English Version

THE PEOPLE'S REPUBLIC OF CHINA

The 2nd National Report for Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management

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Preface

China Government has 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, held on April 29, 2006, 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 September 5, 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 Administrative Region (SAR) of the People's Republic of China, unless otherwise stated by China Government. On September 13, 2006, China sent its submission of accession instrument to the Depositary. The Joint Convention entered into force to China from the day of December 12, 2006 on.

The 1st National Report of the People's Republic of China on the fulfillment of the obligations of the Joint Convention was submitted, in October 2008, to the third Review Meeting of the Contracting Parties.

This report is provided, according to the Article 32 of the Joint Convention, as the 2nd National Report of the People's Republic of China to the forth 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 written by the Central Government of the People's Republic of China, and the part 2 is prepared by the Hong Kong Special Administrative Region of the People's Republic of China. The data for the inventory and lists of this report was as of December 31, 2010.

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 fundamental policies on, and practices of, the safety of spent fuel management and the safety of radioactive waste management in China.

A-2 China has made great efforts to ensure and improve the safety of spent fuel management and the safety of radioactive waste management, to promote sustainable development of nuclear energy and nuclear technology applications, to protect human, society and the environment. Continuous efforts are being made to achieve the objectives. China established and is improving the legislative system following the basic principles of ionizing radiation protection, radiation source safety and radioactive waste management safety. China has built up independent regulatory framework and is expanding its regulatory capabilities. China clarifies and allocates safety management responsibilities among different parties. China took actions to control the generation of radioactive waste and is making greater effort to minimize the generation of radioactive waste. China has planned and is promoting the stabilization and disposal of radioactive waste. China is investigating the strategy of long-term storage and reprocessing of spent fuel to achieve a sustainable safety of spent fuel management.

A.2 Concerned Facilities

A-3 In accordance with the Joint Convention, the Part 1 of this report is focused on the facilities as nuclear power plants (NPPs), research reactors, spent fuel storage/management facilities, large-scale nuclear research facilities, uranium enrichment facilities, nuclear fuel assembly manufacturing facilities, as well as radioactive waste management facilities including radioactive waste storage facilities and disposal sites.

A.3 Structure

A-4 As required by Guidelines regarding the Form and Structure of National Reports (INFCIRC/604/Rev.1), 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. Policies 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

Finally, this Part ends with the corresponding Annexes (Chapter L).

A-5 To avoid the overlapping of the relevant parts in Chapters G and H, according to the suggestions of INFCIRC/604/Rev.1, the regulations, which are universally applicable, governing the spent fuel management facilities and the radioactive waste management facilities, are addressed in Chapter E.

A.4 Summary of the Third Review Meeting

A-6 China 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 review meeting.

A-7 The third Review Meeting of Contracting Parties of Joint Convention convened in May 2009 presented its review comments on the China's National Report, to which attention should be given by China as follows:

(1) Ensure that the development of facilities for storage and disposal of radioactive waste and spent fuel are compatible with the NPP programme;

(2) Regulations and standards for the safe management of radioactive waste to be completed;

(3) Establish processes for control of the scrap metal industry;

(4) To increase efforts to ensure availability of sufficient trained staff to meet the necessities of the nuclear programme;

(5) Continue international participation;

(6) Comprehensive planning and implementation of geological disposal;

(7) Development of documents to support the regulation of safe management of radioactive waste;

(8) Approval of the siting programme for regional disposal facilities for LILW.

A-8 On the other hand, as required by the third Review Meeting of Contracting Parties, the contracting parties should pay attention to the following six issues developing their own national reports that will be submitted to the fourth Review Meeting of Contracting Parties of Joint Convention:

(1) Development of a comprehensive regulatory framework（see E.2.3, E.3）;

(2) The effective independence of regulatory body（see E.2.1, E.3.1）;

(3) Implementation of the strategies with visible milestones（see B.5.2, B.5.3）;

(4) Funding to secure waste management (see E.3.2, F.2.2）;

(5) Education and recruitment of competent staff and employees (see F.2.1); and

(6) Geological repositories for high level waste (B.5.3, H.3).

A.5 Updating of the Previous Report

A-9 The present report updates and supplements the following main activities and progress made in China in the safety of spent fuel management and the safety of radioactive waste management since January 1, 2007 up to December 31, 2010:

(1) In 2010, the IAEA conducted IRRS mission to China was made (see A.6);

(2) The *Regulations on Safe Management of Radioactive Waste* is under development as planned (see E.2.2);

(3) In 2008, the regulatory capability of the Ministry of Environmental Protection/National Nuclear Safety Administration (MEP/NNSA) was reinforced at the time of China's governmental restructure, with significant increases both in the number of qualified staff and in the budget of funds (see E.3.2);

(4) In 2008, the China Energy Administration (CEA) was established while China's governmental agency being reformed, with a re-assignment the functions of relevant governmental agencies with respect to nuclear power program (see E.4.1);

(5) On July 12, 2010, the Ministry of Finance, the People's Republic of China,

issued the *Interim Procedures on Collection, Utilization and Management of the Funds for Treatment and Disposal of Spent Fuel from Nuclear Power Plants* (see F.2.2.1);

(6) One interim dry-storage facility for CANDU reactor's spent fuel was put into operation (see B.2 and G);

(7) Both Guangdong Beilong LILW Disposal Site (Beilong Disposal Site) and Northwestern China LILW Disposal Site (Northwestern Disposal Site) were awarded the formal operational licenses. A site in the southwestern China was authorized for a LILW disposal facility (see B.5.2 and H);

(8) Further measures were taken to control radioactive contamination during recovery of scrap metal (see J.4); and

(9) Inventories and lists updated (see D and L).

A.6 IAEA IRRS Review Mission

A-10 On the invitation of China government, an IAEA mission of 22 senior regulatory experts made an IRRS review to China during July 19-30, 2010. The IRRS review was focused on the MEP/NNSA and its technical support organizations, with respect to responsibility and assignment of governmental agencies, overall safety system, responsibility and function of regulatory body as well as its management system, regulatory activities, relevant regulations and guidelines, emergency preparedness and response, among others. This mission made a number of inspecting visits to China's regulatory activities, including supervision and inspection to the Guangdong Beilong LILW Disposal Site. As well, the mission conducted dialogue and commutation with the relevant staff from Ministry of Health, China Energy Administration, China Atomic Energy Authority, China National Nuclear Cooperation and Guangdong Nuclear Power Group Co. Ltd.

A-11 The mission pointed out that good practices have been made in nuclear safety regulation in China. The inclusions are the *Medium-and-Long-term Plan for Nuclear Power Development (2005-2020)*, *Plan of Nuclear Safety and Radioactive Contamination Prevention and Control*, the policy of "safety first, quality first", and the practices in staff training and equipment regulation.

A-12 Additionally, the mission also gave some comments and suggestions for the further improvement. Principally, the MEP/NNSA should issue, as soon as possible, comprehensive nuclear safety policy and strategy, laws and regulations relevant to nuclear safety, and develop integrated national policy and strategy for

radioactive waste management and spent fuel management.

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 Policies

B-1 China's spent fuel management policy is to implement the reprocessing of spent fuel, so as to achieve closed nuclear fuel cycle.

B-2 In the early 1980's when China commences to develop nuclear power for electricity generation, Chinese government set up the strategy for development of nuclear power in conjunction with relevant development of nuclear fuel reprocessing. Since China's first NPP, Qinshan Nuclear Power Plant (Qinshan NPP), was put into commercial operation on December 15, 1991, there have been 13 nuclear units in commercial operation (see Appendix L.1.1) and 28 under construction in China by the end of December 31, 2010. According to the *Medium-and-Long-term Plan for Nuclear Power Development (2005-2020)*, the total nuclear installed capacity will amount to 40 000 MWe till the year of 2020, with an annual electrical energy generated of 260-280 TWh. To ensure the sustainable supply of nuclear fuel and an efficient utilization of resources, the policy of the closed nuclear fuel cycle and the reprocessing of spent fuel was reaffirmed both in the *Medium-and-Long-term Plan for Nuclear Power Development (2005-2020)* and in *the 11th 5-Year Plan of Nuclear Industry*.

B.2 Spent Fuel Management Practices

B-3 Spent fuel arises from the operations of nuclear power reactors and

research reactors, which are mainly stored in pool at-reactor.

B-4 The at-reactor spent fuel storage facilities, to various extents, have been established at NPPs to accommodate the spent fuel arising from NPPs within a certain period of time. With different type of reactors and different design of nuclear power plants, the at-reactor storage facilities on different scale were built at nuclear power plants, with more information found in section L.1.3.

B-5 From September 2009 on, a dry storage facility of spent fuel at Qinshan Phase III NPP has been put into operation. The construction license was granted in July 2008 for the facility, which is comprised of spent fuel preparation zone, transport zone and dry storage zone, as described in Chapter G.

B-6 The operator of a nuclear power plant has the primary responsibilities for the safety of spent fuel management in the period from operation commencement of nuclear power plant to spent fuel transport to outside. The *Regulations on Nuclear Power Plant Operation Safety* requires that the nuclear power plant operator must be responsible for, and arrange, all activities involving reactor-core and fuel management to ensure the safe use of fuel in a reactor and the safety of fuel during transfer and storage within the plant area. As required, the management procedures for nuclear fuel and reactor-core components must be prepared, including transfer of irradiated fuel, storage in plant area, and preparatory work for delivery of spent fuel to the outside. Spent fuel may be transported to a reprocessing plant for reprocessing or sent to away-from-reactor storage. Only an authorized company can undertake the transportation of spent fuel.

B-7 In a nuclear power plant, duties are assigned to parts responsible for the management of spent fuel. In accordance with the allocation of responsibilities, the responsible parts are responsible for the development of spent fuel withdraw plan and its option, the implementation of withdraw operation, radiation measurement, radiation protection supervision, spent fuel storage, management and inspection of plant buildings and installations, documentation, chemical analysis of water quality and quality assurance.

B-8 The operator of a research reactor is responsible for the safety of spent fuel management. The *Research Reactor Operation Management (HAD202/01)* describes provisions for the production, storage and management of research reactor spent fuel. An authorized company should complete the transport of spent fuel to the reprocessing plant as necessary. The operator of a research reactor should prepare the relevant management procedures with clear-defined responsibility.

B-9 After a strategic decision was made on reprocessing of spent fuel;

China has made every effort to promote the research and development of spent fuel reprocessing technology and has build a pilot reprocessing plant for spent fuel arising from nuclear power reactor in Northwest China with designed capacity of 100 kg/d. After many years of design, verification and review, the pilot plant started construction in 1998, and received the first batch of spent fuel in September 2003. In December 2010, the pilot plant succeeded in commissioning.

B-10 To ensure the strategy of spent fuel reprocessing to be implemented successfully, the program for spent fuel back-end fund management was established in China to define the charging, management and use of the back-end fund（see F.2.2.1）.

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*, radioactive waste is the waste that contains or is contaminated with radionuclides at concentrations or radioactivity greater than the clearance level as established by the regulatory body without foreseen further use.

B-12 In China, radioactive waste arises principally from nuclear power plants, research reactors, nuclear fuel cycle, nuclear technology applications, and the exploitation as well as utilization of uranium and thorium resources. China's radioactive waste categorization system is based on predisposal management and disposal of radioactive waste. Predisposal management-based radioactive waste categorization system takes into account nuclear facility operational experience in combination with the requirements of waste treatment and conditioning, including a quantitative categorization system for radioactive gaseous, liquid and solid wastes. Disposal-based radioactive waste categorization system focuses on the final disposal of radioactive wastes, in conjunction with the origin of waste and disposal approach.

B-13 Predisposal management-based radioactive waste categorization system is applicable for the management activities of gaseous, liquid and solid radioactive wastes in relation to nuclear facility operation, with more detailed categorization for different waste forms according to their radioactive characteristics as shown in Table 1. It is basically consistent with the basic requirements of waste disposal, but with more emphasis on the cleaning index, shielding design and other field protection requirements that shall be met in the process of waste treatment and conditioning for various systems.

Table 1 Predisposal-based waste categorization system

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 bigger 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 bigger than 4×10^{6} Bq/L but not exceeding 4×10^{10} Bq/L
	High level waste (HLW)	Concentrations bigger 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 not exceeding 4×10^{6} Bq/kg (2) Half-life longer than 5a,but shorter than or equal to 30 a, with specific activity more than 4×10^{6} Bq/kg but not exceeding 4×10^{11} Bq/kg (3) Half-life longer than 30 a, specific activity bigger 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 bigger than 2 kW/m^{3} or specific activity more than 4×10^{11} Bq/kg, (2) Half-life longer than 30a, specific activity bigger than 4×10^{10} Bq/kg, or heat release rate bigger than 2 kW/m^{3}
	Alpha radioactive waste	Alpha nuclides with half-life longer than 30 a, specific activity in a single package bigger than 4×10^{6} Bq/kg

B-14 Disposal-based radioactive waste categorization system divides solid radioactive waste into solid low level waste (LLW), solid intermediate level waste (ILW,) solid high level waste (HLW), solid alpha waste and the waste arising from mining and milling of uranium and thorium, and naturally occurring radioactive materials (NORM) waste. The considered disposal options cover centralized deep geological disposal, regional near surface disposal, and centralized landfill, and others, as shown in Table 2. For solid LLW bearing only short-lived radionuclides, the waste can be released from the regulatory control according to the regulatory procedure, when the radioactivity contained reaches below the regulatory clearance levels. But the management of cleared waste should be in compliance with other relevant environmental requirements.

Table 2 Disposal-based radioactive waste categorization system

Waste categorization	**Disposal approach**
Solid HLW	Centralized deep geological disposal
Solid α waste	Centralized deep geological disposal
Solid ILW	Regional near surface disposal
Solid LLW	Regional near surface disposal
Uranium (Thorium) mining and milling waste	Backfilling, damming, centralized landfill
NORM Waste	Backfilling, damming, centralized landfill

B.3.1 Low and Intermediate Level Waste

B-15 Low and intermediate level waste (LILW) arises mainly from nuclear power plant operation and nuclear technology applications.

B-16 Radioactive waste produced in operating nuclear power plants is principally from (1) the operation of the main process equipments and waste treatment equipments, including secondary waste from loop leakage or drainage which includes airborne and liquid radioactive wastes, and from waste treatment system which includes solid radioactive waste, (2) the technical maintenance during operation, (3) the daily operation including the protective articles, equipment and miscellaneous scrap replaced.

B-17 The wastes arising from nuclear technology application refers to contaminants, with foreseen no further use, that arise from the applications of radioisotopes and irradiation technology in industry, agriculture, medicine, research and education, which contain man-made radionuclides with specific activity higher than 2×10^4 Bq/kg, or NORM with specific activity higher than 7.4×10^4 Bq/kg, or

abandoned/disused wastes arising from the above-mentioned activities with surface contamination level exceeding the regulatory limits. Such LILW is featured with wide distribution, broad variety and small quantity.

B.3.2 High Level Waste

B-18 HLW includes the high level liquid waste generated from the reprocessing of spent fuel, and the solidified radioactive form of such waste, as well as spent fuel withdrawn from nuclear power reactor or research reactor pending direct disposal.

B-19 Due to its high radioactive activity, large amount of heat release, high toxicity and long half life, HLW needs to be isolated from the human environment for a long period of time in a reliable manner.

B.3.3 Uranium/Thorium Mining and Milling Waste

B-20 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 mining debris, and tailings characterized by large volume, low activity and simple radionuclide composition.

B.3.4 Naturally Occurring Radioactive Waste

B-21 NORM means wastes containing, or contaminated with naturally occurring materials at a concentration or radioactivity higher than the relevant regulatory level and is forecast with no further use. These may arise principally from the mining and milling of rare-earth minerals and the production of phosphates among others. The radioactivity in such kind of wastes is mainly from radioactive materials associated with raw materials, with quite large volume.

B.4 Radioactive Waste Management Policies

B-22 China Government adheres to the radioactive waste management policy of people orientation, harmony development, prevention priority, strict management, safety priority, and combination of prevention and control.

B-23 Radioactive waste is managed through taking all of reasonable and practicable management measures in such a way that will not impose undue burdens on the future generations, to ensure the adequate protection of human and the

environment both at present and in future and to ensure the sustainable development of beneficial human practices.

B-24 Both the radioactive waste management legislative system and the independent radioactive waste safety regulatory systems are established. Licensing system for radioactive waste management activities is implemented, and licensee undertakes the main responsibility for the safety of radioactive wastes and relevant management facilities.

B-25 Through reasonable selecting and using raw materials, drawing on advanced production technological process and equipment and implementing reuse and recycle of items, it is expected to reduce the generation of radioactive waste and their release to the environment to a level as low as reasonably achievable (ALARA).

B-26 Relevant radioactive waste treatment capacity should be designed constructed and operated simultaneously with the main technological process. Licensee should solidify liquid radioactive waste timely and limit the storage duration for both solidified liquid LILW and solid LILW.

B-27 The radioactive waste management is oriented with disposal and discharge. Both the optimization is implemented for the whole spectrum of waste streams and for the whole process from cradle to grave.

B-28 Solid radioactive wastes are disposed of in accordance with their categories. Uranium mining and milling waste is disposed of in situ; solid LILW would be disposed of in the near surface disposal facilities. Solid HLW and alpha waste would be disposed of in a centralized deep geological disposal repository.

B-29 The research and development of radioactive waste disposal should be carried out through strategic planning, harmonized developing, step-wise decision making, and iterative progress.

B.5 Radioactive Waste Management Practices

B.5.1 Treatment and Conditioning of Radioactive Wastes

B-30 With the development of nuclear industry, including nuclear power plant, and nuclear technology application, China’s radioactive waste management has been gradually improved. In 1950’s when the country’s nuclear industry began to develop, Chinese government put forward the policy that radiation protection should be developed before nuclear industry operation, which required that the work involving radioactivity should be accompanied with waste treatment capability and

that radioactive waste discharge should comply with required standards. Therefore, nuclear industry production and research facilities were all equipped with radioactive waste treatment and storage installations for storage of different category waste in accordance with relevant categorization.

