management. Thus a range of effective waste treatment and disposal technologies were developed, liquid LILW treatment facilities and solid waste conditioning installations were set up and a part of historical liquid LILW was treated and disposed of.

B-32 In 2011, the five-year plan for nuclear facility decommissioning and associated radioactive waste management was developed by CAEA. The plan is being implemented orderly.

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 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 defense programmers, 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 programmers if and when such materials are transferred permanently to and managed within exclusively civilian programmers.

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 shall apply to the management of spent fuel arising from NPPs and research reactors, but not to those held at reprocessing facility.

C.2 Applicability to Radioactive Waste

C-2 This report shall apply to radioactive waste arising from NPPs, research reactors and other nuclear fuel cycle facilities, and apply to disused sealed sources (including ^{226}Ra disused sealed sources) arising from nuclear technology application, but not to radioactive waste containing naturally occurring radioactive materials (NORMs) and those due to nuclear technology applications.

C.3 Applicability to Spent Fuel and Radioactive Waste from Defense or Military Programs

C-3 This report shall not apply to spent fuel and radioactive waste arising from military or defense programs.

C.4 Applicability to Effluent

C-4 This report shall apply to the discharge of gaseous and liquid radioactive effluents described 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 There are a total of 21 NPP spent fuel storage facilities in place, separately associated with 19 units of China's 9 NPPs, as listed in Annexes L.1.1.

D-2 A total of 3 spent fuel storage facilities at research reactors have been constructed, separately associated with 13 reactors that are operated by 3 operators, as listed in L.1. 2.

D.2 Inventory of Stored Spent Fuel

D-3 As of 31 December 2013, there has been a total of 4,367.7 tons of spent fuel generated by NPPs, of which 3,196.9 tons are being held in pool storage at-reactor, 776.6 tons are in dry storage, and 394.2 tons were transported

to the outside, as shown in Annexes L.2,1.

D-4 For information of spent fuel associated with research reactors, see Annexes L.2.2.

D-5 As of 31 December 2013, there is not any spent fuel disposal activity occurred in China.

D.3 Radioactive Waste Management Facilities

D.3.1 Radioactive Waste Treatment and Storage Facilities

D-6 NPPs, research reactors and other nuclear fuel cycle facilities, all of which generate radioactive waste, are all equipped with radioactive waste treatment and storage installations, as shown in Annexes L.3.1-L.3.3.

D-7 In addition, nuclear technology application radioactive waste storage facilities for disused sealed sources are also constructed, as shown in Annexes L.3.4.

D.3.2 Radioactive Waste Disposal Facilities

D-8 There have been two solid LILW disposal sites in operation and one under construction, as shown in Annexes L.3.5.

D.4 Radioactive Waste Inventories

D-9 Of radioactive waste amounts generated from NPPs, large portion still in storage facilities at NPPs, with only small portion delivered to the outside for disposal. Radioactive waste inventory at each NPPs is listed in Annexes L.4.1.

D-10 Radioactive waste inventory at research reactors and nuclear fuel cycle facilities is listed in Annexes L.4.2.

D-11 Inventory of disused sealed sources in nuclear technology application radioactive waste repositories is listed in Annexes L.4.3.

D-12 Inventory of radioactive waste at solid LILW disposal sites is listed in Annexes L.4.4.

D.5 List of nuclear facilities under decommissioning

D-13 Since the last report, there has not yet been any nuclear facility entering decommissioning.

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 For the purpose of extending the effort to fulfill the China's commitment to the Joint Convention and to implement its obligations under the Joint Convention, the Chinese Working Group for Joint Convention Implementation (CWGJCI) was formed and the *Management Measures for Implementing the Obligations under the Joint Convention* was set out.

E-2 The CWGJCI, set up with the approval of the State Council, is responsible for the organization and coordination of the work for Chinese government to implement the obligations arising from the Joint Convention and for ensuring the effective implementation of both the requirements of the Joint Convention for Contracting Parties and the resolutions of various Review Meetings on National Report to the Joint Convention. The CWGJCI is composed of Ministry of Environmental Protection/National Nuclear Safety Administration (MEP/NNSA), Ministry of Industry and Information Technology/China Atomic Energy Agency (MIIT/CAEA), Ministry of Foreign Affairs, Ministry of Public Security (MPS), the National Health and Family Planning Commission (NHFPC) and the National Energy Administration (NEA). The CWGJCI is headed by the MEP/NNSA and the MIIT/CAEA as the deputy Group head. The Secretariat is based in the Department of International Cooperation under the MEP.

E-3 In support of efforts to prepare the National Report to the Joint Convention, a Review Committee and a Technical Group were established. The Review Committee consists of the representatives and experts relevant to the safety of spent fuel management and the safety of radioactive waste management. Under the guidance of the CWGJCI, the Review Committee and the Technical Group work together to prepare China's National Report to the Joint Convention, to review and answer questions to China's National Report submitted by other contracting parties, to review and raise questions to the National Reports of other contracting parties, as well as to provide other

relevant technical support for implementing the obligations of the Joint Convention.

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 licensing 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 materials as radioactive waste, Contracting Parties shall take due account of the objectives of this Convention.

Safe management of activities involving radioactive materials comprises two inseparable aspects: radiological protection and nuclear safety.

E.2.1 Legislative Framework

E-4 Under the *Legislation Law of the People's Republic of China* (LLRPC) and consistent 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, that incorporates a comprehensive set of relevant national laws, administrative regulations, departmental rules, management guides and reference documents, as shown in Figure 1. The laws applicable to the safety of spent fuel management and the safety of radioactive waste management are developed and promulgated by the

National People's Congress Standing Committee (NPCSC); administrative regulations are developed and issued by State Council as mandated by the National Constitution and the relevant laws; departmental rules are developed and issued by environmental protection authority, nuclear facility authority and health and family planning authority, under the State Council, as mandated by the relevant national laws, regulations and responsibility assignment; the management guides are developed and issued by the relevant departments of the State Council; reference documents are developed and issued by the State Council departments or its mandated agencies. Apart from these, a wide range of technical standards are set and issued to standardize and clarify the technical standards for the management of spent fuel and radioactive waste.

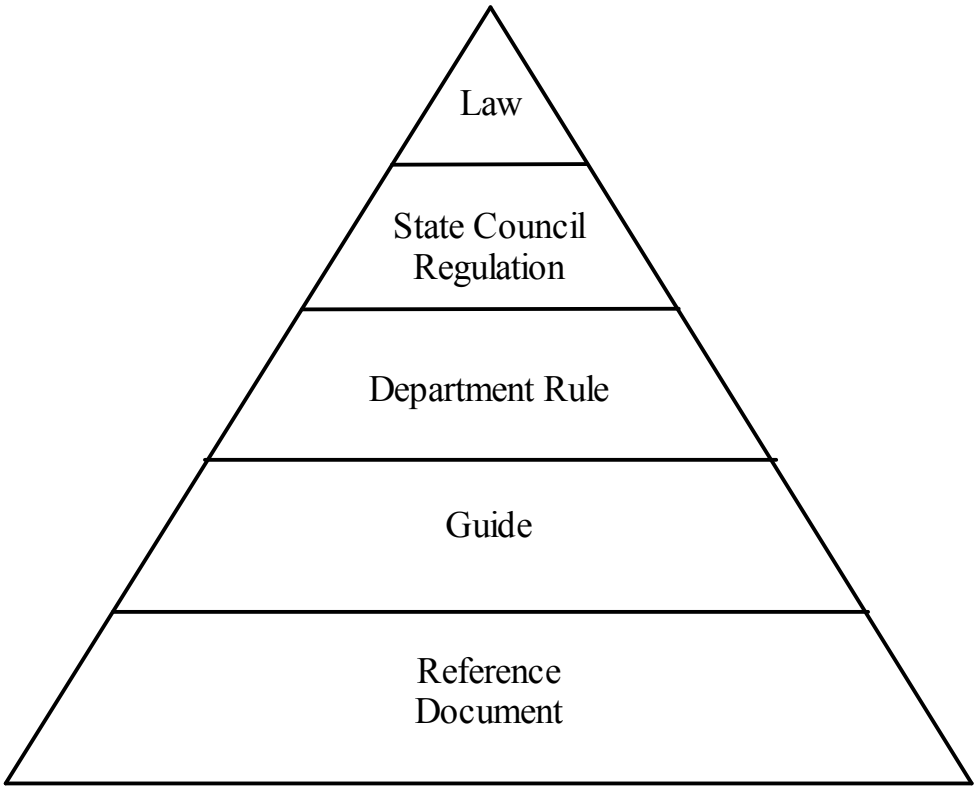

Figure 1 Legislative Framework System in China

E-5 The laws, regulations and rules that have been in effect applicable to such purpose set forth the safety requirements for the management of spent fuel and radioactive waste, which are:

Law of the People's Republic of China on Prevention and Control of Radioactive Pollution (LPCRP), enacted by the NPCSC in 2003;

Regulations of the People's Republic of China on Safety Control of Civilian Nuclear Installations (HAF001), issued by the State Council in 1986;

Regulations on Safety and Protection of Radioisotope and Ray-generating

Installations (RSPRRI), issued by the State Council executive meeting in 2004; and

Regulations on Safety of Radioactive Waste Management (RSRWM), issued by the State Council executive meeting in 2011.

E-6 The *Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources* (GB18871-2002) stipulates the basic requirements of radiation protection and radiation source safety, which apply to the protection of workers in intervention and practice and the safety of radiation sources.

E-7 The laws, regulations, rules, standards and guides currently applicable to such purpose are listed in Annexes L.5.1-L.5.5. The laws, regulations, rules, standards and guides issued since the last Review Meeting are as follows:

(1) Administrative regulations

- *Regulations on Safety of Radioactive Waste Management* (RSRWM), and
- *Regulations of People's Republic of China on Nuclear Power Accident Emergency Management (revised).*

(2) Departmental rules

- *Management Measures on Safety and Protection against Radioisotope and Ray-generating Installation;*
- *Methods for Management of Experience feedback at Operational Nuclear Power Plants;*
- *General Technical Requirements for Modification Action of Nuclear Power Plants after Fukushima Daiichi Nuclear Power Station Accident (trial);*
- *Management Measures for Licensing the Storage and Disposal of Solid Radioactive Waste;*
- *Projects Management Methods of the Funds for Treatment and Disposal of Spent Fuel from Nuclear Power Plants; and*
- *Management Procedures for Diagnosis and Identification of Occupational Disease.*

(3) Management guides

- *Siting of High Level Radioactive Waste Geological Facility* (HAD401/06-2013);and

- *Decommissioning of Gamma-ray Irradiation Installations* (HAD401/07-2013);

(4) Standards

- *Design Criteria for Spent Fuel Storage Pool away from Reactor* (EJ/T 878-2011);
- *Regulations for Environmental Radiation Protection of Nuclear Power Plant* (GB 6249-2011);
- *Technical Requirements for Discharge of Radioactive Liquid Effluents from Nuclear Power Plant* (GB 14587-2011);
- *Regulations for Designing Storage Building of High Level Radioactive Liquid Waste* (GB 11929-2011);
- *Performance Requirements for Low and Intermediate Level Radioactive Waste Form-Cemented Waste Form* (GB 14569.1-2011);
- *Standard Test Method for Leachability of Low and Intermediate Level Solidified Radioactive Waste Forms* (GB/T 7023-2011);
- *Landfill Disposal of Very Low Level Radioactive Waste* (GB/T 28178-2011); and
- *Activity Concentration for Material not Requiring Radiological Regulation* (GB 27742-2011).

E.2.2 Regulatory Framework

E-8 The followings are implemented under the LPCRP, HAF001, RSPRRI and RSRWM:

(1) The licensing regime of spent fuel and radioactive waste management activities has been established, banning the operation of a spent fuel and radioactive waste management facilities without licenses concerned:

- Nuclear facility safety licensing system is implemented in China. The MEP/NNSA is responsible for establishing and approving the granting of nuclear facility safety licenses. These include nuclear facility siting censor position paper，nuclear facility construction license, nuclear facility operation license, and nuclear facility decommissioning permit. Nuclear facilities here refer to NPPs, research reactors, other nuclear fuel cycle facilities, and radioactive waste treatment and/or disposal facilities. The licensees of these facilities must apply for the construction and operation license and for authorizations for siting, fueling and decommissioning, prior to carrying out

such activities. No activity can be started for construction, fueling, operation and decommissioning unless the licenses for such activities have been granted after review and approval of regulatory authority.

- Graded licensing system is implemented in China. The operators of production, distribution and use of radioactive sources must apply for radiation safety licenses. The licenses for the producers of radioactive sources and the users of Category I radioactive source are reviewed, approved and granted directly by MEP, whereas the licenses for the users of Category II, III, IV and V by environmental protection agencies at provincial level.

- The operators dedicated exclusively to the storage and disposal of solid radioactive waste must apply for licenses of such activities. The licenses of such activities are reviewed, approved and granted by the MEP/NNSA.

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

- An appropriate institutional control system is implemented in China, such as radioactive contamination monitoring system, gaseous and liquid radioactive waste release licensing system, effluent and environmental monitoring system, and nuclear accident emergency system. Additionally, qualification management systems are exercised also for both the professionals in spent fuel and radioactive waste management and for the units engaged in radioactive contamination monitoring work.

- The NNSA and its regional branches implement routine inspection, non-routine inspection and daily inspection, and dispatch inspection personnel (or group) to the manufacture, construction and operation fields for implementation of regulatory mission. The environmental protection departments of the people's governments above county-level, jointly with other related departments, implement supervisory inspection of the safety of radioactive waste treatment, storage and disposal activities.

- The operators of nuclear facilities implement file management of testing procedures, operational procedures, QA records, testing results and data, operation and maintenance records, defects and abnormal events; the producers, distributors and users of radioactive sources establish their own relevant management accounts, personal dose files, occupational heath surveillance files; the operators of solid radioactive waste storage and disposal facilities establish records and files of radioactive waste storage and disposal activity as it was.

- The operators of nuclear facilities, nuclear technology application and solid

radioactive waste storage report truthfully, as required by the MEP/NNSA, the status of radioactive waste's generation, discharge, treatment, storage and clearance and delivery for disposal. The operators of solid radioactive waste disposal facilities are required to report, prior to 31st March every year, to the related departments the situations about waste acceptance and disposal and facility operation in the previous year.

- In the event of a nuclear emergency, the operators of nuclear facilities must report immediate the emergency event to the related departments; the operators of nuclear technology application should report immediately the related departments if found radioactive source(s) lost or stolen; the operators of solid radioactive waste storage and disposal facilities should report the related departments the found hidden safety hazards or potential accident.

(3) The regulations and licensing provisions are enforced on spent fuel and radioactive waste management are enforced in China. For the license holder who violates the regulations and licensing terms and conditions, the NNSA has the right to take compulsory measures when necessary or order the license holders to take safety measures or stop the activity endangering the national safety. Depending on their seriousness, the NNSA shall give warning for improvement within a time limit, or order to halt or stop operations for rectification, or order to revoke license for punishment; for the license holder who would not carry out the decision on punishment and not to prosecute overdue, the NNSA shall apply to the people's court for compulsory execution.

(4) The assignment of responsibilities are clearly defined for various administrative departments in aspects of spent fuel and radioactive waste management are clearly defined. The competent administrative department for environmental protection under the State Council exercise overall regulatory control over the radioactive pollution prevention work throughout the country. The competent administrative department of public health under the State Council and other relevant departments, according to the duties specified by the State Council, are responsible for the oversight and administration of the spent fuel and radioactive waste management (see E.3 and E.4).

E-9 Legislative purpose of the LPCRP is to control the radioactive pollution beyond the national standards caused by radioactive substances or rays, to protect the environment and human health, promote the development and peaceful use of nuclear energy and nuclear technology. The law incorporates a Chapter "Radioactive Waste Management", specifying the gaseous and liquid waste emission standards and emission permits, specifying the liquid waste

emission approaches, as well as the solid waste disposal and cost, etc.; with a goal 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.3.1 Independency of Regulatory Body

E-10 In China, the independent regulatory bodies which are relevant to the safety of spent fuel management and the safety of radioactive waste management are the MEP/NNSA, NHFPC and MSP.

E-11 The responsibility assignment of various relevant regulatory bodies is defined clearly in the LPCRP, LPCOD, HAF001, RSRWM and RSPRRI to ensure the independency of regulatory bodies. For example, the LPCRP stipulates that the competent authority of radiation protection under the State Council shall implement, by law, overall regulatory control of radioactive pollution prevention and control work countrywide and that the health and other related competent authorities therein shall be responsible for oversight and administration according to law. The HAF001 points out that the NNSA shall be responsible for making, approving and granting the nuclear facility safety permission certificates.

E.3.2 MEP/NNSA

E.3.2.1 MEP/NNSA Organizational Structure

E-12 MEP/NNSA consists of the headquarter, local surveillance or monitoring stations and technical support organizations, with its organizational structure illustrated in Figure 2.

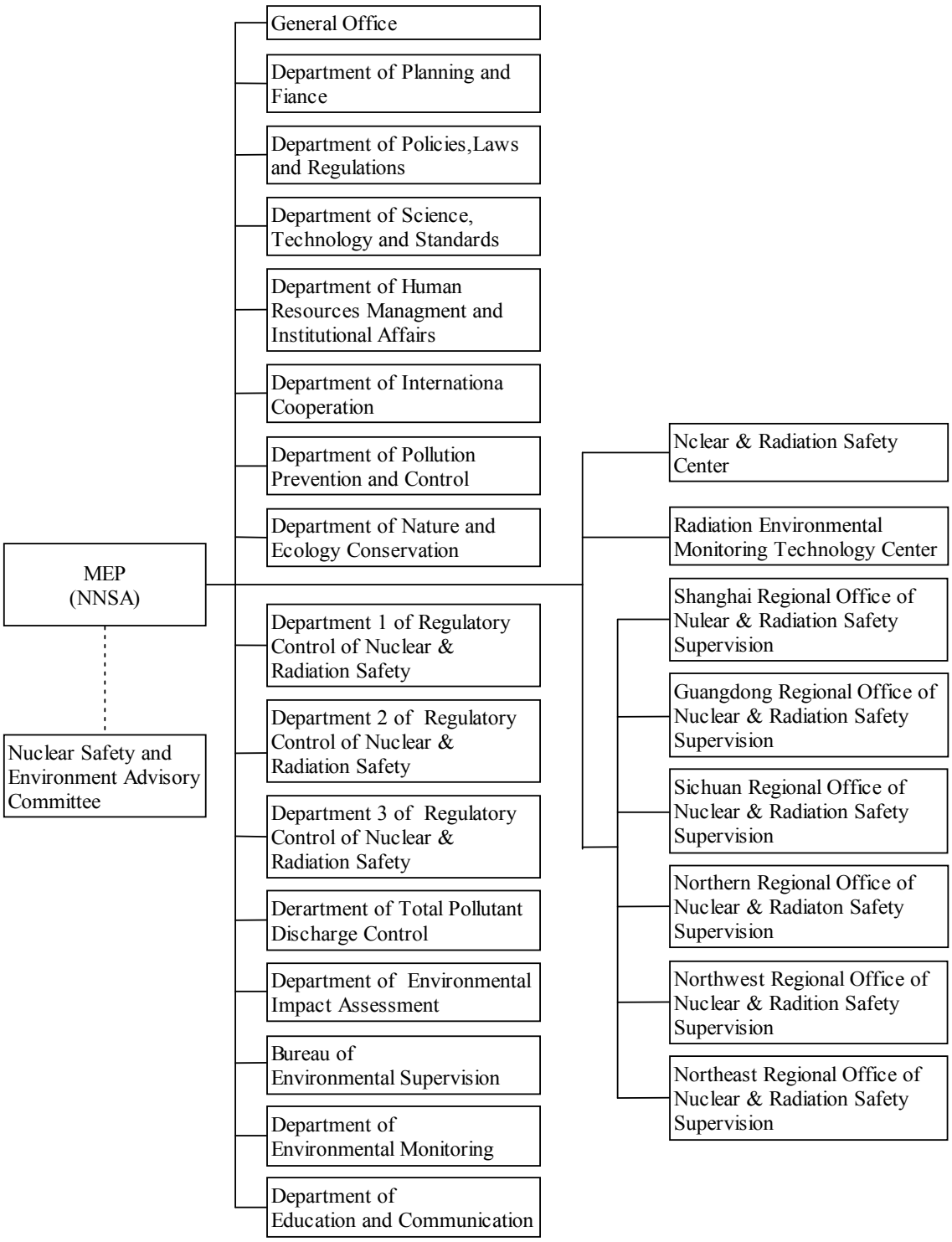

Figure 2 Organization Structure of MEP/NNSA

E-13 The MEP/NNSA's headquarter is based in Beijing, with six regional branches in Shanghai, Shenzhen, Chengdu, Beijing, Lanzhou and Dalian, respectively, which are responsible for routine oversight of nuclear safety and radiation safety in designated areas.

E-14 The MEP/NNSA's specific routine work is undertaken, respectively, by its subsidiary Department 1, Department 2 and Department 3 of Regulatory Control of Nuclear and Radiation Safety.

E-15 In order to fulfill a better implementation of regulatory functions, the MEP/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 power for the radiation environmental monitoring and management countrywide. Additionally, the MEP/NNSA has also established long-term and reliable partnership with other technical support and assistant organizations.

E-16 An Expert Panel of Nuclear Safety and Environment was set up by the MEP/NNSA to provide technical support in drafting nuclear and radiation safety laws and regulations, developing nuclear safety technology/technique and implementing nuclear safety review and oversight.

E.3.2.2 MEP/NNSA Responsibilities

E-17 The MEP/NNSA has the following responsibility over the safety of spent fuel management and the safety of radioactive waste management:

(1) for regulatory control of nuclear and radiation safety; development of policy, planning, laws, administrative regulations, departmental rules, standards and criteria in relation to nuclear and radiation safety, electromagnetic radiation, environmental radiation protection, and nuclear and radiation accident;

(2) for overall regulatory control over nuclear facility safety, radiation safety, environmental radiation protection;

(3) for regulatory control over the licensing, design, manufacture, assembly and non-destructive testing of nuclear safety equipment; and for the safety inspection of imported nuclear safety equipment;

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

(5) for regulatory control of radiation safety and environmental radiation protection against nuclear technology application projects, uranium (thorium) mines and naturally occurring radioactive materials (NORMs); and for radiation protection;

(6) for regulatory control of radioactive waste treatment and disposal safety, and environmental radiation protection work; and for regulatory inspection of

radioactive contamination prevention;

(7) for regulatory control of the safety of radioactive material's transportation;

(8) for the MEP/NNSA' nuclear and radiation emergency response, investigation and treatment; participation in prevention and deposition of nuclear and radiation terrorist events;

(9) for management of qualification of reactor manipulators and special nuclear process workers;

(10) for organizing and implementing of radiation environmental monitoring, supervisory monitoring of nuclear facilities and key radiation sources;

(11) for China's fulfillment of international convention on nuclear and radiation safety;

(12) for guiding the work at nuclear and radiation safety oversight stations.

E.3.2.3 Financial and human resources of MEP/NNSA

E-18 The MEP/NNSA's financial budget for regulatory control and administration reached at 180 millions RMB in 2011 and grew to 350 millions RMB in 2012 and 2013.

E-19 As approved by the central government in 2011, the MEP/NNSA's staffs could increase to more than 1000 in 2012, including 85 in the NNSA's headquarter, 331 in six regional branches and 600 in the Nuclear and Radiation Safety Center. Now, the increased staffs are going to get gradually in place.

E.3.3 The NHFPC

E-20 The NHFPC was established in 2013 through the government structural reform.

E-21 The NHFPC has, in regard to the safety of spent fuel management and the safety of radioactive waste management, the main responsibilities as follows:

(1) developing the laws and regulations concerning prevention and control of occupational diseases in conjunction with the departments concerned, and organizing to develop and issue national occupational health standards;

(2) being responsible for the regulatory control and administration of radioactive occupational disease in medical institutions;

(3) organizing the radiological injury diagnosis and treatment and the

medical rescue in case of nuclear and radiation events; and

(4) being responsible for health emergency related to nuclear and radiation accidents.

E.3.4 Ministry of Public Security (MPS)

E-22 The MPS is, in the aspects of the safety of spent fuel management and the safety of radioactive waste management, principally responsible for the review and approval of on-road transport of spent fuel and radioactive materials and for the registration, reconnaissance and recovery of lost and/or stolen radioactive sources.

E.3.5 State Administration of Work Safety

E-23 The State Administration of Work Safety has the following responsibility over the safety of spent fuel management and the safety of radioactive waste management:

(1) for the review of the pre-assessment report of radioactive occupational disease attributable to the newly-constructed, extended and modified projects;

(2) for the designing review and completion acceptance of protection facilities against radioactive occupational disease attributable to the newly-constructed, extended and modified projects; and

(3) for organizing and implementing, in conjunction with the departments concerned, of the investigation and treatment of accidents induced by acute radioactive occupational disease.

E.4 Government Authorities for Nuclear Power Expansion

E.4.1 China Atomic Energy Authority (CAEA)

E-24 The CAEA consists of Development and Planning Department, Systematic Engineering Department, International Cooperation Department, Comprehensive Department, Nuclear Emergency Safety Department, Coordination Department and Technology Quality Department, together with National Nuclear Accident Emergency Office, Nuclear Materials Control Office, and Radioisotope Management Office. Among the technical centers affiliated to the CAEA are National Nuclear Emergency Technology Support Center, Nuclear Technology Support Center and National Nuclear Security Center.

Its main responsibilities are as follows:

(1) studying and proposing the policy and regulations concerning the

peaceful use of atomic energy in China;

(2) studying and developing the development program, plan and industry standards concerning the peaceful use of atomic energy in China;

(3) organizing demonstration of major nuclear energy research projects and review and approval of the projects concerning the peaceful use of atomic energy in China, and supervising and coordinating the implementation of the major nuclear energy research projects;

(4) regulating nuclear materials, and conducting physical protection of nuclear facilities;

(5) reviewing and managing the export of nuclear materials;

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

(7) taking the responsibility of national nuclear accident emergency administration, organizing to convene the National Nuclear Accident Emergency Coordination Committee (NNAECC) and being responsible for studying developing and implementing national nuclear accident emergency plan; and

(8) being responsible for nuclear facility decommissioning and radioactive waste management.

E.4.2 NEA

E-25 The NEA encompasses 12 departments, which are Comprehensive Department, Legal System and Structural Reform Department, Development and Planning Department, Energy Conservation and Technology Equipment Department, Electricity Department, Nuclear Power Department, Coal Department, Oil and Gas Department (National Oil Reserve Office), New and Renewable Energy Department, Market Regulation Department, Power Safety Regulation Department, and International Cooperation Department.

The responsibilities of the NEA are:

(1) taking the responsibility of nuclear power administration and organizing the development of laws and regulations on nuclear power;

(2) proposing nuclear power expansion program, access conditions, and technical standards, and causing them to be implemented;

(3) providing review comments on geographical distribution of NPPs and

other major projects;

(4) organizing, coordinating and providing guidance on research efforts related to nuclear power;

(5) organizing the emergency arrangement in the event of nuclear accident at NPPs; and

(6) organizing intergovernmental exchange and cooperation in relation to nuclear power and the foreign negotiation and agreement between governments on peaceful use of nuclear energy.

F. OTHER GENERAL SAFETY PROVISIONS

(articles 21 to 26)

F.1 Responsibility of the License holder (article 21)

1. 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.

2. 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.1.1 General Responsibility of the Nuclear Facility Safety License Holder

F-1 Such management facilities as referred to in this report are all subject to the nuclear facility safety licensing, namely (a) at-reactor and/or away-from-reactor spent fuel storage facilities associated with NPPs and research reactors, (b) radioactive waste treatment and storage facilities associated with nuclear facilities, and (c) radioactive waste disposal facilities. The reasons for this are as pointed out by the HAF001:

(1) NPPs, research reactors, nuclear fuel cycle facilities and radioactive waste treatment and disposal facilities are all among nuclear facilities; and

(2) nuclear facility safety licenses should be granted, including Nuclear Facility Construction License and Nuclear Facility Operation License before the construction and operation of nuclear facilities require

F-2 Under the HAF001, the operators of nuclear facilities should be responsible for the safety of nuclear facilities they operate, with the following main responsibilities:

(1) complying with the relevant national laws, regulations and technical standards to ensure the safety of nuclear facilities;

(2) accepting the regulatory control of nuclear safety by the MEP/NNSA and reporting safety situation and providing the related information in a timely and true manner;

(3) holding overall responsibility over the safety relating to nuclear facility,

nuclear materials, the workers, the public and the environment.