B-31 In the early stage, the liquid and gaseous radioactive waste treatment process, as part of nuclear production and research activities and as a component associated with the main production process, employs purification filtration, evaporation, ion exchange among others. Such wastes were discharged into atmosphere and surface water after meeting national standards. Those liquid and solid radioactive wastes that could not be discharged were dedicatedly stored. In general, in the process of nuclear facility construction and operation, the treatment of gaseous and liquid radioactive waste generated received due attention with practical treatment technology being employed. This played an important role to ensure normal operation and environmental protection.

B-32 All sorts of liquid waste generated in the operation of the nuclear facility underwent solidification treatment, evaporator residues of liquid LLW experienced bituminization and the resultant solidified forms, after package, were brought to storage facility for storage. At present, the facilities for waste retrieving, treating and conditioning are being constructed for the radioactive wastes generated in the past practices,

B-33 With the construction and expansion of NPPs and the development of the radioactive waste management concept of taking disposal as core, the progress has been made in radioactive waste treatment and conditioning technology and installation. The NPPs in China are installed with liquid and solid radioactive waste treatment facilities during their construction.

B-34 The NPP operators prepared radioactive waste management programs, which specify the assignment of responsibility of radioactive waste management within each NPP. Radioactive wastes are managed according to their categories at NPPs. Based on the features of each NPP; the specific categorization schemes are developed and applied to the management of radioactive waste arising from NPP operations. In majority of NPPs, radioactive wastes are categorized into process waste, technical waste and other types of waste.

B-35 In general, concentrated liquid and spent ion exchange resins are cement-solidified, the technical waste is held in storage after sorting and compression. Cement solidification processes have been established in the operating NPPs to carry out cement solidification to liquid LILW and spent ion exchange resins, while cement immobilization to spent filter cartridge. If possible, the disposal

application of the solidified wastes should be submitted, or the solidified wastes should be stored in the storage facility at NPPs. On a whole, the facilities for waste storage at NPPs are well constructed and managed in a good manner, which comply with current requirements.

B-36 In addition, various NPPs have further improved waste production control measures and sustainable practices of radioactive waste minimization. Employees and contractors' awareness of waste minimization is being reinforced through training and education activities. Both technological and administrative measures are employed to make waste generation ALARA. These measures include detailed working plan and arrangement to strictly control waste transfer, to maintain normal operation of the waste treatment system, to prevent the generation of the secondary waste, to control the entry of materials into the controlled area, to enhance recovery and reuse of contaminated material, and to conduct modification to the existing technology process. For example, Qinshan NPP conducted technological modification to the older cement solidification system, so that, as a result, the waste drum filling coefficient increased from less than 70% to more than 90%. Daya Bay NPP modified solidification technological process so as to raise the waste loading capacity. New technological process for radioactive waste management is envisaged. In China, new waste treatment technology and operational model are actively introduced in the design of new NPPs, like drum drying, high integrity container, mobile liquid waste treatment devices and centralized waste treatment facility among others.

B.5.2 Low and Intermediate Level Waste Disposal

B-37 In the 1980's, radioactive waste disposal work was initiated in China. In 1983, the former Ministry of Nuclear Industry (MNI) subsidiary Science and Technology Committee set up a panel of radioactive waste treatment and disposal.

B-38 The siting of solid LILW disposal site began in the 1980's and was implemented under the auspice of the former MNI. The initial siting work was conducted in South China, East China, Northwest China, and Southeast China based on the regional distribution of nuclear facilities at that time. Candidate sites have been recommended according to site selection and characterization in different regions of concern.

B-39 The *Chinese Environmental Policy on Disposal of LILWs* was issued in 1992 (GF/1992/D45), which clarify the environmental policy on LILW disposal. The GF/1992/D45 states that national disposal sites for LILWs shall be constructed in succession in the regions where major waste generation are located in order to

dispose of LILWs generated in the region and neighboring regions. The GF/1992/D45 played an active role in promoting the siting and construction of LILW disposal sites. The Northwestern Disposal Site and Beilong Disposal Site were constructed, respectively. Both sites were licensed for operation in February 2011.

B-40 The operating license for the Northwestern Disposal Site shall be in effect during the period from the receipt of 60 thousands m^3 of solid LILW for disposal to the approved closure of site. The operating license for Beilong Disposal Site shall be effective during the period from the receipt of 80 thousands m^3 of solid LILW for disposal until the approved closure of the site. Under the operating license, the operators of the disposal sites are required to carry out periodic safety analysis each 10 years, and to report the assessment results to the NNSA for review. Not later than one year before the closure of disposal units, the operators of the disposal sites should submit the closure application to the NNSA, together their supporting documents. Radiation environmental monitoring has shown that the operation of both sites has no any negative effects upon radiation level in the surrounding areas. So far, there has not been any radiation event to occur.

B-41 Under *the Law of the People's Republic of China on Prevention and Control of Radioactive Pollutio*n, the relevant agencies of Chinese government are organizing to develop the program on the siting of solid radioactive waste disposal site. Till now, the drafting program has been developed and is waiting for approval. The principle is to make an overall plan and implement project in a step-wise, convenient and economic way to ensure safety. Based on future development of nuclear power plants and the distribution of waste generation varying with time and region, the overall development program for LILW disposal will be established including allocation of regions, siting planning, capacity of disposal site and construction plan. Based on the program, a phased implementation approach shall be developed to keep the number and capacity of disposal sites countrywide meeting the demand of radioactive waste disposal in various regions. The target of the overall plan is to complete the siting, and stage I construction, for such 5 disposal sites as in South China, East China, Northwestern China, Southwestern China and North China, prior to 2020, with the total planned volume of 1 million m^3.Construction of the approved regional disposal site should be implemented in multi-stages based on the quantity of LILWs generated and on a basis of gradual disposal capacity extension so as to achieve the effective availability of disposal capacity. When considering the safety of LILW disposal, the transportation is one of the factors. Taking full account of the safety, economy and convenience of radioactive waste transport, a reasonable arrangement should be made for the

coverage of each regional disposal site.

B-42 The solid LILW disposal site now under construction in southwestern region in China is scheduled to be in operation in 2012.

B.5.3 Geological Disposal of High Level Waste

B-43 The study on deep geological disposal of HLW began in 1985 in China, when the initial research and development program was initiated under the auspices of the former MNI in respect of engineering, geology, chemistry and safety. The research and experimental installations, alongside with a wide range of research/experiment and analytical methodologies, were established to simulate chemical environment in geological disposal. The safety assessment of geological disposal was preliminarily launched. The study on pre-siting of HLW disposal facility was conducted. Regional comparisons are preliminarily performed between 5 regions, e.g. East China, South China, Southeast China, Inner Mongolia and Northwest China. Characterization is focused on the Northwest China.

B-44 In 2006, the *Guides on Research and Development Planning of Geological Disposal of HLW* was issued jointly by China Atomic Energy Administration (CAEA), Ministry of Science and Technology (MOST) and the State Environmental Protection Administration (SEPA). The overall goal of the study on geological disposal of HLW in China is to select the potential site with stable geological formation and suitable socio-economic environment and then to complete the construction of the country's geological disposal facility for solid HLW in the mid-21st century, in a way to protect the homeland, the environment and the public from unacceptable hazards through the containment and retardation effects of engineering and geological barriers.

B-45 Under the Guides, the research and development of geological disposal of HLW is divided into three stages: (1) research and development in laboratory and siting of disposal facility (2006-2020), (2) underground experiment (2021-2040), and (3) demonstration of prototype disposal facility and construction of such disposal facility (2041 - the mid-21st century). Around 2020, the tasks are expected to complete include the in-laboratory research and development project involving multidisciplinary fields, preliminary siting of disposal facility, feasibility study on underground laboratory, safety review for underground laboratory construction. Around 2040, such tasks will be completed as the research and development of underground laboratory, the preliminary confirmation of the site of the disposal facility site, the pre-feasibility study report of disposal facility, and the feasibility study and safety review of prototype disposal facility. Till the mid-21st century, the

following objectives would be achieved such as demonstration experiment of prototype disposal facility, final confirmation of disposal facility site, feasibility study of disposal facility and safety review of disposal facility construction, disposal facility construction, and safety review for disposal facility operation.

B.5.4 Nuclear Technology Application Radwaste Management

B-46 In order to keep pace with the development of nuclear technology application, the radioactive waste temporary storage facilities at different scales began to be constructed in China since the 1960's for the purpose of receiving and storing radioactive wastes arising from nuclear technology applications. The *Notification on Strengthening Radioactive Environment Management Arrangement* was issued in 1983. The *Temporary Regulations on Construction of Nuclear Technology Application Radioactive waste Storage Facility* was issued in 1984. The *Rules on Nuclear Technology Application Radioactive waste Management* was issued in 1987.

B-47 The temporary storage facility for nuclear technology application radioactive waste is constructed on a provincial basis. Each province (or autonomous region, or municipality directly under central government) builds one such facility to accommodate wastes arising from research, education medicine and other applications of radioisotope and nuclear technology within the province. Provincial environmental protection agencies have set up special organizations staffed with specialists or professionals who are responsible for supervision and environmental monitoring.

B-48 In 2005, the MEP/NNSA issued the *Criteria on Siting, Design and Construction of Nuclear Technology Application Radioactive waste Storage Facility*. It facilitates the construction of new radioactive waste storage facilities and the upgrade and modification of the old ones. By the end of 2010, construction of 31 radioactive waste storage facilities and one national centralized storage facility for spent sealed radioactive sources (SSRS) were completed.

B 5.5 Management of Waste from Uranium Mining and Milling

B-49 At present, there are six uranium mining and milling centers in operation in China. Under *the Law of the People's Republic of China on Prevention and Control of Radioactive Pollution*, a facility for radioactive contamination prevention and control, associated with a main project for the development and utilization of a uranium mine, should be designed, constructed and operated

simultaneously with such a project. A facility for radioactive contamination prevention and control should be qualified simultaneously with its main project. A main project where its contamination prevention and control facility has been qualified can be put into operation or use. As required, a licensee for uranium mine development and utilization should make reasonable selection and use of raw materials, introduce advanced production process and equipment in such manner as to make radioactive waste generated ALARA. A licensee for uranium mine development and utilization should build both qualified uranium tailing dams and engineering waste rock dumps, where tailings and waste dumps can be placed in a safe manner, to ensure the engineering and environmental safety. Moreover, there are five additional national standards on radioactive waste management relating to uranium mining and milling activities.

B-50 Under *the Law of the People's Republic of China on Prevention and Control of Radioactive Pollution,* a licensee for uranium (or thorium) mine development and utilization should develop the decommissioning plan of uranium (or thorium) mines. The fees required for uranium mine decommissioning should be paid from the national financial budget and/or arrangements.

B.5.6 Recycle and Reuse

B-51 Recycling and reuse of materials is an important initiative to reduce the waste generation and to increase the effectiveness of resources.

B-52 To meet the needs for uranium ore mining and milling and for the recovery and reuse of contaminated metals, the former MNI set up, in the 1970's, the waste steel and iron decontamination and treatment center, thus laying strong foundation for reuse of contaminated metals. After many year's efforts and practices, a comprehensive set of management approaches and working procedures with a sound scientific and technical basis were formed for recycling and reusing contaminated metals. Radioactively contaminated iron slag produced in melting is stored in waste slag storage operating by the treatment center and is periodically transferred to a tailing dam for disposal.

B-53 This Center has a treatment capacity of 2 500 tons per year. Up to the end of 2010, the cumulated amount of radioactively-contaminated metals, which has been treated by the Center reached about 15 thousands tons. Radioactively contaminated metals, after being melting-decontaminated, are subject to strict control for their reuses. Such metals are mainly used for production of radioactive waste drums, shielding materials and uranium mining and milling machines.

B-54 The recovery and reuse of sealed radioactive sources are an important aspect of reducing waste risks and promoting the effective use of resources, mainly involving the recovery and reuse of medical cobalt sources and industrial irradiator cesium sources.

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 Application to Reprocessing of Spent Fuel

C-1 Reprocessing is not part of spent fuel management, so the spent fuel stored in spent fuel reprocessing storage facility is not included in this report.

C.2 Application to Naturally Occurring Radioactive Materials

C-2 Waste which only contains NORM rather than sealed ^{226}Ra source or waste that does not originate from the nuclear fuel cycle are not included in this report.

C.3 Application to Defense or Military Activities

C-3 This report does not include spent fuel or radioactive waste generated within military or defense programs, unless declared that such wastes are transferred permanently to and managed within the scope of civilian program. .

C.4 Applications to Effluent

C-4 This report shall apply to the discharge of gaseous and liquid radioactive effluents.

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.1.1 Nuclear Power Plants

D-1 Since the commencement of the operation of Qinshan NPP in 1991, a total of 13 nuclear power reactor units were connected to electricity grid till December 31, 2010, with additional 28 units under construction. These NPPs are mainly distributed in the coastal areas in Zhejiang province, Guangdong province

and Jiangsu province, China. Annex L.1.1 lists the data relevant to reactor type, installed capacity and time of the units that have been connected to grid for electricity generation.

D.1.2 Research Reactors

D-2 As of December 31, 2010, there have been 12 research reactors in operation, as detailed in Annex L.1.2, with one research reactor having been decommissioned and additional one being decommissioned, as listed in Appendix L.3.

D.1.3 Spent Fuel Storage Facilities

D-3 China's NPPs are installed each with spent fuel storage facilities for spent fuel to be held at plant. Additionally, a dry storage facility for spent fuel away from reactor has been built at Qinshan Phase III NPP, for which the designed capacity and other relevant data are presented in Appendix L.1.3.

D.2 Spent Fuel Inventory

D-4 As of December31, 2010, there has been a total of 3 011.4 tons spent fuel generated, of which 2 477.8 tons are being held in at-reactor storage，211.0 tons are in dry storage, and 322.6 tons were transported to the outside. See Annex L.4 for more information on spent fuel storage at NPPs.

D.3 Radioactive Waste Manage Facilities

D.3.1 Radioactive Waste Generating Facilities

D-5 In China, radioactive wastes results mainly from the operation of NPPs and research reactors, nuclear fuel production, nuclear research activities and nuclear technology applications. Annex L.1.1 and Annex L.1.2 provide the lists of the NPPs and research reactors in operation. Annex L.2.1 shows the facilities in relation to nuclear research, nuclear fuel enrichment and fuel element manufacture facilities.

D-6 To meet the needs of its nuclear power expansion, China has developed the capabilities of uranium enrichment, fuel element manufacture. At present, two uranium enrichment plants are in operation, with annual total centrifugal separation capacity of 1 100 tons separation work. The first nuclear fuel assembly production line was established in 1988 in Sichuan province, supplying its most of nuclear fuel

elements to the Qinshan NPP. Subsequently, the technologies for designing and manufacturing nuclear fuel elements have been imported from France on the step by step basis, to which the technical adaptation was made later on. This means that China's PWR fuel element manufacture can meet the requirements of the international generic standards, so as to ensure that the supply of nuclear fuel elements can meet the demands of the current PWR plants in China. Through introducing Canada's technology, a HWR fuel element production line, with a capacity of 200 t/a, was built in Inner Mongolia, in Northern China, which provides HWR fuel elements for Qinshan Phase III NPP. By importing the US technology, a fuel element production line for AP 1000 unit is being built in Inner Mongolia, Northern China.

D.3.2 Radioactive Waste Treatment Facilities

D-7 Auxiliary radioactive waste treatment and conditioning facilities are erected at each of the NPPs and large sized research institutions, comprising cement solidification, compression, and radioactive wastewater treatment facilities. There is no independent and dedicated radioactive waste treatment facility available up to now.

D.3.3 Radioactive Waste Storage Facilities

D-8 Nuclear facilities, comprising NPPs, nuclear fuel enrichment and manufacture facilities, and large research institutions, are all built with auxiliary radioactive waste storage installations. In addition, radioactive waste receipt and storage facilities have been set up for storing the radioactive wastes arising from nuclear technology applications, as listed in Annex L.2.2.

D.3.4 Radioactive Waste Disposal Facilities

D.3.4.1 Guangdong Beilong LILW Disposal Site

D-9 Beilong Disposal Site is intended for near surface disposal of solid LILWs generated in Southern China. The construction license for the Site was granted by the SEPA in June 1998, with the phase I project completed in October 2000 and then put into commissioning, and the operating license was granted in 2011. As required by the license, this Site is primarily to receive solid LILWs generated by Daya Bay NPP and LingAo NPP during operation and decommissioning, with a disposable capacity of 80 000 m^3 and a total activity of 5.4×10^{15} Bq, excluding sealed radioactive sources

D.3.4.2 Northwestern China LILW Disposal Site

D-10 Northwestern Disposal Site is located in Gansu province in the northwest China. The Site is designed to receive solid LILWs for near surface disposal. The construction of the Site began in 1995, the permission for trail operation was issued by the SEPA in 1999 and operational license was granted by the MEP/NNSA in 2011. The licensed disposal capacity is about 60 000 m^3, comprised of 17 disposal units, allowing to receive total activity of 3.2×10^{16} Bq, excluding sealed radioactive sources.

D.4 Radioactive Waste Inventory

D.4.1 Inventory and Lists of Wastes from Nuclear Power Plants

D-11 The majority of the wastes resulting from the NPPs are held in storage facilities affiliated to the NPPs, only a small part was sent to disposal. These wastes include, among other things, cement-solidified forms of evaporator concentrates; spent ion exchange resin and their cement-solidified forms; slurry, water filters, compressed technical waste. Annex L.5.1 gives the inventory of wastes stored at each of the NPPs.

D.4.2 Radioactive Waste Accumulation from Other Nuclear Facilities

D-12 Other facilities and activities associated with radioactive wastes means primarily large nuclear research institutions, uranium enrichment facilities and fuel manufactures and the activities related to nuclear technology applications. A certain amount of radioactive wastes with various forms and different activities are generated and cumulated in these facilities.

D-13 Annex L.5.2 lists the volume of radioactive wastes that have been cumulated and stored at nuclear facilities involving research, uranium enrichment, fuel element manufacture. Annex L.5.3 gives a list of radioactive wastes and disused sealed radioactive sources being stored in nuclear technology application radioactive waste storage facilities.

D.4.3 Waste Received by the Disposal Sites

D-14 The operating license was granted for each of China's both LILWs Disposal Sites in 2011. As of December 31, 2010, the both Sites have been authorized to receive radioactive wastes, as shown in Appendix 5.4.

E. LEGISLATIVE AND REGULATORY SYSTEM

(Articles 18 to 20)

This section covers the obligations under the following articles:

Article 18. Implementing measures

Article 19. Legislative and regulatory framework

Article 20. Regulatory body

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 Management Measures for Implementing the Obligations under the Joint Convention was set out and the Chinese Working Group for Joint Convention Implementation (CWGJCI) was formed.

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), Ministry of Industry and Information (China Atomic Energy Agency, CAEA), Ministry of Foreign Affairs, Ministry of Public Security and Ministry of Health. The CWGJCI is headed by the MEP and the Ministry of Industry and Information as the deputy Group head. The Secretariat is set at the International Cooperation Bureau 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 and radioactive waste management facilities. 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 national reports of other contracting parties, as well as to provide other relevant technical support for the implementation 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 Historical Development

E-4 Chinese government has attached great importance to the legislation and regulation of nuclear and radiation activities, thus leading to the continued improvement of the legislation and regulation system. In 1960, the *Regulation on Health and Protection for Work with Radioactivity* was promulgated, as approved by State Council. Subsequently in 1974, *Regulation on Radiation Protection（GBJ8-74）* was issued, with a special chapter in it dealing with the management and discharge of radioactive waste. The Article 11 of the *Constitution of the People's Republic of China*, as revised in 1978, lays out "the nation protects the environment and the natural resources from pollution and other public hazards." From then on, the environmental protection was listed in the nation's fundamental law for the first time. In 1979, *the Law of the People's Republic of China on Environmental Protection (for trial)* was promulgated for implementation, stipulating that the design, construction and operation of the facilities used for preventing pollution and other public hazards must be simultaneous with a main project. In 1986, the State Council issued the *Regulations of the People's Republic of China on the Safety Control of Civilian Nuclear Installations (HAF001)*, establishing the nuclear facility licensing system, and setting up independent regulatory body for nuclear facility safety. In 1989, the State Council issued the *Regulations on Radiological Protection against Radioisotope and Ray-generating Installations*, stating that licensing system shall be applied to the production, distribution and use of radioactive sources and the recovery and storage of disused sealed radioactive sources. Various administrative departments under the State Council relating to health, environmental protection and public security shall apply phased regulation to the radiation protection in the production, distribution and use of radioisotopes. The environmental protection competent authority under the State Council is responsible for the regulation of the recovery and decommissioning of sealed radioactive sources. In 1992, the State Council approved and circulated *The Chinese Environmental Policy on Disposal of LILWs (GF/1992/D45)* was issued in 1992, which strongly boosts the matters relevant to radioactive waste disposal. In 1993, the State Council issued the *Regulations on Accidental Emergency Management at Nuclear Power Plant*, setting out the policies, strategies and measures to be adhered to in the event of an emergency. In 2003, *the Law of the People's Republic of China on Prevention and Control of Radioactive Pollution* was promulgated for enforcement. It defines that the environmental protection competent authority under the State Council has the overall responsibilities for the country-wide prevention and control of radioactive pollution by virtue of the

relevant national laws and that other administrative departments under the State Council shall implement their allocated duties in this regard. In 2004, the State Council caused the *Regulations on Radiological Protection against Radioisotope and Ray-generating Installations* of 1989 to be revised, and renamed *Regulations on Safety and Protection of Radioisotope and Ray-generating Installations*. It lays out that the previous by-stage; multi-sector regulatory approach on radioactive sources was changed to a unified regulatory system by the environmental protection competent authority. In 2002, the *Basic Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (GB 18871-2002)*, a Chinese Standards, was issued. *A Five Year Program (2011-2015) for Regulations on Nuclear and Radiation Safety* has been developed by the MEP/NNSA, in order to facilitate planned development of the system of regulations relevant to the safety of spent fuel management and safety of radioactive waste management.

E.2.2 Legislative Framework

E-5 The legislative framework in China regarding the safety of spent fuel management and safety of the radioactive waste management is composed of national laws, administrative regulations, department rules and guidelines, as shown in Figure 1. In addition, relevant authorities also issued a series of standards, and technical documents, for the purpose of standardization of, and provision of guidance to, the technical actions for the safety of spent fuel management and the safety of radioactive waste management.

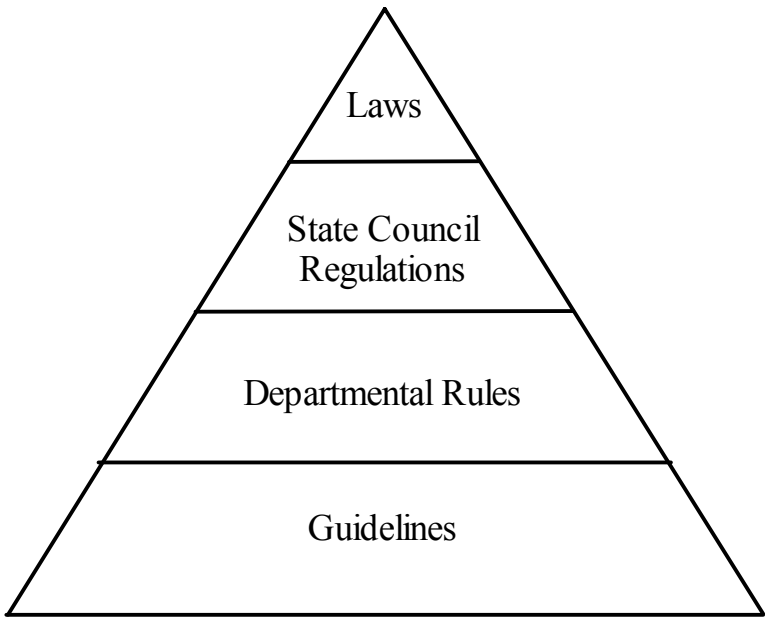

Figure 1 Legislative framework system in China

E.2.2.1 Laws

E-6 The existing national laws applicable to the safety of spent fuel management and the safety of radioactive waste management are:

The Law of the People's Republic of China on Environmental Protection;

The Law of the People's Republic of China on Prevention and Control of Radioactive Pollution;

The Law of the People's Republic of China on Environmental Impact Assessment;

The Law of the People's Republic of China on Prevention and Control of Occupational Disease, and

The Law of the People's Republic of China on Safety of Operation.

E-7 *The Law of the People's Republic of China on Environmental Protection* was promulgated in 1989 by the Standing Committee of the National People's Congress (the Standing Committee of NPC). It is a specific law applicable to protecting and improving accessible environment, preventing and controlling pollution, protecting health of people, and advancing social progress. The *Law of the People's Republic of China on Prevention and Control of Radioactive Pollution* was promulgated in 2003 by the Standing Committee of NPC. This law is applicable to the prevention and control of environmental pollution that are caused by the discharge of gaseous, liquid and solid wastes in the context of nuclear energy expansion, nuclear technology applications, exploitation and utilization of uranium/thorium resources and NORM, so as to attain the goals of preventing and controlling radioactive pollution, protecting the environment and health of people, and accelerate the development and peaceful use of nuclear energy and nuclear technology. The laws applicable to the safety of spent fuel management and the safety of radioactive waste management are summarized in Annex L.6.1.

E.2.2.2 Regulations

E-8 The existing administrative regulations applicable to the safety of spent fuel management and the safety of radioactive waste management are as follow:

Regulations of the People's Republic of China on the Safety Control of Civilian Nuclear Installations;

Regulations of the People's Republic of China on Nuclear Materials;

Regulations on Accidental Emergency Management at Nuclear Power Plant;

Regulations on Safety and Protection of Radioisotope and Ray-generating Installations;

Regulations on Safety of Radioactive Material Transport Management, and

Regulations on Surveillance and Management of Civil Nuclear Safety Equipment.

E-9 These regulations lay out the scope of nuclear safety management, regulatory bodies and their responsibilities and authorities, principles and procedures of regulation, and other important matters related.

E-10 The *Regulations of the People's Republic of China on the Safety Control of Civilian Nuclear Installations* and the *Regulations of the People's Republic of China on Nuclear Materials* were issued in 1986 and in 1987 in succession. These two regulations, on a systematic basis, specifies the aims and scope of regulation of NPPs and nuclear materials, establishes nuclear safety licensing system, defines the methods to be taken for regulation of nuclear materials, allocate the responsibilities/duties of regulatory bodies and nuclear industry competent authorities and the legal liability of operators. The *Regulations on Accidental Emergency Management at Nuclear Power Plant*, issued in 1993, puts forward the policies, strategies and countermeasure for nuclear accident emergency. The *Regulations on Safety and Protection of Radioisotope and Ray-generating Installations*, issued in 2004, provides for a unified regulatory approach in which the environmental protection competent authority under the State Council takes the overall responsibility on radioactive source management. Administrative regulations that are applicable to the safety of spent fuel management and the safety of radioactive waste management are summarized in Annex L.6.2.

E-11 *Regulations on Safety of Radioactive Waste Management* is currently being developed, scheduled to be issued prior to the end of 2011.

E.2.2.3 Departmental Rules

E-12 The departmental rules applicable to the safety of spent fuel management and the safety of radioactive waste management are mainly issued by authorities, under the State Council, responsible for environmental protection, nuclear facilities and health. These rules are issued by virtue of the relevant laws and regulations and in accordance with the assignment and authorization of responsibilities. At the departmental rule level, The SEPA has issued the followings:

Temporary Regulations on Construction of Nuclear Technology Application

Radioactive waste Storage Facility;

Rules on Nuclear Technology Application Radioactive waste Management;

Rules for Radiological Environment Management;

Regulations on Radioactive Waste Safety (HAF401); and

Regulations on the Safety of Radioactive Waste Management at Nuclear Power Plants (HAF0800).

E-13 Annex L.6.3 gives a list of the departmental rules applicable to the safety of spent fuel management and the safety of radioactive waste management.

E.2.2.4 Guidelines

E-14 The guidelines applicable to spent fuel management and radioactive waste management are included in those called series of nuclear safety guidelines (HAD). The currently applicable guidelines on the safety of spent fuel management and the safety of radioactive waste management are presented in Appendix L.6.4.

E.2.2.5 Standards

E-15 China's radioactive waste management standards system comprises national standards (GB series) and departmental standards with inclusion of nuclear industry standards (EJ series), and environmental protection standards (HJ series).

E-16 For the current GB, EJ and HJ standards, there have been more than 50 standards published in relation to radioactive waste management and nuclear facility decommissioning. Radioactive waste management standards system includes three aspects: (1) generic standards, (2) waste management standards in different stages (such as generation, pre-treatment, treatment, discharge, conditioning, storage, transport, disposal, decommissioning and environmental remediation) and (3) special waste management standards (like Uranium geological survey and management of arising from mining and milling, among others). These standards are being applied to the management of radioactive wastes generated from NPPs and nuclear fuel cycle facilities and to the decommissioning of nuclear facilities and the subsequent environmental remediation.

E-17 The current standards applicable to the safety of spent fuel management and the safety of radioactive waste management are provided in Annex L.6.5.

E.2.3 Regulatory Framework

E-18 As stated by *the Law of the People's Republic of China on Prevention and Control of Radioactive Pollution*, the environmental protection competent authority under the State Council has the overall responsibilities for the country-wide prevention and control of radioactive pollution by virtue of the relevant national laws and the health administrative departments, and other departments, under the State Council shall implement their allocated duties in this regard.

E-19 China has established independent regulatory body for the safety of spent fuel management and the safety of radioactive waste management, which implements overall and synchronized regulation with clear division of responsibilities. China is in the course of strongly improving the ability of regulatory body in aspects of human and financial resources (see E.3.2.1 and F.2).

E-20 Licensing system, together with systems of supervision, inspection and reporting are implemented in China for the safety of spent fuel management and the safety of radioactive waste management. Under the relevant laws and regulations, the licenses relevant to the safety of spent fuel management and the safety of radioactive waste management can be divided into nuclear safety license, radiation safety license and qualification certificates.

E-21 The Regulations of the People's Republic of China on the Safety Control of Civilian Nuclear Installations lay out the matters relevant to nuclear safety license, which is applicable to:

(1) Nuclear power plants (nuclear power for electricity generation, heat-electricity co-generation plant, and nuclear steam and heat supply plant)；

(2) Reactors other than nuclear power reactors（research reactor, experimental reactor, criticality installation）；

(3) Nuclear facilities involving fuel fabrication, manufacture, storage and reprocessing；

(4) Radioactive waste treatment and disposal facilities；and

(5) Other nuclear facilities subject to strict control.

E-22 In terms of different types of activities, nuclear safety licenses include:

(1) License for nuclear facility construction;

(2) License for nuclear facility operation;

(3) License for nuclear facility operators; and

(4) Other documents to be approved.

E-23 *Regulations on Safety and Protection of Radioisotope and Ray-generating Installations* lays out that radiation safety licenses are applicable to the undertakings involving the production，distribution and use of radioisotope and rays-generating installations.

E-24 Qualification certificate is set according to the Article 46 of *the Law of the People's Republic of China on Prevention and Control of Radioactive Pollution*, that any unit established to operate an independent radioactive waste storage or disposal facility shall obtain a license under the approval of the competent environmental authority of the State Council prior to operation. No activities for radioactive waste storage or disposal can be conducted without prior approval or beyond the license. No solid radioactive waste may be provided to or transferred to someone who without license for storage and disposal.

E-25 Environmental impact assessment system, discharge permission system and environmental monitoring system are also implemented in respect of the safety of spent fuel management and the safety of radioactive waste management in China.

E-26 Radioactive source categorization-based management system is implemented in China. Radioactive sources are categorized into five categories: Category I, II, III, IV and V according to the potentially attributed to environmental and human hazards by their activity from high to low. By such categorization, licensing of radiation safety is implemented at two levels, namely, radiation safety license is granted by competent environmental protection agency at either national level or provincial level. The license for the user of Category I radioactive source is reviewed, approved and granted directly by MEP, while the licenses for Category II, III, IV and V by environmental protection agencies at provincial level.

E.3 Regulatory Bodies (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 Brief

E-27 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, Ministry of Health and Ministry of Public Security.

E.3.2 MEP/NNSA

E.3.2.1 MEP/NNSA Organizational Structure

E-28 The MEP/NNSA consists of the headquarter, regional offices for supervision or monitoring and technical support organizations, with its organizational structure illustrated in Figure 2.

E-29 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 supervision of nuclear safety and radiation safety in designated areas. In order to fulfill a better implementation of regulatory functions, the MEP/NNSA set up the Nuclear and Radiation Safety Center as its technical support and assistant guarantee power. Additionally, the MEP/NNSA has established long-term and reliable relationship with other technical support and assistant organizations. An expert panel concerning nuclear safety and the environment was set up to provide technical support in aspects of drafting nuclear safety and radiation safety laws and regulations, decision-making, technical development, technical review and supervision.

E-30 In 2009, the Central Government approved the staff of MEP/NNSA to reach at a total number of 1 000 by the end of 2012, including headquarter staff of

70, six regional offices staff of 330, and the Nuclear and Radiation Safety Center staff of 600. The total number of the nuclear safety and radiation safety staff of MEP/NNSA was 310 by the end of 2010. The financial budget for running cost in 2010 was 120 millions RMB and the special funds for building capacity amounted to 300 millions RMB.