F-3 The following measures shall ensure the license holders of nuclear facility safety to fulfill their responsibilities.

(1) only when an applicant has met the specified requirements, can the MEP/NNSA grant the applicant Nuclear Facility Construction License and Nuclear Facility Operation License. If the proposed project and the selected site have been approved by the relevant competent departments, it would have obtained the ability to operate the proposed nuclear facility and, in addition, to ensure to hold the overall safety responsibilities.

(2) only after having been granted Nuclear Facility Construction License, can the applicant construct its proposed nuclear facility. Only after having been granted Nuclear Facility Operation License, can the applicant operate its proposed nuclear facility.

(3) the nuclear facility construction shall be in compliance with the requirements in Nuclear Facility Construction License and its operation shall be in compliance with the requirements in Nuclear Facility Operation License.

(4) the MEP/NNSA and its dispatched agencies are entitled to dispatch oversight group or personnel to the manufacture, construction and/or operation sties to implement the regulatory mission of nuclear safety; and

(5) the MEP/NNSA are entitled to take the compulsory measures, if necessary, to order the nuclear facility operator to take safety measures or terminate the activities endangering the safety.

F.1.2 General Responsibility of the Radiation Safety License Holder

F-4 The following responsibilities are under RSPRRI and RSRWM.

(1) disused sealed sources should be returned to the manufacturers, original exporters, or sent to licensed storage or disposal facilities of solid radioactive waste;

(2) the manufacturers, distributors and users of radioactive sources should obtain radiation safety licenses.

F-5 The holders of radiation safety licenses should be responsible for the protection and safety of radioactive sources they operate and assumes any legal liability for any harm that such radioactive sources might cause, as required by RSPRRI,

F-6 The following measures will ensure that the holders of radiation safety

licenses fulfill their liabilities or responsibilities.

(1) the applicants shall meet certain conditions, such as qualified professionals or technicians, workplace, installations and equipment, safety and protection management organizations or personnel, required protective articles and monitoring devices, sound regulations and rules, and emergency measures.

(2) the license holder shall provide education, training and inspection in safety and protection to the workers directly involved the radiation-related activities, and the unqualified workers are not permitted to work.

(3) The license holder shall carry out individual dose monitoring and occupational health inspection and establish individual dose records or files for the workers directly involved in the radiation-related activities.

(4) the license holder shall conduct annual evaluation of the safety and protection situation of radioactive sources they operate and make timely improvement if potential risk being discovered.

(5) the license holder, who intends to terminate its operating activities, shall account and list the radioactive sources in its possession, and make appropriate arrangement in a way as to keep no potential risk.

(6) the license holder of Category I, II or III source who intends to distribute such radioactive source to another user shall sign agreement with the user on return of disused sealed source.

(7) the user of radioactive source should return disused sealed source to manufacturer or original exporter in accordance with said agreement, or to a licensed solid radioactive waste storage or disposal facility.

(8) the license holder shall prepare the independent emergency plan to be ready for emergency response; and

(9) the competent environmental protection agencies of the people's governments at or above county-level shall work with other related agencies to implement oversight and inspection of the license holder within their responsibility scope and, if necessary, have power to take the compulsory measures.

F.1.3 General Responsibility of License Holder for Solid Radioactive Waste Storage and Disposal

F-7 Under RSRWM and the *Management Measures for Licensing the Storage and Disposal of Solid Radioactive Waste* (MMLSDSRW), the facilities

dedicated exclusively to the storage and/or disposal of solid radioactive waste, including disused sealed sources, should be obtain the license for solid waste storage and/or disposal.

F-8 Accordingly, the operators dealing with the storage and/or disposal of radioactive waste arising nuclear technology applications should be involved with the relevant licenses.

F-9 Under RSRWM and MMLSDSRW, the license holder should take the responsibility for the safety of solid radioactive waste they store and dispose of.

F-10 The following measures ensure the license holder of solid radioactive waste to fulfill their responsibilities.

(1) the applicants shall meet certain conditions, such as legal qualification, qualified organizational agencies, professionals and technicians, required registered funds, equipment and workplace, protective and monitoring devices, sound management system and quality assurance (QA) system;

(2) the license holder should establish the record and archive system, keeping a true and complete set of records about solid radioactive waste in terms of their origin, number and amount, characteristics, storage and disposal location, clearance, delivery and acceptance and other relevant information;

(3) the license holder should establish both sound management system and QA system in consistent with nuclear safety regulatory requirements, including operational procedures for storage and disposal, QA program, monitoring plan for storage and disposal facility operations, radiation monitoring plan, emergency plan, among others. The archival records about disposal of solid radioactive waste should be preserved permanently;

(4) the license holder should provide, prior to 31st March a year, the environmental protection competent department of the State Council with the last year's summary report of storage and disposal activities, including the information about acceptance, storage and/or disposal, clearance, delivery for disposal, and radiation monitoring among others;

(5) the license holder should provide training and inspection to the related personnel on expertise in the areas of radioactive waste management, radiation protection and environmental radiation monitoring and so on;

(6) the license holder should, in accordance with both operational monitoring plan and environmental radiation monitoring plan, examine the facility safety and carry out radiation monitoring of groundwater, surface water,

soil and air; and record faithfully monitoring data; and identify the reason, take countermeasures and report to the related department if finding out potential environmental hazards or the level of environmental radionuclides exceed of the relevant national standards;

(7) the license holder should establish sound safety and security system at different levels; and

(8) the environmental protection competent departments of the people's governments at or above county-level shall work with other related agencies to implement oversight and inspection of the license holder within their responsibility scope and, if necessary, are entitled to take the compulsory measures.

F.2 Human and Financial Resources (article 22)

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

i) qualified staff is available 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-11 The workers engaged in radiation safety-related activities during the operating lifetime of spent fuel and radioactive waste management facilities include nuclear facility workers, nuclear safety supervisory personnel, and radiation safety workers.

F-12 Under the LPCRP, the qualification management system is implemented in China for the professionals engaged with radioactive pollution prevention and control. The operators of nuclear facilities, as well as nuclear technology applications and facilities for storage and/or disposal of solid radioactive waste, should provide the workers and staff involved directly in treatment, storage and disposal activities with the technical and professional training and inspection in regard to radiation protection (such as laws, regulations and standards) and operation safety. The relevant personnel can

carry out the relevant post only after appropriate qualification inspection and acquirement with post qualification certificate.

F.2.1.1 Recruitment, Training and Inspection of Staff in Nuclear Facilities

F-13 Under the *Staffing, Recruitment, Training and Delegation at NPPs* (HAD103/05-2013), the operators of nuclear facilities implement the system of recruitment, training, re-training and delegation of the personnel engaged directly with the management of spent fuel and radioactive waste,

F-14 The operators of nuclear facilities efforts to recruit the professional talents necessary for the spent fuel and radioactive waste management in such manner as high school education, 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-15 The requirements for post qualification are defined in accordance with the relevant regulations, guides, and standards and on the basis of the post-specific task analysis. The training and retraining program and procedures are developed and implemented for those involved directly in spent fuel and radioactive waste management. The relevant personnel can carry out the relevant post with responsibility only after appropriate training, qualification inspection, and acquirement with post qualification certificate or authorization granted.

F-16 Validity period management is applied by the above operators to the qualification and authorization for personnel. After expiration of effective period, the extension and renewal of qualification certificates shall be made in accordance with the post-specific requirements. Furthermore, additional re-training and re-authorization are needed to ensure for the personnel to meet the post-specific requirements.

F-17 Under the *General Technical Requirements for Modification Action of Nuclear Power Plants after Fukushima Daiichi Nuclear Power Station Accident (trial),* the plans for training and emergency drill/exercise about beyond design basis accident are adjusted for the licensed personnel; training plan and re-training periods were defined concerning the Serious Accident Management Guides (SAMG); the training of NPPs' staff is enhanced in the event of the serious accidents, specially training in case of beyond design basis accident.

F-18 The training, authorization and qualification management, as required, are the same for both Chinese and foreign contractors' staff, subject to strict control and supervision under the contractor management policy.

F.2.1.2 Qualification, training and inspection for nuclear safety supervisory staff

F-19 According to the relevant laws and regulations and the task needs, the personnel selection, training and inspection, both written and oral, shall be conducted by the MEP/NNSA, including those at the spent fuel and radioactive waste management facilities. The Certificate for Nuclear Safety Supervisor shall be granted by the MEP/NNSA to the qualifier.

F-20 The MEP/NNSA pays high attention to the training of nuclear safety supervisory staff, and focuses ongoing training efforts on nuclear safety supervisory staff in many ways, for example, including semi-annual training of newly recruited workers at training center of a NPP, on-the-job training of nuclear safety supervisory staff, communication with nuclear power personnel on-the-job training; inviting international experts to present lectures on nuclear safety training workshop or seminar, dispatching personnel to participate in short-term training workshop sponsored by foreign regulatory agencies and international organizations. Additionally, there are annually 30 degree education and training opportunities.

F.2.1.3 Training and Inspection of Radiation Safety Workers

F-21 Under the RSPRRI, a producer, distributor or user of radioactive sources shall provide training in safety and protection knowledge to its workers directly associated with production, distribution and use of such sources. Inspection shall be given to the trainee. The worker who would not pass the given inspection is not fit the job post with radiation safety related responsibility. The training program, in conjunction with training materials, was developed by the MEP in such a way as to have an enhanced training management and consistent training and inspection requirements.

F-22 At the invitation of the MEP, the IAEA has provided training to the trainers at eight national-level training institutions accredited by the MEP in China. Meanwhile, provincial level environmental protection departments also sponsored radiation safety training within their regions. The trainees are divided into three levels according to the radiation risks they face in radiation safety work involved. The primary radiation safety training is implemented by the provincial level departments and the training at other two levels is undertaken by the above national-level training institutions. The qualified trainees need to accept re-training at four year intervals.

F-23 Since early 2011 to the end of 2013, the national-level training bodies

provided more than 23,000 training opportunities and meanwhile the training opportunity number provided by provincial-level training bodies was nearly 170,100.

F.2.1.4 Registered Nuclear Safety Engineer System

F-24 Under the LPCRP, Chinese government issued in November 2002 the *Temporary Regulations on Registration qualifications for Nuclear Safety Engineer* (TRRQNSE) in order to raise the quality of the technical staff for nuclear safety related activities, standardize the key-post management, ensure the nuclear and radiation environment safety and maintain the national and public interests. The TRRQNSE establishes the occupational qualification system for the technical staff working on the nuclear safety key posts providing related technical services for the nuclear energy, nuclear technology applications and nuclear safety. The occupational scope of a registered nuclear safety engineer covers review of nuclear safety case, oversight of activities affecting nuclear safety, manipulation and operation of nuclear facilities, quality assurance, radiation protection, radiation environmental monitoring, and other fields closely related nuclear safety prescribed by the MEP/NNSA.

F-25 Subsequently, *Nuclear Safety Engineer Registration Management Rules* was issued in 2004, and the *Temporary Regulations on Continued Education of Registered Nuclear Safety Engineer* issued in 2005. *Directory of Key Posts of Certified Qualification System for Registered Nuclear Safety Engineers* (the first posts) was issued in 2009. It specifies minimum number of workers and key posts for registered nuclear safety engineers, such as comprehensive safety management, quality assurance, radiation protection, reactor operation, radiation environmental monitoring and assessment, etc., applicable to operators of NPPs, designers of nuclear facilities and specialized nuclear power engineering companies.

F-26 To ensure the safety of storage and disposal of solid radioactive waste, the RSRWM Regulations on Radioactive Waste Safety points out that the facilities dedicated solely to storage and/or disposal of solid radioactive waste should set up the organization with capability of ensuring the operation safety of such facilities; the storage facility should be staffed with more than 3 technicians involved in radioactive waste management, radiation protection and environmental monitoring, at least 1 of which is registered nuclear safety engineer; the LILW disposal facility should manned with more than 10 technicians working with radioactive waste management, radiation protection and environmental monitoring, among which at least 3 are registered nuclear

safety engineers; the facility for disposing of HLW and alpha waste should have more than 20 technicians working with radioactive waste management, radiation protection and environmental monitoring, at least 5 of which are registered nuclear safety engineers.

F-27 Country-wide inspection is sponsored annually for applicants for registration qualification after being given systematic training and qualification certification. The subjects to be examined cover nuclear safety related laws and regulations, nuclear safety related comprehensive knowledge, nuclear safety related practices and nuclear safety case analysis. "*Qualification Certificate of the People's Republic of China for Registered Nuclear Safety Engineer*" is granted to the qualifier after he or she passed the given inspection. The validity period of a registration is 2 years. Continued educational regime is performed for the registered nuclear safety engineers.

F-28 Since inspection and accreditation for the qualification of nuclear safety engineers were implemented in 2014 for the first time, there have been a total of 3,129 persons who are granted qualification certificates of registered nuclear safety engineers by the end of 2013.

F.2.2 Financial Guarantee

F.2.2.1 Financial Guarantee for Operation and Decommissioning

F-29 In China, the cost required every year for carrying out the activities relating to safe operation of, and safety modification to, nuclear facilities, including spent fuel and radioactive waste management facilities, will be borne by the operators of such nuclear facilities. A certain amount of fees shall be raised from the revenues collected by every year of electricity generation as the facility's cost needed for the safety modification to such a NPP, the safe operation of spent fuel and radioactive waste management facilities, and final decommissioning activities. The yearly planning and financial budget of a nuclear facility attach higher priority to the project associated with safety modification.

F-30 The *Interim Procedures on Collection, Utilization and Management of the Funds for Treatment and Disposal of Spent Fuel at Nuclear Power Plants* (IPCUMFTDSFNPP) was issued in July 2010 by the CAEA together with the related departments. The said funds are 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 such reprocessing, (5) construction, operation,

modification and decommissioning of reprocessing plant, and (6) other applications related to such treatment and disposal. Funds are collected according to the charging standards of RMB 0.026 Yuan/kWh for the actual online sales electricity generated by NPPs after 5 years commercial operation. Such funds are charged into electricity generation costs for a NPP. By using such funds, the spent fuel transport capability building and the maintenance of spent fuel storage facilities are underway by the effort of the CAEA.

F-31 Under LPCRP and RSRWM, the operators of nuclear facilities and nuclear technology applications shall, as required by the competent department of environmental protection under the State Council, treat solid radioactive waste and liquid waste that cannot be purified for release to make them become stable and standardized solidified waste forms. Such wastes should be timely sent to licensed storage and disposal facilities for storage and disposal while at the same time the incurred costs should be borne by the operators of nuclear facilities generating such waste. For instance, the costs for disposing of solid LILWs at Daya Bay NPP Base are calculated on the base of the estimated amount of solid LILWs generated in the next year and the estimated unit price of related disposal of LILWs, and then collected equitably on the monthly basis.

F-32 Under the LPCRP, the operators of nuclear facilities shall prepare its decommissioning program, in which the costs to decommission shall be predicated and listed in the cost estimates or production costs. At present, decommissioning funds have been pre-appropriated for the operational NPPs in China, including spent fuel and radioactive waste management facilities at the NPP sites, with the account established for such funds. With reference to international conventions, the eventual decommissioning costs for nuclear facilities are determined to be 10% of final account for nuclear equipment online at the time such NPPs is completed in construction. The interest fees calculated, within the lifetime of NPPs using the actual interest rate method on the basis of the amortized costs of estimated liabilities, are charged into financial costs. At present, the above funds are managed on the part of NPPs and subject to the oversight of special regulatory bodies to prevent such funds from being used for other purposes.

F-33 China has established insurance regime for nuclear incident liability. Under the *State Council's Reply on Nuclear Accident Damage Compensation Liability* (SC Letter 64, 2007), all operators of such NPPs have bought insurance enough to fulfill their nuclear liability, during operation of NPPs or prior to spent fuel storage, transport and reprocessing. As the third part liability

insurance, the highest compensation to injury or damage in the event of a nuclear incident is limited to RMB 300 million. If exceeding this limit, the highest financial compensation provided by the country is RMB 800 million.

F.2.2.2 Financial Guarantee for Pos-closure of Disposal facilities

F-34 For radioactive waste disposal facilities that are closed in a normal condition, the responsibility for their long-term surveillance rests with the the license holder of such facilities. The costs required for the post-closure maintenance, monitoring and emergency response are covered in the disposal fees collected on the part of LILW disposal site.

F-35 Under the RSRWM and MMLSDSRW, the operator of a facility dedicated exclusively to disposal activities of solid radioactive waste, when applying for the license of solid radioactive waste disposal, (1) shall provide a matched amount of registered fund, with not less than RMB 30 million for solid LILW disposal facilities and not less than RMB 100 million for solid HLW and alpha waste; (2) shall have the capability of financial guarantee to ensure that disposal activities shall persist to the end of safety surveillance period; and (3) the unit supplying financial guarantee shall bear the costs required for facility shutdown and safety surveillance in the case of the operator of the facility bankruptcy or license termination.

F.3 Quality Assurance (article 23)

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

F.3.1 Basic Quality Assurance Requirements

F-36 Basic QA requirements are provided for under the *Regulations on NPP Quality Assurance Safety* (HAF003), which are applicable to the quality assurance of NPPs-generated spent fuel and radioactive waste management. The quality assurance for the management of spent fuel and radioactive waste from other nuclear facilities other than NPPs is implemented by reference to such basic requirements. The basic QA requirements are mainly as follows:

(1) to prepare and effectively implement overall QA program for nuclear facility and QA related sub-program for various tasks, to prepare written procedures, detailed rules and drawings and to provide periodic review and revision of them, making periodic management review to determine QA

program's status and validity and, if necessary, to take appropriate corrective actions;

(2) establishing a licensed organization and/or body with clearly allocated responsibility and authority as well as and channel of internal and external communication; controlling and coordinating working interfaces between various organizations, controlling the selection, staffing, training and qualification inspection of personnel to ensure that the personnel acquire and maintain adequate technical skills;

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

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

(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, spare components and components, controlling the loading, unloading, storage and shipping of items and taking appropriate maintenance related important items to ensure the quality of the said items are properly protected from being damaged;

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

(8) establishing and effectively implementing the inspection and test program, verifying satisfaction of items and activity with specified requirements in order to demonstrate that the functions of the structure, system and components are in a satisfactory manner; controlling the selection, calibration, and operating conditions of the measuring and test equipment, and identifying and controlling the inspection, test and operating conditions;

(9) controlling the marking, review and treatment of items that do not satisfy requirements, prescribing the responsibility and authority for reviewing and treating them and making re-inspection of repaired items at work;

(10) identifying and correcting the conditions that may affect or has detracted from quality; for the conditions that has severe detracted from quality, corrective actions should be taken after investigation of 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 records are such clear, complete and correct as to provide the sufficient evidence to quality of items and activity; and

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

F-37 In addition, 10 QA safety guides are developed which provide complementary requirements and implementation recommendations for the above-mentioned basic requirements.

F.3.2 Quality Assurance for Spent Fuel Management

F-38 The systematic QA programs were developed by the operator of spent fuel management facilities and submitted to the MEP/NNSA for recognition as part of license application documents,.

F-39 All matters involved in the design and operation of spent fuel management facilities are implemented strictly as required by QA program. These matters include design and manufacture of important items and systems in spent fuel storage facilities, maintenance of sub-criticality of stored spent fuel, radiation protection, fuel heat removal, fuel shielding, erosion control, related operational procedures of nuclear material or fuel during commissioning, normal operation and in the event of predicated operation incident, maintenance, test, inspection and check of safety related equipment, record and documentation, radioactive waste management, record-keeping of fuel characteristics during storage, nuclear material safeguard system (when needed), and physical protection system and so on.

F-40 QA bodies, independent of other departments, are responsible for development, management, supervision and improvement of the QA program. They implement planned internal and external QA supervision, audit, review and assessment through which the defects existing in QA system can be found and improved in a timely manner. Meanwhile, further strict management shall be conducted by taking on non-conformance and corresponding corrective

measures, collecting and analyzing of QA information and trend, and reporting the followed results periodically to the higher competent authorities. If necessary, the timely corrective actions shall be taken.

F-41 The management department provides periodic scrutiny on the suitability and effectiveness of QA programs. These departments focus attention on the internal and external oversight and inspection results within assessment period, together with the related information, such as quality problems, corrective measures, quality trend, incident and malfunction, personnel qualification and training, among others. Based on the problems found in the above scrutiny, like defects in QA program, management, and quality, they shall, by conducting reason analysis, prepare and implement specific corrective measures and notify the related departments and facilities in written form.

F.3.3 Quality Assurance for Radioactive Waste Management

F-42 Under the GB 14500-2002, the following steps are taken, by the operators of both nuclear fuel cycle facilities and nuclear technology application radioactive waste storage facilities, to ensure the development and implementation of QA program relevant to radioactive waste management and/or disused sealed sources.

(1) the operators of waste management facilities have developed QA program according to 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 disused sealed sources in accordance with the QA program that has been reviewed and approved by the MEP (NNSA);

(2) in order to ensure the implementation of QA program, the designer, constructor and operator of both nuclear fuel cycle facilities and nuclear technology application radioactive waste storage facilities have developed, and have been implementing, the relevant QA sub-program and other quality-related documents;

(3) in the process of developing and implementing the QA management documents, the above operators focused special attention to the personnel's education and provided training and inspection of these personnel in respect of safety culture; and

(4) QA program consists mainly of quality policy and system; organizations for developing and implementing of QA; control of design, construction, operation and commissioning of facilities; procurement control of materials and

services; control of waste generation and sorting; 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 oversight and inspection.

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

F-43 There have been two solid LILW disposal sites in operation and one under construction. Under *Regulations for Shallow Ground Disposal of Solid Low and Intermediate-Level Radioactive Wastes* (GB 9132-1988), the operators all prepared and have been implementing respective QA programs in siting, design, construction and operation of the disposal sites, with representation of the QA inclusions and requirements for during-closure and post-closure institutional control period.

(1) during the time period beginning construction until the end of active institutional control period, the overall responsibility for facility safety rests with the operators. These operators have developed and implemented comprehensive QA program, which is subject to the recognition by the NNSA; and

(2) the comprehensive QA program takes account of the potential impacts of all safety-related activities, structures, systems and components upon a disposal facility. The QA program describes every step from planning, siting, design, construction, operation, safety evaluation through to facility closure, permanent record-keeping and institutional control activities relating to disposal facility.

(3) the essential parts of QA program takes into account the potential impacts of all activities, structures, systems and components upon a disposal facility, and gives the design-related suggestions. As clearly pointed out in the QA program, all activities, structures, systems and components, having the potential impacts on the safety of operation and disposal, must be determined on the basis of safety assessment results in the phases of operation and closure of such a disposal facility.

F.3.5 Regulatory Bodies' Primary Activity

F-44 The MEP/NNSA controls QA activities related to spent fuel and radioactive waste management safety in respects of:

(1) reviewing and recognition the QA programs for spent fuel and radioactive waste management and other types of safety related important documents, including their important revisions, as required of QA, safety

regulations and other types of safety related guides;

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

(3) organizing technical review of major non-conformance and oversee effectively the process of addressing such non-conformance.

F-45 The MEP/NNSA, working with its regional branch stations, has been carrying out a wide range of oversight and inspection of the safety and quality-related major activities in respect of spent fuel and radioactive waste management, and has been seriously fulfilling nuclear safety related duties pursuant to nuclear safety regulations and other related policy instruments.

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 materials 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-46 Under GB 18871-2002, for radiation exposure from a given source in a practice, optimization of protection should be achieved. Taking account of socioeconomic factors, the doses to individuals, number of exposed individuals and the possibility of exposure are all kept as low as reasonably achievable (ALARA).

F-47 Under the *Regulations on NPP Siting Safety* (HAF101), *Regulations on NPP Design Safety* (HAF102), *Regulations on NPP Operation Safety* (HAF103), the radiation exposure in nuclear facilities are ensured to have been

kept at ALARA through the following measures:

(1) taking account of the site and environmental characteristics that might affect the migration of released radioactive materials to human;

(2) employing appropriate design and layout for the structures, systems and components in the spent fuel and radioactive waste management facilities, such as shielding, appropriate materials should be used to reduce the activity of corrosion products, and zoning by the degree of radiation and contamination;

(3) implementing the requirements that the person activities in radiation zone and the possibility of person suffering contamination on site be reduced when designing spent fuel and radioactive waste management facilities, for example, measures to control the flow of persons and materials;

(4) treating and/or disposing of spent fuel and radioactive waste in appropriate ways and/or conditions;

(5) taking measures to reduce the amount and concentration of radioactive materials which are generated from spent fuel and radioactive waste management facilities and is spreading over the site and/or released to the local environment;

(6) deploying the equipments that can carry out enough radiation protection monitoring in normal and accidental conditions, such as stationary dose rate meters, monitoring systems to measure activity concentration of radioactive materials in air, instrument to measure radioactive surface contamination, and devices to measure dose and contamination to measuring persons;

(7) developing and implementing radiation protection program, including precautionary measures practiced in technology and management, like environmental radiation monitoring and decontamination of persons, equipment and structures or buildings;

(8) verifying whether radiation protection program is correctly implemented and whether goal is achieved through oversight and inspection, and subsequently modifying such program, if needed;

(9) staffing qualified health physics professionals with awareness of the design and operation of spent fuel and radioactive waste management facilities;

(10) achieving reasonable control of generation and release of radioactive effluents and waste, and enhancing radioactive waste management;

(11) setting effluent release limits, periodically reviewing these limits, developing methods and procedures to monitor and control such release, and

developing off-site monitoring program; and

(12) developing waste management program, and reporting to MEP/NNSA and other relevant departments for approbation.

F-48 The principled requirements that should be complied with in radiation protection in nuclear facilities are put forth by national nuclear safety regulatory bodies in a range of rules on the siting, design and operation of nuclear facilities.

(1) in siting of nuclear facilities, the public and the environment should be protected from excess radiation impacts caused by radioactive incident and while at the same time the account should be taken of radioactive release in normal conditions;

(2) the radiation protection requirements should be incorporated into the design of nuclear facilities, for example, optimizing the facility layout, arranging for shielding and reducing the activities and stay time of workers within radiation zone, and radioactive materials should be treated into proper forms in appropriate ways and conditions ;

(3) amount and concentration of radioactive materials released to the environment should be reduced by taking measures;

(4) full consideration should be taken of possible accumulation of radiation level with time in worker stay area and minimizing the generation of radioactive waste and so on;

(5) the operators of nuclear facilities should make evaluation and analysis of radiation protection requirements and situation in such facilities, and develop radiation protection programs to ensure the verification of whether or not such programs is implemented and the established goal is achieved in such manners as oversight, inspection and inspection, take corrective measures when needed; and

(6) functional departments of radiation protection should develop and implement the radioactive waste management program and the environmental monitoring program and carry out assessment of environmental radiation impacts.

F.4.2 Dose Limits

F-49 The GB18871-2004 sets forth the radiation protection principles, requirements and the dose limits, which are consistent with those recommended by the ICRP and the BSS developed by the IAEA.

F-50 The individual dose limits to workers and the members of key group of population are as follows:

—Occupational exposure

(1) annual average effective dose limit of 20 mSv is prescribed by regulatory body, averaged over 5 consecutive years, rather than any traceable average;

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

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

(4) annual equivalent dose for extremities 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 5 successive year periods does not exceed 1 mSv;

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

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

F-51 Dose constraints have been respectively set by all nuclear facilities taking account of economic and social factors, which are less than the relevant national limits.

F-52 As has been shown by the monitoring results of occupational exposure, the annual effective doses to workers in China's operating NPPs are less than the national relevant limits (see L.6).

F.4.3 Discharge Limits

F-53 Under Article 40 of the LPCRP, discharge of gaseous and liquid radioactive waste must be consistent with the national standards on prevention and control of radioactive pollution.