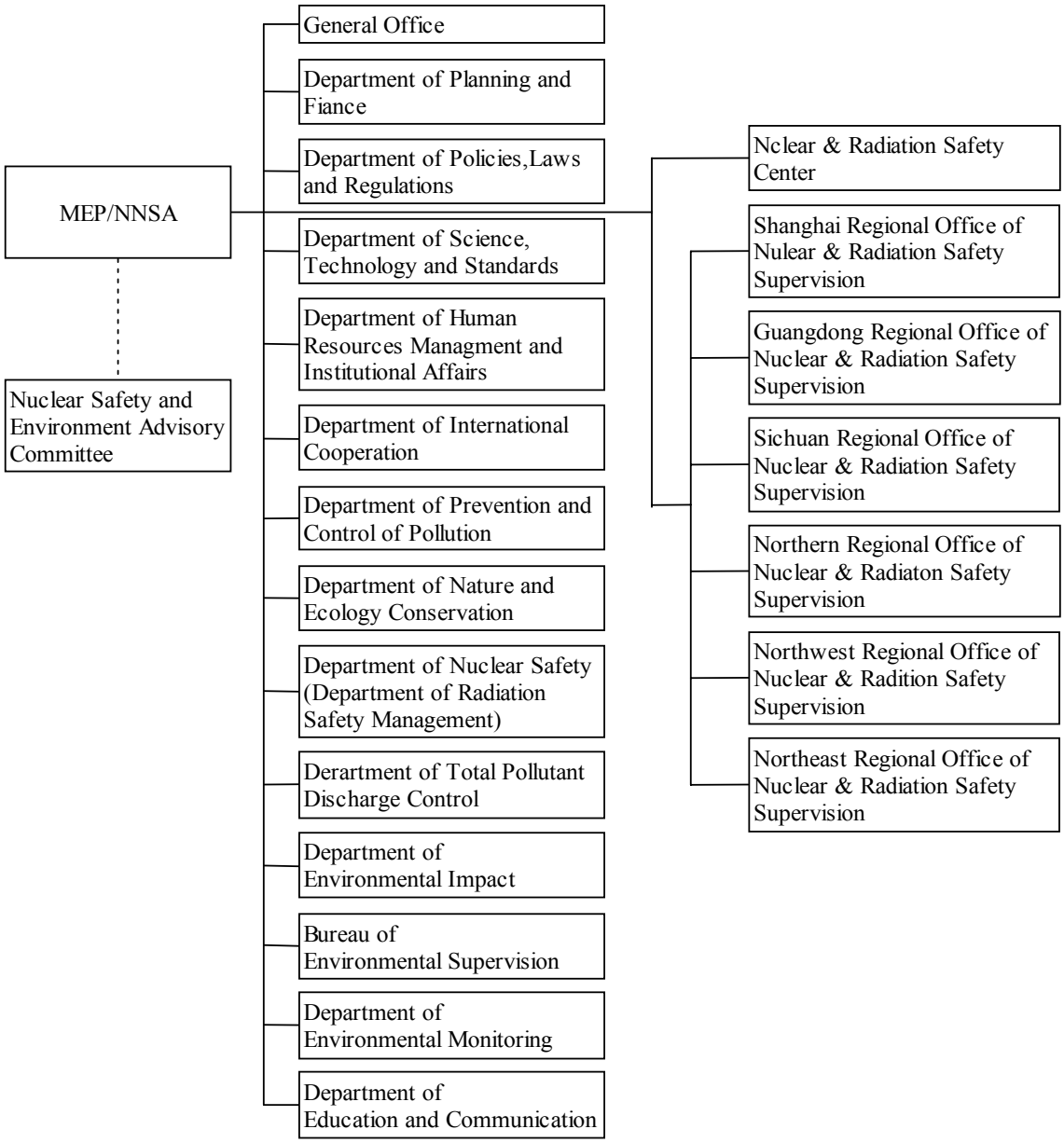

Figure 2 The Organization Structure of the MEP/NNSA

E.3.2.2 MEP/NNSA Responsibilities

E-31 MEP/NNSA undertakes the overall regulation of the country-wide prevention and control of radioactive pollution, through review and authorization, supervision and inspection, and supervisory monitoring of the activities associated with licensees. Thus it can be ensured that the licensees assume the responsibility of safety and conduct activities in compliance with relevant laws and regulations. MEP/NNSA is principally responsible for:

(1) Drafting and establishing policy, strategy and regulations relevant to nuclear safety, radiation safety, prevention and control of radioactive pollution, and coordinating development and publication of relevant standards;

(2) Licensing and regulating of nuclear safety, radiation safety and prevention and control of radioactive pollution;

(3) Investigating and tackling nuclear safety accident and radiation safety accident, in cooperating with other relevant organizations in providing guidance on, and supervision of the preparation and implementation of NPP emergency plan, and working with other relevant organization in participating with nuclear accident emergency through the conciliation and resolution of the dispute relating to nuclear safety;

(4) Conducting review, authorization, supervision and inspection of environmental impact assessment;

(5) Supervisory monitoring the discharge of radioactive effluents and radiation environmental release; and

(6) Planning and coordinating relevant scientific research and promoting dissemination of relevant knowledge.

E.3.3 Ministry of Health

E-32 The Ministry of Health has, in the aspects of the safety of spent fuel management and the safety of radioactive waste management, the main responsibilities of:

(1) Developing the laws and regulations, and programs, concerning prevention and control of occupational diseases in conjunction with the departments concerned, and organizing national occupational health standards to be issued;

(2) Reviewing, supervising and managing technical service bodies for personal dose monitoring of the workers involved in radiation-related works;

(3) Organizing the radiological injury diagnosis and treatment and the medical rescue in the case of nuclear and radiation accident.

E.3.4 Ministry of Public Security

E-33 The Ministry of Pubic Security is, in the aspects of the safety of spent fuel management and the safety of radioactive waste management, principally responsible for investigating and recovering the lost sealed radioactive sources, and for the security of road transport of radioactive materials.

E.4 Other Major Governmental Agencies

E-34 Apart from the regulatory bodies mentioned-above, there are two major governmental agencies, CAEA and CEA, having the relation to the safety of spent fuel management and the safety of radioactive waste management. The CEA was newly established when China's governmental department reform was being undertaken in 2008.

E.4.1 China Atomic Energy Authority

E-35 In addition to the forgoing mentioned regulatory bodies, the China Atomic Energy Authority (CAEA) is one of the primary governmental agencies relevant to the safety of spent fuel management and the safety of radioactive waste management, with the following functions:

(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, review and approval of proposed 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, reviewing and managing the import and export of nuclear materials;

(5) 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;

(6) Leading in organizing national nuclear accident coordination committee,

studying, developing and implementing national nuclear accident emergency plan; and

(7) Managing physical security of the NPPs.

E.4.2 CEA

E-36 The CEA, as an administrative department for development, planning and management of energy resources in China, has the responsibilities of:

(1) Organizing the development of laws, regulations and rules of nuclear power;

(2) Developing nuclear power expansion program, entry, and technical standards, and enabling them to be implemented;

(3) Providing review comments on geographical distribution of nuclear power plants and other major projects;

(4) Organizing, harmonizing, and providing guidance on, research efforts related to nuclear power;

(5) Organizing the emergency arrangement in the case of nuclear accident at NPPs; and

(6) Organizing international exchange and co-operation with other countries in relation to nuclear power.

F. OTHER GENERAL SAFETY PROVISIONS

(Articles 21 to 26)

This section covers the obligations under the following articles:

Article 21. Responsibility of the licence holder

Article 22. Human and financial resources

Article 23. Quality assurance

Article 24. Operational radiation protection

Article 25. Emergency preparedness

Article 26. Decommissioning

F.1 Responsibility of the Licensee (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 The licenses in relation to the safety of spent fuel management and the safety of radioactive waste management comprise nuclear safety license, radiation safety license and qualification license.

F.1.1 General Responsibility of the Nuclear Safety Licensee

F-2 The responsibility of a nuclear safety licensee is defined clearly in the Law of the People's Republic of China on Prevention and Control of Radioactive Pollution and the Regulations of the People's Republic of China on the Safety Control of Civilian Nuclear Installations.

F-3 The nuclear safety licensee is responsible for the safety of nuclear facilities, with the following main responsibilities:

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

(2) Preventing and controlling radioactive pollution in its institution and keeping him under the regulatory control;

(3) Reporting safety situation and providing the related information in a timely and true manner;

(4) The operator of nuclear fuel cycle facility takes the overall responsibility over nuclear fuel cycle facility, including spent fuel management; and

(5) Holding overall responsibility on the safety relating to nuclear facility, nuclear materials, the workers, the public and the environment.

F.1.2 General Responsibility of the Radiation Safety Licensee

F-4 The Regulations on Safety and Protection of Radioisotope and Ray-generating Installations 2005 clearly specifies the responsibility of a radiation safety licensee:

(1) The radiation safety licensee shall be responsible for the safety and protection of the radioisotope and ray-generating installations within its institution and shall bear the responsibility over the subsequent radioactive hazards pursuant to law;

(2) The radiation safety licensee shall provide education, training and examination in safety and protection to the workers who are directly involved in the production, distribution and use of radiation-related materials, and the unqualified workers are not permitted to work;

(3) The radiation safety licensee shall, in accordance with the regulations on individual dose monitoring and health management, conduct individual dose monitoring and occupational health examination for the workers who are directly involved in the production, distribution and use of radiation-related materials, and establish individual dose record and occupational health surveillance file;

(4) The radiation safety licensee shall make annual evaluation of the safety and protection situation of the radioisotope and ray-generating installations within the institution where he or she is employed and make timely improvement if potential risk being discovered;

(5) The radiation safety licensee，if terminating its operating activities, shall account and list the radioisotopes and radioactive waste in its possession, and make appropriate arrangement in a way as to keep no potential risk. If a licensee involving

the production, distribution and use of radiation-related materials is changed, then the new holder shall take over such responsibility, except as otherwise specifically provided for before such modification. However, this modification will not in any way relieve the part concerned of its responsibility.

(6) The radiation safety licensee shall make the agreement with the user of sealed radioactive source concerning return of SSRS to the manufacturer; the user of sealed radioactive source should return SSRS to manufacturer or country of origin in accordance with such agreement. The SSRS that can not be returned to manufacturer or country of origin should be sent to a licensed centralized radioactive waste storage facility.

(7) The user of radioactive sources of Category IV and V shall, in accordance with the provisions of the MEP, bring the packaged and conditioned SSRS to the licensed centralized radioactive waste storage facility. The facilities where Category I, II and III radioactive sources are used or radioactive sources are produced, as well as ray-generating installation with radioactive pollution when operation is ended, shall be decommissioned according to relevant laws and regulations.

(8) Independent emergency plan should be prepared and be ready for emergency response.

F.1.3 Radioactive Waste Safety Responsibility of the Licensee

F-5 *The Law of the People's Republic of China on Prevention and Control of Radioactive Pollution*, alongside other instruments, lays down the responsibility of a licensee for the radioactive waste management safety.

F-6 A licensee shall carry out radioactive waste management under laws, regulations and standards and take the primary safety responsibility.

F-7 A licensee shall make reasonable selection and use of raw materials, introduce advanced production process and equipment in such manner as to minimize radioactive waste generation at a reasonably achievable level. The discharge of gaseous and liquid wastes into the environment shall be consistent with the relevant national standards. The limits of the waste quantity to be discharged shall be applied to the environmental protection agency responsible for review and authorization of environmental impact assessment documents of the concerned facility. And the results shall be reported periodically. Liquid radioactive waste which is not permitted to discharge to the environment shall be treated and stored as required by national standards on radioactive pollution prevention and control.

F-8 A licensee shall transfer, after treatment, generated radioactive waste to

the relevant disposal facility pursuant to the provisions issued by competent authority of environmental protection under State Council and bear the cost for disposal.

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 Human Resources

F-9 The requirements for qualifications and training for all sorts of staff are laid out by *the Law of the People's Republic of China on Prevention* and *Control of Radioactive Pollution, HAF001, HAF401,* and *GB14500-2002*.

F-10 With the rapid expansion of nuclear power and nuclear technology application in China, the demand for human resources has been growing dramatically. To the end, Chinese government, together with the operators of nuclear facilities, is developing the staff education and training program to meet an increasing demand for human resource. Alongside with nuclear power program, Chinese government is developing the staff educational plan.

F-11 At present, the development of human resource in nuclear industry sector is through the following ways:

(1) A large number of nuclear engineers, technologists and management staff have been fostered, who having gained abundant experiences as backbone, are qualified in the design, construction and operation in the sector of nuclear industry;

(2) Nuclear facilities that have been put into operation continue to contribute wide variety of technicians and management staff to those under construction and

nuclear safety regulatory bodies;

(3) Registered nuclear safety engineer system has been established for the key position relating to nuclear safety under the current qualification certificate regime. For specialized nuclear occupations, national occupational qualification certificate regime is under implementation through setting national standards and reinforcing occupational technical competence;

(4) Training in radiation safety;

(5) Specialist recruitment and introduction regime is reinforced. On the basis of currently enlarged student recruitment at universities and colleges in China, a large number of excellent students are selected as entry into nuclear field for advanced study. Availability of human resources, as required by nuclear power, are made through recruitment from the graduates from universities and middle- and high-level colleges, selection of senior managers across the country, and introduction of technicians and specialists from different types of power plants and industries;

(6) The way is being broaden to have access to human resources through establishing nuclear energy technical institutes at universities, in cooperation with research bodies, enhanced international cooperation and exchange, dispatching technicians for advanced study in advanced nuclear power countries; and

(7) Abroad nuclear specialists are recruited.

F.2.1.1 Training and Evaluation of Staff in Nuclear Facilities

F-12 Recruitment, training and re-training of nuclear facility operational personnel and authorization are subject to the nuclear safety guideline "*Staffing, Recruitment, Training and Delegation at NPPs*".

F-13 As required by the relevant regulations, guidelines, and standards, the requirements for post qualification is defined, on the basis of the post-specific task analysis, and the training and retraining program and procedures are developed and implemented. The personnel working in nuclear facilities can carry out the relevant post with responsibility only after appropriate training, qualification examination, and acquirement with post qualification certificate or authorization granted.

F-14 Validity period management is applied to the qualification and authorization for nuclear facility personnel. After expiration of effective period, the extension and renewal of qualification certificate shall be made in accordance with the post-specific requirements. Furthermore, additional training and re-training are needed to ensure for the personnel to meet the post-specific requirements.

F-15 Dedicated training organizations are set up at NPPs, which are responsible for planning, implementation, assessment and improvement of training program and equipped each with a sound training center, covering the whole process of training simulator used for the purpose of NPP operator training, re-training and examination, as well as training of manageable staff.

F-16 With account being taken of their importance in relation to the facility safety, more strict control is applied to the training, examination, and qualification of the operating personnel of nuclear facilities.

F-17 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-18 With the expansion of nuclear power production in China, systematic training approach is being drawn on at nuclear facilities. Training demand analysis is based on the actual work conditions. With focus on the safe operation of nuclear facilities, different types of training and technical support activities are carried out in so far as to continue to raise the level of knowledge and competence of nuclear facility' personnel. Training resources are optimized through standardizing teaching material preparation. Trainer management and cultivation are strengthened by many approaches. The internal and external evaluation and feedback are conducted to continue the improvement of the existing training system.

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

F-19 In order to ensure the quality of nuclear safety supervisor, the *Detailed Rules of the People's Republic of China on Regulating of Civil Nuclear Facility Safety* definitely specifies the requirements for nuclear safety supervisor, including education background, work experience, competency and basic professional quality, etc.

F-20 According to the relevant laws and regulations and the need of work, the personnel selection, training and examination, both written and oral, shall be conducted by the MEP/NNSA Certificate for Nuclear Safety Supervisor shall be granted by the MEP/NNSA to the qualifier.

F-21 The MEP/NNSA pays high attention to the training of nuclear safety supervisor, and focuses ongoing training efforts on nuclear safety supervisor in a wide range of ways, for example, including semi-annual training of new workers at training center of a NPP, on-the-job training of nuclear safety supervisor,

communication with nuclear power personnel on on-the-job training; inviting international experts to present lectures on nuclear safety training at 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 personnel to receive degree education and training.

F.2.1.3 Registered Nuclear Safety Engineer System

F-22 In order to raise the quality of the technical staff for nuclear safety related activities, Chinese government, in November 2002, issued the *Temporary Regulations on Qualifications for Registered Nuclear Safety Engineer* under which the occupational qualification system was established for the technical staff working on the key nuclear safety related posts who are providing nuclear safety related technical services for the nuclear energy and nuclear technology applications. It was issued consistent with the relevant provisions of *the Law of the People's Republic of China on Prevention and Control of Radioactive Pollution* to maintain institutional management of the key posts with nuclear safety related responsibility, ensure nuclear and radiation environmental safety, and defend national and the public's interests. The occupational scope of a registered nuclear safety engineer covers review of nuclear safety case, supervision of activities affecting nuclear safety, manipulation and operation of nuclear facilities, quality assurance, radiation protection, radiation environmental monitoring, and other nuclear safety closely related fields prescribed by the MEP/NNSA .

F-23 Subsequently, *Temporary Regulations on Registered Nuclear Safety Engineer Management* was issued in 2004, and the Temporary Regulations on Continued Education of Registered Nuclear Safety Engineer was issued in 2005. Directory of Key Posts of Certified Qualification System for Registered Nuclear Safety Engineers (the first batch of posts) was issued by the MEP/NNSA 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 NPPs, designers of nuclear facilities and specialized nuclear power engineering companies.

F-24 Country-wide examination 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 examination. The validity period of a registration is 2 years. Continued educational regime is performed for the registered nuclear safety engineers.

F.2.1.4 Training and Certificate of Radiation Safety

F-25 Under Article 28 of *Regulations on Safety and Protection of Radioisotope and Ray-generating Installations*, any undertakings which produce, distribute and use the radioisotope and ray-generating installations shall provide training in nuclear safety and protection knowledge to the workers who are directly associated with production, distribution and use of them. Examination shall be given to the trainee. The worker who does not passed the given examination is not fit for 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 examination requirements. Training organizations have been accredited with whole process supervision being provided of training and examination. By the end of 2010, a total of 17 635 personnel received training countrywide, of which 6 745 person-time training was completed in 2010.

F.2.2 Financial Resources

F.2.2.1 Financial Resources for Operation

F-26 The cost required for carrying out the activities relating to safe operation of, and safety modification to, nuclear facilities in China 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 a facility's cost needed for safety modification, radioactive waste management and decommissioning activities. The yearly planning and financial budget of a nuclear facility attach higher priority to the project and fund associated with the safety modification of the facility.

F-27 Under *the Law of the People's Republic of China on Prevention and Control of Radioactive Pollution*, the operators of nuclear facilities and nuclear technology applications shall, as required by the competent authority of environmental protection under the State Council, bring the solid radioactive waste generated by such facilities to disposal site and bear the related cost.

F-28 This Law also sets out that the operators of nuclear facilities shall prepare nuclear facility decommissioning plan and the cost of decommissioning nuclear facilities in the future shall be determined in advance and covered in the budget estimates or production cost. Expenses and management rules are currently under study and preparation.

F-29 Under *the Law of the People's Republic of China on Prevention and Control of Radioactive Pollution*, the *Interim Procedures on Collection, Utilization and Management of the Funds for Treatment and Disposal of Spent Fuel from Nuclear Power Plants* was issued in July 2010 jointly by Ministry of Finance, National Development and Reform Commission, and Ministry of Industry and Information Technology. It sets forth that the funds for treatment and disposal of spent fuel are government funds, and that the full sum of revenue shall be handed over to the Central Treasury and integrated into the central budget management according to the principle of separation between revenue and expenditure, and that a PWR nuclear power plant that has already been in commercial operation for more than 5 years shall pay spent fuel treatment and disposal funds in accordance with this Interim Procedures, with the charging standards of RMB 0.026 Yuan/kWh for the actual online sales electricity generated. From now on, the standards for collection of such funds shall be adjusted in due time by Ministry of Finance, in conjunction with National Development and Reform Commission, Ministry of Industry and Information Technology/China Atomic Energy Authority and China Energy Administration in response to the scale of nuclear power expansion and the increasing need for the funds for treatment and disposal of spent fuel. Such funds are charged into electricity generation costs for a nuclear power plant.

F-30 The funds for treatment and disposal of spent fuel are used for payment for the purposes of treatment and disposal of spent fuel, encompassing spent fuel transport, storage of spent fuel away from reactor, reprocessing of spent fuel, treatment and disposal of HLW generated from reprocessing; building, operation, modification and decommissioning of reprocessing system, and for other fees related. The Interim Procedures began to be implemented from October 1, 2010 on.

F.2.2.2 Financial Resources for After-closure

F-31 Cost of disposal of LILW includes the cost for surveillance and maintenance of post-closure of a disposal facility, for which the management rules on collection and payment of the cost are being developed.

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 Quality Assurance Policy

F-32 The policy of safety first is adhered to for spent fuel and radioactive waste management in China. The operators of nuclear facilities are required under the *Regulations on NPP Quality Assurance Safety (HAF003)* to make and implement Quality Assurance (QA) Program at any stage in its life cycle, provide for the management of any work related to quality and provide appropriate control conditions for achievement of activities affecting quality.

F-33 China's QA policy for spent fuel and radioactive waste management facilities is as follows:

（1）Clarification of QA responsibility

The overall responsibility for a safety of nuclear facility rests with the operator of such nuclear facility, who must comply with the requirements of the relevant QA and safety regulations and is responsible for making and implementing the QA program for such a nuclear facility as a whole. The operator of a nuclear facility can delegate whole and part of its responsibility of making and implementing QA program to other contractors but remains accountable for the validity of QA program. At the same time, this does not detract from the responsibility of the contractors.

（2）Fulfillment of QA requirements

QA program includes activities needed to make items and services to meet the required quality, those needed for verifying and validating the required quality, and those necessary for obtaining objective evidence to the forgoing activities. Various requirements of QA program are required to be described in written form and should be followed. Participants with nuclear facility project are forced under contract to apply systematic approach to the planning, management, implementation and demonstration of their undertaken activities. All activities are documented in such a manner that each of such activities can be undertaken by special persons complying with requirements and can be checked against document.

（3）Verification of compliance

Verifying compliance with the established quality requirements is an essential part of QA activity. The persons responsible for verification and inspection should be independent of those who have been undertaking such a task. Also, independent review and supervision persons should have no relevance to the organizations and/or bodies responsible for completing such a task so as to ensure that the items and activities concerned are adequately controlled and verified in various stages of siting, design, equipment manufacture, construction, commissioning and operation.

（4）Adoption of graded approach to QA

Although a full set of principles applicable to the all activities affecting quality, the corresponding control and verification approach or grade can be designated to such items and activities subject to their safety significance. This allows input reasonable QA cost to ensure that more attention and control are focused on the quality of safety related important items and activities.

（5）Validation of QA program

QA inspection system is established to verify the adequacy and validity of QA program through the review, check and investigation of the development and implementation of QA program. All management agencies/departments involved in QA program shall carry out assessment of the current status, applicability and validity of those within the scope of their own responsibility on a regular basis and, if necessary, make timely revision to QA program.

F.3.2 Basic Quality Assurance Requirements

F-34 Basic QA requirements was provided for under *HAF003*, which are

(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 line of internal and external communication; controlling and coordinating working interfaces between various organizations, controlling the selection, staffing, training and qualification examination of personnel to ensure that the personnel acquire and maintain adequate technical skills;

(3) Controlling the preparation, review, 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 preparation of procurement documents, evaluating and selecting the suppliers and controlling the procured items and services to ensure to be consistent with requirements of procurement documents;

(6) Identifying and controlling materials, spare parts and components, controlling the loading, unloading, storage and shipping of items and maintaining safety related important items appropriately to ensure item quality 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 structure, system and components work in a satisfactory manner; controlling the selection, calibration, test 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 have potential to damage quality; for the conditions that has severe damage to quality, corrective actions should be taken after investigation of cause in order to prevent reoccurrence;

(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;

(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-35 In addition, there are 10 QA safety guidelines which provide complementary requirements and implementation recommendations for the above-mentioned basic requirements.

F.3.3 Quality Assurance for Safety of Spent Fuel Management

F-36 On 10 July 1998, the NNSA issued the *Regulations on Design of Spent Fuel Storage Facility (HAD301/02)* and the *Regulations on Operation of Spent Fuel Storage Facility（HAD301/03)*, under which the QA for design and operation of spent fuel storage facility was clearly laid down as an independent chapter in each of the two documents. The operator of the spent fuel interim storage facility is required to hold the responsibility for developing and implementing both the related activities and the QA program, as specified by the guidelines. QA program shall cover the activities, system, components and materials specified in guidelines and meet the principles and targets in *HAF003* and other related guidelines. As required, the design and operation of spent fuel interim storage facility must be consistent with QA program. QA program must be implemented for all activities at spent fuel facility, including maintenance of sub-criticality of stored spent fuel, radiation protection, fuel heat removal, fuel shielding, erosion control, commissioning, normal operation, nuclear material or fuel related operational procedures in the event of predicated operation incident, safety related equipment maintenance, test, inspection, record and documentation, radioactive waste management, record-keeping of fuel characteristics during storage, nuclear material safeguard system (when needed), and physical protection system. The safety system of spent fuel storage facility and the safety related system and components are required, in both design and operation, to be consistent with applicable QA requirements in relation to significance of safety. Safety related important items in spent fuel storage facility, along with the design and manufacture of system and the validation of materials, must be in conformance with the principles and targets provided for in *HAF003* and other safety related guidelines

F.3.4 Quality Assurance for the Safety of Radioactive Waste Management

F-37 The *Regulations on Radioactive Waste Safety (HAF401)* was issued by NNSA on 5 November 1997. Operating organizations are required to maintain the sufficient dependency of the functional departments responsible for QA arrangements within them, with clear allocation of responsibility and authority to

the relevant persons. Also, it is clearly pointed out that QA program is applicable for all activities relating to radioactive waste management, and especially to those aspects significant to safety. QA program should ensure that waste package meet the requirements of waste acceptance.

F.3.4.1 NPP's QA for Radioactive Waste Management Safety

F-38 The *Regulations on Radioactive Waste Management (GB 14500-2002*） sets out that the target of QA is to provide sufficient confidence to the public and regulatory body to ensure that:

(1) radioactive waste management facility is designed, constructed, operated, closed and decommissioned in accordance with safety requirements;

(2) wastes are always in controlled conditions from its generation to disposal (discharge); the characteristics of waste stream, waste package and discharged effluent are clear and reliable; and

(3) all activities in waste management and related products are consistent with the relevant laws, regulations, standards and the regulatory requirements or license requirements.

F-39 The operators of waste management facilities shall develop and implement a QA program in accordance with the facility scale and complexity as well as the potential risks of wastes and such QA program should be subject to the review and authorization of regulatory bodies. In order to ensure the implementation of QA program, the designer, constructor and operator of waste management facility shall make and implement the relevant QA sub-program and other quality related documents. QA management documents shall pay special attention to the personnel's education, training and examination in respect of safety culture. The main elements that should be considered for inclusion in the QA program are prescribed also.

F-40 QA program for waste treatment and conditioning system shall include process control to assure acceptable waste form and stable waste package be produced. Such process control shall include a certificate of the process, practically effective process parameters obtained from the practical test, verification of acceptance of the process parameters and measures to modify the parameters if there is necessary.

F-41 In addition, a QA program shall include the preparation, preservation and use of the records and documents that are related to radioactive waste handling, shipment and disposal. Shipment listing system should be established and followed

for waste package transfer and shipping.

F.3.4.2 Quality Assurance for LILW Near Surface Disposal

F-42 QA requirements are laid down in the *Regulations on Near Surface Disposal of Solid LILW (GB 9132-1988)*, under which a QA program must be prepared and implemented for near surface disposal of radioactive waste. Such QA program is required to provide for the QA arrangements at any stage of such disposal, such as siting, design, construction, operation, closure and post-closure institutional control period, in order to ensure that all the safety related activities are consistent with the relevant standards and criteria.

(1) An overall QA program must be applicable to all safety related activities, structures, systems and parts of a disposal system. This comprises all steps, closure, long period record-keeping and disposal-related institutional control actions that may take place in the process from planning to siting, design, construction, operation, and safety evaluation.

(2) The essential parts of QA program must take into account the potential impacts of all activities, structures, systems and parts upon a disposal facility, with their design being considered. Those activities, structures, systems and parts relating to the safety of operation and disposal must be determined on the basis of safety assessment results in phases of operation and closure of such a disposal facility; and

(3) Within the period from the beginning of construction to active institutional control, an operator must be designated to hold the overall responsibility for such disposal facility. The operator must establish and implement an overall QA program, including the authorization granted by regulatory body.

F.3.5 Regulatory Control Activities

F-43 The MEP/NNSA controls QA arrangements for the safety of spent fuel management and the safety of radioactive waste management in respects of:

(1) Reviewing and authorizing the QA programs for spent fuel and radioactive waste management and other types of safety related important documents, including their important revisions, as required QA, safety regulations and other types of safety related guidelines.

(2) Supervising the implementing 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 onsite; 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-44 The MEP/NNSA, working with its regional branch stations, has been carrying out a wide range of supervision and inspection of the safety related important activities in respect of spent fuel and radioactive waste management, and 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 Basic Requirements of Radiation Protection

F-45 A wide spectrum of laws, regulations and national standards are promulgated in China to ensure the achievement of the goals of radiation protection.

F-46 On 28 June 2003, the Standing Committee of NPC promulgated *the Law of the People's Republic of China on Prevention and Control of Radioactive Pollution*, laying down prevention and control of radioactive pollution as follows:

(1) The operator of a nuclear facility shall be responsible for the prevention and control of radioactive pollution arising from such a facility and subject to the regulatory control of the competent authority of environmental protection and other relevant agencies, and take the liability of radioactive pollution arising from such a facility;

(2) The operator of any nuclear facility shall monitor the types and concentrations of radionuclides in the surrounding environment and the quantity of radionuclides in effluents from such a facility, and report the monitoring results to the competent authorities of environmental protection both under the State Council and at the provincial level;

(3) The operator of any nuclear facility shall make the effort to reduce the radioactive waste generation ALARA. Release of gaseous and liquid radioactive wastes into the environment shall be consistent with national standards on radioactive pollution prevention and control, and the quantitative results of release shall be reported to the competent authorities of environmental protection.

F-47 On 8 October 2002, the *Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (GB18871-2002)* was issued Under the *GB18871-2002*, the principles and requirements of radiation protection are the same as the basic safety standards recommended by ICRP 60 Recommendations and the BSS issued by IAEA together with other international organizations.

F-48 Any nuclear facility is required to set dose limits as management goals under the *GB18871-2002* taking account of economic and social factors, which should be lower than the relevant national limits. The *GB18871-2002* requires that release of radioactive materials into the environment shall be controlled in such a way to determine the important pathways through which the public are exposed to radioactive material and that the impacts upon the human and the environment shall be assessed. The *GB18871-2002* also sets up the following individual dose limits:

-------Occupational exposure

(1) Effective dose of 20 mSv per year is prescribed by regulatory body, averaged over defined 5 year periods, rather than any traceable average;

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

(3) Annual equivalent dose for Lens of the eye is 150 mSv;

(4) Annual equivalent dose for hands and feet, or skin is 500 mSv;

-------Public exposure

(1) Annual effective dose limit is 1 mSv;

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

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

(4) Annual equivalent dose for skin is 50 mSv

F-49 Principles and requirements of radiation protection were provided for by national nuclear safety regulatory bodies in a wide spectrum of regulations governing the siting, design and operation of nuclear facilities at any stages:

(1) At the stage of siting, the public and the environment should be protected from excess radiation exposure from emerging radioactive accidents, simultaneously with due account being taken of normal release of radioactive materials from nuclear facilities;

(2) Full consideration should be given to radiation protection, such as optimized facility deployment, installation shielding, in such a way to make the activities and occupancy time of persons within radiation areas as less as possible, and radioactive waste be treated properly;

(3) Taking necessary measures to reduce quantity and concentrations of radioactive materials within plant area or released to the environment;

(4) Taking into careful consideration possible accumulation of radiation level with time within occupancy area in such a way as to as less radioactive waste as possible to be generated;

(5) Carrying out, on the part of operating nuclear facilities, assessment and analysis of radiation protection requirements and their implementation, making and implementing radiation protection programs to ensure the implementation of such programs and the verification of their goal achievement, and if necessary taking necessary corrective actions; and

(6) Making and implementing, by radiation protection functional departments, radioactive waste management programs and environmental monitoring program to assess environmental impacts of radioactive release.

F-50 Under the *Regulations on NPP Design Safety* issued by the MEP/NSSA in April 2004, nuclear safety analysis should be accomplished in designing NPPs to assess the possible doses to both NPP's workers and the public and potential environmental consequences. Wide variety of measures is required to be taken for controlling radiation exposure and reduce possibility of an accident. The design of

NPP safety shall adhere to the principles that the probability of an event that is likely to result in high radiation dose or radioactive material release occurs in very low, if possible, and that an event with high probability has no or minor radiation consequences.

F-51 The *Regulations on Radiation Protection for NPPs (GB6249-1986)*, clearly sets out effective dose equivalent to any adult individuals of the public arising from released radioactive materials into the environment from NPPs and the annual release limits of airborne and liquid radioactive effluents.

F-52 Until now, the Regulations have been brought up to date and the updated version shall be implemented from September 1, 2011 on.

F.4.2 Occupational Exposure

F-53 According to the monitoring results of occupational exposures, the average annual dose equivalent to workers in the operating NPPs in China is far below the national limits given in standards, as shown in Table L. 7.

F.4.3 Public Exposure

F-54 Monitoring was made in the surrounding environment in provinces where China' NPPs are located. The results show that the discharged quantities of effluents in operational NPPs caused the maximum individual doses to the public in the proximity far lower than national limits.

F.4.4 Discharge of Effluent

F-55 *The Law of the People's Republic of China on Prevention and Control of Radioactive Pollution* provides for the establishment of national environmental monitoring network around the country to monitor radioactive pollution. The competent authority of environmental protection under the State Council shall work with other relevant agencies to cause the environmental monitoring network to be established for the purpose of monitoring and management of radioactive pollution. A national system shall be established on the basis of a combination of national supervisory monitoring and nuclear facility monitoring to monitor the types and concentrations of radionuclides contained in the environment and effluents from nuclear facilities.

F-56 Article 40 to Article 42 of the Law lay down the basic requirements for discharge of effluents. Under Article 40, discharge of gaseous and liquid radioactive wastes must be consistent with national standards for prevention and control of

radioactive pollution. Under Article 41, for discharging gaseous and liquid wastes consistent to national discharge standards, the generator of gaseous and liquid radioactive waste shall apply to the corresponding environmental protection authority that is responsible for review and approval of environmental impact assessment and report discharged results on a regular basis. For discharging liquid wastes consistent to national discharge standards, the generator of such waste shall use such discharge approach as competent authority of environmental protection permitted. Permeable well, sink, natural fracture and cavern, alongside with other un-permitted approaches, are prohibited from being used to discharge liquid radioactive waste.

F-57 The *Management of Effluents and Wastes from NPPs (HAD401/01)* sets out the principles, scope, objectives, methods, procedures, measures, documentation and organizational management and so on.

F-58 The *Technical Regulations on Liquid Radioactive Waste Discharge from LWR Nuclear Power Plant (GB 14587)* sets forth the specific requirements for the discharge way of effluents from NPPs, discharged amount and site conditions.

F-59 Environmental monitoring program was developed by nuclear facilities for key nuclides, exposure pathways (transfer) and key populations as defined in the environmental impact report with a view to carrying out environmental radioactivity monitoring to ensure compliance with the provision of the relevant national laws and regulations, satisfaction with radioactive waste discharge limits and protection of the public from radiation impacts arising from nuclear facility operation.

F-60 Environmental radioactive monitoring includes background monitoring, routine environmental radiation monitoring, radioactive effluent monitoring.

F-61 Pre-operation monitoring means a two-year long survey of radioactive background and ocean ecology through which the information on key nuclides, key exposure (transfer) pathway and key populations can be obtained. The investigated media comprise air, surface water, groundwater, terrestrial and marine organisms, foods, soils among other things. Environmental gamma radiation level is investigated within 50 km of the proposed sites with others within 20 km of the proposed sites. What to be analyzed and measured includes environmental radiation level and radionuclides released from nuclear facilities. Before operation of NPPs in China, environmental radioactivity backgrounds are measured and the results preserved in such a manner as to ensure the representative of environmental monitoring extent and frequency that meet the relevant requirements.

F-62 Routine environmental radiation monitoring means that as much

optimization as possible is achieved by nuclear facilities through making full use of pre-operation survey information on the premise to meet the needs of environmental assessment. Environmental monitoring focuses on what is deemed to be maximum risks to the key populations.

F-63 Radioactive effluent monitoring refers to the monitoring of gaseous and liquid radioactive effluents after nuclear facilities come into operation, involving total quantity and concentrations of nuclides released and the main nuclides to be analyzed. Monitoring results show that the release amount of the radioactive effluents from every NPP is not in excess of national limits. The factions of the quantity of radioactive effluent discharged by NPPs in China during 2007-2010 to the limits of national standards are shown in L. 8.