F-54 *Regulations for Environmental Radiation Protection of Nuclear Power Plants* (GB6249-2011) sets forth the specific requirements for the release of airborne and liquid effluents from on-land stationary NPPs in the normal conditions, as follows:

(1) the effective dose to any individual of the public arising from all nuclear power reactors at any site must be less than 0.25 mSv dose constraint; the dose management goal values for air-borne and liquid effluents should be set, respectively, by the operators of NPPs in accordance with the values of dose

constraints authorized by the national regulatory bodies;

(2) the total annual release amount of radioactive effluents should be controlled on the one-reactor basis; the control values for a 3000 MW (thermal) reactor are shown in Table 2 and 3;

(3) the control values for a larger-than or less-than 3000 MW (thermal) reactor should be adjusted appropriately; and

(4) for multiple same reactors at one site, the total annual release from all units should be controlled up to a fourfold increases; for multiple various reactors at one site; the total annual release from all units should be controlled according to the authorization by the MEP/NNSA.

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

	LWR	**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}	

F-55 In period time of 2011-2013, the percentage of annual release of radioactive effluents from China's NPPs to the annual limit authorized by the MEP/NNSA is shown in Appendix L.7, indicating the releases of radioactive effluent from NPPs are all less than the relevant national limits.

F-56 Environmental monitoring was carried out by the environmental monitoring stations in provinces where NPPs are located in. The monitoring results indicate that the maximum individual dose equivalent is far less than the relevant national limits.

F.4.4 Preventing Unplanned or Uncontrolled Release of Radioactive materials to the Environment

F-57 Under GB14587-2011 and the *Management of Radioactive Effluents and Waste Arising from Nuclear Power Plant* (HAD401/01),the following measures are taken by the operators of NPPs to ensure the limitation to release:

(1) based on the environmental characteristics at NPP sites and the technological level at which radioactive waste could be treated and in compliance with ALARA principle, the amounts of radioactive effluent to be released are applied to the MEP/NNSA for authorization prior to the first fueling (afterwards at 5 year regulars);

(2) total annual amount released by a NPP is controlled on a basis of quarter and month, with the total quarterly amount released not exceeding half of the annual amount authorized and the total monthly amount released less than one fifth of the total annual release amount;

(3) pool discharge is employed for liquid radioactive effluent while air-borne radioactive effluent needs to be purified before released into the environment via stack;

(4) for the purpose of locating the discharge outlet of liquid radioactive effluent, several considerations are taken into account, such as downstream water collection point, and thermal and radionuclide discharge, to keep away from centralized water collection point, aquatic breading site, migratory route, fishery and other environmentally sensitive zones;

(5) discharge of liquid radioactive effluent is controlled based on radionuclide concentration, for which optimal practicable technology is considered and is optimized in combination with site condition and operational experience feedback;

(6) effluent monitoring program is developed, in line with which air-borne and liquid effluents are monitored;

(7) liquid radioactive effluent in pool is monitored prior to being discharged with automatic alarm and release control devices installed on the discharge pipelines;

(8) reliable QA system is established by the operators of NPPs, and suitable measuring equipment and approach are deployed for effluent monitoring in normal operational condition;

(9) effective engineering scheme is used in the design of effluent sampling system to reduce effluent loss in pipelines in the process of sample collection.

F-58 The corresponding measures were taken by the operators of other nuclear facilities to prevent unplanned and uncontrolled release of radioactive materials.

F-59 Regarding unplanned or uncontrolled release, as have been pointed out in the RSRWM, the operator of solid radioactive waste storage and/or disposal facilities should conduct radioactivity monitoring for groundwater, surface water, soils and air around the facility. If any hidden danger to safety is discovered to have occurred or any radionuclide content in the ambient environment is in excess of relevant national standards, the necessary precautionary measures should be taken immediately after identification of cause while at the same time such situation should be reported to the relevant competent body. If a radiation accident would be rated, then emergency response plan for such facility should be activated and accordingly reported to the relevant bodies under the relevant laws and regulations so as to carry out accident emergency work.

F-60 Since the last Review Meeting, no unplanned or uncontrolled release of radioactive materials 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.5.1 Nuclear Accident Emergency

F.5.1.1 Basic requirements for nuclear emergency

F-61 Under the *Law of People's Republic of China on Dealing with Emergency Event* (LDEE), the *Law of the People's Republic of China on Prevention and Control of Radioactive Pollution* (LPCRP), the *National Nuclear Emergency Planning* (NNEP), the *Regulations on Nuclear Accident*

Emergency Management at Nuclear Power Plant (RNAEMN), the *Emergency Preparedness and Response of NPP Operators* (EPRNPO), and the *Emergency Preparedness and Response of Nuclear Fuel Cycle Facility Operators* (EPDNFO), three-level organization regime is implemented in China for nuclear emergency response at national, provincial, and facility levels. The matched emergency plans are established respectively.

F-62 At the national level, the *National Emergency Plan* (revised) was issued by the State council in June 2013 and in effect. It is not only applies to nuclear incidents occurring at nuclear facilities within territory of China and caused by the associated activities, but also to those that could have occurred outside the territory of China but could have led, and have potentials to lead, to impacts on the mainland of China. This revision edition clearly defines the fundamental policy, implementation principles, organizational system, nuclear accident emergency response at nuclear facilities, post-accident recovery action at nuclear facilities, including emergency response to spent fuel transportation accidents and other nuclear accidents and other emergency preparedness and countermeasures, like training and exercise. The NNAECC is responsible for organizing the Plan to be developed, revised, disseminated, and for related training and exercise.

F-63 At the NNAECC members' and provincial level, the members of the NNAECC and relevant provincial authorities all have improved their respective special plans in accordance with the *National Emergency Planning* (NEP, revised).

F-64 For the nuclear facility emergency organizations, the requirements are clearly set forth in the relevant regulations, such as RNAEMN, EPRNPO and EPDNFO. The RNAEMN specifies that the emergency organization of NPPs, the provincially mandated departments and the State Council mandated departments should prepare their own respective nuclear accident emergency plans for likely nuclear accident at NPPs. The RAEMNPO and EPDNFO point out that the nuclear facility operators should prepare onsite emergency plans and, prior to first fueling, submit them together with final safety analysis report to the MEP/NNSA for review and approval. Emergency plan should be re-reviewed and revised during nuclear facility operation.

F-65 The Nuclear Power Groups' responsibilities are explicitly established over emergency rescue, emergency capability building and emergency resource guarantee in the event of an emergency, as required by the recently revised *National Nuclear Emergency Plan*, the *Overall Requirements for Nuclear*

Power Groups on Building Onsite Rapid Rescue Teams for Nuclear Emergency at NPPs, and the *Technical Requirements for Nuclear Power Groups on Building Onsite Rapid Rescue Teams for Nuclear Emergency at NPPs* (trail). Two nuclear emergency rescue teams are set up based respectively on two nuclear power bases, QNPP and Daya Bay, with necessary rescue equipment, organizations and mechanism deployed. As a redundancy and supplement to the onsite emergency capability, the both teams can implement onsite rapid emergency rescue tasks in the event of a severe accident and can be adapted to the cases of multiple reactors and variable types of reactors.

F.5.1.2 Emergency organizational system

F-66 Three-level emergency organizational system which has been established in China, as illustrated in Figure 3, consists of national nuclear emergency organization, provincial emergency organizations (including autonomous region, municipality directly under central government where nuclear facilities are located) and the nuclear facility's emergency organizations.

F-67 National Coordinating Committee for Nuclear Accident Emergency (NCCNAE) organizes and coordinates the country-wide nuclear emergency management arrangement. National Nuclear Accident Emergency Response Office (NNAERO) /CAEA takes charge of the day-to-day work of the NCCNAE. If necessary, the State Council shall lead, organize and coordinate country-wide nuclear accident emergency arrangements.

F-68 MIIT, MPS, Ministry of Civil Affairs, MEP, Ministry of Foreign Affairs, NHFPC and other related agencies shall make efforts to implement nuclear accident emergency response arrangement within the scope of their responsibilities. NCCNAE examines and approves the emergency planning of provinces (off-site nuclear accident emergency plan), and supervises the developing and implementing such plannings. The MEP/NNSA executes independent oversight of NPPs' nuclear accident emergency arrangements, and overseeing the development and implementation of NPP nuclear accident emergency plan.

F-69 Provincial emergency organizations (including autonomous region, municipality directly under central government where nuclear facilities are located) are responsible for nuclear accident emergency preparedness and emergency response within their administrative areas, and command off-site nuclear accident emergency response actions.

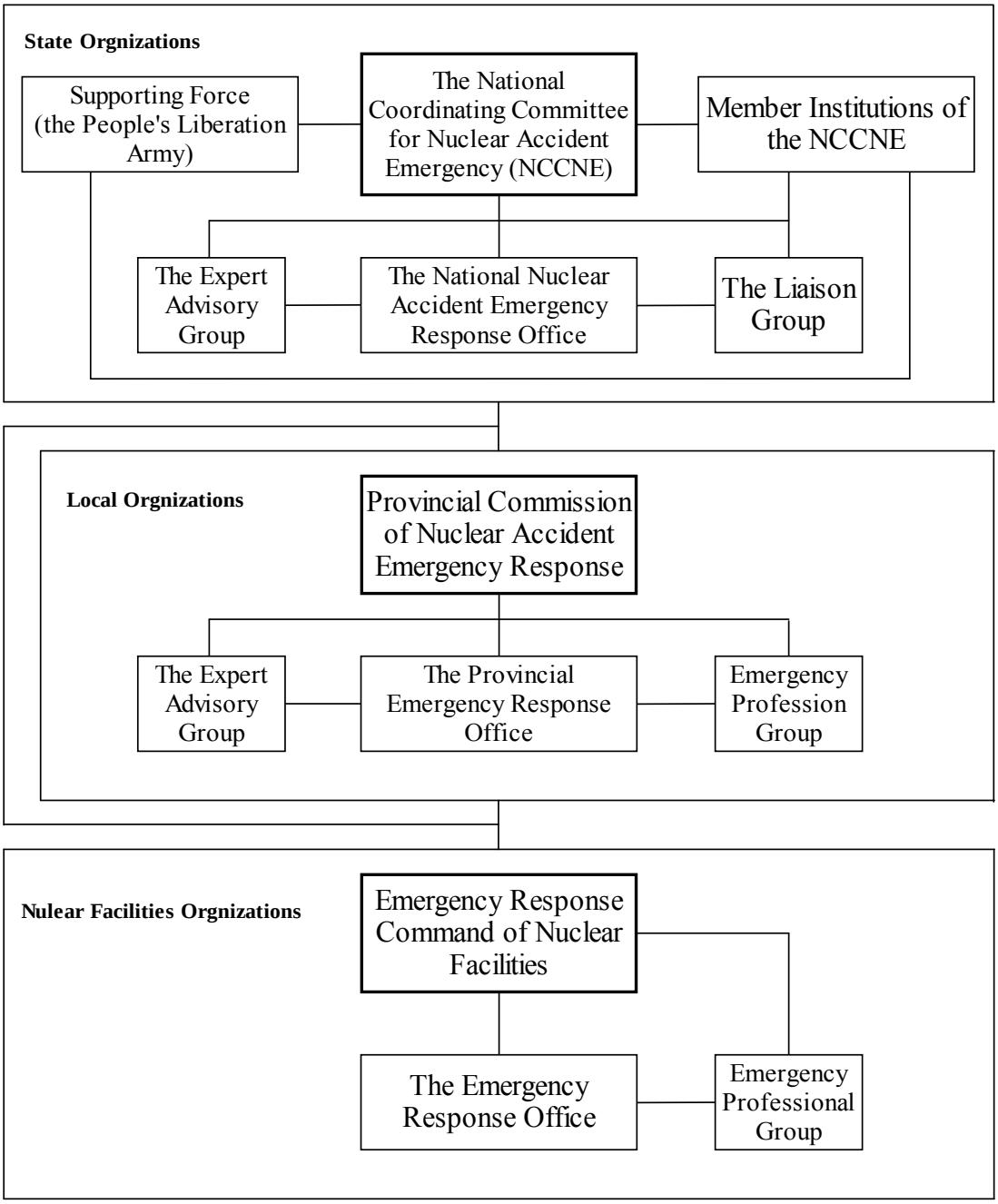

Figure 3 Organizational Structure of National Nuclear Emergency Response System

F-70 Nuclear accident emergency organizations of nuclear facilities are responsible for onsite nuclear accident emergency preparedness and emergency response, command their own nuclear accident emergency response actions, assist and help the related agencies in making nuclear accident offsite emergency preparedness and emergency response, make suggestions on initiating off- site emergency actions and protective actions timely.

F.5.1.3 NPP Onsite and Offsite Emergency Plan.

F-71 For likely nuclear accident at NPPs, their operators prepared onsite emergency plan, the NPP-located province's governments prepared offsite emergency plan, and the NNAECC prepared national nuclear accident emergency response and preparedness plan. These emergency plans all include emergency response organizations and their responsibilities, emergency preparedness and response schemes, devices and equipment, safety-related deployment, assistance and other technical details. These plans, at three different levels, are inter-connected and harmonized, each with implementation procedures as their support and detailed rules. Additionally, the main members of the NNAECC, together with supportive organizations and army, prepared their own respective emergency plans and, as required, followed by review and approval and periodic revision.

F-72 The National Nuclear Emergency Plan and the onsite and/or offsite nuclear accident emergency plans shall be subject to the review and approval by the relevant departments.

F.5.1.4 Nuclear Accident Emergency Drill and Exercise

F-73 Under NNEP, the nuclear accident emergency organizations at various levels should carry out nuclear emergency exercise through desktop and actual maneuvers to test, maintain and enhance emergency ability in response to nuclear accident. The nuclear accident emergency joint exercise at the national level will be implemented under the coordination of the NNAECC, generally once every three to five years. Provincial level nuclear accident emergency exercise will be organized by provincial nuclear accident emergency committee for implementation, normally once every two to four years. Nuclear facility emergency exercise will be organized and implemented under the deployment of nuclear facility emergency headquarter, generally once every two years, but with appropriate addition for the site with more than three units. Prior to first fueling, the nuclear facility operators all participate with the onsite and offsite joint exercise organized by provincial nuclear accident emergency committee.

F-74 The national emergency ability to nuclear accident has received much greater attention in China. Four national nuclear emergency support centers are set up in conjunction with six emergency rescue teams. Initiatives to building nuclear emergency basic ability are made by the concerted efforts by operators of NPPs, users of nuclear technology, and operators of other major nuclear facilities. Nuclear emergency committees, together with their routine

administrative offices, are established in 16 provinces. At present, national nuclear accident emergency rescue teams are in the process of construction, as required by the State Council.

F-75 Joint nuclear emergency exercises are performed periodically at national level. In order to verify the validity of nuclear emergency plan and its implementation procedures, the first national large-scale three-level joint emergency exercise to nuclear accident was conducted on 10 November 2009. This exercise inspected the full range of national ability to respond nuclear and radiation events, through which the operating mechanism is improved and the emergency force are fostered. During this exercise, the CAEA invited the Japanese and Korean delegations to observe this activity and notified to the IAEA, as required by the *Convention on Early Notification of a Nuclear Accident*.

F-76 Wide variety of emergency exercises are performed at the nuclear facilities that have been in operation, in the efforts to test, improve and enhance the ability of emergency preparedness and response. In accordance with the relevant requirements, the emergency exercise is conducted once every two years at each of NPPs. The operators of nuclear fuel cycle facilities and research reactors also conducted emergency exercise as required. An emergency exercise was conducted in 2011 at QNPP. Two onsite comprehensive exercises were completed at Daya Bay NPP in the same year. In 2012, an onsite comprehensive nuclear accident emergency exercise was conducted at Tianwan NPP.

F-77 For the purpose of verifying the validity of emergency preparedness at newly built NPPs, a nuclear accident emergency exercise was conducted at each of China's NPPs prior to the first fueling. An onsite comprehensive emergency exercise and a joint exercise, in conjunction with offsite emergency organizations, were conducted respectively at Hongyanhe NPP in 2012. Three exercises, consisting of one onsite comprehensive exercise and two joint exercises with offsite emergency organizations, were conducted at Ningde NPP in the same year. One emergency exercise jointly with offsite emergency organizations was conducted at Yangjiang NPP in 2013.

F.5.1.5 Emergency Preparation and Response to Outside Likely Nuclear Accident

F-78 Under the NNEP, the emergency response to nuclear incidents that could have occurred outside the territory of China but likely to have led, and have potentials to lead, to impacts on the mainland of China can be implemented by reference to this Plan. For the nuclear accident that could have occurred or likely to occur in another country else that have potential impacts on China's mainland, the NNAECC will organize to conduct information collection and dissemination, radiation monitoring, between-department consultation, analysis and judgment, port control, market regulation, international notification and assistance among other things. If necessary, the national emergency headquarter will be activated to take the overall responsibility for commanding, organization and coordination of the nuclear emergency response efforts.

F-79 During the Fukushima crisis in 2011, the timely and effective response efforts were initiated by China's relevant agencies. The NNAECC initiated the nuclear emergency coordination mechanism timely in such a manner as to contact Japanese Government, obtain basic information, fully monitoring accident situation in progress, and learn what to be taken in response to the accident through Chinese embassies and consulates overseas and the embassies and consulates in China. The National Nuclear Accident Emergency Office (NNAEO/CAEA) released the relevant information to the whole society after information collection. The NNAECC members also launched actively information dissemination. The MEP/NNSA made the special column "Japanese Earthquake Ensuing Concerns" available for the pubic on its website. It also held press conference and organized experts to be interviewed in attempt to explain nuclear emergency knowledge and the issues of public concern. Since 12 March 2011, the environmental radiation monitoring data were made available on the MEP/NNSA website while at the same time the main radiation monitoring results appeared periodically on the relevant government media. The State Oceanic Administration began marine monitoring of radioactivity immediately after the Fukushima accident and released timely the monitoring results on its website.

F.5.2 Emergency Response to Radiation Accident

F-80 Radiation accident refers to those in which radioactive source is lost, stolen or out of control, or to those in which radioisotope is out of control, therefore leading to abnormal exposure of radiation to person.

F-81 Chinese laws and regulations on radiation accident emergency include LPCRP, HAF001 and MMSPRRI, etc.

F-82 According to the nature, severity, controllability and impact extent of a radiation accident, they are classified into exceptionally serious radiological accidents, major radiological accidents, serious radiological accidents and ordinary radiological accidents.

F-83 Environmental protection departments of people's governments at or above county level should prepare radiation accident emergency plan governing the areas under their jurisdiction in conjunction with departments of public security, health and family planning, finance, news and press. These departments should submit the prepared emergency plans to the local people's governments at the same level for authorization. Such plans should present emergency agency, responsibility assignment, emergency personnel training, emergency rescue equipment, funds, materials reserve, radiation accident classification, emergency response measures, radiation accident investigation, reporting and treatment procedures, radiation information disclosure, pubic communication, etc.

F-84 The holders of radiation safety license prepared emergency plans based on the estimated risks of radiation accident for their own respective facilities and are ready for emergency.

F-85 When finding radiation accident or operation malfunction likely to result in radiation accident, the holder of radiation safety license should start emergency plan and take emergency measures, while at the same time fill in a preliminary report to the local governments within two hours. If a radiation accident would have taken place, the holder of license should also report to local governments, public security departments, health and family planning departments.

F-86 Under RSPRRI, graded response and graded treatment are implemented against radiation accident in China. While accident taking place, the local governments at or above county level should, based the radiation accident classification, activate and implement the relevant emergency plans.

The government departments above county level, including environmental protection, public security, and health and family planning, should make all-out effort to take effective and timely measures in the event of radiation emergency within their respective responsibility scope.

F-87 Since the last report to the Joint Convention review meeting, there are a total of 31 radiation accidents to have occurred, of which 13 accidents were in 2011, 9 in 2012 and 9 in 2013, respectively. Among which 4 were serious radiological accidents whereas the remainders were ordinary radiological accidents, without leading to damage to individuals and contamination to the environment.

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-88 Nuclear facility decommissioning are equipped with qualified personnel. Under the *Safety Requirements for Decommissioning of Nuclear Facility* (GB/T 19597-2004), the management organizations of nuclear facility decommissioning are all provided with proper number of decommissioning experts and original operational and management personnel of the facility to be decommissioned. Among the nuclear facility decommissioning workforce are professionals and experts involved in operation, decontamination, robot or remote manipulator, engineering technology, dismantling and demolition, quality assurance, waste management, and security and safety.

F-89 Nuclear facility decommissioning is provided with enough financial resource. Under LPCRP, the costs required to decommission shall be predicated and listed in the cost estimates or production costs. At present, decommissioning funds have been pre-appropriated for the operational NPPs in China, including spent fuel and radioactive waste management facilities' decommissioning at the NPP sites. For instance, the eventual decommissioning costs for Daya Bay NPP is determined to be 10% of original assets value online

at the time it was completed in construction.

F-90 Costs required for decommissioning the legacy of nuclear facilities are arranged in national financial budget.

F-91 Radiation safety measures are considered and implemented in nuclear facility decommissioning to ensure limited release. Under GB/T 19597-2004, independent radiation safety organizations have been set up in all nuclear facilities and safety management is implemented in the line with proper safety procedures. In preparatory phase of decommissioning, the radiation protection program was prepared, involving abnormal decommissioning conditions and emergency measures; special radiation safety equipment, technical procedures, administrative procedures are employed in accordance with actual conditions; division of facility zone to be decommissioned, division and management of sub-zone were carried out according to radiation level, contamination level or radionuclides; appropriate safety system and necessary radiation monitoring meters were deployed, including isolation room and/or shutter, to keep the doses to workers and the public ALARA; radiation safety measures are used, like effective ventilation and air purification devices; radiation monitoring is performed including effluent monitoring; limits and control are imposed to doses to worker and the public. Management should be made, as specified by the relevant laws and regulations, of gaseous and liquid effluents from nuclear facilities in the process of decommissioning.

F-92 Emergency preparedness is implemented for nuclear facility decommissioning. Under GB/T 19597-2004, the operators of nuclear facilities should, based on specific situations, prepare and implement the emergency plans that might be in response to the abnormal conditions likely to occur. Such emergency plans should incorporate the potential event-related emergency procedures and personnel training among others. Emergency procedures should be updated through emergency drill and test.

F-93 Documentation important to nuclear facility decommissioning should be reserved. Under GB/T 19597-2004, the operators should implement appropriate and most recent QA program. In prepare the QA program relating to decommissioning project, attention should be paid to collection and preservation of documents and data. The records on all decommissioning projects should be preserved permanently.

G. SAFETY OF SPENT FULE 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 operators of NPPs, research reactors and spent fuel storage facilities. Under HAF001, the operators shall hold the overall responsibility for nuclear facilities they operate, including spent fuel management facility, and shall be subject to the nuclear safety regulatory bodies.

G-2 The safety of management of spent fuel stored at NPP reactors are subject to the provisions of HAF101 HAF102, HAF103, the *Handling and Storage System at NPPs* (HAD102/15), *Management of Core and fuel at NPPs* (HAD103/03) and *Design Criteria for Pressurized Water Reactor Spent Fuel*

Storage Facilities at Nuclear Power Plant (EJ/T 883-1994).

G-3 The safety of management of spent fuel at research reactor shall be subject to the requirements of the *Regulations on Research Reactor Design Safety* (HAF201) and the *Regulations on Research Reactor Operation Safety*（HAF202）.

G-4 The safety of management of spent fuel away from reactor shall abide by the provisions of *Regulations on Civil Nuclear Fuel Cycle Safety* (HAF301), *Design of Spent Fuel Storage Installation*（HAD301/02), *Operation of Spent Fuel Storage Installation* (HAD301/03) and *Safety Assessment of Spent Fuel Storage Installation* (HAD301/04).

G-5 For the management of spent fuel stored at reactor and/or away from reactor at NPPs and research reactor, the following measures are taken to reduce as much as possible undue burden over the future generations:

(1) avoid as much as possible actions that impose reasonably predictable impacts on future generations greater than those permitted for the current generation. Vitrification shall be implemented of liquid HLW generated from spent fuel reprocessing and the vitrified waste forms shall be disposed of in deep geological formation. Under RSRWM, the deep geological disposal facility for solid HLW should meet safety isolation requirements of more than 10,000 years after its closure; and

(2) avoid as much as possible imposing undue burdens on future generations. China's spent fuel management policy is to reprocessing spent fuel. At present, a large sized commercial reprocessing-recycle pilot project has started operation, with equipped with liquid HLW vitrification facility. In addition, The *Interim Procedures on Collection and Utilization of NPP Spent Fuel Disposal Funds* was issued.

G.1.1 Requirements for Management Safety of Spent Fuel Stored at Reactor at NPPs

G-6 As required by HAF102, HAD103/03, and EJ/T 883-1994, the following measures are taken to ensure enough protection of individuals, society and the environment from radioactive hazards during all phases of spent fuel management at NPPs:

(1) to ensure that the criticality issues are solved properly. The major measures to be taken are to comply with the layout that has been approved, meet the requirements for neutron absorbers in storage facility, implement

relevant QA program and ensure the inventory of spent fuel less than the maximum capacity of storage. Here, neutron absorber may be fixed thin plate as absorber or boron-containing water in storage pool. These measures can ensure the integrity and sub-criticality of spent spent fuel.

(2) to ensure that the residual heat release are addressed properly. Considerations are taken into account, such as the maximum capacity of storage pool, burnup, radioactive decay, and designed cooling capacity of spent fuel pool, so as to ensure the redundancy of cooling system to a certain degree; the pool is provided with suitable system of water make-up and drainage to achieve forced cooling function and maintain the required water temperature, as well as equipped with restorable ability for cooling capability loss; the coolant flow required to derive maximum decay heat of fuel assembly is considered in design of spent fuel rack; and

(3) to ensure the amount of radioactive waste generated is kept as low as practicably achievable . The major measures to be taken are to use stainless steel and other materials as fuel pool liner to ensure leak tightness of spent fuel pool, select proper surface roughness of liming for convenient decontamination, consider possibility of container falling on spent fuel assembly in design of container loading and unloading pool, provide monitored zone with necessary monitoring and decontamination equipment to prevent occurrence of unacceptable contamination; to make the equipment and materials than may contact with water compatible with pool water; to provide damaged fuel with storage equipment;

(4) to consider interdependent relationship between various steps. The spent fuel drawn from reactors is stored temporarily in storage at NPPs and then sent to centralized storage facility or to reprocessing facility. The spent fuel sent to the centralized facility will be also sent to reprocessing facility. Type, burnup, cooling period and other characteristics of spent fuel are all considered in devices and transport operations involved in every stages of the spent fuel management. In this process, the applicants should submit detailed technical documents to evidence the measures taken can ensure the safety of spent fuel management in every stage.

(5) to ensure providing effective protection of individuals, society and the environment. Complying with the Departmental Rules on the siting, design and constructions of NPP, the operators perform management of spent fuel facilities, implement QA program approved by the MEP/NNSA and meet the dose constrains approved by the MEP/NNSA.

(6) to adequately consider potential biological, chemical and other factor-related hazards. During the normal operation, the temperature in pool should be kept at safety level to make workers conformable. Fuel plant should be designed and constructed in such a manner to have capability of preventing local fire spread.

G.1.2 Requirements for Management Safety of Spent Fuel Storage at Research Reactor

G-7 Under the the HAF201and HAF202, the following measures are taken to ensure enough protection of individuals, society and the environment against radioactive hazards during the all phases of spent fuel management at research reactor:

(1) to ensure that the criticality issues are solved properly. The major measures to be taken are to provide adequate place to store research reactor spent fuel, to store spent fuel assembly in accordance with approved procedures and assessed layout, set fixed absorber (such as boron carbide aluminum plate) in storage pool, or neutron absorber dissolved in pool water, and implement required supervisory and management procedures.

(2) to ensure that the residual heat release issues are dealt with properly. The major measures to be taken are to ensure frequent flow of coolant in design of rack and storage pool, employ forced or natural cycle approach to release residual heat and set water make-up feed installation with some redundancy.

(3) to ensure the amount of radioactive waste generated is kept as low as practicably achievable. The major measures to be taken are to set purification system, control composition of cooling medium, prohibit weights from moving over fuel storage zone, limit crane operation at required minimum height, periodically examine crane, monitoring leakage from pool, and individually store and timely treat the damaged and leakage spent fuel.

G-8 Additionally, the interdependent relationship between different steps in spent fuel management is taken into account in much the same way as nuclear power plant to ensure provide enough protection of individuals, society and the environment and full consideration of the potentials of biological, chemical and other hazards relative to spent fuel management.