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 Overall Emergency Framework

F-64 Under the *National Overall Contingency Emergency Plan of the People's Republic of China*, the emergency planning system includes overall emergency planning, site-specific emergency planning, local emergency planning, facility emergency planning. The emergency arrangements related to the safety of spent fuel management and the safety of radioactive waste management are implemented in accordance with the *National Nuclear Emergency Planning*, the *Nuclear Accident Emergency Planning of the MEP/NNSA*, and the *Radiation Accident Emergency planning of the MEP/NNSA*.

F.5.2 Nuclear Accident Emergency

F.5.2.1 Basic requirements for nuclear emergency

F-65 The *National Nuclear Emergency Planning* applies to NPPs and other types of nuclear facilities, which clearly formulates the underlying policy for nuclear emergency management, emergency classification, emergency planning zone division, emergency organizations, emergency preparedness, emergency response and emergency termination and restoration.

F-66 Nuclear emergency management in China adheres to the basic policy of protecting the public and the environment in a synchronized manner that is always actively compatible and on the alert under unified command. A relatively comprehensive system of nuclear emergency regulations and a three-level nuclear accident emergency organizational system have been established, by way of which once a serious accident would had occurred, the necessary and effective emergency response actions could be initiated. China has issued nuclear emergency regulations and standards, involving nuclear accident emergency reporting system, medical treatment, serious accident emergency management, radioactive material transport emergency management, nuclear accident transboundary impact management among others, thus promoting the standardized management of nuclear emergency arrangements.

F.5.2.2 Emergency organizational system and responsibility

F-67 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-68 National Coordinating Committee for Nuclear Accident Emergency (NCCNAE) organizes and coordinates the country-wide nuclear emergency management arrangement. Its responsibility includes:

(1) Implementing national policy governing nuclear accident emergency arrangements and developing national strategy concerning nuclear accident emergency arrangements;

(2) Organizing and coordinating nuclear accident emergency arrangements between various relevant agencies under the State Council, various agencies of nuclear sector, local governments, NPPs, other nuclear facilities and armies;

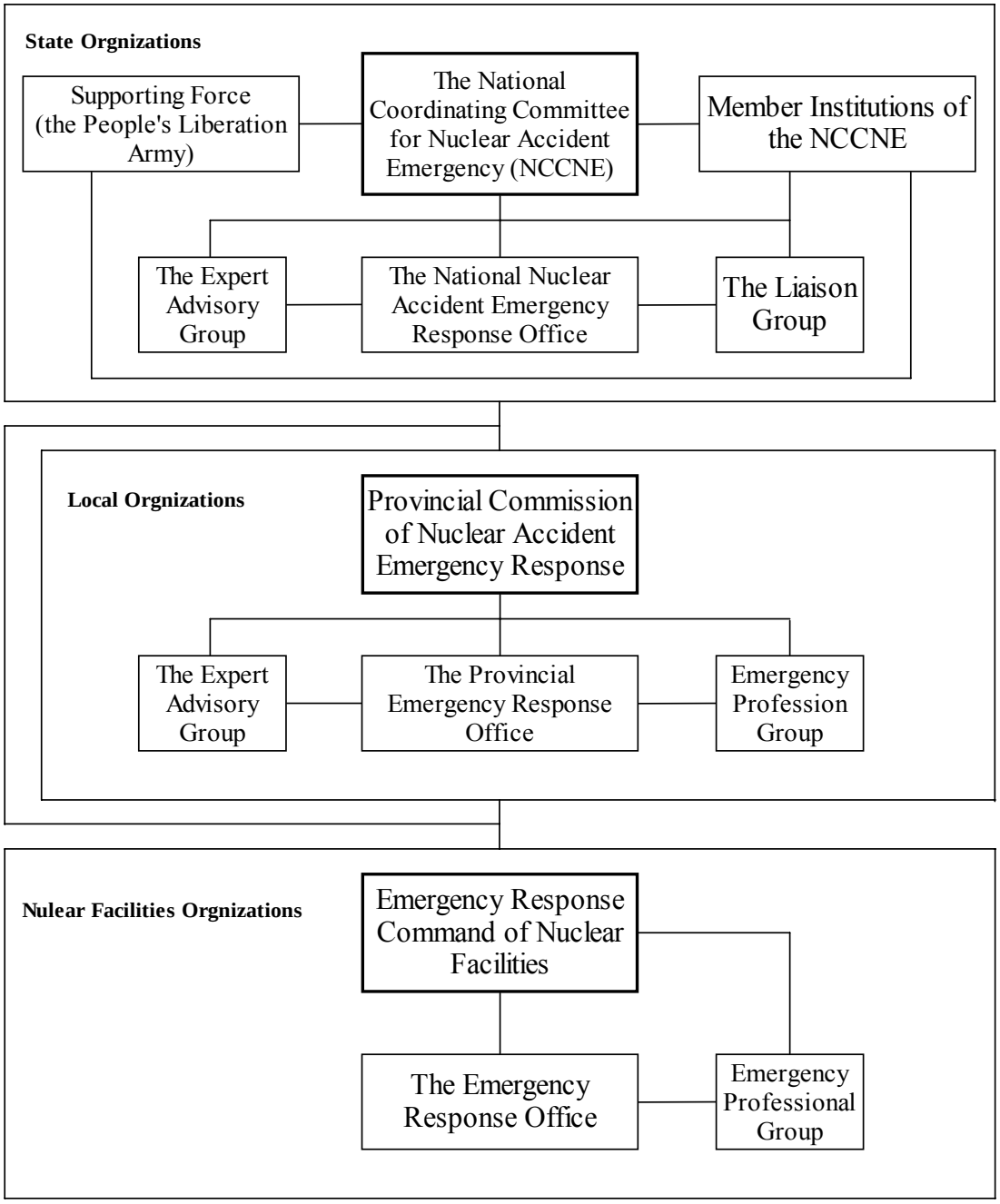

Figure 3 Organizational Structure of National Nuclear Emergency Response System

(3) Reviewing national nuclear accident emergency arrangement planning and yearly annual plan;

(4) Organizing to prepare and implement national nuclear accident emergency plan, and reviewing and approving off site emergency plan;

(5) Timely approving initiation and termination of off-site emergency situation in case of nuclear emergency;

(6) Making decisions, organizing and commanding emergency assistance actions and reporting to the State Council in a timely manner;

(7) Providing suggestions on taking special emergency actions to the State Council, as appropriate;

(8) Being responsible for carrying out international conventions, bilateral or multi-lateral agreements in relation to nuclear accident emergency, reviewing and approving nuclear accident announcement and international bulletins, and initiating requests for international assistance; and

(9) Undertaking other matters delegated by the State Council.

F-69 If necessary, the State Council shall lead, organize and coordinate country-wide nuclear accident emergency arrangements.

F-70 National Nuclear Accident Emergency Response Office (NNAERO) is the management body for country-wide nuclear accident emergency arrangements, with the following prime responsibility:

(1) Implementing nuclear accident emergency policy and strategy developed by the State Council and the NCCNAE;

(2) In charge of the day-to-day work of the NCCNAE;

(3) Implementing national nuclear accident emergency plan, making aware of, coordinating, and advancing the emergency arrangements made by the members of the NCCNAE; notifying, guiding and coordinating emergency preparedness arrangements between local governments and NPPs;

(4) Receiving, handling, transfer, notification, and reporting information on nuclear and radiation emergency, undertaking the specific matters in respects to compliance with international convention, bilateral and multi-lateral cooperation agreements and requesting international assistance;.

(5) Preparing national nuclear accident emergency planning and yearly plan, developing scientific and technical plan and emergency technical support system plan;

(6) Organizing to review off-site emergency plan, off-site exercise plan and off-and on-site combined exercise plan, and making review comments;

(7) Organizing liaison arrangement and expert consultant activity;

(8) Organizing nuclear emergency training and exercise;

(9) Collecting information, submitting reports and suggestions during an emergency, timely delivering and implementing decisions and directives issued by the State Council and the NCCNAE, and inspecting and reporting the progress achieved; and

(10) Undertaking the related matters determined by the NCCNAE after termination of an emergency situation.

F-71 The MEP/NNSA executes independent supervision of NPPs' nuclear accident emergency arrangements, and overseeing the development and implementation of NPP nuclear accident emergency plan.

F-72 The competent authorities of environmental protection, health, army and other related agencies shall make efforts to implement nuclear accident emergency response arrangement within the scope of their responsibilities.

F-73 Nuclear accident emergency committees of provincial governments where nuclear facilities are located are responsible for nuclear accident emergency arrangements within their administrative areas, with the following prime responsibility:

(1) Enforcing national regulations and policies governing nuclear accident emergency arrangement;

(2) Organizing to prepare off-site nuclear accident emergency plan, and implementing nuclear accident emergency arrangements;

(3) Commanding off-site nuclear accident emergency response actions;

(4) Organizing assistance to nuclear accident emergency response actions;

(5) Notifying timely accidental information to the adjoining provinces, autonomous regions and municipality directly under the central government;

(6) If necessary, provincial governments would lead, organize and coordinate the nuclear accident emergency arrangements within their administrative areas;

F-74 Nuclear accident emergency organizations of nuclear facilities have the following responsibilities:

(1) Enforcing national regulations and policies on nuclear accident emergency

arrangements;

(2) Preparing onsite nuclear accident emergency plan and making nuclear accident emergency arrangements;

(3) Determining nuclear accident emergency classification, commanding nuclear accident emergency response actions;

(4) Timely notifying information on nuclear accident situation to the higher competent authorities, the MEP/NNSA and the agencies designated by provincial governments and making suggestions on initiating off- site emergency actions and protective actions; and

(5) Assisting and helping the agencies designated by provincial governments in making nuclear accident emergency arrangements.

F-75 In order to expedite the building of nuclear emergency technical system, the NNAECC entrusted the relevant institutions with forming a number of technical centers and first-aid teams in respect of emergency monitoring, radiation protection, and aerial monitoring, among others. As a result, the National Technical Support Center for Nuclear Emergency and Response (NTSCNER) was established with the responsibility of undertaking the technical and research efforts relevant to national nuclear emergency and response.

F.5.2.3 Emergency event classification

F-76 Emergency events are classified into four levels, emergency standby, plant emergency, plant area emergency, and offsite emergency.

(1) Emergency standby: Certain types of special conditions and external events that could endanger the safety of nuclear facilities are expected to have occurred. After emergency standby declared, the prompt measures shall be taken to mitigate and evaluate the resulting consequences and enhance the emergency preparation of operators and even local governments according to circumstances.

(2) Plant emergency: Release of radioactive materials would have occurred or be on the point of occurring, however the actual or foreseeable radiation consequences are only confined within the plant area. After plant emergency declared, the operator shall take prompt actions to mitigate the potential accident consequences and protect the personnel in plant area.

(3) Plant area emergency: Radiation consequences of the accident would have extended or is likely extend to the entire plant area, however, the radiation levels beyond the site boundary are expected to have not reached or unlikely to reach the

status of intervention levels. After plant area emergency declared, the prompt actions should be taken to mitigate accident consequences and protect the personnel within the plant area and the preparation should be made to take offsite protection actions according to the circumstances.

(4) Offsite emergency: Radiation consequences are expected to have exceeded plant boundary. Onsite and offsite personnel start to take actions, and onsite and offsite emergency plans start up. Once offsite emergency is declared, then actions shall be taken promptly to mitigate the accidental consequences and protect the on-site persons and the public from being affected.

F-77 Emergency events for other types of nuclear facilities are generally classified into three levels: emergency standby, plant emergency, and plant area emergency. In case there is severe potential risk, off-site emergency may also be applicable.

F.5.2.4 Report of Emergency Status

F-78 In the event of emergency standby, the emergency organizations of a nuclear facility shall enter preparation status for taking mitigation measures and notify the situation of accident to the offsite and to provincial emergency organization and the NNAERO in a timely manner. On-shift monitoring should be intensified.

F-79 In the event of plant emergency, the operator of a NPP involved shall implement emergency planning and take necessary measures for returning the NPP to a safety condition and meanwhile notify accident condition to the offsite in line with the specified procedures. Provincial nuclear emergency organization should activate provincial emergency commanding center and notify information about accident. The relevant emergency teams shall be on the standby status. The NNAERO shall activate the NTSCNER and report to the NCCNAE, as well as the related departments and experts, and enhance liaison with the operators so as to be ready for implementing emergency assistance and preparedness.

F-80 In the event of plant emergency, the operator shall implement emergency planning to take measures in order to return the NPP to a safety condition and evacuate the general personnel from onsite, notify accident condition to the offsite and perform offsite radiation monitoring in the areas surrounding the NPP. Provincial emergency organization, together with its related officers, shall enter provincial emergency commending center to direct emergency response actions and report the accident condition to the NNAERO. Each of emergency teams shall be on the standby status and start to act as required. The NNAERO shall report

to the NNAECC and notify the related departments to do their best in implementing emergency assistance and preparedness. The officers of the NNAECC shall enter the National Nuclear Emergency Center so as to be ready to report timely to the State Council.

F-81 In the event of offsite emergency (overall emergency) in case of a serious nuclear accident occurring, the operator of a nuclear facility shall provide the provincial nuclear emergency organization with suggestions about timely entering offsite emergency condition. Provincial nuclear emergency organization shall report to the NCCNAE for requesting approval to be on the offsite emergency condition. In response to the request, the NCCNAE shall review whether or not need to enter offsite emergency condition. In very urgent situation, provincial nuclear emergency organization may decide to enter offsite emergency condition, and then report this situation to the NCCNAE in a timely manner. The NCCNAE shall timely report the current offsite emergency condition to the State Council and, where necessary, request coordination of emergency response.

F-82 When a nuclear accident is likely to result in a transboundary radiation effect, notification shall be implemented in accordance with the *Convention on Early Notification of a Nuclear Accident*.

F-83 When a NPP has returned to a safety condition from the accident consequences that have been mitigated, the offsite emergency condition is terminated. The operator of the NPP and provincial government shall cause their respective work to be returned to the normal.

F.5.2.5 Emergency Communication with the Public

F-84 The NNAERO establishes information alert network to reinforce information communication with the relevant agencies and committees, local government and nuclear facility operators.

F-85 Local governments are responsible for popularization and dissemination of the knowledge on nuclear safety and radiation protection for the public in the vicinity of nuclear facilities and during an emergency provide guidance on emergency radiation protection like alert, shielding, evacuation, administration of anti-radiation drugs.

F-86 Nuclear facility operator shall, through local broadcasting, propagation materials, invite the local public to visit such a nuclear facility and participate in and observe emergency exercise in order to eliminate nuclear concern and make it possible the public involved in nuclear emergency response in the event of an emergency.

F-87 Provincial environmental protection agency, where nuclear facilities are sited, shall make annual environmental monitoring report available to the public through news media every year.

F-88 Nuclear emergency organizations at different levels shall conduct a wide variety of the public information communication activities, thus laying the wider social foundation for nuclear emergency and enhancing the friendly relationship between adjoining communities in the vicinity of such nuclear facility.

F.5.2.6 Emergency Training and Exercise

F-89 To raise the professional skill of nuclear emergency personnel, national and local emergency organizations shall, through training course, technical exercise and emergency knowledge examination, reinforce human capability for nuclear emergency in order to supply adequacy of human resources and capabilities for nuclear emergency preparedness and response.

F-90 Prior to operation of nuclear facilities, systematic training and examination shall be made for all emergency response personnel including emergency commanders. Throughout the operational lifetime of a NPP, training and examination shall be made once a year in response to the emergency task that is expected to be accomplished.

F-91 Nuclear facility emergency training should comprise special purpose emergency training and on-the-job emergency training, with the attendance of nuclear facility's personnel (including contractors), emergency response staff and those with high technical skills and competence in emergency organizations. The contents of training involve as many aspects of nuclear emergency preparedness and response as possible.

F-92 In order to demonstrate the validity of nuclear emergency preparedness in the NPPs newly built in recent years; nuclear accident emergency exercises are conducted prior to the first fuelling, as required by nuclear safety regulations.

F-93 A wide variety of periodical emergency exercises are conducted at NPPs that have been in operation in order to test, modify and reinforce emergency preparedness and response capabilities.

F-94 To demonstrate the validity of the *National Nuclear Accident Emergency Planning* and its implementation procedures, the first national large-scale three-level combined nuclear accident emergency exercise was launched on November 10, 2009, which has made an overall test of the ability of the country to deal with nuclear and radiation contingency in a manner to improve operational

mechanism and exercise the emergency force. On the invitation of the CAEA, the delegation of Republic of Korea and Japan has made an inspecting visit to this exercise. Also notification was made to the IAEA according to the Convention on Early Notification of a Nuclear Accident.

F.5.2.7 International Arrangements of Nuclear Accident Emergency

F-95 China is a signatory to the *Convention on Early Notification of a Nuclear Accident* and to the *Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency*. Chinese government complies with the obligations of the both Conventions

F-96 CAEA issued *Regulations on Transboundary Emergency Management for Radiological Impacts of Nuclear Accident* in April 2002, which states that, in the situations of transboundary nuclear accident impacts, China shall carry out the obligations of the relevant international conventions and implement the provisions relating to emergency response.

F-97 When a nuclear accident occurs in China to have potential impacts beyond its boundary, the NNAERO shall collect information on the accident to, under the *Convention on Early Notification of a Nuclear Accident*, notify and inform the states or regions that may have received or potentially receive impacts in a timely manner or through IAEA.

F-98 Nuclear Accident Emergency Center, Ministry of Health, as a liaison institution in China of WHO-REMPAN, has been actively participating in the communication exercises and broadened exercises sponsored by WHO-REMPAN and make timely response to emergency event abroad.

F-99 At the same time, China's nuclear emergency management level is being raised through multilateral and bilateral international cooperation channels and active promotion of exchange of the personnel and information and learning about the experiences gained in other countries. China has established bilateral cooperation and technical exchange with France, America, Canada, Russia, Ukraine, Japan, Korea and other countries.