G-9 Under the *Core Management and Fuel Handling for Research Reactors*(HAD202/07), the Guides issued by MEP/NNSA in 2012, the safety goals related to handling and storing irradiated fuel assembly are:

(1) to ensure that fuel is always in sub-criticality;

(2) to prevent fuel assembly damage;

(3) to maintain the environment in which integrity of fuel element clad could not degraded;

(4) to ensure the ability of adequate residual heat removal;

(5) to ensure that radioactive materials released to the environment be kept below the limits specified and the radiation exposure of personnel be kept ALARA. In order to achieve the above goals, the Guides establish the safety requirements for the handling, storage and inspection of irradiated fuel respectively.

G.1.3 Requirements for Spent Fuel Storage away from reactor

G-10 Requirements for and recommendations on away-from-reactor spent fuel management are provided in the HAF301, HAD301/02 and HAD301/03, with special emphasis on the safety of dry storage or pool storage. The main points are as follows:

(1) to maintain the sub-criticality of spent fuel, the main measures include choice of geometrically safe configuration and use of fixed neutron absorbers during physical deployment, etc;

(2) to design the suitable structure and layout, the main measures are to select as short and/or straight moving pathway as possible and minimize the movement of weights over spent fuel pool, and adequate deployment of contamination measurement and safe storage of leakage and damaged spent fuel;

(3) to providing enough radiation protection, under the relevant national regulations and *Radiation Protection Design for Nuclear Power Plants* (HAD 102/12), radiation protection measures are provide for workers and the public; radiation protection principles with which nuclear facilities comply also apply to the design of pool or dry storage of spent fuel;

(4) to ensure the containment of radioactive materials, the main measures include ventilation system and waste gas purification system, as well as monitoring methods;

(5) to ensure heat removal, the main measures include setting up forced cooling system in early phase of facility operation and subsequent natural cooling, and installing redundant or diverse heat removal systems; and

(6) to use the appropriate materials, the main measures are to choose authorized structural materials and welding methods to make the structure and components in contact with spent fuel assembly compatible with spent fuel assembly, and to take account of the impacts of corrosive medium for purpose of convenient decontamination.

G-11 QNPP III's interim spent fuel dry storage facility is an away-from-reactor dry storage facility, with the following main features:

(1) spent fuels from HWRs contain too low content of ^{235}U and ^{239}Pu to reach criticality;

(2) MACSTOR-400 module is storage container capable of inactive heat dissipation, which can make spent fuel cladding temperature not to exceed the specified limits under natural convection conditions;

(3) during storage and subsequent transportation, spent fuel is shield with provided pool water, workbox, transportation cask and concrete. Such shield can assure the safety of workers and the public; and

(4) in addition to spent fuel cladding, both fuel basket and storage drum also provide shielding to radioactive materials, thus ensuring containment of radioactive materials.

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-12 Spent fuel storage facility is built at each of China's operating NPPs for purpose of receiving and storing the spent fuel withdrawn from such NPPs, At present, the away-from-reactor spent fuel storage facilities built at all of such NPPs are employing wet-storage approach, with an additional away-from-reactor dry-storage facility at QNPP III. In similarity to NPPs, the at-reactor spent fuel wet-storage facilities have been built for research reactors.

G-13 Although the extended spent fuel storage has not yet become a concern in China, the safety impacts resulting from this issue has received enough attention. The periodic safety inspection over the past decade included the scrutiny of management of spent fuel. In addition to tracking the international tendency, new research efforts should be added, as needed, including international cooperation.

G.2.1 Review of Facility Safety

G-14 Under HAF001, prior to construction and operation, the operators of existing NPPs and research reactors all prepared and submitted to the MEP/NNSA the environmental impact statements, preliminary safety analysis reports, final safety analysis reports, nuclear facility QA programs, nuclear facility commissioning program, nuclear accident emergency plans and other related documents.

G-15 The MEP/NNSA mandates its technical support organizations to review the submittals, such as environmental impact statements and preliminary safety analysis reports, etc., from such operators and to carry out onsite inspection. After such review and inspection, the findings of technical support organizations shall presented to the nuclear and radiation expert panel for further review. Subsequently, the panel shall form review results. Based on these findings and review results, the MEP/NNSA shall decide whether or not approve the above application presented by the operators.

G-16 After having approved by the MEP/NNSA, the operators of existing NPPs and research reactors begin construction and operation of such facilities including spent fuel management facilities.

G-17 In the design, construction and operation of existing NPPs and research reactors, the operators of such facilities complied strictly with the requirements of HAF101, HAF102, HAF103, HAF201, HAF202, HAF301 and EJ/T 883-1994.

G.2.2 Reasonable Modifications to Existing Facilities

G.2.2.1 Periodic Safety Review of Operating NPPs

G-18 Under HAF103, the operators shall, based on the gained operational experiences and on the new significant safety information from related sources throughout operating lifetime, conduct systematic re-assessment of NPP safety in accordance with management requirements. The HAF103 also specifies that the above re-assessment shall be based on periodic safety review.

G-19 Safety review, conventional and specific, and periodic (10 years normally) safety review of China's existing NPPs are conducted by their operators under *In-commissioning examination of NPPs* (HAD103/07)and *Periodic safety review for NPPs* (HAD103/11). The period safety review is conducted after 10 years of NPPs' operation, subsequently once a decade or so, until the end of facility lifetime. The periodic safety review covers all aspects of

NPP safety, namely all in-plant facilities, structures, system and components covered in the operation license, as well as personnel allocation, organizational structure, emergency plan, radiation environmental impacts and other safety elements relevant to nuclear units, including spent fuel management facilities.

G-20 The second 10-year periodic safety review to the QNPP was conducted in 2011 and the first 10-year review to QNPP II and QNPP III was also conducted in the same year. The second 10-year periodic review to Daya Bay NPP was conducted in 2012. The scope of review covers design and actual aspects of spent fuel handling and storage systems, spent fuel storage pool cooling and purification systems, together with enough relevant documents and records. The focus of review was on important structures, systems and components and the ability to endure external environmental impacts under the normal and abnormal conditions, such as normal operation, maintenance and testing and postulated accidents, and the ability to response to expected natural disaster and superimposed impacts of normal and abnormal conditions, the ability to implement required safety function when concurrent use of these items, the ability to removal residual heat under normal and abnormal conditions, redundancy of components playing safety functions in the event of postulated single accident superimposed by loss of off-site power supplies, ability to ensure no damage to system, measures to make in-service inspection, periodic inspection, operation function inspection of safety-related components, the safety of fuel storage under the conditions of normal operation and postulated accident, including containment, filtration, residual heal removal, monitoring and alarming, and ability to reduce occupational expose. The review concluded that such systems are in consistent with the requirements of the current safety standards as fuel handling and storage system, and cooling and purification system of spent fuel storage pool. Modification approach are suggested to improving the identified deviation and weakness. Timely improvements were made in such a way as to raise the safety and reliability of system.

G.2.2.2 Comprehensive Safety Inspection of NPPs and Research Reactors Countrywide

G-21 Comprehensive safety inspections of countrywide civil nuclear nuclides were conducted during March to December 2011, including NPPs and research reactors.

G-22 As discovered in this course, the major problems in spent fuel management facilities are:

(1) there is lack of precautionary and mitigation measures tackling serious accident at spent fuel management facilities of some NPPs;

(2) design basic flood level at QNPP's spent fuel management facility site is difficult to endure the extreme situation due to land reclamation planning;

(3) NPPs at Daya Bay NPP base may have potentials to face impacts from Manila Trench's utmost earthquake-triggered tsunami;

(4) the site at which high fluence engineering test reactor (HFETR)'s spent fuel management facility and radioactive waste management facility are located can not endure the seismic intensity in the site area.

G-23 In view of the problems found during the inspection, 16 safety improvement requirements were determined and the short-, medium- and long-term plans were developed according to the importance and feasibility of the various safety improvements, requiring and urging nuclear facilities to complete their improvement actions. In order to standardize the common improvement actions of NPPs, the MEP/NNSA issued the *General Technical Requirements for Nuclear Power Plant Modification following Fukushima Accident* (trail) in June 2012, as guiding document for subsequent improvement actions. This document puts forward a number of requirements, for instant, increasing spent fuel pool water level and temperature monitoring.

G-24 As required, the operators of nuclear facilities developed their own respective implementation plans. By the end of 2013, the modification requirements raised in short- and mid-term plans were all met. All requirements put forward in the long-term plan are due to be met by the end of 2015. The major modifications that have been completed by the end of 2013 are as follows:

(1) all NPPs at QNPP Base have confirmed and reviewed the updated operational manuals and emergency procedures for spent fuel pools, which give clear requirements for the monitoring and control of temperature and water level in spent fuel pools and detailed procedures for spent fuel pool make-up water operation; both Daya Bay-based NPPs and the Tianwan NPP have completed the reconstruction of the monitoring and make-up systems for spent fuel pool under the condition of power supply loss;

(2) the reconstruction project for heightening levee has been completed at the QNPP;

(3) the seismic margin evaluation and analysis and the seismic tsunami assessment have been completed at Daya Bay Base, indicating that potential

tsunami would result in no impacts on the safety and stability of the operation of spent fuel management facilities at all NPPs at Daya Bay Base.

(4) aseismic check and modification were made of the HFETR’s spent fuel management facility and radioactive waste management facility; currently, the reconstruction work is proceeding for the emergency rescue in response to the natural disasters such as landslides and road congestion.

G-25 All NPPs have already established warning and information communication mechanisms on external disasters with the weather, ocean, earthquake and other relevant departments and have completed the evaluation and upgrading of the procedures on earthquake monitoring, alarm, record, regular testing and emergency response and the development of the related systems.

G-26 Additionally, spent fuel transfer and radioactive waste treatment and disposal are underway as planned at all of civil research reactors.

G.2.2.3 Evaluation of Safety Margin against External Events at NPPs

G-27 The MEP/NNSA issued in 2013 the *Notifications on Evaluating External Event Safety Margin at Nuclear Power Plants*, requiring China’s operating NPPs to further evaluate the safety in related facilities, including spent fuel management facilities. The safety margin should be evaluated against beyond design basis external events, with the same scope and depth as in the compression test conducted in Europe counties. This is to optimize and implement the modification actions suggested by the comprehensive safety inspections. The external events covered in the evaluation are earthquake (initiator), floods (initiator), total loss of power supply (ensuing loss of safety systems). The evaluation focuses on the effectiveness of spent fuel management facilities to respond to, prevent and mitigate potential external extreme events, and to eliminate the potential weakness in spent fuel management facilities.

G-28 Based on deterministic theory, it is assumed that, in the course of evolution of extreme natural disasters, several layers of defense would be in successive failure, but without account taken of failure probability. Based on this assumption, the modification actions were presented in aspects of organizational system or technical capability through evaluating the robustness and safety margin of defense in depth in spent fuel management facilities.

G-29 On the basis of evaluation results and peer review findings, all operating NPPs in China can meet the 1.5 times, or larger, design basis seismic requirements and have safety margin against beyond design basis floods.

However, the QNPP 300 MWe unit's spent fuel management facility is located in wetland, which is not in consistent with beyond design basis flood level requirements. Full ranges of countermeasures have been developed by all NPPs against total failure of electric power supply, equipped with storage battery capable of supplying electric energy for longer than 8 hours.

G-30 At the QNPP, the modification of flood control dam has been completed, having safety margin against beyond design basis flood.

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 Licensing Process and Information Disclosure

G-31 The Chinese government attaches great importance to the siting of nuclear facility. Under the LPCRP, site selection of nuclear facility shall undergo scientific demonstration, and shall go through licensing process according to national relevant requirements. Prior to licensing process, the environmental impact statement should be prepared and submitted to the environmental department of the State Council for review and approval. No license and the other documents can be granted without authorization.

G-32 Under the HAF001, prior to constructing a nuclear facility, the license

of construction shall be obtained. One of the prerequisites of obtaining nuclear facility construction license is that the site selected has been approved by environmental department and planning department of the State Council or provincial government and national nuclear safety department.

G-33 China has established a comprehensive set of licensing process for site selection. Firstly, the applicant shall submit the MEP/NNSA the site safety analysis report and environmental impact statement in the siting phase of a NPP, including the analysis and assessment of spent fuel storage facility. Secondly, the MEP/NNSA's technical support organizations shall conduct review of these submittals, giving written questions, and then, the applicant shall answer the questions, revise and submit revised version of above documents. Based on these efforts, the reviewing organizations shall write their review comments on above both documents (or review report) and submit to the MEP/NNSA. At last, the MEP/NNSA shall organize the expert panel of nuclear safety and the environment to review the both reports revised and presented by the applicant along with the review comments or review report provided by reviewing organizations. Following the both report passed review, the MEP/NNSA shall grant site use permit and the EIA approval to the applicant and copy them to other related departments.

G-34 Under the *Guideline on Government Information Disclosure for Environmental Impact Assessment of Construction Project* (trail), an applicant shall make legally the full information of environmental impact statement available to the public prior to submitting it to the MEP/NNSA. When accepting the environmental impact statement, the MEP/NNSA shall also make such information open to the public. Prior to approving the proposed project, the MEP/NNSA shall make its comment available to the society and the public on either approving or disapproving the environmental impact assessment statement. After having approved such project, the MEP/NNSA shall make the licensing process open to the public.

G.3.2 Siting of Spent Fuel Storage Facility

G-35 Under HAF101, HAF201, HAD301/02 and other related nuclear safety guides, in the process of siting the existing spent fuel storage facilities, the following tasks are completed:

(1) evaluating the site factors that may influence the safety of spent fuel management facilities in their lifetime, such as industrial, transportation and military facilities in the surrounding environment, hurricane, tornadoes,

lightning, hail, freezing rain, snow and tropical cyclones, rainfall-caused floods, earthquake-caused waves, broken liquid-retaining structure-caused floods and waves, potential volcano, earthquake rupture, slope instability, ground subsidence, subsidence and uplift, earthquake, soil liquefaction, the plane crash, significant natural phenomena and extreme conditions, important artificial events, atmospheric dispersion of radioactive materials, dispersion of groundwater and surface water and uses of soils and water, etc;

(2) evaluating the impacts on the safety of individuals, society and the environment arising potentially from spent fuel management facilities. Evaluating potential release of radioactive materials; using suitable models to evaluate the atmospheric dispersion of radioactive materials, the potential impacts of contaminated surface water on local population and the migration of radionuclides in hydrogeological unit, potential impacts of contaminated groundwater on local population and the ability of mitigation measures required to be taken under accident condition, including emergency plan;

(3) providing the pubic with the information on the safety of spent fuel management facilities. Under the *Law of People's Republic of China on Environmental Impact Assessment* and the *Provisional Regulations for the Public Involvement in Environmental Impact Assessment*, the applicants in the phase of NPP siting shall disseminate the information on NPP project construction to the public at internet websites and on the publicly available media. 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 assessment conclusions. The applicants also announced the environmental impact assessment statement to the public and solicited the public comments. For example, before submitting environmental impact assessment report on interim dry spent fuel storage facility, the applicants disseminated the main content of the report to the public through the local media for comment collection. They also held the public meetings, briefing the situation of construction projects, exchanging the main assessment results with each other, collecting and answering questions. Among the stakeholders participating in meetings are professionals, representatives of enamoring communities and surrounding villagers.

(4) Chinese NPPs are almost located in the eastern coastal area, with spent fuel storage facilities built on site. No impacts upon any other Contracting Parties could be from its current spent fuel storage facilities.

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 Facility at NPPs

G-36 Under HAF102, EJ/T883-1994, GB/T 19597-2004, GB 6249-2011 and HAD102/15, the following main measures were taken in the design and construction of spent fuel management facilities at NPPs in addition to preventing criticality and ensuring residual heat removal.

(1) the engineering technological measures were taken for the purpose of release restriction and planned release. These measures include segregation and filtration, controlling iodine and other radioactive materials below the required limits, making airflow to be controlled within fuel building, controlling release from fuel handling room at minimum limits, filtering gaseous waste before released to stack, installing airborne radioactivity monitoring system, monitoring and controlling dispersion of contaminants, setting drainage sump leading to liquid radioactive waste treatment system, monitoring and controlling liquid radioactive waste release to the environment, and preventing storage facility from being submerged.

(2) conceptual plan of decommissioning was considered. The structures, equipment and systems in spent fuel storage facility were designed to consider future convenient decommissioning of nuclear facility as a whole. The preliminary decommissioning plan for nuclear facility, along with spent fuel management facility, were developed and submitted to the higher competent authorities. The inclusions of the plan encompass considerations of basic safety issues, expected decommissioning strategy, the impacts of the current or proposed technology on facility to be decommissioned, arrangement of systems sheared between the facilities under decommissioning and in service, impacts of

decommissioning process on the environment, management of decommissioning wastes, decommissioning costs and their raise, and assurance agencies.

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

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

G-37 Under HAF201, the following main measures were taken in the design and construction of spent fuel management facilities at research reactors in addition to preventing criticality and ensuring residual heat removal.

(1) the measures with capability to prevent radioactive materials from being released to the environment were taken. Adequate systems of containment, ventilation, filtration and decay were put in place in spent fuel storage facility. Both radiation monitoring system and ventilation system, along with necessary filtration system, were installed in place where radioactive concentrations were higher. Adequate sampling measures were provided.

(2) decommissioning of reactors along with their spent fuel storage facility should be put into consideration in the phases of design and construction in order to release the decommissioned site for future unrestricted use. The measures to facilitate decommissioning and demolishing should be considered. Suitable materials were selected as building materials of structures, systems and components required so as to minimize the generation of radioactive wastes and to facilitate decontamination. Account was taken of the facilities necessary for managing radioactive wastes generated from decommissioning.

(3) experience, test, and analytical means were used to support the technology to be employed in design and construction of spent fuel facility. Sufficient safety analysis and assessment were applied to the design of spent fuel storage facilities at research reactors to demonstrate enough safety, and necessary functional tests were conducted for all safety-related important items.

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

G-38 Under HAF301 and HAD301/02, the following main measures were taken in the design and construction of nuclear fuel cycle facilities, along with spent fuel management facilities, in addition to preventing criticality and ensuring residual heat removal.

(1) containment system, ventilation system, waste gas filtration system, and adequate radiation monitoring equipment were put in place to control concentrations and amounts of radioactive material to be released to the environment.

(2) decommissioning plans were developed, with associated measures being designed, including reduction of decontaminated equipment and components. Measures to easily remove radioactive waste and decontaminated articles were employed.

(3) the technologies that have been proven by test and engineering to be effective were employed to conduct safety analysis and assessment in respect to design.

G-39 Fuel basket and storage drum within module were designed and manufactured for interim dry storage facility at QNPP III to confine radioactive materials during storage of damaged spent fuel bundles. Two different decommissioning plans were considered for interim day storage facility, postponed module demolition and released site for unrestricted use. Both covered the issues related to demolition, decontamination, and site restoration, including materials selection, facility design and layout, radioactive materials handling and storage, etc.

G.5 Safety Analysis 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-40 Under LPCRP and HAF001, prior to applying for construction and operation licenses of proposed nuclear facilities and for decommissioning authorization, the operators of such nuclear facilities should prepare environmental impact statement and submit them to competent environmental authority under the State Council for review and approval. Prior to construction, such operators should submit the MEP/NNSA nuclear facility construction written application, preliminary safety analysis report and other related documents. Prior to operation, such operators should submit the MEP/NNSA nuclear facility operation written application, final safety analysis report and other related documents. No fueling and commissioning operations can be carried out until the relevant authorizations have been granted.

G-41 Under *Detailed Rules of the People's Republic of China on Regulating Civil Nuclear Facility Safety* I *—Application and Granting of NPP Safety Licenses* (HAF001/01), applying for NPP construction license needs submittals of (1) approval letter to NPP feasibility study report, (2) approval letter to NPP environmental impact statement, (3) preliminary safety analysis report for NPP, and (4) NPP QA program (in commissioning phases). Applying NPP first fueling authorization requires submittals of (1) final NPP safety analysis report, (2) approval letter to NPP environmental impact report, (3) NPP commissioning program, (4) NPP emergency plans by operators, and (5) NPP QA program (in commissioning phase), as well as other relevant documents.

G-42 For existing spent fuel storage facilities, both safety analysis and environmental impact assessment were conducted prior to their construction and operation and associated safety analysis report and environmental impact statement report were prepared, with increasingly extended scope and depth. Safety analysis and environmental impact assessment encompass the

description of structures, systems and components; performance criteria for their uses; description of design process; description of facility construction and management; general description of facility operation; performance predication and analytical and assessment methodology. Regarding performance predication, the models, parameters, boundary conditions, assumptions and reasons used in such analysis and assessment were made clear; potential impacts on spent fuel storage facility of natural conditions and phenomena, in the external man-made events and natural events were confirmed, the natural conditions and phenomena are like weather, climate, hydrogeology, geological conditions, topography and geomorphology, potential natural fire and explosion, etc, external man-made events include explosions, fire, aircraft crash, flying object, downfall of fuel container and weights, release of toxic, hazardous or radioactive materials, etc, and the external natural events are floods, earthquake, subsidence and landslide, etc., together with temporal variation of impacts; based on structure analysis, the integrity of facility's components was demonstrated under the operational conditions (structure and mechanical load, thermal load and process, temporal variation of materials nature, measures incorporated in design) and accident conditions; radioactive and/or non-radioactive impacts of spent fuel storage facilities on human and the environment were analyzed under normal operating and accident conditions, and compared with the developed performance criteria, involving maintenance of sub-criticality, decay heat removal and radiation protection, etc; the conclusions were drawn on safety analysis and environmental impact assessment.

G-43 For instance, prior to construction of interim dry storage facilities, the operators conducted preliminary safety analysis and preliminary environmental impact assessment of them and prepared and submitted the associated reports to bodies concerned. In these reports, engineering plan was described; on-site strata, structure, rock and soil physical and mechanical properties, and adverse geologic phenomena and groundwater were assessed, indicating the suitability of the site; environmental impacts and doses to workers under normal operating and accident conditions were analyzed to ensure they are entirely below the relevant national limits. Prior to the operation of interim dry storage facilities, the operators conducted final safety analysis and environmental impact assessment, and prepared and submitted the associated reports to the relevant bodies. In addition to detailed description of design of interim dry storage facilities encompassing fuel bundles, fuel handling equipment, fuel basket, shielded transportation cask, transportation equipment, module structure,

structures, auxiliary facilities, such both reports described the seismic and geological properties, gave design earthquake parameters, analyzed potential impacts of external natural events and human factor-induced events and precautionary measures, assessed possible radiation exposure of workers and the public. About public exposure, the public is exposed directly to spent fuel storage module will not suffer significant radiation impacts. For occupational exposure, radiation doses occur during transfer of spent fuel bundles in storage pool into spent fuel baskets, during operation of spent fuel in shielded workbox and during operation of transportation casks and transfer of spent fuel baskets from transportation canisters to storage modules. Sufficient shielding and monitoring system are taken into consideration in design of interim dry storage facilities. A periodic safety analysis of dry storage facility is performed every 5 years. Corrective measures are taken according analytical results of safety, if necessary.

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-44 In China, the operators of nuclear facilities are required to be directly responsible for the safety of the nuclear facilities they operate, and take overall safety responsibility. Under the HAF001, prior to construction and commissioning, such operators shall submit the relevant documents to the MEP/NNSA in phases. Only after approved by the MEP/NNSA, can the construction of such facilities and fuel handling and commissioning be started. Only when nuclear facility operation license have been granted, can such nuclear facilities be put into operation.

G.6.1 Operation of Spent Fuel Storage Facilities at NPPs

G-45 The operators prepared operation plans for their own respective spent fuel storage facilities. Such plans cover commissioning, operation, maintenance and modification, inspection and testing, radiation protection, prevention of radioactive release to the environment, accident and emergency preparation, accident records, reporting and investigation, quality assurance and inspection, training, nuclear materials regulation, physical protection, etc, to the extent that each of such all aspects corresponds to specific system or incident significant to safety.

G-46 In order to manage and control risks to safety within facility, the operators developed, as required by the *OL&C and operational procedure for nuclear power plant* (HAD103/01), operational limits and conditions in accordance with the technical specifications for design, test, experience and assessment of spent fuel storage facility. These include minimum cooling capacity of spent fuel cooling system and the minimum water level above spent fuel, prohibition of storing spent fuel in any places outside the specified location, minimum backup storage capacity, reactive remaining redundancy, and radiation monitoring requirements in spent fuel storage area. These limits and conditions all have gained the approval by the MEP/NNSA. Additionally, authorized limits lower than these limits are also established by the operators with a view to prevent violation of such operational limits and conditions as have been approved.

G-47 All operators implement the management of spent fuel storage facilities in accordance with the programs and procedures prepared and approved before they are put into operation. The programs said here cover those concerning operation, periodic maintenance, monitoring, testing and inspection on which the operation safety closely related safety systems 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, fuel containment, maintenance and verification of heat removal, shielding maintenance, loosen components and vibration monitoring, periodic testing, inspection of storage facility, response to operational events and accident conditions, emergency plan, management of periodic review, and other related procedures.

G-48 For the management and operation of spent fuel assembly storage, the prime assurance conditions are to:

(1) record in detail fuel serial number, storage location, storage time and label them with marks;

(2) monitor water temperature, level and leakage of lining in spent fuel storage pool, maintain normal operation of spent fuel storage pool and cleaning system, carry out periodic water sampling and analysis to keep controlling water quality in terms of various parameters, and recharged water consistent with water quality requirements for desalt water;

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

(4) prohibit fuel hoisting operation and prohibit heavy items other than hoisting and rigging equipment from moving above spent fuel storage pool without written consent, so as to prevent heavy items from falling to damage spent fuel;

G-49 The inspections of irradiated fuel assemblies are managed in such manner as to:

(1) prepare spent fuel inspection plan prior to each shutdown and inspect irradiated fuel assembly in accordance with approved plan;

(2) timely repair the defects of irradiated fuel assembly in accordance with procedures if discovered; and

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

G-50 Spent fuel management facilities can be provided with engineering and technical assistance and support in all safety-related areas during their entire operating lifetime.

G-51 The operators of NPPs submit their annual operation safety reports to the MEP/NNSA every year. Under HAF001, the accident occurring in spent fuel management should be reported to the MEP/NNSA as part of all production activities at NPPs.

G-52 The operators of NPPs developed operational experience feedback programs, according to which the operating experiences are collected and analyzed and then are make available to the periodic review and revision of all operating procedures. With accumulated experiences, the operational radiation protection programs are reviewed and revised correspondingly. During operation, the safety analyses are conducted and, if necessary, the corrective actions are also taken, including revision to “Final Safety Analysis Report” and “emergency plan”. For instance, revisions to “the Final Safety Analysis Report for Baya Bay NPP”, “Final Safety Analysis Report for Lingao NPP Units 1, 2” and “the Final Safety Analysis Report for Lingao NPP Units 3, 4” were completed in 2012 based on the input and feedback from the operating data collected. These revised reports were all approved by the MEP/NNSA.

G-53 Under GB/T 19597-2004, the nuclear facility decommissioning mid-term plans should be developed after a period of operation, or after a major event or accident would have occurred. 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 in nuclear facility, decommissioning resources assurance, and commissioning costs, etc. The impacts of any possible event or accident occurring during operation of nuclear facility on decommissioning must be reflected in the mid-term plans.

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

G-54 The principled requirements for spent fuel assembly management is specified in the HAF202, to which supplementary explanations are made in HAD202/01 and HAD202/07, thus detailing the safety requirements for research reactor core management and spent fuel handling, and providing guidance an recommendations on these issues.

G-55 The operators of research reactors are responsible for and arrange for all activities covered by the reactor core management and the onsite fuel management. In order to ensure the safety of spent fuel assembly handling and storage, the operators prepared technical specifications in relation to the safety of spent fuel management facility operation, which specified the operating limits and conditions of reactors along with their spent fuel storage facilities. For instance, limit k_{eff} is developed to maintain sub-criticality of spent fuel, storage pool water level limits to ensure radiation exposure reduction and residual heat removal, and storage water quality limits to ensure no degradation of fuel cladding. Additionally, the accident treatment procedures were

established to cope with the possible occurrence of accident during spent fuel handling.

G-56 In practical operation and handling, the developed operational procedures were implemented strictly and necessary measures taken, to ensure the system will have enough redundancy available to make operating limits and conditions not to be exceeded. Spent fuels withdrawn from reactor core are generally put on fuel racks in core to wait radioactive decay of short-lived radionuclides and subsequently sent to storage pool. For handling of spent fuel, materials movement over spent fuel storage racks is strictly controlled to avoid materials downfall leading to damage to fuel assemblies. And safety interlocks were installed on handling equipment to prevent fuel assemblies from downfall during lifting. Underwater cameras were used for periodic inspection of spent fuel assemblies to eliminate hidden dangers in a timely manner. Safety oversight was enhanced to determine whether or not pool water meet the standards required; and pool water was monitored and sampled at regular intervals for determining radionuclides in water and their activity concentrations so as to ensure the quality of water of pool meet the standards required. Measures to ensure normal operation of ventilation system were taken to make airborne concentrations within the range of the operating limits and conditions. A comprehensive set of record regime was established to document the details of spent fuel assemblies and ensure the accuracy and traceability of related information.

G-57 Any events occurring at research reactors should be reported and treated in accordance with the relevant provisions. After treatment, written reports should be submitted to higher authorities and regulatory bodies.

G-58 Analyses of data collected during the operation of spent fuel storage facility indicates that, in order to reduce exposure of workers to radiation, necessary modifications to spent fuel storage facility may be conducted where appropriate. Modifications significant to safety must be reported to the MEP/NNSA for review and approval. Such modifications must be in compliance with the procedures of safety analysis, design, construction and commissioning.

G-59 During operating lifetime of a research reactor, the operator and reactor management organizations must prepare its decommissioning plan abiding strictly by the decommissioning requirements for reactor along with spent fuel management facility.

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

G-60 The HAF301 puts forth the principled requirements for the operation and management of civil nuclear fuel cycle facilities, along with away-from-reactor spent fuel storage facilities. The HAD301/03 defines the safety requirements and recommendations on away-from-reactor spent fuel storage facilities.

G-61 Away-from-reactor spent fuel storage facilities are in consistent with design requirements and safety requirements. The operators established the scheme for safe operation of spent fuel storage facilities, including operating procedures, commissioning plan, QA program, training plan, radiation protection program, emergency preparedness, environmental release control of radioactive materials.

G-62 Operating limits and conditions are defined, including sub-criticality maintenance, radiation safety, and residual heat removal, etc. For instance, any spent fuel bundle to be transferred into basket will be required to have cooled for 6 years in spent fuel pool before being transported to interim dry storage facility. The dose limit within module preparation area and spent fuel storage area is set at 25 μSv/h.

G-63 The operation, maintenance, monitoring, inspection and testing or interim dry storage facility is proceeding in line with the procedures that have been already approved. The above plans, provisions, procedures and requirements are comprised of those in relation to spent fuel storage, storage module, storage drum, fuel basket serial number, fuel basket inspection, basket loading, drying and welding, transportation and lifting, gamma-rays continuous monitoring, radiation protection in module storage area, storage drum routine inspection and oversight, storage module, storage drum, fuel basket and shielded workbox inspection and maintenance, equipment maintenance, testing and acceptance.

G-64 Interim dry spent fuel facility can gain all of engineering and technical supports related to safety during its lifetime.

G-65 Any event or accident deviating from operating conditions should be reported, as specified, to the relevant regulatory bodies with respect to its nature, extent, consequence and remedial measure.

G-66 Operating data of interim dry storage facility are gathered in relation to gamma radiation monitoring in onsite environment, radiation monitoring at storage module and workplace. Also air sampling for storage drum and heat

conductivity monitoring in interior of module are conducted in attempt to verify design and provide experience feedback for the subsequent module manufacturing.

G-67 Decommissioning plan shall be reviewed and updated on an as-needed basis, during operation of away-from-reactor spent fuel storage facility, with advance in decommissioning technology, possible occurrence of event, revision of laws, regulations and policy, and variation in facility operating experience and costs, etc.

G.7 Spent Fuel Disposal (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-68 China's policy on spent fuel management is to reprocess spent fuel. At present, there has not be any arrangement for the final disposal of spent fuel in China.

H. SAFETY OF RADIOACTIVE WASTE MANAGEMENT

(article 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 policy and strategy, along with a complete set of laws and regulations and standards, on radioactive waste management has been established and a wide range of measures envisaged for implementing the safety of management of radioactive waste, so as to achieve the goals of protecting individuals, society and the environment against radioactive and other hazards.

H-2 The appropriate steps have been taken to ensure the residual heat produced during the radioactive waste management can be removed well. Under GB 14500-2002 and GB 11929-2011, for the design of liquid HLW

storage tank, all reasonable and practical approaches should be taken to ensure criticality safety. The storage tanks are in-built with cooling systems with a full standby capability and equipped with multiple and diverse instrumentations to measure such important process parameters as temperature and liquid level. In the event of cooling water, the independent emergency cooling system in the tanks can ensure the temperature in storage tank remains below 60℃.

H-3 China's laws and regulations require that the quantity of radioactive wastes generated should be kept at the levels that are as low as reasonably achievable (ALARA). Under the LPCRP, any nuclear facility operator and nuclear technology utility should adopt advanced technology and equipment through reasonably selecting and utilizing raw materials and in such a way as to minimize the quantity of radioactive wastes generated. Under the GB 14500-2002, the generation of radioactive waste in any nuclear activities should be kept at as low as practicably achievable, both radioactivity and amount generated. As required by the *Requirements for the Safety of Newly-constructed NPPs during 12th Five-year Plan* (for approval), the best available technology should be employed to treat liquid, gaseous and solid wastes generated; the solid radioactive waste generated by a 1000 MWe NPP should not exceed 50 m^3/unit·year, except for big equipment contaminated during the process of maintenance.

H-4 The regulations, standards, guides that have been already issued take account of the interdependency between several different steps to manage radioactive waste, for example, from their generation, collection, classification, treatment and conditioning to their storage, disposal and release and even to their recycle and reuse, as shown in Figure 4.

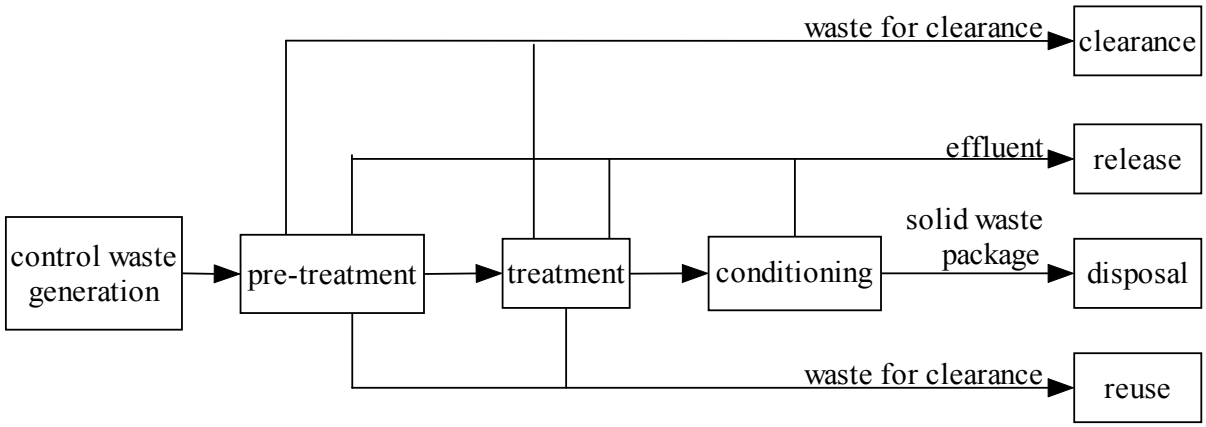

Figure 4 Basic Steps towards Radioactive Waste Management

H-5 Under the *Legislation Law of the People's Republic of China* (LLRPC), a legal framework comprised of national laws, administrative regulations, departmental rules, management guides and reference legal instruments governing radioactive waste management has been established and maintained in China. Implementation of these instruments can provide the protection of individuals, society and the individuals. These documents were developed and issued in accordance with stringent procedures. These set out the specific requirements for every step in radioactive waste management and criteria for protection of the public, the workers and the environment in respect of several main links in waste management (including the disposal of solid radioactive waste and the release of radioactive effluents), which are basically consistent with internationally endorsed standards and criteria. The MEP/NNSA, alongside with the competent authorities of nuclear facilities, shall conduct regulatory control and supervisory monitoring of compliance of such facilities with standards.

H-6 China has taken full consideration of biological, chemical and other hazards that are likely attributable to the management of radioactive wastes. Under GB 9133-1995, GB 16933-1997, GB 9132-1988 and GB 14500-2002, when developing the classification system of radioactive wastes, account was taken of potential chemical, biological and other hazards. Wastes received and disposed have enough chemical, biological, thermal and radioactive stability and will not produce toxic gases. Radioactive waste treatment systems are equipped with fire protection and explosion-proof device 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 its laws, regulations and standards, China stipulated that efforts should be made to avoid the taking of actions that are expected to impose greater adverse impacts on the future generations than the current generation. Under the RSRWM, the solid radioactive waste generated in operating nuclear facilities, and the liquid radioactive waste that could not be discharged through purification shall be treated by turning into stabilized and standardized solid waste for on-site safe storage, and be timely delivered to the licensed solid radioactive waste disposal facility for disposal. The solid LILW disposal facilities should meet safety isolation requirements of more than 300 years after closure; and the deep geological disposal facilities for solid HLW should meet safety isolation requirements of more than 10,000 years after closure. Under the GB9132-1998, effective dose to public was also prescribed. With conducting above requirements, we can strive to avoid actions that impose reasonably

predictable impacts on future generations greater than those permitted for the current generation

H-8 In its laws, regulations and standards, Chinese government expresses that effort should be made to avoid undue burden on future generations. Under the RSRWM, radioactive waste management shall ensure no undue burden to be imposed on future generations. IPCUMFTDSFNPP was issued in July 12, 2010 (F.2.2.1). There have been two solid LILW disposal sites in operation in China. New ones are being under planning and construction according to needs of nuclear energy expansion in the country. The work on geological disposal of radioactive waste is also proceeding in an orderly way. The purpose of these efforts is to avoid undue risks and burdens imposed upon the future generations.

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-9 In China, there are three types of radioactive waste management facilities, which are nuclear facilities' waste management system, storage facilities for radioactive waste arising from nuclear technology application and LILW disposal site.

H-10 Under LPCRP and RSRWM, HAF401 and MMLSDSRW, the operators of radioactive waste management facilities have carried out assessment of such facilities' major modifications and related practices, both existing and newly constructed, and prepared and submitted safety analysis report and environmental impact report to the MEP/MMSA. The facilities dedicated exclusively to treatment and disposal of solid radioactive waste have been granted licenses by the MEP/NNSA through review and approval. National environmental radiation monitoring network has been established to promote the capability building in this regard and to conduct the monitoring

and management of radioactive contamination. For example, Tianwan NPP submitted in 2012 to the NNSA the *Application for Modifications to Liquid Radioactive Waste Solidification Container* Safety at *Tianwan NPP*, which was approved in March 2013 by the NNSA after review. The MEP/NNSA issued the *Construction Criteria on Environmental Radiation Monitoring System at NPPs* (trail) to govern the monitoring of radioactive effluents from NPPs and to regulate the building of such monitoring systems at newly constructed NPPs. "The management and use platform for environmental radiation monitoring data countrywide" was put into operation in 2011 to realize the rapid exchange and sharing of monitoring data. In November 2012, a total of 100 environmental radiation monitoring stations constructed newly countrywide were put into operation. In 2013, the evaluation work of environmental radiation monitoring capability was ended in 31 provinces (regions or manipulates) countrywide. A total of 560 persons in 41 batches received the environmental radiation monitoring training on personal comprehensive ability and skills.

H-11 Under HAD103/07 and HAD103/11, the 10-year periodic safety review has been conducted at China's operating NPPs, such as QNPP, QNPPII, QNPPIII, Daya Bay NPP, covering solid radioactive waste management system review and radiation environmental impact assessment. During the process of solid radioactive waste review, the assessed were anti-seismic performance, shielding performance, operability, maintainability, heat removal measures, leakage prevention capability of waste resin storage tank; low level solid waste storage system safety, solidified forms storage system safety; stability of cemented forms during long-term storage; retrievability of low level solid waste and solidified forms; and durability of container. The review results indicated that the assessed systems, as a whole, are in consistent with the current safety basic requirements. On the other hand, timely improvements were made to non-conformance discovered during the process of review, and also to those discovered in operation, thus enhancing the safety and reliability of these systems.

H-12 Comprehensive inspection was made to radiation safety of nuclear technology application, uranium mining and milling and radioactive materials transportation. This inspection was conducted in 2012 by the MEP/NNSA, in four phases such as self-inspection by the operators, screening survey by provincial environmental protection departments and local supervisory stations, and random inspection and oversight by the MEP/NNSA. Wide varieties of radioactive sources were involved in this screening survey countywide, which

were produced, distributed and used (including storage) in industry, agriculture, medicine, research and social services. Also, radiation safety situations in nuclear technology applications were among this survey. Countrywide scrap metal recovery and melting yards were surveyed, through which the radiation monitoring situations in these yards were made clear and associated potential safety hazards and incompliance with regulations identified have been corrected.

H-13 A thorough inspection of nuclear and radiation safety was completed. This inspection was conducted during July to November 2013, in which follow-up inspection and re-elevation of various improvement actions were implemented, with eight improvements involved, such as nuclear and radiation safety actions after Fukushima accident, radioactive waste management and radiation environmental protection, etc. Nuclear power bases, civil research reactors, radioactive waste disposal facility and nuclear technology application facility received inspection. This inspection concluded that the current operating nuclear facilities are kept in safe operation and the ones under construction are controlled in quality, having good radiation environmental quality by and large. The problems identified in the two inspections made separately in 2011 and 2002 were timely solved in this inspection and various nuclear and radiation safety improvement actions were implemented.

H-14 There have been currently two solid LILW disposal sites in operation, Guangdong Beilong disposal site and Northwest China disposal site. Guangdong Beilong disposal site began its site selection in 1991. The construction of the first phase project of the repository site was completed in October 2000. The siting work of Northwest China disposal site began in 1988, with the first phase project completed in 1998 and put into trial operation in 1999. Both Sites were put into commercial operation, after being granted operation licenses by the MEP/NNSA in 2011 based on their trial operation. Such documents and procedures were prepared and implemented strictly at both Sites as quality assurance, radiation protection, radioactive waste management, environmental monitoring, computer data management and emergency plan. These documents and procedures were re-reviewed and re-evaluated at a regular interval. In addition, both Sites are required to receive periodic safety assessment every 10 years and their assessment results will be reported to the MEP/NNSA for review.

H-15 Supervisory environmental monitoring was conducted around nuclear facilities. The MEP/NNSA and environmental monitoring departments of

provinces where nuclear facilities are located organized periodically supervisory monitoring of the environment around nuclear facilities and require the holders of license to carry out periodic monitoring and evaluation of their facilities. The monitoring results have shown that the gamma radiation dose rates in air in the surrounding environment of radioactive waste storage and disposal facilities are all fall within the fluctuation range of local background level; there are no significant variations in activity concentrations of radionuclides other than tritium in aerosol, precipitates, surface water, groundwater, soils and other environmental media around NPPs compared with previous years; this is because that elevated tritium activity concentrations cause much lower radiation dose to the public than the relevant national dose limits; there is also no significant variations in activity concentrations of samples gathered at other nuclear facilities than NPPs compared with previous years.

H-16 China has launched in 2011 an environmental radiation survey and assessment project , which is scheduled to span ten years and covers three NPPs, three research bases of reactors and four uranium enrichment and fuel manufacturing bases, with a view to building an information and data bank gathering the environmental radiation situations at NPPs countrywide. By the end of 2013, the organizational structure for the project management had been completed, through which the relevant personnel was trained, the project methodological study conducted, the technical guides, scheme and QA documentation prepared for the survey and assessment, and part of monitoring work implemented. For example, these include the environmental radiation survey at QNPP Base and in the China Institute of Atomic Energy (CIAE) and the environmental gamma doserate surveillance onsite and offsite at China North China Fuel Co., Ltd. along with field penetrating radiation doserate and accumulated dose monitoring in plant area. These tasks are currently underway.

H-17 Radioactive wastes generated in past practices are retrievable. If found unable to meet the storage and disposal requirements in forms, package, and surface doserate, radioactive waste will be required to be re-conditioned until meeting the acceptance requirements concerned.

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-18 Chinese Government attaches high priority to the siting of radioactive waste management facilities, with the relevant regulations and standards being developed to guide the siting of different radioactive waste management facilities.

H-19 As required by the LPCRP, the siting of nuclear facility should be demonstrated scientifically and should apply for licensing in accordance with the national regulations. Prior to applying for licensing, the environmental impact statement should be prepared and submitted to the environmental protection department of the State Council. No license and the other documents can be granted without authorization.

H-20 The licensing process for the siting of radioactive waste management facility is in much the same as in spent fuel storage facility siting(G.3.1).

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

H-21 The site-related factors were evaluated as required by the *Requirements on Safety Analysis Report for Solid LILW Interim Storage* (EJ 532-1990) during the process of siting of solid LILW interim storage facility, such as geographical location, population distribution, natural resources (like mineral reserves, food, economic crops, aquatic products, etc.) industry, transportation, military facility, meteorology (like hurricanes, typhoons, tornadoes, thunderstorms, floods, etc.) hydrology, geology , earthquake and so on.

H-22 Under the GB 14589-1993, the NPP-affiliated solid LILW interim storage facility should meet the following requirements:

(1) stand-alone storage facilities are all sited at a relative remote location in the plant area, to certain extent, away from main traffic line and connected to the main line through road;

(2) flood control standards are same as nuclear islands standards;

(3) the bottom of the storage facility must be above the highest groundwater table; and

(4) the storage facility should be kept far away water resource preservation area.

H-23 Possible impacts of theses nuclear facilities on individuals, the society and the environment were evaluated. Under the EJ 532-1990, the annual individual dose equivalents and annual collective dose equivalents to such workers of storage facilities were evaluated during the siting of solid LILW interim storage faculties as operation, maintenance, waste handling and in-serve inspection, etc.; possible impacts of these storage facilities on the ambient environment were evaluated under normal and accidental conditions to demonstrate the acceptability of siting conditions and safety facility.

H-24 No impact could be created on any other Contracting Party from China's existing nuclear facility-affiliated radioactive waste storage facilities.

H.3.1.2 Siting of Radioactive Waste Storage Facility associated with Nuclear Technology Application

H-25 The site-related factors were evaluated, as required by the *Criteria on Siting, Design and Construction of Nuclear Technology Application Radwaste Storage Facility* (CSDCNTARSF) and the GB 14500-2002, the natural

conditions and socioeconomic conditions at the site were evaluated during the siting of nuclear technology applications' radioactive waste storage. The results are:

(1) natural conditions at site are characterized by relatively flat topography, small slope, relatively simple geological structure, low seismic intensity, deep underground water level, far from the surface water; stable geological conditions (there is no debris flow, landslide, collapse, as well as the erosion surface phenomenon), poor permeability, enough bearing capacity of foundation soil, and good meteorological conditions (like temperature, humidity, content of corrosive components in air, etc).

(2) the socioeconomic conditions around the site are characterized by no military testing ground, no facility to produce and store flammable and explosive and dangerous articles, no mineral area of important development value, no scenic tourist area, no drinking water sources, or no economic development zone, and there being convenient transportation and convenient water and power supply.

H-26 The impacts of such facilities on individuals, the society and the public were evaluated, as required by the CSDCNTARSF, the potential impacts on such facilities from the external and natural events and possible impacts on individuals and the environment from the releases of radioactive and hazardous materials were evaluated to ensure providing adequate isolation and robust confinement of the public and the environment from radioactive waste, as required by the relevant regulatory bodies. .

H-27 No impact could be created on any other Contracting Party from China's existing radioactive waste storage facilities associated with nuclear technology application.

H.3.1.3 Siting of solid radioactive waste disposal facilities

H-28 The site-related factors were evaluated, as required by GB9132-1988 and GB14500-2002, during the process of siting of solid radioactive waste disposal facility, involving earthquake, regional stability, geological structure and lithology, engineering geology, hydrological geology, mineral resources, natural and cultural resources, population density, surface water and drinking waster, urban, airports, military test site and the distance away from the inflammable and explosive dangerous goods warehouse etc.

H-29 The impacts of such facilities on individual, the society and the public were evaluated, with account taken of the post-closure evolution of the site

condition. Under GB 9132-1988 and GB 14500-2002, analyses were made, in the process of siting, of amounts and probability of migration of radionuclides into human environment, associated mechanisms, pathway, and velocity of radionuclide into human body, together with estimating initially the individual dose equivalent and collective dose equivalent under normal conditions, natural and artificial events, and also preliminarily analyzing and evaluating the environmental impacts of disposal facilities during construction, operation and post closure, and the possible impacts of the surrounding environment on disposal facilities.

H-30 Under RSRWM, and other relevant standards and guides, the siting of Goungdong Beilong Solid LILW Disposal Site, Northwest Solid LILW Disposal Site, and Southwest Solid LILW Disposal Site were completed in full compliance with the requirements of regional survey, site characterization and site determination. Sufficient investigation and demonstration were conducted of around-the-site geological structure, hydrogeology as well as other natural and socioeconomic conditions. For instance, the siting of Southwest site was completed in 2010. During regional screening survey, a total of 5 candidate sites were identified based on the local natural conditions, population, economy, and communications, etc. On the basis of field reconnaissance on these sites, the site characterization was conducted at 3 of these candidate sites. Subsequently in 2010, the preparation of the environmental impact statement and the safety analysis report in siting phase was completed. At last, the Southwest site was approved by the MEP following review.

H-31 CAEA's effort to siting HLW disposal repository is focused on the candidate Beishan site located in Gansu province following the initial comparison between the pre-selected regions, such as in East China, South China, Southwest China, Inner Mongolia and Xinjiang. The research efforts were launched for HLW geological repository in Beishan Gansu in aspects of geology, hydrogeology, seismic geology and socioeconomic conditions. Bore drilling activities were partly conducted to obtain the in-depth samples of rock core and water and other relevant information, thus developing the preliminary approach to evaluation of granite site. China's study and development efforts will continue in the years ahead. The work that will be completed around 2020 are the early laboratory-based research and development in the related disciplinary fields, preliminary site selection of disposal repository and the safety review of underground laboratory construction.

H-32 No impact could be created on any other Contracting Party from

China's existing Solid LILW Disposal Sites.

H.3.2 Information Publicity

H-33 Information disclosure has been receiving much more attention than ever, especially involving the siting of radioactive waste management facilities. Following the "principles of openness with non-openness as exception", the information disclosure system is under progressive perfection and information disclosure channels are greatly built to meet the needs of the public for awareness of nuclear and radiation safety and to enhance the confidence of the public in nuclear energy and technology applications.

H-34 The efforts to promote and standardize information disclosure work is in progress. The MEP/NNSA issued in April 2011 the *Notification on Enhancing NPPs' Nuclear and Radiation Safety Information Disclosure* and the *Information Disclosure Plan on Nuclear and Radiation Safety Regulatory*(trial). Subsequently in May 2013, the MEP/NNSA clearly requiring that information disclosure and publicity be implemented in the process of the major decision making on the siting, construction, operation and decommissioning of nuclear facilities, and enhancing information disclosure in such manners as to define the extent to which information is disclosed, enhance information channel building, implement information disclosure procedures, and strength evaluation of social reactions. In November 2013, the MEP/NNSA issued the *Guiding on Government Information Publicity for Environmental Impact Assessment of Construction Project* (trial). This document points out that, prior to submitting the environmental impact statement to the MEP/NNSA, the applicants of construction projects should legally disclose the full text of information. Having accepted the said environmental impact statement, the MEP/NNSA should make the full text of information available to the public legally and should make its comment public on either approving or disapproving the environmental impact statement. After having approved such project, the MEP/NNSA shall open to the society the licensing process.

H-35 The building of information publicity channel is underway. The major platforms are the MEP's information website and NNSA's sub-website. Additional channels include Environmental Bulletin, Environmental Yearbook, NNSA's Annual Report, Annual Report on Environmental Radiation Monitoring, News Release, China Environmental Report, as well as radio and television, etc.

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-36 A wide spectrum of legal instruments were issued in China, such as the *Technical Rules about Solid Radioactive Waste Processing System for Light Water Reactor Plants* (GB 9134-1988), *Design of Radioactive Waste Management System for Nuclear Power Plant*（HAD401/02）, the *Criteria on Siting, Design and Construction of Nuclear Technology Application Radwaste Storage Facility*, (GB 9132-1988), *Regulations for Radioactive Waste Management*（GB 14500-2002）, GB/T 19597-2004, to govern the design and construction of the radioactive waste management facility designed for nuclear facility, the waste storage facility associated with nuclear technology application and the LILW repository.

H.4.1 Design and Construction of Nuclear Facility-affiliated Radwaste Management Facilities

H-37 To limit possible radiological impacts to individuals, the society and the environment, the following measures were mainly considered and taken in accordance with GB 9134-1988 and HAD401/02:

(1) radioactive waste management systems are separated from those of non-radioactive waste management system;

(2) zone division has been made of radioactive waste management facility and comprehensive measures taken, based on radiation level and contamination extent, covering appropriate radiation shielding and radiation monitoring

meters;

(3) the technological processes of classification, collection and treatment of radioactive waste were designed according to the origin and nature of them, including well-designed waste treatment technology (filtration, adsorption and washing, flocculation sedimentation, centrifugal separation, evaporation, ion-exchange, membrane technology) and well-installed waste gas treatment system, and ventilation system in radioactive work zone, for which gas flow direction, a certain amount of negative pressure and/or air changes are maintained and electric-gas interlocks are installed.

(4) suitable materials are selected in line with operational conditions and consideration is taken of corrosion, decontamination and radiation effects;

(5) for the systems that need to be maintained and examined after decontamination, their inner surface is designed smooth and to have washing or cleaning connectors.

(6) sampling points are designed to set at appropriate part of system, using as short sampling pipeline as possible and installing concurrently-used-with-system pipelines for frequent sampling activities; continuous monitoring is carried out of gaseous and liquid radioactive effluents prior to release; the monitored items may be gross alpha and gross beta radioactivity and concentrations of radionuclides in terms of source terms within facility; flow measuring equipment is set to control release of effluents;

(7) for the design and layout of buildings, additional loading that could be created during or after its decommissioning is considered, with account taken of several factors, such as the place and space required for decommissioning;

(8) the necessary precautionary measures are considered in attempt to reduce the impacts potentially from the major risks discovered in safety analysis, such as earthquake, floods, air crash, natural and artificial events; these measures include main system equipment, fittings, supports, and ability of equipment to endure the impact from the operating basis earthquake; and

(9) functions to detect explosive gas, automatically control and alarm, and prevent explosion are designed to avoid the potential of explosion.

H-38 Conceptual plan is considered for the decommissioning of radioactive waste management facilities. Under GB/T 19597-2004 and the *Regulations on the Safety of Nuclear Facility Decommissioning* , preliminary decommissioning plans should be prepared by the operators of nuclear facilities and submitted to the higher competent authorities. The preliminary decommissioning plans

incorporate the considerations of basic safety concerns, expected decommissioning strategy, safety of technology currently available or to be developed in the course of decommissioning practices, decommissioned waste management, decommissioning costs and financing means, and guarantee institutions.

H-39 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 issued and in effect. These specifications have also drawn on the experiences of operation and management experience gained over the past.

H-40 Prior to granting construction license, the NNSA organized review and evaluation of the environmental impact assessment report, the preliminary safety report and the QA program submitted by the operators in license application and construction phases. In the process of nuclear facility construction, the NNSA and its regional branch dispatch nuclear safety inspectors or groups of inspectors to the fabrication and construction fields for implementation of the following oversight missions:

(1) reviewing whether the safety data submitted is consistent with the reality;

(2) supervising whether the construction process is consistent with the approved design requirements; and

(3) supervising whether the management process is consistent with the approved QA program etc.

H-41 The radioactive waste treatment facilities for the concurrent use by multiple nuclear units were designed using well-proven technologies at both Sanmen NPP and Haiyang NPP under construction. As an additional one to nuclear islands' waste treatment systems, such facility can treat all sorts of wastes that are generated, but cann't be directly treated, by nuclear islands, thus avoiding unnecessary duplication of equipment at multiple units. Radioactive waste treatment facility on site is divided into three zones, waste processing building, laundry and interim storage facility. Its functions are to treat solid and liquid radioactive wastes, wash work clothes and shoes for reuse, and provide interim storage of waste packages. The design of radiation protection associated follows the ALARA principles. The facility employs compaction and extra-compression technologies to achieve volume reduction and waste minimization. In addition, the treated liquid waste is going to be discharged after sample measurement and continuous monitoring.