F.5.3 Radiation Accident Emergency

F.5.3.1 Radiation Accident Emergency System

F-100 *Radiation Accident Emergency Pre-plan* is applicable to radiation accidents other than nuclear accidents, which mean the loss, theft and out of control

of radioactive materials or the incidents that radioactive material imposed unintended or abnormal exposures to persons. The pre-plan provides for radiation accident emergency management principles, emergency organizations and their responsibilities, classification of radiation accidents, emergency actions, emergency termination and recovery, and emergency logistics.

F-101 Radiation emergency management follows the principles of human-oriented, prevention first and unified leadership and is implemented in ways of classified and district-based management, graded response and in full-time and part-time participation and adequate utilization of the available resources.

F.5.3.2 Classification of Radiation Accidents

F-102 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, with exceptionally serious radiological accidents as the most serious and ordinary radiological accidents as the least.

F.5.3.3 Organizational Structure and Responsibility

F-103 Under the unified command of emergency leading group under the MEP, as radiation accident emergency response arrangement, the MPS and the MH make radiation accident emergency preparedness in normal conditions or take prompt and appropriate response to radiation accident during an emergency within the scope of their responsibilities. The radiation accident emergency organizational system is shown in Figure 4. The emergency leading group under the MEP shall serve as the nuclear/radiation accident emergency leading group under the MEP when radiation accident occurring. This includes a nuclear/radiation accident emergency office based at the Nuclear and Radiation Safety Center under MEP. The Center is responsible for commanding radiation accident emergency response when accident occurring, while in normal condition it is for the maintenance of radiation accident emergency system. In an emergency, the Center and the environmental radiation monitoring technical center under the MEP shall serve respectively as nuclear/radiation accident emergency technical center under the MEP and radiation environmental emergency monitoring technical center under the MEP.

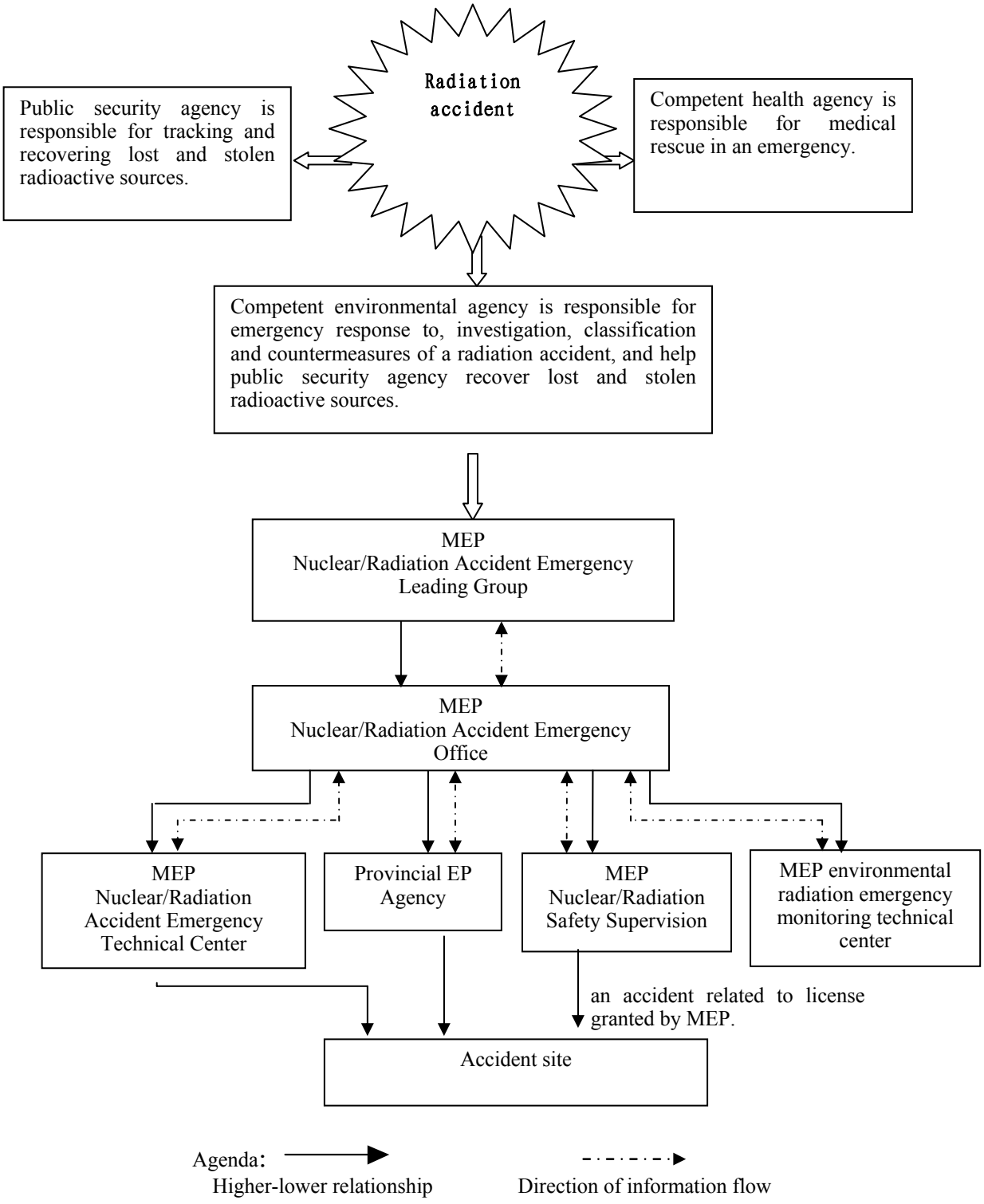

Figure 4 Radiation emergency organizational system

F-104 The MEP is responsible for the investigation and emergency treatment of special major radiation accident and for providing technical guidance on emergency treatment of such accident to provincial environmental protection agencies. Provincial environmental protection agencies are responsible for investigation and emergency treatment of less major radiation accident, and radiation accident.

F.5.3.4 Radiation Accident Emergency Plan

F-105 The MEP is responsible for emergency response to radiation accidents, and for investigation and classification of the accident. For this reason, *Radiation Accident Emergency Plan* is specially established. Under the *Council of State Decree 449*, the environmental protection agencies of the people's governments at or above county-level should work with the agencies responsible for public security, health and finance at the same level to make joint effort to prepare radiation accident emergency plan within their own administrative areas. The plan is subject to approval of county-level people's governments to ensure their legality and validity and should make them available to the public in an appropriate form.

F-106 The licensee shall prepare emergency plan for its facility based on potential accident risk and make emergency preparedness.

F-107 Radiation accident emergency plan includes emergency organizations, assignment of responsibility, organization and training of emergency personnel, provision of equipment, funds and materials for medical emergency rescue, classification of radiation accident and emergency response measures, and the investigation, reporting and treatment procedures radiation accident.

F.5.3.5 Radiation Accident Report and Emergency Response

F-108 Once a radiation accident occurs, the holder of radiation safety license shall initiate emergency plan that has been prepared in advance and take emergency measures to check the effectiveness of the measures taken from time to time. Within two hours after an accident occurring or being discovered, report shall be made to the agencies responsible for the environment, health and public security. After receiving such a report, the agencies should dispatch personnel to the accident site to conduct emergency fieldwork in a way consistent with the provisions, and at the same time report the information to their respective upper level competent agencies in a prescribed way. The personnel that have arrived at the accident site should carry out their own respective responsibility through taking effective measures, controlling and eliminating accidental impacts. In the case of an exceptionally

serious radiological accident or a major radiological accident, the people's governments at the level of province, autonomous region and municipality directly under the State shall report to the State Council not later than 4 hours after the accident occurs.

F-109 When an accident is in the process or expected to have potentials to occur, the environmental agencies of above-county-level people's governments have powers to take such measures as directing to suspend the operation that have led or could lead to radiation accident and as organizing to control accident site.

F-110 After an accident occurs, the people's governments above county-level shall initiate and organize to implement emergency plan in a way consistent with radiation accident scale.

F-111 In the entire process of initiating and organizing to implement emergency plan, the emergency agencies hold the over responsibility for the continuality and validity of measures taken in respect of various links, with emphasis on the coordination between various responsible agencies, the investigation of causes and process, the classification of accidents, the assessment and promotion of consequence treatment effectiveness, the administrative punishment, the assistance to the public security agencies in search of stolen sources in respects of techniques, equipment and human resources. The public security agencies have the prime responsibility for placing the case on file and searching the lost and stolen sources and deploying the police powers. The health agencies have overall responsibility for the validity and completeness of medical emergency, conducting medical emergency rescue, give diagnosis and treatment to the radiation-injured persons.

F-112 An institution or undertaking where radiation accidents would have occurred shall immediately send potential radiation-injured persons to the hospitals designated by local health agency or to those with the conditions of first aids in order for such injured persons to receive examination and treatment, or request hospital to bring physicians and nurses onto the accident site for first aids.

F.5.4 Medical Emergency for Nuclear and Radiation Event

F-113 Under *the Law of the People's Republic of China on Dealing with Emergency Event*, *Regulations on Safety and Protection of Radioisotope and Ray-generating Installations*, *Regulations on Accidental Emergency Management at Nuclear Power Plant*， and *National Nuclear Emergency Planning*, etc., Ministry of Health has revised its *Medical Emergency Plan for Nuclear and Radiation Accident*,

and issued two national standards, such as *Off-site Medical Emergency Plan and Preparedness for Nuclear Accidents (GBZ170/T-2006)* and *Principles of Medical Intervention and Treatment for Nuclear Accidents (GBZ113-2006)*. The first meeting on medical emergency work for nuclear or radiation events was held in 2009, issuing *Notification of Ministry of Health on Enhancing Medical Emergency Work for Nuclear and Radiation Events(WFYJ/2009/100),* with a view to comprehensively pushing forward both the system building and the capability building for medical emergency for nuclear and radiation events.

F-114 Medical emergency offices, at different levels from Ministry of Health to provincial administrative agencies, have been set up for undertaking the responsibilities of medical emergency for nuclear and radiation events. The Medical Emergency Center for Nuclear Accident, Ministry of Health, has subsidiary radiation monitoring and assessment department, technical support department and three clinical departments, served as separately by professional medical and health care institutions from medical, education and military sectors. Meanwhile both a medical emergency decision-making and commanding system and a technical support system for nuclear and radiation events are included in the Center, to guarantee the allocation of instruments and equipment at medical emergency laboratories and on the emergency fields and carry out research on rapid diagnosis techniques for emergency events. Medical institutions and radiological health agencies are assigned, in conjunction with medical emergency teams for nuclear and radiation events formed, to perform radiological injury rescue and radiological health investigation.

F-115 Since 2004, a training course for the key qualified teachers for medical emergency for nuclear and radiation events has been held annually, by Ministry of Health, at provincial level. In 2007 and 2009, two separate medical emergency exercises for nuclear and radiation events were performed, with model teaching films prepared for distribution and demonstration across the country.

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-116 Under Article 27 of *the Law of the People's Republic of China on Prevention and Control of Radioactive Pollution*, the operators of nuclear facilities shall prepare decommissioning plan. The expense for nuclear facility decommissioning and waste disposal should be drawn in advance and listed in investment estimates and production cost.

F-117 The following standards governing nuclear decommissioning activities have been developed:

Requirements for Nuclear Facility Decommissioning (GB/T 19597-2004）;

Regulations on Radiation Protection for Decommissioning NPPs and Large Sized Reactors（GB11850-1989）;

Regulations on Radiation Protection for Decommissioning Nuclear Fuel Reprocessing Plant（EJ588-1991）;

Regulations on Environmental Management Techniques for Decommissioning Reactor (GB14588-1993）.

F-118 Decommissioning activities are considered to be part of practice. The requirements for radiation protection in decommissioning activities are the same as those for general practice activities. The specific provisions are given in relevant requirements, for general principles on radiation safety, division and management of nuclear facility decommissioning sub-area, radiation safety measures, dose limits and control, waste safety management (including liquid and gaseous waste discharge) and radiation monitoring.

F-119 The *GB/T 19597-2004* and other relevant instruments state that

emergency plans or procedures shall be implemented in response to abnormal incident that are expected to occur in decommissioning activities. Training of personnel on decommissioned site shall be carried out in respect of emergency procedures. The operator should ensure that emergency plan implementation procedures relating to unexpected events have been taken into account and the corresponding emergency measures and resources preparedness have been provided, including personnel training, and renewal of emergency procedures through periodical exercise and test.

F-120 The chapter of Quality Assurance in the *GB/T 19597-2004* states that QA program for decommissioning project includes record of decommissioning activities, information collection and related preservation measures and that the record of each task in decommissioning activities should be kept for long time period, including the complete and correct information on quantity, location, distribution and type of residual radioactive materials in the facilities.

F-121 In recent years, the decommissioning of Shanghai mini reactor was completed, with the scope including whole of the mini reactor system, equipment, buildings and structures, and newly-constructed and reconstructed facilities during decommissioning within the facility area. Post-decommissioning monitoring concludes that environmental gamma radiation levels inside and outside the facility site are comparable with the normal environmental background level. The decommissioned project site has reached the level of unlimited open to the outside. Shandong Jinan mini reactor is currently under decommissioning.

F-122 From 2004 to date, more than 30 decommissioning projects for the sites where nuclear technology applications were once performed have been completed, covering chemical experimental building, nuclear technology application radioactive waste storage facilities, and irradiation facilities. The decommissioning of these facilities has led to unlimited open of more than 40 thousands square meters to the outside.

G. SAFETY OF SPENT FUEL MANAGEMENT

(Articles 4 to 10)

This section covers the obligations under the following articles:

Article 4. General safety requirements

Article 5. Existing facilities

Article 6. Siting of proposed facilities

Article 7. Design and construction of facilities

Article 8. Assessment of safety of facilities

Article 9. Operation of facilities

Article 10. Disposal of spent fuel

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 The operators of NPPs, research reactors, and spent fuel storage facilities are responsible for the safe management of spent fuel in China. Under *the Law of the People's Republic of China on Prevention and Control of Radioactive Pollution*, the operators (licensees) of nuclear facilities are responsible for the prevention and control of Radioactive Pollution within their facilities and receive the regulation by the regulatory bodies for nuclear safety. The *Regulations on Civil Nuclear Fuel Cycle Facility Safety (HAF301)* states that the operators of nuclear fuel cycle facilities shall take the full responsibility for the safety of such facilities, including spent fuel management. The siting, design and operation of spent fuel storage facilities at NPP reactors are subject to the provisions of *Regulations on the Safety of NPP Siting (HAF101)*, *Regulations on the Safety of NPP Design (HAF102), Regulations on the Safety of NPP Operation (HAF103),* the *Handling and Storage System at NPPs (HAD102/15)* and *Management of Core and fuel at NPPs (HAD103/03).*

G-2 The safe management of reactor spent fuel shall be subject to the requirements of the *Regulations on Research Reactor Operation Safety.*

G-3 Other types of spent fuel storage facilities shall implement the provisions of the *Design of Spent Fuel Storage Facility*（*HAD301/02*）, *Operation of Spent Fuel Storage Facility (HAD301/03)* and *Assessment of the Safety of Spent Fuel Storage Facility (HAD301/04)*.

G-4 Under the *HAF001*, the license management regime and the procedures for implementing safety regulation are provided for. The operators of nuclear facilities are required to be directly responsible for the safety of such nuclear facilities, to comply with national laws, regulations and technical standards, to ensure the safety of nuclear facilities, to be subject to the nuclear regulation of the NNSA. They also take full responsibility for the safety of nuclear facilities operated by them, the safety of nuclear materials and the safety of the workers, the public and the environment.

G-5 In designing spent fuel storage facility, both onsite temporary storage and long term storage, due account has been taken of actions that are expected to

impose greater adverse impacts on the future generations than the current generation. The cost of spent fuel management shall be responsible by its generators, so as to avoid imposing undue burdens on the future generations.

G-6 The operators of nuclear facilities shall, prior to the operation of such facilities, submit *the Application for Nuclear Facility Operation*, *Final Safety Analysis Report* and other necessary documents to the NNSA. No nuclear fuelling can be started for commissioning unless the authorization has been granted. No operation can be performed until nuclear facility operation license has been granted. Nuclear facilities shall be operated in a manner consistent with the provisions of such license. This means that the operation, storage and transport of spent fuel are all under the regulation of the NNSA, thereby ensuring that such activities can meet the relevant safety requirements.

G-7 Under the *HAF001*, reliable design characteristics must be provided (through nuclear criticality safety analysis) to maintain fissile material unit and array below the sub-criticality in any operating conditions and accidental conditions, with additional deployment of criticality accident detection and alarm system. Civil nuclear facilities are provided with commissioning and operating procedures, including training, operating rules, supervision, check, test, maintenance, modification and record-keeping, so as to ensure that the effective precautionary measures have been established and maintained in such a manner as to protect workers, the public and the environment against radiation hazards.

G.1.1 Requirements for the Safety of Spent Fuel at NPPs

G-8 As required by *Regulations on the Safety of NPP Operation*, the operators of NPPs shall be responsible for, and arrange, all activities involving the management of core and fuels in order to ensure the safe use of such fuels in core and the safety of them during their handling, transfer and storage within the plant, as follows：

(1) The operators of NPPs shall prepare the technical conditions and procedures governing the procurement, loading, use, unloading and test of fuels and core parts. The program for fueling and refueling has to be prepared and reported to the NNSA in a manner consistent with design requirements. The monitoring of core conditions shall be carried out and the program for fueling and refueling shall be reviewed and modified as required. The criteria and procedures for treating material with defects have to be prepared to minimize the radioactivity in fissile in cooling loop or gaseous effluent;

(2) The procedures for management of fuels and core parts have to be prepared, involving transfer of un-irradiated and irradiated fuels, onsite storage and the preparedness for delivery to offsite;

(3) The measures have to be taken to ensure the design and enrichment of fuels charged is consistent with the requirements by the NNSA. The storage options for un-irradiated and irradiated fuels should be submitted to the NNSA for approval;

(4) The package, transport and delivery of un-irradiated and irradiated fuels have to be consistent with national regulations and the applicable international criteria; and

(5) A complete record-keeping system, involving core management, fuel characteristics, core parts and fuels handling, and fuel storage, has to be established.