H.4.2 Design and Construction of Radioactive Waste Storage Facility associated with Nuclear Technology Application

H-42 To limit possible radiological impacts to individuals, the society and the environment, the following measures were mainly considered and taken in accordance with the CSDCNTPRSF:

(1) the entire area of the facility is divided into storage area, office area and isolation zone, with a certain distance span existing between storage area and office area to a certain degree. Isolation zone should be around the waste storage facility;

(2) building layout is designed to regulate flow of personnel and material in such way as to minimize potential for cross-contamination;

(3) process design should meet the requirements for the systems, equipment, instruments and handling devices required for the acceptance, transfer, storage, retrievability, transportation, decontamination and removal activities conducted during the operation, maintenance and decommissioning of such a waste repository; specific measures include classification of disused sealed sources and their storage in groups in shielded pits with lids with some distance between each other;

(4) the facility is installed with proper ventilation equipment to direct the proper airflow and to ensure adequate number of ventilation changes;

(5) necessary radiation monitoring means and meters are provided such as potable doserate meters, surface contamination monitors, potable air samplers to monitor the contamination level of workers, at workplaces and in air; and

(6) necessary personal dose meters and personal protective articles, such as protective clothes, gloves, shoes and masks are provided for workers involved in handling, lifting, inspection, storage and monitoring of radioactive waste;

H-43 Conceptual plan was considered, in phase of design, for radioactive waste storage facilities associated with nuclear technology applications. Under the CSDCNTPRSF:

(1) source term estimating for nuclear facilities to be decommissioned;

(2) goals of decommissioning and radiation measurement requirements at termination of decommissioning;

(3) proposed decommissioning plan (such as characterization, removal of radioactive materials and disused sealed sources, decontamination, demolition and termination radiation measurement) and the potentials for safety of

decommissioning using available technologies;

(4) resources and conditions required for facility decommissioning and resulting waste treatment; and

(5) requirements for continued evaluation, elaboration and renewal of decommissioning plan in construction and operation phases.

H-44 technical measures available for decommissioning of waste storage facility are employed in design, mainly including:

(1) the floor, wall and worktable surface that could to be likely contaminated is made of smooth and seamless materials from which contaminants are difficultly absorbed contaminants or from which contaminants are easily removed;

(2) buildings, equipment and pipeline are arranged to allow sufficient channel and space to enable operating workers to access for decontamination and dismantling operation;

(3) equipment and pipeline are arranged to avoid radioactive material deposition in system and in local part, with further account being taken of possibility of in-situ decontamination; and

(4) due consideration are given to ventilation to prevent the potential contamination being spread in the course of operation, decommissioning, decontamination, and dismantling.

H-45 The principles followed in the design of radioactive waste storage facility associated with nuclear technology applications is to use the technology, process, equipment and instrumentations that have proven in practices to be safe, reliable and effective. The technical specifications 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 issued and in effect.

H.4.3 Design and Construction of LILW Disposal Site

H-46 To limit possible radiological impacts to individuals, the society and the environment, the following measures were mainly considered and taken, in accordance with the GB 14500-2002 and GB 9132-1988, in the design and construction of LILW disposal sites:

(1) multiple barriers, consisting of engineering barrier (waste forms, container, disposal structure, and backfilling materials) and natural barrier, are

developed and provided;

(2) proper waterproof and drainage systems are set; the engineering barrier is 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 absorbability of rocks, surface runoff and ground water table and other site characteristics are considered in design of site waterproof; the design of drainage system can ensure frequent drainage of impounded water on the ground at site and in disposal units;

(3) in addition to drainage and waterproof, the design of disposal site also involves unit backfilling, overburden structure, surface treatment, and plantation; the holes and channels to monitor groundwater are installed in the vicinity of disposal units and proper locations onsite;

(4) disposal units are arranged in line with the overall plan, including access, walkways, contaminated area and non-contaminated area;

(5) waste acceptance zones are equipped with detection instrumentations for measuring doserate, surface contamination, cargo certificate of vehicle and cask; inspection device for unloaded waste drum (box); radiation monitoring and warning systems; installations to treat damaged containers: devices for transportation equipment decontamination, and facility to treat waste generated from decontamination; and

(6) laboratories are established for conducting routine analysis of water, soils, air and plant samples; individual decontamination, individual and environmental monitoring, instrumentation and equipment maintenance, and equipment decontamination.

H-47 Guangdong Beilong disposal site and Northwest China disposal site both meet the design requirements by *Regulations on Near-surface Disposal of Solid LILW* (GB 9132-1988). At Guangdong Beilong disposal site, 8 disposal units have been completed with the structure of all-above-ground grave mound. The disposal units are constructed with reinforced concrete structure, and space between waste drums would be backfilled with sand and cement grout. Each unit, when it is full, would be covered with reinforced cement cap. After closure, such site will be covered with 5 m thick overburden. In order to reduce entry of rainwater into disposal unit, drainage ditches are designed around the disposal facility with each unit being installed with mobile active water shed. Below the unit bottom, a drainage collecting system was established. In the case of the

Northwest China disposal site, Disposal unit for such site is designed to use reinforced cement structure without bottom. Between waste drums and between waste drum and disposal unit would be backfilled with sandy soil, when a disposal unit is full ,it will be poured with reinforced cement to form top plate. After closure, the top of each disposal unit will be finally covered with a 2 m thick overburden. During the process of disposal facility construction, reinforced bottom plate was added for higher safety.

H-48 The NNSA initiated the review efforts to grant the license of constructing Southwest solid LILW disposal site in 2011; subsequently in 2012, the NNSA completed the review of the environmental impact assessment statement in construction phase and the construction license of such a disposal site, and then approved the environmental impact assessment statement in construction and issued construction license.

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;

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-49 Under the LPCRP and HAF001, proper safety analyses and environmental assessments were completed before the construction of the current radioactive waste management facilities.

H-50 Under GB 14500-2002, EJ 532-1990, CSDCNTPRSF, and GB 9132-1988, the safety analyses and environmental assessments were completed to some extent before the construction of the current radioactive waste management facilities, here considering possible accident spectrum during the

operation of facility (like ventilation system failure, waste lifting malfunction, waste transfer incident, container leakage, earthquake, floods, sandstorm, fire, mis-operation, and inadvertent intrusion); defining the model, parameter, assumption and rationale envisioned in the analyses and assessments, analyzing possible environmental and human impacts under normal and abnormal conditions; calculating maximum annual effective dose equivalent, annual average effective dose equivalent and annual collective dose equivalent in assessed area under the accidental condition; comparing with performance criteria established; drawing on the conclusions on safety analysis and environmental impacts of concern; making clear the problems existing in current facilities and the countermeasures to be taken to improve safety quality. The NNSA approved in 2011 the safety analysis reports submitted by Sanmen NPP and Haiyang NPP concerning nuclear waste treatment facilities.

H-51 Before construction of a disposal facility, a systematic safety assessment and an environmental assessment for the period following closure were carried out under GB 9132-1988, with emphasis on predication, analysis and assessment of possible environmental impacts of the existing disposal sites during their construction, operation and post-closure phases and the potential for surrounding environment impact on disposal sites, etc. The assessment results of the existing disposal sites show that the disposal site was chosen in a closed environment with low population and good regional stability. Natural disaster such as typhoon, flooding and earthquake would not lead to destructive threat to the disposal site. Local geological media, with low permeation rate and strong adsorption onto radionuclide, is in line with national requirements on LILW disposal. In the normal conditions after closure of the disposal site, the release of radionuclides through groundwater may result in annual maximum individual dose to the public far below the national limits. Even in the case of inadvertent intrusion after closure of disposal site, the dose to the intruder will below the national limits. Therefore, the disposal sites will not lead to any unacceptable impacts on the environment.

H-52 As has been already pointed out by the GB 14500-2002, the environmental impact assessment should be revised and updated according to the relevant national or departmental provisions and requirements and then submitted to the regulatory bodies.

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

(vii) 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;

(viii) 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-53 Under the LPCRP, the radioactive waste management facility, associated with a nuclear facility, should be constructed simultaneously with the main project in their design, construction and operation. Completion acceptance system is implemented in China for environmental protection facilities,

associated with supporting facilities of a nuclear facility. It is required that, after completion of the main project, the application report for trial operation shall be submitted to the MEP/NNSA. No trial operation can be started without approval. After completion of trial operation, the checking and acceptance after completion for environmental protecting facilities shall be performed by the MEP/NNSA. After being qualified, these facilities can be put into operation.

H.6.1 Operation of Nuclear Facility-affiliated Radwaste Management Facilities

H-54 No operation license is needed for the operation of radioactive waste management systems equipped for nuclear facilities. Under the LPCRP，HAF001 and MMLSDSRW, before operation of a nuclear facility，its operator should submit the written application for nuclear facility operation to the NNSA, together with the final safety analysis report and other related documents. The NNSA shall review these documents and grant operation licenses to the qualified. The existing radioactive waste treatment and storage facilities equipped for NPPs, research reactors and nuclear fuel cycle facilities are only responsible for treatment and storage of wastes generated by the facilities themselves, therefore there being no need for obtaining license.

H-55 Operational limits and conditions were set by the operators of all nuclear facilities for radioactive waste management facilities under HAF103, HAD103/01, HAF202, HAD202/01 and HAF301, together with other documents relating to NPPs' radioactive waste treatment systems, including continuous workload of fixing and packaging machineries, alarming limits and detectable limits of radiation monitoring meters (including effluent monitoring), and operational limits of ventilation system. These limits and conditions are reviewed and updated in keeping with experience gained and technological progress.

H-56 The operation, maintenance, monitoring, inspection and testing of radioactive waste management facilities were conducted in accordance with established procedures. Under HAF103, HAF202, HAF301, HAD103/06, and HAD202/01 and relevant technical specifications, the operators of all nuclear facilities prepared operational program, maintenance program, environmental monitoring program, oversight program, and waste management program, etc. In addition to these programs, additional operating procedures are prepared covering system process, main equipment, valve manipulation, and preset operation; besides, the maintenance plans and procedures for radioactive waste management facility are prepared, along with radioactive effluence controlling

and monitoring procedures. And non-radioactive simulation test and inspection procedures on engineering scale are prepared including operating model and parameters related to radioactive waste management system and equipment. The operators of nuclear facilities all follow strictly the above programs and procedures.

H-57 Engineering and technological supports are available in many aspects of training, operation, QA, radiation protection and emergency preparedness, maintenance and oversight. Under the HAD103/06, the maintenance workers are allowed to taken turns to attend training, on a regular basis, held by construction contractors or equipment manufacturers during the entire operational lifetime of a nuclear facility's radioactive waste management facility; professional advices are available from the external expert institutions with respect to operational experiences of the facility, failure and malfunction analysis; the QA-related review can be performed independently by qualified external experts; consultations about radioactive effluent release and on-field waste treatment may be obtained from professional institutions. Nuclear facilities are able to receive appropriate medical service and bioassay establishments, along with recommendations and guidance on in-service inspection. In similarity, the engineering and technology support relating to the safety field is also available for the entire operating period of the radioactive waste management facilities built for other nuclear facilities.

H-58 Procedures for characterization and segregation of radioactive waste are applied. The operators of NPPs classify usually radioactive wastes generated at NPPs into process waste, technical waste and other types of waste according to their origin. Furthermore, the process wastes include evaporated residual liquid, waste resins, sediment and filter core, etc; technical wastes include compressible and incompressible waste and combustible and incombustible waste. The operators developed radioactive waste segregation procedures to characterize all classes of wastes.

H-59 A safety-related incident or/and accident, if occurred, shall be reported by the operator of the related nuclear facility to the NNSA and the local branch therein.

H-60 Under GB/T 19597-2004, after a period of operation of a nuclear facility, the operator of such a facility shall prepare the mid-term decommissioning plan, which should provide a detailed description of how to treat radioactively contaminated or exposed structures, systems and components during its radioactive waste management facility maintenance, in order to

develop the decommissioning plan of the radioactive waste management facility. Under the *Regulations on Safety of Nuclear and Radiation Facility Decommissioning* that is currently under development, the operator of a nuclear facility since operation should make revision of its decommissioning plan at a 5 year interval. When a decommissioning plan is in need of substantial revision in response to a major change, event or accident taking place at a nuclear facility, a timely revision to this plan is necessary.

H.6.2 Operation of Radioactive Waste Storage Facility associated with Nuclear Technology Application

H-61 Under the MMLSDSRW, issued in December 2011, the operators of all radioactive waste storage facilities associated with nuclear technology application have obtained the operation licenses.

H-62 Operational conditions are set for the radioactive waste storage facilities associated with nuclear technology applications, such as surface dose rate limits of disused sealed source storage containers and of variable locations at such facilities, and number of ventilation change in different areas, etc. For instance, dose rate at 0.5 m above cover plate surface is not in excess of 20μSv/h and number of air change is about 2 per hour in storage area, with negative pressure of about 20 Pa.

H-63 A full range of management operational procedures have been established and implemented strictly by the operators of radioactive waste storage facilities associated with nuclear technology applications, such as those for equipment operation and manipulation, for acceptance, inspection and validation of disused sealed sources, for packaging and conditioning of disused sealed sources, for workers' body surface contamination inspection and decontamination, for vehicle and tools contamination inspection and decontamination, and for periodic equipment inspection and testing, as well as operational monitoring plan and radiation environmental monitoring plan, etc.

H-64 Radioactive waste storage facilities associated with nuclear technology application can be provided with engineering and technical assistance and support in all areas related to safety during their entire operating lifetime.

H-65 Procedures for radioactive waste characterization and segregation are prepared by the operators of radioactive waste storage facilities associated with nuclear technology application.

H-66 A safety-related accident, if occurred, shall be reported timely to the relevant regulatory bodies under the RSRWM, which points out that the

operator of a radioactive waste storage facility shall identify causes, take protective measures and report to the environmental protection departments of provinces, autonomous regions or municipalities where such a facility is located when discovering potential safety hazards and environmental radioactivity in excess of relevant national limits; a radiation accident, if occurred, should be reported to the relevant departments by law, and emergency response should be activated.

H-67 Under the *Regulations on Safety of Nuclear and Radiation Facility Decommissioning* that is currently under development, the operator of a nuclear facility shall develop a mid-term decommissioning plan after a period of operation and shall revise this decommissioning plan at a 5 year interval. When a decommissioning plan is in need of substantial revision in response to a major change, event or accident taking place at a nuclear facility, a timely revision to this plan is necessary.

H.6.3 Operation of LILW Disposal Facility

H-68 Operation licenses were granted in 2011 by the MEP/NNSA to Guangdong Beilong Solid LILW disposal site and Northwest Solid LILW disposal site, specifying the category of waste, radionuclide inventory, waste disposal activity and licensed period.

H-69 Operational conditions and limits were established for operation of both disposal sites under GB 9132-1988, GB 16933-1997 and GB/T 15950-1995 in respect to radionuclide content in radioactive waste packages, radiation level on container surface, surface contamination limits, mechanical stability of waste forms, leaching resistance, free liquid, chemical composition, heat and radiation stability, resistance to ignitability, anti-microbial destructivity, package container and loaded amount.

H-70 Operation procedures were developed under the RSRWM and GB 9132-1988 and implemented strictly for the management of both disposal sites, involving operational procedures for waste disposal, QA program, procedures of operation and manipulation, radiation protection program, environmental monitoring plan, accident emergency plan, procedures for periodic equipment testing, etc. Consistent with disposal site surveillance and management requirements, operational monitoring plan and environmental radiation monitoring plan, in addition to facility safety inspection, the radiation monitoring was conducted of groundwater, surface water, rocks and soils, plant, and air in the surrounding environment. Monitoring and inspection data were

recorded truthfully. The summary report of the previous year is reported to the MEP/NNSA before March 31 every year. Monitoring results indicate that no significant variations were found in the environmental situation at both sites before and after waste acceptance.

H-71 Radioactive waste disposal facilities can obtain engineering and technical support in all areas relating to safety during their entire operating lifetime.

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

H-73 A safety-related accident, if occurred, shall be reported timely to the relevant regulatory bodies under the RSRWM, which points out that the operator of a radioactive waste disposal facility shall identify causes, take protective measures and report to the environmental protection departments of provinces and nuclear industry authority, when discovering potential safety hazards and environmental radioactivity levels in excess of relevant national limits; a radiation accident, if occurred, should be reported to the relevant departments by law, and emergency response should be activated.

H.7 Institutional Measure 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 body 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 requirements have been provided for in the existing relevant laws, regulations and standards.

H-75 For record keeping, the operator of solid radioactive waste disposal facility shall, under the RSRWM, establish archives for solid radioactive waste disposal to faithfully and completely record issues concerning disposal activities such as origin, quantity, characteristics, and emplacement of solid radioactive

wastes. The archives on solid radioactive waste disposal shall be permanently preserved.

H-76 On institutional controls, Under the RSRWM, a solid radioactive waste disposal facility shall be closed complying with the relevant laws and regulations and subsequently permanent marks should be set in the designated areas. After closure of a disposal facility, the operator of such a disposal facility shall carry out institutional control according to the approved institutional control program. Under GB/T 15950-1995, groundwater monitoring should continue to focuse on the analyses of chemical indicators and radioactive materials early after closure. If finding that groundwater has reached at ground surface and eventually enter into stream, river or lake, these waters should be monitored. Plant and burrowing animal, along with their excrement, should be sampled to analyze, so as to determine radionuclide absorption on them and to explain whether biological barrier continue to be effective.

H-77 As necessary interventional measures, the post-closure surveillance, for example, environmental monitoring, access restriction, facility maintenance, archive keeping and likely emergency actions, shall be carried out according to the GB 9132-1988, in combination with the involvement of national and local environmental protection departments. Under the HAF401, post-closure institutional controls shall be carried out so that remedial actions can be implemented.

I. TRANSBOUNDARY MOVEMENT (article 27)

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.

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.

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 Under Article 47 of the LPCRP, both radioactive waste and goods contaminated with radioactivity are prohibited from being imported into, or moved through, China's territory. However, radioactive waste and good contaminated with radioactivity which is generated from the products exported from the People's Republic of China can be returned in accordance with committed conditions after regulatory approval.

I-2 Article 16 of RSPRRI requires the competent foreign trade authority under the State Council, in conjunction with the competent environmental protection authority under the State Council, General Administration of Customs, the administration of quality supervision, inspection and quarantine of the State Council and the competent authority of radioisotopes producers, to develop and issue both the catalog of limited radioisotopes for imported and exported and the catalog of prohibited radioisotopes for import and export. The radioisotopes being currently listed in the catalog of limited radioisotopes for import and export can not be imported unless they have underwent the review and obtained the approval from the competent environmental protection authority under the State Council and the foreign trade competent authority under the State Council has granted import license in accordance with relevant national foreign trade regulations. The radioisotopes other than the above-specified can be imported after implementing the national foreign trade regulations.

I-3 As a typical transboundary movement, the waste arising from the inspection and repair of hydraulic components of main pump at Ling'ao NPP was returned to China. In the course of transportation, such waste was packaged into special-purpose metal drum and then into special-purpose container, followed by air transportation back to China prior to 31st December 2013 along with repaired hydraulic components. The other transboundary movement is that 170 disused sealed sources were returned to Canada.

I-4 As of 31st December 2013 China has never shipped spent fuel or

radioactive waste to any area south of latitude 60°degrees South for storage or for disposal.

J. DISUSED SEALED SOURCES (article 28)

1. 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.

2. 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 Description of Radioactive Source Application

J-1 Radioactive sources are managed in China according to its categorization which is consistent with *Categorization of Radioactive Sources* (RS-G-1.9). A graded approach to management is implemented in China for nuclear technology applications. The MEP exercise regulatory control of the production of radioactive sources and the distribution and use of Category I sources, while the sources of Category II, III, IV and V by environmental protection agencies at provincial level.

J-2 The comprehensive inspection of radiation safety in nuclear technology applications was organized by the MEP/NNSA in 2012, which indicates that there have been 12,366 users of radioactive sources in China, with 111,767 radioactive sources in use.

J.2 Requirements on Disused Sealed Source Management

J-3 China attaches great importance to the safety of radioactive sources management during their entire lifetime. In recent years, a number of regulations and rules were issued, such as RSPRRI, *Methods for Licensing of Radioisotopes and Ray-generating Installations Safety* (MLRRIS), RSRWM, and MMSPRRI. These set forth the requirements for the production, distribution, use, transfer, import and export, use in different areas, storage, disposal, recycle and clearance of radioactive sources during their entire lifetime.

J-4 These also make clear stipulations to the management of disused sealed sources:

(1) a producer or importer of radioactive sources who intends to sell Category I, II and III sources should sign return agreement with the buyer of

such sources.

(2) a user of Category I, II or III radioactive sources who intends to transfer his radioactive source to another user should sign return agreement of disused sealed sources with such user. If an imported radioactive source is transferred, the user to receive such radioactive source should obtain the copy of return agreement from the original exporter.

(3) an user of Category I, II or III radioactive sources should, within 3 months after the sources become disused, return the disused sealed sources to manufacturer or original exporter in accordance with the signed return agreement. Those radioactive sources under these categories that can not be returned to the original manufacturer or exporter should be brought to the licensed solid radioactive waste storage facility or directly to the licensed solid radioactive waste disposal facility.

(4) a user of Category IV or V radioactive sources should carry out conditioning and packaging of such sources in accordance with the provisions of competent environmental protection department concerned and then transfer them to the licensed storage or disposal facility.

(5) a user of radioactive source who intends to send disused sealed source to licensed solid radioactive waste storage or disposal facility shall bear the relevant costs.

(6) a user of radioactive source should make a registration to the competent provincial environmental protection departments within 20 days after completion of the activities such as the return and transfer of disused sealed source to the manufacturer or original exporter, or to solid radioactive waste storage or disposal facility.

(7) a disused sealed source, but still has value, which has been transferred to the storage facility or returned to the original manufacturer can be reused after finishing related register according to the requirements of RSPRRI.

(8) a solid radioactive waste storage facility shall store and clean up the disused sealed sources, in terms of the Categories, which have been received according to the relevant national standards and the provisions of the MEP/NNSA, and provide them timely clearance, or otherwise, send them to licensed solid radioactive waste disposal facility.

(9) a scrap metal recovery or smelting firm shall send orphan source, if discovered during its operation, to licensed radioactive waste storage facility associated with nuclear technology applications in the locality where the

firm is located.

J.3 Recovery of Exported Source

J-5 Under the PSPRRI, an exporter of radioactive sources shall provide the MEP with the certificates by which the importer can legally hold such sources and, with the authorization of the MEP, the corresponding procedures should be performed according to the related international conventions and agreements contracted or signed by Chinese government.

J-6 Abiding by the *Code of Conduct for the Safety and Security of Radioactive Sources* and the *Guidelines on the Import and Export of Radioactive Sources,* China promises to recover radioactive sources exported from China.

J-7 Under the MLRRIS, an exporter of radioactive sources shall submit related Radioactive Source Export Forms to the MEP, along with copies of effective agreement signed between exporter and importer. There is a column in the form to be marked with whether or not such sources shall be returned to the importer.

K. PLANNED ACTIVITIES TO IMPROVE SAFETY

K.1 National Measures

K.1.1 Improvement of Policy and Regulations System for Radioactive Waste Management

K-1 China will vigorously promote the efforts to develop the *Atomic Energy Act of the People's Republic of China* and the *Nuclear Safety Law of the People's Republic of China*.

K-2 China will continue to strength the efforts to research and develop the management documents in relation to the LPCRP, to establish the management rules on nuclear facility decommissioning and associated costs as well as radioactive waste disposal costs, to make revision of radioactive waste classification standards, and to develop the guides on waste minimization.

K.1.2 Enhancing Regulatory Capability of the Safety of Spent Fuel Management and the Safety of Radioactive Waste Management

K-3 Under the *"Twelfth-Five Year Plan" and the 2020 Future Vision on Nuclear Safety and Radioactive Pollution Protection and Control,* China will enhance the safety capability building including nuclear and radiation safety. The national technology research and development base will be built for the regulatory control of nuclear and radiation safety, equipped with necessary research means and technology equipment. A full range of capability will be reinforced comprising safety analysis, safety assessment, audit and validation. Comprehensive capability of safety review, oversight and monitoring will be promoted to continue improve the regulatory capability for nuclear and radiation safety.

K-4 Meanwhile, China will continue to strengthen the regulatory control on the safety of spent fuel management and the safety of radioactive waste management and to raise the relevant regulatory capability in an overall planning and step-by-step manner, while taking full account of the relevant needs and raising the oversight capacity of nuclear and radiation safety.

K.1.3 Promoting the development of LILW Disposal

K-5 Solid LILW disposal is currently a key point in the country's radioactive waste disposal. China will firstly guarantee the safety and

efficiency of the operation of both Guangdong Beilong LILW Disposal Site and Northwestern China LILW Disposal Site, continue to facilitate conditioning of existing solid LILW and its near surface disposal, improve the quality assurance and testing of radioactive waste forms. China will continue to promote the siting planning of solid radioactive waste disposal site in such a way as to construct new LILW disposal sites in accordance with the approved siting plan. China will promote the near surface disposal of disused sealed sources on the basis of research efforts focused on disposal options of disused sealed sources. China will enhance the study of intermediate depth disposal of solid LILWs that are unsuitable for near surface disposal.

K-6 The research on geological disposal of solid radioactive waste is a long-term undertaking. Following the work objectives and nodes put forth in the *Guides on Research and Development Planning of Geological Disposal of HLW,* China will push forward the implementation of the relevant research and development work in an orderly and step-by-step way on a basis of overall planning. The work to be initiated recently will be siting and relevant assessment in relation to geological disposal and a full range of research initiatives on disposal concept design, safety assessment, radionuclide chemical form, disposal engineering barrier, and the pre-study of underground laboratory related to geological disposal of radioactive waste.

K.2 International Cooperation

K-7 Chinese government will continue to pays attention to the platform role that the IAEA has played in promoting international cooperation in respect of the safety of spent fuel management and the safety of radioactive waste management. China actively participates in international and regional training courses, forums or workshops and meetings sponsored by IAEA. In addition, China will continue to actively participate with the research and development of the unified international standards and to promote the international cooperation and exchange.

K-8 Chinese government will steadily push forward cooperation with the European Union, the United States, France, Britain, Japan, Russia and Spain etc. in aspect of the safety of spent fuel management and the safety of radioactive waste management. Furthermore, this aspect will be included, as needed, in the contents of information sharing, experience exchange, and personnel exchange and training while signing the cooperative agreement

and memorandum on nuclear safety. At the same time, China will improve international peer review frequency, pay attention to emergency response and assistance, and strengthen bilateral and multilateral cooperation in the field of technical import and joint research.

K-9 Chinese government will actively participate in regional nuclear safety cooperation, which includes the cooperation among China, Republic of Korea and Japan in the field of nuclear safety, Asian Nuclear Safety Network and Forum of Nuclear Cooperation in Asia. Though these platforms, relevant member states would commonly share experiences and lessons learnt in respect of the safety of spent fuel management and the safety of radioactive waste management, and these platforms would promote member states to maintain and achieve a high level of safety in aspects of spent fuel management and radioactive waste management.

L. ANNEXES

L.1 List of Spent Fuel Management Facilities

L.1.1 Spent Fuel Storage Facilities at NPPs

No.	Facility Name	Affiliation	Design Capacity（tHM）	Time to Commission
1	Spent fuel pool1	Qinshan NPP	184	1991
2	Spent fuel pool 2	Qinshan NPP	231	1991
3	Spent fuel pool 1	Qinshan Phase II NPP	317	2001
4	Spent fuel pool 2	Qinshan Phase II NPP	317	2002
5	Spent fuel pool 3	Qinshan Phase II NPP	317	2010
6	Spent fuel pool 4	Qinshan Phase II NPP	317	2011
7	Spent fuel pool 1	Qinshan Phase III NPP	941	2002
8	Spent fuel pool 2	Qinshan Phase III NPP	941	2003
9	Spent fuel dry storage facility	Qinshan Phase III NPP	8251	2009
10	Spent fuel pool 1	Daya Bay NPP	319	1992
11	Spent fuel pool 2	Daya Bay NPP	319	1993
12	Spent fuel pool 1	Ling'ao Phase I NPP	554	2001
13	Spent fuel pool 2	Ling'an Phase I NPP	554	2002
14	Spent fuel pool 1	Ling'ao Phase II NPP	554	2010
15	Spent fuel pool 2	Ling'ao Phase II NPP	554	2010
16	Spent fuel pool 1	Tianwan NPP	325	2005
17	Spent fuel pool 2	Tianwan NPP	325	2006
18	Spent fuel pool 1	Hongyanhe NPP	1206	2012
19	Spent fuel pool 2	Hongyanhe NPP	1206	2013
20	Spent fuel pool 1	Ningde NPP	554	2013
21	Spent fuel pool 1	Yangjiang NPP	555	2013

Note：As of 31 December 2013.

L.1.2 Spent Fuel Storage Facilities at Research Reactors

No.	Facility Name	Operator	Location
1	Spent fuel pool of CIAE	China Institute of Atomic Energy	Beijing
2	Spent fuel pool of Tsinghua University	Tsinghua University	Beijing
3	Spent fuel pool of NPIC	Nuclear Power Institute of China	Sichuan Province

Note：As of 31 December 2013.

L.2 Inventory of Spent Fuel

L.2.1 Inventory of Spent Fuel at NPP

No.	Facility Name	NPP	Capacity（tHM）	Existing Fuel（tHM）
1	Spent fuel pool1	Qinshan NPP	184	157.6
2	Spent fuel pool 2	Qinshan NPP	231	43.4
3	Spent fuel pool 1	Qinshan Phase II NPP	317	162.2
4	Spent fuel pool 2	Qinshan Phase II NPP	317	145.7
5	Spent fuel pool 3	Qinshan Phase II NPP	317	51.5
6	Spent fuel pool 4	Qinshan Phase II NPP	317	18.4
7	Spent fuel pool 1	Qinshan Phase III NPP	941	623.8
8	Spent fuel pool 2	Qinshan Phase III NPP	941	632.6
9	Spent fuel dry storage facility	Qinshan Phase III NPP	8251	776.6
10	Spent fuel pool 1	Daya Bay NPP	319	223.3
11	Spent fuel pool 2	Daya Bay NPP	319	220.6
12	Spent fuel pool 1	Ling'ao Phase I NPP	554	233.4
13	Spent fuel pool 2	Ling'an Phase I NPP	554	248.1
14	Spent fuel pool 1	Ling'ao Phase II NPP	554	68.0
15	Spent fuel pool 2	Ling'ao Phase II NPP	554	91.9
16	Spent fuel pool 1	Tianwan NPP	325	123.1
17	Spent fuel pool 2	Tianwan NPP	325	122.3
18	Spent fuel pool 1	Hongyanhe NPP	1206	0.0
19	Spent fuel pool 2	Hongyanhe NPP	1206	0.0
20	Spent fuel pool 1	Ningde NPP	554	31.0
21	Spent fuel pool 1	Yangjiang Npp	555	0.0
Amount of wet-storage at reactor			10590	3196.9
Amount of interim dry-storage facility			8251	776.6
Total			18841	3973.5

Note：As of 31 December 2013.

L.2.2 Inventory of Spent Fuel at Research Reactors

No.	Facility Name	Operator	Existing Fuel（tU）
1	Spent fuel pool of CIAE	China Institute of Atomic Energy	5.19 E－01
2	Spent fuel pool of Tsinghua University	Tsinghua University	6.38 E－03
3	Spent fuel pool of NPIC	Nuclear Power Institute of China	0.00 E＋00

Note：As of 31 December 2013.

L.3 List of Radioactive Waste Management Facilities

L.3.1 Radioactive Waste Treatment and Storage Facilities at NPPs

No.	Facility Name	Affiliation	Design Capacity	Time to Commission
1	21# LILW storeroom	Qinshan NPP	868 m^3	1991
2	24# solid waste storeroom	Qinshan NPP	2000 m^3	1991
3	Spent resin storage system	Qinshan NPP	110 m^3×2	1991
4	Liquid waste solidification system	Qinshan NPP	556 drum/a	1991
5	Waste compressing system	Qinshan NPP	100 drum/a	1991
6	Waste storeroom	Qinshan Phase II NPP	Metal drum: 7500 Cement barrel: 2625	2002
7	TES system (solidification, immobilization)	Qinshan Phase II NPP	1000 m^3/a×2	2002
8	TES system (compressing)	Qinshan Phase II NPP	260 m^3/a×2	2002
9	Waste storeroom	Qinshan Phase III NPP	Technical waste: 663.4 m^3 Process waste: 219.12 m^3	2002
10	Spent resin storage system	Qinshan Phase III NPP	200 m^3×4	2002
11	Waste compressing system	Qinshan Phase III NPP	640d drum/a	2002
12	TES system (solidification, immobilization)	Daya Bay NPP	960 m^3/a	1994
13	DQS workshop (compressing, storage)	Daya Bay NPP	Pre-compressing: 2 m^3/d Storage: 1200 m^3	1994
14	DQT workshop (storage)	Daya Bay NPP	Storage: 2590 m^3	1994

No.	Facility Name	Affiliation	Design Capacity	Time to Commission
15	TES system (solidification)	Ling'an Phase I NPP	960 m^3/a	2002
16	LQS workshop (compressing, storage)	Ling'an Phase I NPP	Pre-compressing: 2 m^3/d	2002
			Super compressing: 1.6 m^3/d	
			Storage: 1200 m^3	
17	TES system (solidification)	Ling'an Phase II NPP	205m^3/a	2012
18	KQT workshop (storage)	Ling'an Phase II NPP	Storage: 2500m^3	2011
19	1# solid radwaste compressing system	Tianwan NPP	250 drum/unit•a	2007
20	1# liquid radwaste cementation system	Tianwan NPP	180 drum/unit•a	2007
21	1# solid radwaste storeroom (steel barrel)	Tianwan NPP	1100 drum	2007
22	1# solid radwaste Storeroom (concrete barrel)	Tianwan NPP	240 drum	2007
23	2# solid radwaste compressing system	Tianwan NPP	250 drum/unit•a	2007
24	2 liquid radwaste cementation system	Tianwan NPP	180 drum/unit•a	2007
25	2# solid radwaste storeroom (steel barrel)	Tianwan NPP	1100 drum	2007
26	2# solid radwaste Storeroom (concrete barrel)	Tianwan NPP	240 drum	2007
27	Cement barrel storeroom used by two reactors (91UKT)	Tianwan NPP	1760 drum	2007
28	Cement solidification facility (9TES1&9TES3)	Hongyanhe NPP	4 ~ 8 drum/8h	2013
29	Sorting and compressing facility (0TES2)	Hongyanhe NPP	840m^3/a	2013
30	Storeroom（QT）	Hongyanhe NPP	6450 drum	2013
31	Waste solvent storeroom (QR)	Hongyanhe NPP	81 m^3	2013
32	Waste oil storeroom (QV)	Hongyanhe NPP	19 m^3	Not running
33	9TES system (solidification)	Ningde NPP	205 m^3/a	2013

No.	Facility Name	Affiliation	Design Capacity	Time to Commission
34	0QS workshop (compressing, storage)	Ningde NPP	Pre-compressing and super compressing: 1.2 m^3/d	2013
			Storage: 3376 m^3	
35	9TES system (solidification)	Yangjiang NPP	6-8 drum/8h	2014
36	0QS/QT workshop (compressing, storage)	Yangjiang NPP	108.4 m^3/a	2014

Note：As of 31 December 2013.

L.3.2 Radioactive Waste Treatment and Storage Facilities at Research Reactors

No.	Facility Name	Operator	Design Capacity
1	Ventilation system	CIAE	360000 m^3/h
2	Liquid waste temporary storage room	CIAE	4800 m^3
3	Liquid waste treatment system	CIAE	4 m^3/h
4	Solid waste temporary storage room	CIAE	3000 m^3
5	Liquid waste treatment system	Tsinghua University	0.48 m^3/d
6	Cement solidification system	Tsinghua University	0.8 m^3/d
7	Compressor	Tsinghua University	0.2 m^3/h
8	Ventilation system	NPIC	340000 m^3/h
9	Liquid waste treatment system	NPIC	2 m^3/h
10	Cement Solidification workshop	NPIC	5 drum/d
11	Waste temporary storage room	NPIC	2300 m^3

Note：As of 31 December 2013.

L.3.3 Radioactive Waste Treatment and Storage Facilities at Nuclear Fuel Cycle Facilities

No.	Facility Name	Operator	Design Capacity
1	Ventilation system	Shaanxi Uranium Enrichment Plant	49000 m^3/h
2	Liquid waste pool	Shaanxi Uranium Enrichment Plant	1500 m^3
3	Solid waste temporary storage room	Shaanxi Uranium Enrichment Plant	3340 m^3
4	CaF_2 residue storeroom	Gansu Uranium Enrichment Plant	2000 m^3
5	Exhaust gas treatment and release system	Northern China Nuclear Fuel Assembly Plant	4.6×10^5 m^3/h
6	Waste water clarifier tank	Northern China Nuclear Fuel Assembly	200 m^3

No.	Facility Name	Operator	Design Capacity
		Plant	
7	Liquid waste and residue treatment system	Northern China Nuclear Fuel Assembly Plant	Extraction: 405.6 kgU/d Solid residue treatment: 128 kgU/d
8	Combustible waste incinerator	Northern China Nuclear Fuel Assembly Plant	20 kg/h
9	Solid waste conditioning equipment	Northern China Nuclear Fuel Assembly Plant	6 water filter/d
10	Waste temporary storage room	Northern China Nuclear Fuel Assembly Plant	874 m^2
11	Evaporation pond	China Jianzhong Nuclear Fuel Co., LTD	6.52×10^4 m^3
12	Waste temporary storage room	China Jianzhong Nuclear Fuel Co., LTD	12500 m^3

Note：As of 31 December 2013.

L.3.4 Nuclear Technology Application Radwaste Storage Facilities

No.	Facility Name	Location	Design Capacity（m^3）	Start of Operation
1	Anhui Radioactive Waste Storage Facility	Anhui	980	2009
2	Beijing Radioactive Waste Storage Facility	Beijing	2453	2007
3	Fujian Radioactive Waste Storage Facility	Fujian	600	2010
4	Gansu Radioactive Waste Storage Facility	Gansu	800	2009
5	Guangdong Radioactive Waste Storage Facility	Guangdong	600	2001
6	Guangxi Radioactive Waste Storage Facility	Guangxi	800	2002
7	Guizhou Radioactive Waste Storage Facility	Guizhou	600	2010
8	Hainan Radioactive Waste Storage Facility	Hainan	400	2009
9	Hebei Radioactive Waste Storage Facility	Hebei	800	2011
10	Henan Radioactive Waste Storage Facility	Henna	800	2008
11	Heilongjiang Radioactive Waste Storage Facility	Heilongjiang	1254	2013
12	Hubei Radioactive Waste Storage Facility	Hubei	700	2000
13	Henna Radioactive Waste Storage Facility	Hunan	800	2003
14	Jilin Radioactive Waste Storage Facility	Jilin	1200	1998

No.	Facility Name	Location	Design Capacity（m^3）	Start of Operation
15	Jiangsu Radioactive Waste Storage Facility	Jiangsu	1200	2010
16	Jiangxi Radioactive Waste Storage Facility	Jiangxi	600	2012
17	Liaoning Radioactive Waste Storage Facility	Liaoning	800	2012
18	Inner Mongolia Radioactive Waste Storage Facility	Inner Mongolia	800	2010
19	Ningxia Radioactive Waste Storage Facility	Ningxia	400	2009
20	Qinghai Radioactive Waste Storage Facility	Qinghai	400	2010
21	Shandong Radioactive Waste Storage Facility	Shandong	1486	2004
22	Shanxi Radioactive Waste Storage Facility	Shanxi	1200	2010
23	Shaanxi Radioactive Waste Storage Facility	Shaanxi	800	2013
24	Shanghai Radioactive Waste Storage Facility	Shanghai	1774	2008
25	Sichuan Radioactive Waste Storage Facility	Sichuan	500	2010
26	Tianjin Radioactive Waste Storage Facility	Tianjin	800	1991
27	Tibet Radioactive Waste Storage Facility	Tibet	200	2010
28	Xinjiang Radioactive Waste Storage Facility	Xinjiang	600	2008
29	Yunnan Radioactive Waste Storage Facility	Yunnan	800	2010
30	Zhejiang Radioactive Waste Storage Facility	Zhejiang	800	2009
31	Chongqing Radioactive Waste Storage Facility	Chongqing	600	2010
32	Centralized Spent Sealed Radioactive Source Storage Facility	Gansu	2600	2011

Note：As of 31 December 2013.

L.3.5 Radioactive Waste Disposal Facilities

No.	Facility name	Location	Status
1	Northwestern China LILW Disposal Site	Gansu	In Operation
2	Guangdong Beilong LILW Disposal Site	Guangdong	In Operation

Note：As of 31 December 2013.

L.4 Inventory of Radioactive Waste

L.4.1 Inventory of NPP Radioactive Waste

（Unit: m^3）

No.	NPP Name	Radioactive Waste Volume													
		Concentration		Spent ion exchange resin		Sludge		Water filter		Technological Waste		Other		Total	
		Uncondi-tioned	Waste Package	Uncondi-tioned	Waste Package	Uncondi-tioned	Waste Package	Uncondi-tioned[a]	Waste Package	Uncondi-tioned	Waste Package	Uncondi-tioned	Waste Package	Unconditioned[b]	Waste Package
1	Qinshan NPP	0.0	1206.8	57.4	0.0	0.0	0.0	0	96.2	0.0	569.9	0.0	0.0	57.4/0	1872.9
2	Qinshan Phase II NPP	0.0	396.0	0.0	636.0	0.0	62.0	0	183.9	0.0	1020.6	0.0	0.0	0.0/0	2298.5
3	Qinshan Phase III NPP	0.0	0.0	91.3	0.0	0.0	0.0	0	91.9	0.0	406.8	0.0	0.0	91.3/0	498.7
4	Daya Bay NPP	0.0	150.0	0.0	342.0	0.0	20.0	40	152.5	0.0	1230.6	7.6	0.0	7.6/40	1895.1
5	Ling'ao Phase I NPP	0.0	90.0	3.2	306.0	0.0	4.0	52	150.5	0.0	611.7	6.2	0.0	9.4/52	1162.2
6	Ling'ao Phase II NPP	0.0	32.0	9.5	11.2	0.0	0.0	35	12.0	0.0	179.2	0.5	0.0	10.0/35	234.4
7	Tianwan NPP	149.2	219.4	4.8	803.1	0.0	36.0	0	0.0	0.0	450.8	0.0	25.4	154.0/0	1534.7
8	Hongyanhe NPP	0.0	0.0	0.0	0.0	0.0	0.0	37	0.8	8.6	27.6	0.0	0.0	8.6/37	28.4
9	Ningde NPP	0.0	0.0	0.0	0.0	0.0	0.0	5	0.0	32.2	0.0	0.0	0.0	32.2/5	0.0
10	Yangjiang NPP	0.0	0.0	0.0	0.0	0.0	0.0	2	0	25.0	0.0	0.0	0.0	25.0/2	0.0
Total		149.2	2094.2	166.2	2098.3	0.0	122.0	171	687.8	65.8	4497.2	14.3	25.4	395.5/171	9524.9

Note：As of 31 December 2013.

a-Number of water filter

b-Volume of unconditioned radwaste except water filter/number of unconditioned water filter

L.4.2 Inventory of Radioactive Waste Other Than NPPs

(Unit: m^3)

No.	Type	Radioactive Waste Volume									
		Intermediate level liquid waste		Intermediate level solid waste		Low level liquid waste		Low level solid waste		Total	
		Uncondi-tioned	Waste Package	Uncondi-tioned	Waste Package	Uncondi-tioned	Waste Package	Uncondi-tioned	Waste Package	Uncondi-tioned	Waste Package
1	Research Reactors	1520.7	931.2	392.5	27.0	993.0	753.8	3955.0	566.6	6861.2	2278.6
2	Uranium Enrichment Facilities	0.0	0.0	0.0	0.0	1.1[a]	0.0	3608.6[a]	0.0	3609.7[a]	0.0
3	Fuel Fabrication Facilities	0.0	0.0	0.0	0.0	27.5	0.0	927.0+101.7[a]	115.0	954.5+101.7[a]	115.0
Total		1520.7	931.2	392.5	27.0	1020.5+1.1[a]	753.8	4882.0+3710.3[a]	681.6	7815.7+3711.4[a]	2393.6

Note：As of 31 December 2013.

a-The unit is t.

L.4.3 Inventory of Disused Sealed Sources in Nuclear Technology Application Radwaste Storage Facilities

No.	Province	Disused Sealed Source
1	Anhui	944
2	Beijing	8754
3	Fujian	539
4	Gansu	748
5	Guangdong	935
6	Guangxi	404
7	Guizhou	532
8	Hainan	194
9	Hebei	630
10	Henan	2083
11	Heilongjiang	736
12	Hubei	1050
13	Hunan	752
14	Jilin	672
15	Jiangsu	697
16	Jiangxi	141
17	Liaoning	281
18	Inner Mongolia	777
19	Ningxia	170
20	Qinghai	147
21	Shandong	1070
22	Shanxi	717
23	Shaanxi	176
24	Shanghai	264
25	Sichuan	305
26	Tianjin	1358
27	Tibet	41
28	Xinjiang	567
29	Yunnan	654
30	Zhejiang	1303

No.	Province	Disused Sealed Source
31	Chongqing	287
32	Gansu	79859
Total		107787

Note：As of 31 December 2013.

L.4.4 Inventory of Waste for Disposal

No.	Disposal Site	Waste Received (m^3)	Total Activity (Bq)
1	Northwestern China LILW Disposal Site	9454.72	8.16 E+13
2	Guangdong Beilong LILW Disposal Site	1493.16	3.87 E+13
Total		10947.88	1.20 E+14

Note：As of 31 December 2013.

L.5 Relevant laws, regulations, rules, guidelines and standards

L.5.1 Relevant Laws

Title	Issued by	Entry into force
The Law of the People's Republic of China on Environmental Protection	the Standing Committee of the National People's Congress	1989
The Law of the People's Republic of China on Prevention and Control of Water Pollution	the Standing Committee of the National People's Congress	1996（Revised）
The Law of the People's Republic of China on Prevention and Control of Air Pollution	the Standing Committee of the National People's Congress	2000
The Law of the People's Republic of China on Marine Environment Protection	the Standing Committee of the National People's Congress	2000
The Law of the People's Republic of China on Safety of Operation	the Standing Committee of the National People's Congress	2002
The Law of the People's Republic of China on Environmental Impact Assessment	the Standing Committee of the National People's Congress	2003
The Law of the People's Republic of China on Prevention and Control of Radioactive Pollution	the Standing Committee of the National People's Congress	2003
The Law of the People's Republic of China on Prevention and Control of Solid Waste Pollution	the Standing Committee of the National People's Congress	2005（Revised）
The Law of the People's Republic of China on Prevention and Control of Occupational Disease	the Standing Committee of the National People's Congress	2011（Revised）

L.5.2 Relevant Administrative Regulations

Title	Issued by	Entry into force
Regulations of the People's Republic of China on the safety control of civilian nuclear installations	the State Council	1986
Regulations of the People's Republic of China on nuclear materials	the State Council	1987
Regulations of the People's Republic of China on nuclear power accidental emergency management	the State Council	2012（Revised）
Regulations of the People's Republic of China on nuclear export management	the State Council	1997
Regulations of the People's Republic of China on nuclear dual-use item and relevant technologies management	the State Council	1998
Regulations on safety and protection of radioisotope and ray-generating installations	the State Council	2005
Regulations on surveillance and management of civil nuclear safety equipment	the State Council	2008
Regulations on safety of radioactive material transport management	the State Council	2010
Regulations on safety of dangerous chemical material management	the State Council	2011（Revised）
Regulations on safety of radioactive waste management	the State Council	2012

L.5.3 Relevant Rules

Title	Issued by	Entry into force
1 Generic Series		
Detailed rules (i) of the People's Republic of China on regulating civil nuclear facility safety - application and granting of NPP safety licenses	NNSA	1993
Annex 1 of the detailed rules (i) of the People's Republic of China on regulating civil nuclear facility safety - granting and management procedures of NPP operator license	NNSA	1993
Detailed rules (ii) of the People's Republic of China on regulation of civil nuclear facility safety – regulation of nuclear facility safety	NNSA	1995
Annex 1 of the detailed rules (ii) of the People's Republic of China on regulation of civil nuclear facility safety – reporting system of NPP operators	NNSA	1995
Annex 2 of the detailed rules (ii) of the People's Republic of China on regulation of civil nuclear facility safety – reporting system of research reactor operators	NNSA	1995
Annex 3 of the detailed rules (ii) of the People's Republic of China on regulation of civil nuclear facility safety ii – reporting system of nuclear fuel cycle facilities	NNSA	1995
Detailed rules (iii) of the People's Republic of China on regulation of civil nuclear facility safety - provisions on application and procedure for reactor safety license	NNSA	2006
Detailed rules (i) for regulations on NPP accident emergency management – emergency preparedness and	NNSA	1998

Title	Issued by	Entry into force
response of NPP operators		
Regulations on NPP quality assurance safety	NNSA	1991
Temporary regulations on road transport of NPP spent fuel	CAEA, MPS, MoT and MoH	2003
Regulatory procedures on transfer and transboundary movement of nuclear products (trail)	NNSA	2000
2 Nuclear Power Plant Series		
Regulations on NPP siting safety	NNSA	1991
Regulations on NPP design safety	NNSA	2004
Regulations on NPP operation safety	NNSA	2004
Annex 1 of the regulations on NPP operation safety – management of NPP during refueling, modification, and accidental shutdown	NNSA	1994
Methods for management of experience feedback at operational nuclear power plants	NNSA	2012
General Technical Requirements for Modification Action of Nuclear Power Plants after Fukushima Daiichi Nuclear Power Station Accident (trial)	NNSA	2012
3 Research Reactor Series		
Regulations on research reactor design safety	NNSA	1995
Regulations on research reactor operation safety	NNSA	1995
4 Nuclear Fuel Cycle Installation Series		
Regulations on civil nuclear fuel cycle safety	NNSA	1993
5 Spent Fuel and Radioactive Waste Management Series		
Temporary regulations on construction of nuclear technology application radwaste storage facility	SEPA	1984
Management approach on urban radioactive waste	SEPA	1987
Assumptions on the potential accident at spent fuel reprocessing plant	NNSA	1995
Design safety guidelines on spent fuel reprocessing plant	NNSA	1995
Regulations on radioactive waste safety	NNSA	1997
Rules for categorization of radioactive sources	SEPA	2005
Criteria on siting, design and construction of nuclear technology application radwaste storage facility	SEPA	2005
Provisions on decommissioning management of nuclear facilities and radioactive waste	CAEA	2010
Interim procedures on collection, utilization and management of the funds for treatment and disposal of spent fuel at nuclear power plants	MF，NDRC，MIIT	2010

Title	Issued by	Entry into force
Management measures for licensing the storage and disposal of solid radioactive waste	MEP	2014
6 Emergency Series		
Regulations on training in npp accident emergency	NNAERO	2003
Regulations on transboundary emergency management for radiation impacts of nuclear accident	NDSTC	2002
Intervention principles and levels for the public protection in an event of a nuclear emergency	NNSA, SEPA	1991
Derived intervention levels for the public protection in the event of a nuclear emergency	NNSA, SEPA	1991
Emergency preparedness and response for radioactive sources and radiation technology applications	CAEA, MoH	2003
Reporting system on accident emergency at NPPs	CAEA	2001
Regulatory procedures on emergency exercise for npp accident	CAEA	2003
Regulations on management of special revenue for npp accident emergency preparedness	MoF, CAEA	2007
Decision-making on protection measures and rehabilitation against serious accident in later stage	CAEA	2000
Emergency preparedness and response to radioactive materials transport accident	CAEA	2000
7 Nuclear Series		
Detailed rules for the regulations of the People's Republic of China on regulating nuclear materials	NNSA, NEA, CAEA	1990
8 Civil Nuclear Safety Equipment Regulatory Management Series		
Regulatory provisions on import and export of civil nuclear safety equipment	SEPA	2007
9 Radioisotopes and Ray-generating Installations Regulatory Series		
Methods for licensing of radioisotopes and ray-generating installations safety	SEPA	2008（Revised）
Management measures on safety and protection against radioisotope and ray-generating installation	MEP	2011
10 Others		
Rules for radiological environment management	SEPA	1990
Regulations on management of special revenue for NPP accident emergency Preparedness	MoH	2007
Regulatory procedures for radiological protection devices and radioactivity-containing products	MoH	2002

L.5.4 Relevant Guidelines

Name	Issued by	Entry into force
1 Generic Series		
Emergency preparedness and response for nuclear power plant，HAD 002/01	NNSA	2010
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
Research reactor emergency planning and preparedness，HAD 002/06	NNSA	1991
Emergency planning for operators of civil nuclear facilities，HAD 002/07	NNSA	2010
Quality assurance program for NPPs，HAD003/01	NNSA	1988
Quality assurance organization of NPPs，HAD003/02	NNSA	1989
Quality assurance for items serve and procurement for NPPs，HAD003/03	NNSA	1986
Quality assurance record system for NPPs，HAD003/04	NNSA	1986
Oversight and inspection of quality assurance for NPPs，HAD003/05	NNSA	1988
Quality assurance for design of NPPs，HAD003/06	NNSA	1986
Quality assurance during construction of NPPs，HAD003/07	NNSA	1987
Quality assurance during items manufacture for NPPs，HAD003/08	NNSA	1986
Quality assurance during commissioning and operation of NPPs，HAD003/09	NNSA	1988
Quality assurance during procurement, design and construction of nuclear fuel elements, HAD003/10	NNSA	1989
2 Nuclear Power Plant Series		
Seismic issues in design of siting NPPs，HAD101/01	NNSA，NEA	1994
Atmospheric dispersion problems in siting NPPs，HAD101/02	NNSA	1987
Population distribution problems in siting and assessment of NPPs，HAD101/03	NNSA	1987
External human-made event in siting NPPs，HAD101/04	NNSA	1989

Name	Issued by	Entry into force
Hydrological dispersion problems of radioactive materials in siting NPPs，HAD101/05	NNSA	1991
Relevance of NPPs siting to hydrology，HAD101/06	NNSA	1991
Site survey of NPPS，HAD101/07	NNSA	1989
Determination of design basis flooding for costal NPP site，HAD101/08	NNSA	1989
Determination of design basis flooding for costal NPP site，HAD101/09	NNSA	1990
Extreme meteorological event related to NPP siting，HAD101/10	NNSA	1991
Design basis tropical cyclone for NPPs，HAD101/11	NNSA	1991
Issues relating to safety of NPP base，HAD101/12	NNSA	1990
Safety principle of npp design，HAD102/01	NNSA	1989
Design and evaluation of anti-earthquake design for NPPs，HAD102/02	NNSA	1996
Safety function and graded components for bwrs, pwrs and pressurized tube reactors，HAD102/03	NNSA	1986
Flying object and secondary effect protection inside NPPs，HAD102/04	NNSA	1986
External human-made event relating to design of NPPs，HAD102/05	NNSA	1989
Design of NPP reactor containment system，HAD102/06	NNSA	1990
Design of NPP reactor core safety，HAD102/07	NNSA	1989
NPP reactor cooling system and related systems，HAD102/08	NNSA	1989
Final heal well of npp and directly related heat conduction system，HAD102/09	NNSA	1987
NPP protection system and related facilities，HAD102/10	NNSA	1988
Fire protection at NPPs，HAD102/11	NNSA	1996
Radiation protection design for NPPs，HAD102/12	NNSA	1990
NPP emergency power system，HAD102/13	NNSA	1996
NPP safety related instrument and control system，HAD102/14	NNSA	1988
Handling and storage system at NPPs，HAD102/15	NNSA	2007
Computer-based system software of safety significance for nuclear power plant，HAD102/16	NNSA	2004
Safety analysis and verification for nuclear power plant，HAD102/17	NNSA	2006
OL&C and operational procedure for nuclear power plant，	NNSA	2004

Name	Issued by	Entry into force
HAD103/01		
NPP commissioning procedures，HAD103/02	NNSA	1987
Management of core and fuel at NPPs，HAD103/03	NNSA	1989
Radiation protection during operation of NPP，HAD103/04	NNSA	1990
Staffing, recruitment, training and delegation at NPPs，HAD103/05	NNSA	2013
Organization and operational management of operators of NPPs， HAD103/06	NNSA	2006
In-commissioning examination of NPPs，HAD103/07	NNSA	1988
Repair and maintenance of NPPs，HAD103/08	NNSA	1993
Oversight of important safety items at NPPs，HAD103/09	NNSA	1993
Fire protection for NPPs，HAD103/10	NNSA	2004
Periodic safety review for NPPs，HAD103/11	NNSA	2006
Aging management for NPPs，HAD103/12	NNSA	2012
3 Research Reactor Series		
Format and contents of research reactor safety analysis report，HAD201/01	NNSA	1996
Research reactor operation management，HAD202/01	NNSA	1989
Management of criticality installation operation and experiment，HAD202/02	NNSA	1989
Application and modification of research reactor，HAD202/03	NNSA	1996
Decommissioning of research reactor and criticality installation，HAD202/04	NNSA	1992
Commissioning of research reactor，HAD202/05	NNSA	2010
Research reactor maintenance, regular testing and inspection，HAD202/06	NNSA	2010
Core management and fuel handling for research reactors，HAD202/07	NNSA	2012
4 Nuclear Fuel Cycle Installation Series		
Format and content of safety analysis report of uranium fuel fabrication installation，HAD301/01	NNSA	1991
Design of spent fuel storage installation，HAD301/02	NNSA	1998
Operation of spent fuel storage installation，HAD301/03	NNSA	1998
Safety assessment of spent fuel storage installation，HAD301/04	NNSA	1998
5 Radioactive Waste Management Series		
Management of radioactive effluents and waste arising from	NNSA	1990

Name	Issued by	Entry into force
nuclear power plant，HAD401/01		
Design of radioactive waste management system for nuclear power plant，HAD401/02	NNSA	1997
Design and operation of radioactive waste incineration installation，HAD401/03	NNSA	1997
Categorization of radioactive waste，HAD401/04	NNSA	1998
Siting of radioactive waste near surface disposal facility，HAD401/05	NNSA	1998
Siting of high level radioactive waste geological facility，HAD401/06	NNSA	2013
Decommissioning of gamma-ray irradiation installations，HAD401/07	NNSA	2013
6 Nuclear Materials Regulation Series		
Nuclear fuel balance budget for low enriched uranium conversion and element fabrication plant，HAD501/01	NNSA	2008
Guidelines on physical protection for nuclear power plant，HAD501/02	NNSA	2008
Alarming system against intrusion to nuclear facility，HAD501/03	NNSA	2005
Access control of nuclear facility，HAD501/04	NNSA	2008
Physical protection of nuclear materials transportation，HAD501/05	NNSA	2008
Format and content of safety analysis report of physical protection and nuclear materials accountancy and control，HAD501/06	NNSA	2008
Nuclear materials accountability for nuclear power plant，HAD501/07	NNSA	2008
7 Civil Nuclear Safety Equipment Regulatory Management Series		
Civil Nuclear safety simulated machinery and equipment parts production（trail），HAD601/01-2013	NNSA	2013
Technical requirements on civil nuclear safety equipment installation and license applicant（trail），HAD601/02-2013	NNSA	2013

L.5.5 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	AQOIQ	2002
Regulation of radiation protection for handling nonsealed radioactive material，GB 11930-2010	NTSB	2011
Glossary of nuclear science and technology terms—Part 3:Nuclear fuel and nuclear fuel cycle，GB/T 4960.3-2010	AQOIQ,NSMC	2010
Glossary of terms:Nuclear science and technology -Radiation protection and safety of radiation sources，GB/T 4960.5-1996	NTSB	1996
Glossary of nuclear science and technology terms—Part 7:Nuclear materials control and safeguards，GB/T 4960.7-2010	AQOIQ,NSMC	2010
Glossary of term: nuclear science and technology - Part 8: Radioactive waste management，GB/T 4960.8-2008	AQOIQ, NSMC	2008
Regulations for the safe transport of radioactive material, GB11806-2004	AQOIQ, NSMC	2005
Quality assurance for packaging used in transport of radioactive material, GB/T 15219-2009	AQOIQ, NSMC	2009
Activity concentration for material not requiring radiological regulation，GB 27742-2011	AQOIQ, NSMC	2012
2 Nuclear Power Plant Series		
Regulations for environmental radiation protection of nuclear power plant，GB 6249-2011	MEP,AQOIQ	2011
Safety design rule for spent fuel dissolving system of nuclear fuel reprocessing plant， EJ/T 1142-2002	CAEA	2002
Design criteria for pressurized water reactor spent fuel storage facilities at nuclear power plant， EJ/T883-2006	CAEA	2006
Design criteria for spent fuel storage pool away from reactor, EJ/T878-2011	CAEA	2011
3 Radioactive Waste Management Series		
3.1 Fundamental Document		
Regulations for radioactive waste management，GB 14500-2002	AQOIQ	2003
Classification of radioactive waste，GB 9133-1995	SEPA，AQOIQ	1996
3.2 Generation, Pre-treatment, Treatment and Discharge		
The technical rules about solid radioactive waste processing system for light water reactor plants，GB 9134-1988	SEPA	1988
The technical rules about radioactive waste processing system for light water reactor plants，GB 9135-1988	SEPA	1988
The technical rules about gaseous radioactive waste processing system for light water reactor plants，GB 9136-1988	SEPA	1988

Name	Issued by	Entry into force
Authorized limits for normalized releases of radioactive effluents from nuclear fuel cycle，GB 13695-1992	NTSB	1993
Technical requirements for discharge of radioactive liquid effluents from nuclear power plant，GB 14587-2011	MEP、AQOIQ	2011
The general regulation for environmental radiological assessment，GB 11215-1989	SEPA	1990
General requirements of quality assurance program for effluent and environmental radioactivity monitoring at nuclear facilities, GB 11216-1989	SEPA	1990
Graphical signs for environmental protection--Discharge outlet(source)，GB 155621.1-1995	SEPA	1997
Radiological protection management for medical radioactive waste，GBZ 133-2009	MoH	2009
Radioactive source term of PWR nuclear power plant for operational states，GB/T 13976-2008	AQOIQ, NSMC	2008
Decontamination of radioactively contaminated surfaces - Part 1: Method for testing and assessing the ease of decontamination，GB/T 14057.1-2008	AQOIQ, NSMC	2008
Decontamination of radioactively contaminated surface—Part 2:Testing method of decontamination agents for textiles，GB/T 14057.2-2011	AQOIQ, NSMC	2011
Characterization of radioactive waste forms and packages，EJ 1186-2005	NDSTC	2005
Technical regulations on LILW volume reduction system，EJ/T 795-1993	CNNC	1993
3.3 Waste Conditioning		
Standard test method for leachability of low and intermediate level solidified radioactive waste forms，GB/T 7023-2011	SEPA	2011
Standard of safety for low and intermediate-level solid radioactive wastes packages，GB 12711-1991	NTSB	1991
Performance requirements for low and intermediate level radioactive waste form-Cemented waste form，GB 14569.1-2011	MEP、AQOIQ	2011
Characteristic requirements for solidified waste of low and intermediate level radioactive waste - Plastic solidified waste，GB 14569.2-1993	NTSB	1994
Characteristic requirements for solidified waste of low-and intermediate-level radioactive waste--Bitumen solidified waste，GB 14569.3-1995	NTSB	1996
Packaging container for low - and intermediate - level radioactive solid wastes steel drum，EJ 1042-1996	CNNC	1996
Container for low-and intermediate - level radioactive solid wastes Steel box，EJ 1076-1998	CNNC	1998
Concrete container for low-and intermediate-level radioactive solid wastes，EJ/T 914-2000	CNNC	2000
3.4 Waste Storage		
Regulations for interim storage of low-and intermediate-level radioactive solid wastes，GB 11928-1989	NTSB	1989

Name	Issued by	Entry into force
Regulations for designing storage building of high level radioactive liquid waste，GB 11929-2011	AQOIQ, NSMC	2012
Technical rules for interim storage of low and inter-mediate level solid radioactive waste from nuclear power plant，GB 14589-1993	NTSB	1993
Requirements on safety analysis report for solid LILW interim storage，EJ/T 532-1990	CNNC	1990
3.5 Waste Disposal		
Regulations for shallow ground disposal of solid low and intermediate-level radioactive wastes，GB 9132-1988	SEPA	1988
Regulations for disposal of solid low-and intermediate level radioactive wastes in rock cavities，GB 13600-1992	NTSB	1992
Acceptance criteria for near surface disposal of radioactive waste，GB 16933-1997	NTSB	1997
Graphical signs for environmental protection solid waste storage (disposal) site，GB 15562.2-1995	SEPA	1995
General requirements for environmental radiation monitoring around near surface disposal site of low-intermediate level radioactive solid waste，GB/ T 15950-1995	SEPA	1995
Regulations for design of near surface disposal facilities of low and Intermediate level radioactive wastes - disposal except in rock caverns，EJ/T 1109.1-1999	CNNC	1999
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	SEPA	1993
Siting of near surface disposal facilities of low-and intermediate-level radioactive wastes，HJ/T 23-1998	SEPA	1998
Landfill disposal for very low level radioactive waste，GB/T 28178-2011	AQOIQ, NSMC	2012
Activity measurements of solid materials considered for recycling re-use,or disposal as non-radioactive waste, GB/T 17947-2008	AQOIQ, NSMC	2008
3.6 Nuclear Facility Decommissioning and Environmental Reclamation		
Technical regulations for environmental management of reactor decommissioning，GB 14588-2009	AQOIQ	2009
Clearance levels for recycle and reuse of steel,aluminum,nickel and copper from nuclear facilities，GB 17567-2009	AQOIQ, NSMC	2009
Safety requirements for decommissioning of nuclear facilities，GB/T 19597-2004	AQOIQ, NSMC	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

Name	Issued by	Entry into force
3.7 Management of Radioactive Waste from Uranium Mining and Milling		
Regulations for safe management of radioactive wastes from the mining and milling of uranium and thorium ores， GB 14585-1993	SEPA, NTSB	1994
Technical regulations of the environmental management of decommissioning of uranium mining and milling facilities，GB 14586-1993	SEPA, NTSB	1994
Regulation for radiation environmental monitoring in uranium mine and mill，GB 23726-2009	MEP, AQOIQ	2010
Regulations for radiation and environment protection in uranium mining and milling，GB 23727-2009	AQOIQ, NSMC	2009
Regulation for radiation environmental impact assessment in uranium mine and mill，GB/T 23728-2009	MEP, AQOIQ	2009
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.6 NPP Occupational Exposure

NPP Name		year	Annual average individual effective dose（mSv）	Annual maximum individual effective dose（mSv）	Annual collective effective dose（Man.Sv）	Normalized collective effective dose（man·mSv/GWh）
Qinshan NPP		2011	2.82E-01	5.11E+00	4.21E-01	1.69E-01
		2012	4.10E-02	3.68E+00	3.80E-02	1.34E-02
		2013	2.81E-01	6.07E+00	4.95E-01	2.15E-01
Daya Bay NPP		2011	3.27E-01	8.43E+00	9.93E-01	6.20E-02
		2012	4.13E-01	8.12E+00	1.24E-00	7.80E-02
		2013	5.49E-01	1.33E+01	1.77E+00	1.19E-01
Qinshan Phase II NPP	Uint 1 & 2	2011	3.28E-01	8.00E+00	7.77E-01	8.10E-02
		2012	4.49E-01	9.33E+00	1.06E+00	1.12E-01
		2013	3.14E-01	6.36E+00	7.25E-01	7.20E-02
	Uint 3 & 4	2011	1.46E-01	5.55E+00	4.39E-01	9.30E-02
		2012	7.40E-02	2.12E+00	1.68E-01	1.60E-02
		2013	1.91E-01	4.41E+00	4.52E-01	4.40E-02
Ling'ao NPP	Uint 1 & 2	2011	4.19E-01	8.33E+00	1.39E+00	8.70E-02
		2012	2.97E-01	6.06E+00	9.47E-01	6.00E-02
		2013	8.87E-01	1.37E+01	3.24E+00	2.20E-01
	Uint 3 & 4	2011	2.08E-01	5.66E+00	7.47E-01	7.10E-02
		2012	2.86E-01	6.64E+00	9.29E-01	5.90E-02
		2013	1.88E-01	5.66E+00	5.77E-01	3.43E-02
Qinshan Phase III NPP		2011	3.61E-01	1.46E+01	8.32E-01	7.20E-02
		2012	3.16E-01	8.66E+00	6.89E-01	5.90E-02
		2013	3.24E-01	6.36E+00	6.30E-01	5.30E-02
Tianwan NPP		2011	2.24E-01	3.79E+00	6.04E-01	3.76E-02
		2012	3.45E-01	4.23E+00	1.01E+00	6.24E-02
		2013	1.77E-01	2.62E+00	4.67E-01	2.80E-02
Hongyanhe NPP		2011	-	-	-	-
		2012	3.00E-03	2.81E-01	3.94E-03	-
		2013	1.50E-02	1.02E+00	3.09E-02	4.85E-03
Ningde NPP		2011	-	-	-	-
		2012	3.00E-02	9.41E-01	4.28E+00	5.78E-01
		2013	1.20E-02	1.27E+00	2.62E+01	3.78E-03

items (unit) / NPP Name / year		Annual average individual effective dose (mSv)	Annual maximum individual effective dose (mSv)	Annual collective effective dose (Man.Sv)	Normalized collective effective dose (man·mSv/GWh)
Yangjiang NPP	2011	-	-	-	-
	2012	-	-	-	-
	2013	3.00E-03	1.57E+00	5.00E-03	-

L.7 NPP Radioactive Effluents

Percent of Radioactive Effluents to the Discharge Limits（％）

（From 2011to 2013）

NPP Name \ category / items / year			Gaseous Effluents			Liquid Effluents	
			Noble gas	Halogen	Aerosol	Tritium	Other Nuclides
Qinshan NNP		2011	5.130	0.145	7.038	47.898	2.000
		2012	2.468	0.193	11.509	23.874	1.317
		2013	0.945	0.019	0.572	53.904	2.721
Daya Bay NNP		2011	2.443	0.194	0.072	21.111	0.115
		2012	0.176	0.038	0.174	20.356	0.168
		2013	0.138	0.028	0.128	17.111	0.139
Qinshan Phase II NNP		2011	0.277	0.370	0.074	40.000	2.766
		2012	0.261	0.404	0.109	49.364	3.138
		2013	0.315	0.360	0.299	57.727	2.181
Lingao NNP	Uint 1 & 2	2011	0.132	0.019	0.091	24.222	0.103
		2012	0.151	0.034	0.085	24.844	0.114
		2013	0.137	0.021	0.119	21.867	0.135
	Uint 3 & 4	2011	0.336	0.029	0.134	4.578	0.075
		2012	0.291	0.046	0.123	13.822	0.171
		2013	0.219	0.032	0.144	17.822	0.110
Qinshan Phase III NNP		2011	2.459	1.326	0.138	8.056	3.333
		2012	2.000	0.205	0.073	6.052	3.800
		2013	3.480	1.746	0.057	9.504	4.550
Tianwan NNP		2011	36.748	34.688	75.369	64.946	21.500
		2012	26.098	95.393	18.473	72.283	15.650
		2013	60.244	12.466	13.177	78.804	13.983
Hongyanhe NNP		2011	-	-	-	-	-
		2012	0.013	0.038	0.008	0.000	0.006
		2013	0.168	0.862	0.073	12.524	0.085

NPP Name / year / items / category		Gaseous Effluents			Liquid Effluents	
		Noble gas	Halogen	Aerosol	Tritium	Other Nuclides
Ningde NNP	2011	-	-	-	-	-
	2012	0.040	0.020	0.030	0.001	0.020
	2013	0.270	0.070	0.100	11.530	0.140
Yangjiang NNP	2011	-	-	-	-	-
	2012	-	-	-	-	-
	2013	0.017	0.014	0.020	0.001	0.021

Notes:

1. The release amount of radioactive effluents is dependent on power of nuclear units.

2. For each NNP, the Discharge Limits of radioactive Effluents are respectively approved by NNSA.

L.8 References

L.8.1 Documents

No.	References
1	The fifth national report of the People's Republic of China to the Convention on Nuclear Safety, 2010.
2	The sixth national report of the People's Republic of China to the Convention on Nuclear Safety, 2013.
3	National report of the People's Republic of China to the Code of Conduct on the Safety and Security of Radioactive Sources, NNSA, August 2007
4	China nuclear power report, NEA, 2010
5	Annual report of nuclear safety, NNSA，2010
6	Annual report of nuclear safety, NNSA，2011
7	Annual report of nuclear safety, NNSA，2012
8	Long and intermediate period development planning of nuclear power, national development and reform commission (2005-2020)，2006
9	Integrated regulatory review rervice (IRRS) mission to China，IAEA，2012.
10	"Twelfth-Five Year Plan" and the 2020 future vision on nuclear safety and radioactive pollution protection and control，MEP(NNSA), NDRC, MF, NEA, CAEA，2012.
11	Report on civilian nuclear facilities nationwide comprehensive security and inspection，MEP(NNSA),NEA, CSB,2012.
12	National nuclear emergency plan (Revised)，State Council, 2013.
13	"Twelfth-Five Year Plan" on energy development，State Council, 2013.
14	2011 the environment in China，2012.
15	2012 the environment in China，2013.
16	2013 the environment in China，2014.

L.8.2 Websites

More Information can be available at the following websites:

No.	Agency Name	Website
1	MEP	www.mep.gov.cn
2	CAEA	www.caea.gov.cn
3	CNNC	www.cnnc.com.cn
4	NEA	www.nea.gov.cn
5	MPS	www.mps.gov.cn
6	NHFP	www.chinapop.gov.cn
7	SWAS	www.chinasafety.gov.cn

L.9 Abbreviation

No.	Abbreviation	Full name
1	ALARA	As Low As Reasonably Achievable
2	AQOIQ	Administration of Quality Oversight, Inspection and Quarantine
3	Beilong Disposal Site	Guangdong Beilong LILW Disposal Site
4	BSS	Basic Safety Standard
5	CAEA	China Atomic Energy Authority
6	CGN	China General Nuclear Power Group
7	CIAE	China Institute of Atomic Energy
8	CNNC	China National Nuclear Corporation
9	CSDCNTARSF	Criteria on Siting, Design and Construction of Nuclear Technology Application Radwaste Storage Facility
10	CWGJCI	Chinese Working Group for Joint Convention Implementation
11	EPDNFO	Emergency Preparedness and Response of Nuclear Fuel Cycle Facility Operators
12	EPRNPO	Emergency Preparedness and Response of NPP Operators
13	EU	European Union
14	HIC	High Integrity Containers
15	HLW	High level waste
16	IAEA	International Atomic Energy Agency
17	ICRP	International Commission on Radiological Protection
18	ILW	Intermediate level waste
19	IPCUMFTDSFNPP	Interim Procedures on Collection, Utilization and Management of the Funds for Treatment and Disposal of Spent Fuel at Nuclear Power Plants
20	Joint Convention	The Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management
21	LDEE	Law of People's Republic of China on Dealing with Emergency Event
22	LLRPC	Legislation Law of the People's Republic of China
23	LLW	Low level waste
24	LPCOD	Law of the People's Republic of China on Prevention and Control of Occupational Disease
25	LPCRP	Law of the People's Republic of China on Prevention and Control of Radioactive Pollution
26	MEP	Ministry of Environmental Protection, P. R. of China
27	MIIT	Ministry of Industry and Information Technology
28	MLRRIS	Methods for Licensing of Radioisotopes and Ray-generating Installations Safety
29	MMLSDSRW	Management Measures for Licensing the Storage and Disposal of Solid Radioactive Waste

No.	Abbreviation	Full name
30	MMSPRRI	Management Measures on Safety and Protection against Radioisotope and Ray-generating Installation
31	MoF	Ministry of Finance
32	MoH	Ministry of Health
33	MoT	Ministry of Transport
34	MPS	Ministry of Public Security
35	NDRC	National Development and Reform Commission
36	NEA	National Energy Administration
37	NHFPC	National Health and Family Planning Commission
38	NNAECC	National Nuclear Accident Emergency Coordination Committee
39	NNAEO	National Nuclear Accident Emergency
40	NNEP	National Nuclear Emergency Planning
41	NNSA	National Nuclear Safety Administration
42	NORMs	Naturally Occurring Radioactive Materials
43	Northwestern Disposal Site	Northwestern China LILW Disposal Site
44	NPCSC	National People's Congress Standing Committee
45	NPIC	Nuclear Power Institute of China
46	NPPs	Nuclear Power Plants
47	QA	Quality Assurance
48	RNAEMN	Regulations on Nuclear Accident Emergency Management at Nuclear Power Plant
49	RSPRRI	Regulations on Safety and Protection of Radioisotope and Ray-generating Installations
50	RSRWM	Regulations on Safety of Radioactive Waste Management
51	SAMG	Serious Accident Management Guides
52	SRTF	Site Radioactive Treatment Facility
53	TRRQNSE	Temporary Regulations on Registration qualifications for Nuclear Safety Engineer

PART 2

A. Overview

1.1 No spent fuel is generated nor exists spent fuel-related facility in Hong Kong SAR. So the Chapter 2 of Joint Convention, Safety of Spent Fuel Management, is not applicable in Hong Kong SAR.

1.2 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, Hong Kong SAR 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 Hong Kong SAR, 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.

1.3 The management of radioactive substances in Hong Kong SAR 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.

1.4 In addition, a purpose-built Low-level Radioactive Waste Storage Facility ("Storage Facility") was commissioned in Hong Kong SAR in mid-2005. It is a crucial facility to enable a holistic and effective management of radioactive wastes in conformance with the high standard of management culture on radiation safety.

B. Policies and Practices

2.1 The *Radiation Ordinance* (Cap. 303 of the Laws of Hong Kong SAR) and the associated licensing system form the legal basis for the control of radioactive substances and radioactive wastes in Hong Kong SAR. The Hong Kong SAR Radiation Board ("the Board") is established as the regulatory

authority under the *Radiation Ordinance*.

B.1 Definition of Radioactive Wastes

2.2 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.

2.3 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

2.4 Radioactive wastes produced in Hong Kong SAR are classified into the following basic categories according to their properties –

i) Solid waste;

ii) Liquid waste;

iii) Gaseous waste; and

iv) Exempt waste.

2.5 Solid radioactive waste mainly includes disused sealed sources and solid wastes contaminated by radioactive substances, etc. Sealed sources are widely used in medical and industrial sectors. Sealed sources in medical applications based on the Categorization of Radioactive Sources of International Atomic Energy Agency (IAEA) include the higher activity Category 1 and Category 2 sources, such as caesium-137 in blood irradiator systems and cobalt-60 in gamma knife radiosurgery system, as well as those Category 3 or lower 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 cobalt-60, 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, strontium-90 and thallium-201 β-sources in the measurement of material thicknesses as well as

nickel-63 β-sources in electron capture devices.

2.6 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 indicator lights, etc.

2.7 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, strontium-90, 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.

2.8 Gaseous radioactive waste mainly refers to waste radioactive gases, vaporised radioactive liquid and radioactive aerosols, such as krypton-85 and technetium-99m vapour, etc.

2.9 Exempt waste refers to waste that is released from regulatory control in accordance with exemption principles.

C. Radioactive Waste Management Policies and its Practices

C.1 Radioactive Waste Management Policy

3.1 The fundamental principle of Hong Kong SAR's radioactive waste management policy is to minimise the waste arising at source. The Board adopts the following management policies to 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. In case that the manufacturer has wound up or there are justifiable reasons proving that such measure is 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 Radiation 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 Radiation 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 recover 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

3.2 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

4.1 As stated in paragraph 3.1, the basic principle for the management of radioactive wastes of Hong Kong SAR 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.

D.1 Safety Management Practices of the Storage Facility

4.2 The Storage Facility, with a designed storage capacity of 140m^3, has been commissioned in Hong Kong SAR since mid-2005. Presently the total volume of waste in store is about 68m^3. It is estimated that the storage capacity will meet the waste storage requirement of Hong Kong SAR in the coming 100 years. Apart from this facility, Hong Kong SAR does not have any other proposed radioactive waste facilities.

4.3 The siting and planning of the Storage Facility were studied and examined in detail by the Environmental Protection Department ("EPD") of the Hong Kong SAR 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.

4.4 The Storage Facility is located at Siu A Chau, a small remote island located at the southeast 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.

4.5 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

4.6 At present, the majority of the low-level radioactive wastes produced in Hong Kong SAR, 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 Annex I.1.

E. Legislative and Regulatory Framework

5.1 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.

5.2 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.

5.3 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 Radiation 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.

5.4 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.

5.5 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 Hong Kong SAR. The licensing system has been accredited with ISO9001:2000 Quality Management System certification since 2004, and then updated with ISO9001:2008 Quality Management System certification, which reflects the quality of the management system and the commitment to continual improvement. For the whole of licensing system, together with radioactive source-related database and their information system, electronic working procedures have been employed since 2010, in order to enhance the capability of data analysis and processing, and to facilitate appropriate management of sealed sources over the life-cycle from the beginning to the end.

5.6 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 possible radiation exposure and contamination on individuals, society and the environment.

F. General Safety Provisions

F.1 Responsibility of the licence holder

6.1 According to the radiation regulations, 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 transportation, 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

6.2 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.

6.3 The Storage Facility is the property of and fully funded by the Hong Kong SAR 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

6.4 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.

6.5 The Storage Facility is operated and managed in accordance with ISO14000 Environmental Management Systems, which reflects its commitment to management quality and environmental protection.

F.4 Operational Radiation Protection

6.6 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.

6.7 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 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. The data of 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 Emergency Preparedness

6.8 The contractor of the Storage Facility has, as required by the Radiation 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

6.9 At the planning stage of the Storage Facility, the Hong Kong SAR

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 Hong Kong SAR Government will formulate detailed plans, provide the funds and take charge of the decommissioning work at an appropriate time.

G. Transboundary Movement

7.1 Hong Kong SAR does not produce any sealed sources or radioactive substances and, therefore, the transboundary movement of radioactive substances is confined to transshipment 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 Hong Kong SAR is required to be covered by a valid import licence issued under the *Import (Radiation) (Prohibition) Regulations* (Cap. 60 of the Laws of Hong Kong SAR) 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.

7.2 The transportation of radioactive substances in Hong Kong SAR 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 transportation should be conducted under the personal supervision of the approved supervising persons prescribed by the licence. The licensee is required to submit to the Radiation Board reports and records of the transportation activities after they have been completed.

H. Disused Sealed Sources

8.1 As stated in paragraph 7.1, Hong Kong SAR does not produce any sealed sources or radioactive substances. Therefore, the Article 28 of Joint Convention, Disused Sealed Sources, is not applicable in Hong Kong SAR.

I. Annex

I.1 List of Radionuclides in Low-level Radioactive Waste Storage Facility in Hong Kong SAR

Isotope	Total Activity (Bq)	Major Sources of Wastes
Caesium-137	6.1×10^5	Medical radiation sources
Radium-226	7.1×10^4	Lightning conductor heads, luminous watch dials and hands, medical radiation sources
Cobalt-60	4.7×10^4	Radioactive check sources
Promethium-147	4.0×10^4	Luminous watch dials and hands
Strontium-90	2.5×10^4	Medical radiation sources
Gadolinium-153	1.1×10^4	Medical radiation sources
Americium-241	6.8×10^3	Radioactive check sources, smoke detectors
Thorium-232	1.2×10^3	Rayon mantles for kerosene lanterns

I.2 References

[1] Radiation Ordinance (Cap. 303 of the Laws of Hong Kong SAR)

[2] Import (Radiation) (Prohibition) Regulations (Cap. 60 of the Laws of Hong Kong SAR)

[3] Guidance on the Import and Export of Radioactive Sources, IAEA (2005)

[4] Code of Conduct on the Safety and Security of Radioactive Sources, IAEA (2004)

[5] Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, IAEA (1998)

[6] Categorization of Radioactive Sources, Safety Guide No. RS-G-1.9, IAEA (2005)

[7] International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources, Safety Series No. 115, IAEA (1997)

[8] Regulations for the Safe Transport of Radioactive Material, Safety Standards Series No. TS-R-1, IAEA (2009)

[9] IAEA Safety Glossary (2007)