G-9 *Fuel Handing and Storage System at NPPs (HAD102/15)* sets out the design and safety requirements for the handling and storage in order to ensure during operating conditions and accidental conditions:

(1) prevention of criticality by accident;

(2) avoidance of excess irradiation; and

(3) prevention of unacceptable release of radioactive materials.

G-10 *The Management of Core and Fuel at NPPs (HAD103/03)* states that withdrawing spent fuel has to be in accordance with refueling plan, with marks on fuels. Any handling of the withdrawn fuels must be consistent with prepared radiation protection measures. The damaged fuel elements must be treated in an appropriate manner.

G-11 The requirements for spent fuel storage at NPPs are:

(1) to ensure the integrity and sub-criticality of fuel and that the handling, storage and check shall be carried out in accordance with written procedures and by such devices in such facilities as have been approved;

(2) to be consistent with the approved way in which spent fuel are emplaced and with the requirements on neutron absorber in storage facilities, as well as to meet the maximum volume of such facilities; prescribed neutron absorber may be stationary thin absorbing plate or boron-containing water in storage pool, the related quality assurance procedures have to be followed to ensure meeting the requirements of critical safety;

(3) to ensure that, when being stored under water, the water quality has to meet the prescribed temperature, pH value, radioactivity and chemical and physical

characteristics;

(4) to prohibit heavy items that are not among hoisting and rigging equipment from being moved without the item-by-item approval of relevant organizations, in order to prevent the fuels stored in water pool from being damaged; prior to fueling, hoisting and rigging equipment over water pool have to be checked to ensure corrective handling;

(5) to carry out radiation protection supervision of fuel storage facilities; only trained and authorized persons are allowed to enter into storage installation area; all handling activities have to be carried out in accordance with written procedures;

(6) to take necessary precautionary specific measures to storage pool to limit hazardous impacts of radiation exposure; and

(7) to prepare appropriate safety rules for dry-storage or under-liquid storage rather than water storage.

G.1.2 Requirements for the Safety of Spent Fuel from Research Reactors

G-12 The *Regulations on Research Reactor Operation Safety* applies to the safe management of spent fuel arising from research reactor, which requires that:

(1) the operators shall be responsible for arrangement of all activities relating to core management and onsite fuel management. Offsite fuel shall be managed in accordance with the relevant national regulations;

(2) the operators shall, in accordance with design requirements, prepare technical specifications and procedures available for procurement, handling, use, withdrawing and test;

(3) the core arrangement must be consistent with the intention and assumptions of design that are given in operating limits and conditions;

(4) in order to minimize the release of radioactive fission products, the operating limits and conditions, in conjunction with the procedures tackling fuel element damage, must be developed;

(5) the rules to ensure the quality of fuel elements, assembly and core parts during their charging and/or discharging, and to ensure nuclear safety and security, should be prepared; the storage option for un-irradiated and irradiated fuels must be submitted to the NNSA for approval;

(6) the package, transport and delivery of irradiated and un-irradiated fuel

assembly must be in compliance with the related laws, regulations and standards; and

(7) a complete set of record-keeping system consistent with QA program must be maintained, in order to be used in the core management, fuel status and fuel management.

G.1.3 Requirements for Spent Fuel Interim Dry-storage Facilities

G-13 Qinshan Phase III NPP is a CANDU-6 reactor NPP imported from Canada. To address the issues of spent fuel over the life-cycle, an interim dry-storage facility on-site for spent fuel began in 2008 to be constructed, with 18 MACSTOR-400 modules planned. It can accommodate 432, 000 spent fuel assemblies after completion of all ones. In 2009, 2 modules were completed. The general principles are as follows:

(1) Keep sub-criticality of spent fuel;

(2) Maintain containment of radioactive materials, provide radiation protection to the public, the workers, and prevent unacceptable exposure; and

(3) Ensure removal of residual heat of spent fuel.

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-14 At-reactor spent fuel storage facility is built at each of NPPs in China for the purpose of receiving and storing spent fuel discharged at such NPPs, At present, the spent fuel storage facilities built at all of such NPPs are employing wet-storage approach, with an additional interim dry-storage facility at Qinshan Phase III NPP. A spent fuel storage facility is a part of the NPP， such that its siting, design, construction, operation should be the responsibilities of such a NPP. The capacity of a spent fuel storage facility affiliated to a NPP should be designed to accommodate spent fuel withdrawn from such a NPP within a considerable period of time. The spent fuel storage facilities for research reactors are similar to wet-storage approach at NPPs.

G.2.1 Safe Management of Spent Fuel at NPPs

G-15 In designing NPPs, the criticality issues and removal of residual heat arising from onsite spent fuel storage have been taken into account in accordance with the national regulations. The operation of the existing spent fuel storage facilities at China's NPPs is consistent with the above procedures. The operation experience of existing spent fuel storage facilities has shown that the management of spent fuel is efficacy and efficient.

G-16 A wide spectrum of spent fuel safety management measures have been developed and implemented at NPPs in accordance with the national regulations. It is required that a wide range of management documents should be prepared and submitted at stages of applying for license, involving transfer of un-irradiated and irradiated fuels, onsite storage and delivery to outside. The storage plan for irradiated fuel should be submitted to the NNSA for approval in accordance with the national regulations. The package, transport and delivery of irradiated fuel must be consistent with international and national requirements. At NPPs, a number of record-keeping systems have been established and maintained for core management, fuel performance, handling of fuels and core parts, and fuel storage. .

G-17 The main measures for maintenance and operation of spent fuel storage pool are as follows:

(1) Maintaining appropriate pH value and other chemical conditions in pool water, such as ion concentrations of halide to prevent fuels, core parts and structure from being eroded;

(2) Keeping water temperature above minimum limit for avoidance of boron crystallization;

(3) Restricting water evaporation and controlling radioactivity in pool water to reduce contamination and radiation level in pool area;

(4) Keeping transparency of water and provide sufficient under water lighting for the convenience of the underwater operation.

G-18 The measures envisaged to ensure the safety of handling in spent fuel storage facilities are as follows:

(1) Controlling water level in the storage pool between the highest and lowest levels;

(2) Periodically checking the availability of radiation monitoring meters and making corrective adjustments to ensure energizing alarm signals when radiation level reaching alarm limits;

(3) Controlling fuel not to be lifted up to water surface by using permitted procedures and tools to restrict radiation level on water surface;

(4) Correctively operating ventilation system;

(5) Conducting appropriate personnel supervision and adequate training; and

(6) Only permitting necessary personnel access to pool area.

G-19 Interdependency between different steps in spent fuel management at NPPs must be taken into account in order to minimize the quantity of radioactive wastes and, in operating condition, reduce them to levels that are ALARA.

G.2.2 Safe Management of spent fuel from research reactors

G-20 Spent fuel storage facilities for research reactors are designed and operated taking account of criticality safety, residual heat removal and radiation protection, etc. associated with spent fuel assemblies. The operators of research reactors prepared, as required by the relevant national regulations, management procedures for storage, operation and delivery of spent fuels, and full records of the related activities. The measures to deal with the safe management of research reactors are mainly as follows:

(1) Spent fuel pool should be filled with deionized water and equipped with purification system to ensure water quality and prevent fuel clad from erosion;

(2) Water level in the pool should be maintained constant, with radioactivity monitoring kept in place; and

(3) Special tools approved should be used to ensure the safety of the handling of spent fuel assemblies.

G.2.3 Safe Management of Spent Fuel Interim Dry-storage Facilities

G-21 At the time of constructing spent fuel interim dry-storage facility, the operator of Qinshan Phase III NPP submitted both Safety Analysis Report and Environmental Impact Report to the regulatory authorities, who had both reports to be reviewed in accordance with the relevant standards. The review focused on spent fuel receipt criteria of such a facility, natural conditions of the site and its surroundings, radiation impact during facility operation. It was confirmed that the design of the facility meets the related safety requirements and that the facility is acceptable.

G-22 Radiation monitoring plan was prepared with the aim of ensuring the

long-term safety of facility operation, encompassing on-site environmental gamma radiation monitoring, storage modules and workplace radiation monitoring, air sampling for storage drums, etc. Meanwhile, thermal conductivity within each of modules should be also monitored in order to verify the design and then feedback the experiences learnt to the subsequent module construction.

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-23 Chinese government has attracted considerable importance to the siting of proposed nuclear facilities, for which a wide spectrum of laws and regulations has been promulgated. *The Law of the People's Republic of China on Prevention and Control of Radioactive Pollution* requires scientific demonstration to be carried out for the siting of the proposed nuclear facilities and licensing procedures to meet the relevant requirements. Prior to being licensed, environmental impact assessment should be prepared and submitted to the competent environmental authority under the State Council for approval. No agencies related can issue licensing documents without approval of the environmental impact assessment.

G-24 A wide range of regulations set out the requirements for the siting of proposed spent fuel management facilities.

G-25 The *HAF301* states the requirements for the safety of production, processing, storage and reprocessing of civil nuclear fuel, including requirements on sites of such facilities. The sites of such facilities and the areas where such facilities are sited and the surrounding environment of such nuclear facilities must meet the following requirements:

(1) There should be no external natural events and human-made events to take place that are likely to severely affect the safety of nuclear fuel cycle facilities during its lifetime, or reasonably applicable measures can be taken to mitigate the effects of the potential events to an acceptable level;

(2) In normal operating condition of nuclear fuel cycle facilities, the radiation exposure to the public, caused by the comprehensive impacts of proposed site and such facilities, shall be kept at ALARA level and meet the requirements of national regulations; and

(3) In accidental condition, the public can be protected from unacceptable radiation exposure, including appropriate measures to be taken.

G-26 High priority of China Government to the management of proposed spent fuel management facilities is embodied by well established licensing procedures for proposed sites.

G-27 Under the nuclear facility licensing system established in China, the NNSA is responsible for granting nuclear facility license. No nuclear facility can be constructed unless a construction license has been granted for such a facility. Under the *Regulations of the People's Republic of China on the Safety Control of Civilian Nuclear Installations*, the prerequisite for obtaining nuclear facility construction license is that a proposed site has been approved by the competent authorities of environmental protection, planning at the central level or the provincial level, and the NNSA.

G-28 In applying for the license for constructing dedicated spent fuel management facilities, the applicants has to submit detailed site assessment report to the NNSA, which must describe (1) the external event likely taking place in the area where such a facility is sited and that is likely to affect nuclear fuel cycle facility safety, (2) site characteristics and its environmental characteristics that are likely to have impacts on released radioactive material migration to human body under the conditions of both nuclear fuel cycle facility operation and accident, (3) characteristics relating to assessment of radiation hazards to individuals and

populations and to emergency measures to be taken whenever necessary, (4) the site-related design basis standards external events and associated design basis standards, (5) assessment model and analytical methodology to be used, and (6) the reason for selection of such a site.

G-29 The NNSA conducts independent review of site assessment documents and provides *Written Site Selection Review Comments*.

G.3.1 Siting of Spent Fuel Storage Facilities at NPPs

G-30 The siting of a spent fuel storage facility at a NPP follows the *Regulations on the Safety of NPP Siting,* which requires that account must be taken of the interactional factors between the site and other aspects both in normal conditions and accidental conditions (including those potentially resulting in taking emergency measures). As well, consideration must be given to accidental condition (including those leading to taking emergency measures), and all external natural events and human-made events that are likely to have significant effects on the safety of NPPs. Also the applicants are required to have to provide submission relating to assessment of proposed sites to ensure a full consideration of natural phenomenon and characteristics in respect of such sites, analyze the population features in the area where nuclear facilities are sited and the capabilities to implement emergency plan during NPP lifetime, determine site-related design basis standards, the tasks that applicants will have to accomplish during site assessment, and the mission the NNSA will undertake.

G.3.2 Siting of Spent Fuel Storage Facilities at Research Reactors

G-31 The siting of spent fuel storage facilities at research reactor follows, with respect to siting, the *Regulations on Research Reactor Design Safety*. One of the main aims of research reactors siting is to protect the public and the environment from the impacts arising from radiation accidents and normal releases. In assessing the appropriateness of a proposed research reactor site, the considerations that should be taken into account are (1) impacts from external events likely taking place in the area where proposed reactor is sited (both natural and human-made), (2) site and environmental characteristics affecting radioactive material migration to human body, (3) population density and distribution and topographic features in surrounding area that are related to the possibility of emergency plan implementation and assessment of individual and population risk.

G.3.3 Siting of Spent Fuel Interim Dry-storage Facilities

G-32 The *Design of Spent Fuel Storage Facility (HAD301/02)* states the requirements for the dedicated spent fuel storage facilities that are not as part of NPPs. As required, the siting of interim spent fuel storage facilities should be subject to authorization by the NNSA and comply with the criteria and procedures stated in The *Regulations on NPP Siting Safety* and the related guidelines. Determination of proposed spent fuel storage facility site should be based on adequate safety and environmental assessments, including geology, topography, hydrogeology and civil installations. Account also should be taken of natural events like earthquake, fault zone, flooding, wind, rain, snow lightening and of human-made events such as aircraft crash and explosion. For proposed spent fuel storage facility sites affiliated to NPPs or to research reactors, the requirements applicable to the corresponding nuclear facilities should be complied with.

G-33 For the purpose of constructing an interim spent fuel interim dry-storage facility, the applicant analysed external natural events, including bad weather phenomena such as lighting, tornado, typhoon and related shooting objects, fire, earthquake and module-air-intake blockage, as well as those events resulting from external or/and human factors like fire, explosion, shooting objects, aircraft or vehicle impacts and so on. The potential impacts from these phenomena were estimated and engineering prevention measures proposed.

G-34 Assessments were made of the possible radiation exposure to the public and workers after beginning of facility operation. For the public exposure, as calculated, the dose rate to a building closest to the storage facility was measured to be 0.03μSv/h, and the direct exposure to the members of the public from modules does not pose significant radiation impacts. For the occupational radiation exposure, radiation doses are mainly from the transfer of spent fuel into fuel basket in pool and the operation of them in shielded tank, handling of shielded casks, and the process during which fuel basket is moved from shielded casks into storage modules. Adequate shielding was considered in design. Calculation showed that the maximum annual doses to workers are not in excess of 8 mSv. Also monitoring system is provided for the monitoring purpose.

G-35 Under the *Provisional Regulations for the Public Involvement in Environmental Impact Assessment*, the content of the environmental impact report on construction of temporary spent fuel storage facility should be publicly announced, prior to its submittal, on local media for advice. Also, public consultation forum should be held to inform the public of the details of construction project. The aim is to communicate the assessment results obtained with the public

and to response to the comments solicited. The participants should include experts concerned, representatives of local government staff, neighboring communities and villagers.

G-36 The operation of the facility shall pose no unacceptable impacts on other Contracting Parties.

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

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

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

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

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

G-37 Under Article 5, Design and Construction, of *HAF 301*, in view of such considerations as defense against external sabotage effects, radiation safety, criticality safety, fire protection, explosives safety, accident emergency, the effective technology tested and proven by engineering should be employed to ensure reliability required, with an overall objective of protecting workers, the public and the environment from radiation hazards.

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

G-38 Design and construction of spent fuel storage facility, as part of a NPP, need submission of license application at the same time as applying for the construction license of such a NPP, with coverage of spent fuel transfer channel, storage pool, storage rack, coolant water treatment installations.

G-39 For the design of spent fuel charging and/or discharging and storage system, the *Regulations on NPP Design Safety* states the following requirements:

(1) Employing physical means or process (geometric safety arrangements where appropriate) to prevent criticality from being reached under the optimal

moderation conditions at a NPP;

(2) Fully removing heat under operating conditions and design basis standards conditions;

(3) Checking irradiated fuel;

(4) Periodically checking and testing component parts significant to safety;

(5) Preventing spent fuel from falling down in the process of transfer;

(6) Preventing unacceptable stress from being generated on fuel element or assembly in the process of fuel charging and discharging;

(7) Preventing spent fuel transport cask, hoisting and rigging device or other damaged objects from falling, by accident, onto fuel assembly;

(8) Safely store damaged fuel element or assembly;

(9) Providing corrective radiation protection measures;

(10) Marking appropriate symbols on each fuel assembly;

(11) Controlling concentration level of soluble absorber (if applied to criticality safety); and

(12) Readily maintaining and decommissioning fuel storage and charging and/or discharging installations, and, if necessary, being readiness for decontaminating fuel charging and/or discharging and storage equipment and workplace.

G-40 For the reactors installed with water pool system for storage of irradiated fuels, such measures have also to be provided in design as (1) controlling chemical concentrations and radioactivity of irradiated fuels in pool water, (2) monitoring and controlling water level of pool water and detecting the leakage from such a pool, and (3) preventing pipe rupture from resulting in pool water exhaustion (namely anti-siphon measures).

G-41 Engineering experiences proven should be address in all above designs, and further test, quality control and management should be maintained in the process of construction. Construction-period reporting system should be implemented to maintain effective defense against radioactive hazards in respect of protecting workers, the public and the environment from being damaged.

G-42 All existing spent fuel management facilities at the operating NPPs have drawn on the experiences currently at the stages of design and construction.

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

G-43 Design and construction of spent fuel storage facility, as part of research reactor, need submission of license application at the same time as applying for the construction license of such reactor, with coverage of spent fuel transfer channel, storage pool, storage rack, coolant water treatment installations.

G-44 Decommissioning and dismantling measures must be taken into account in design of spent fuel related facilities, with special emphasis on:

(1) Selecting material in such a manner as to minimize radioactive waste generation and to be convenient to decontamination;

(2) Necessary accessibility; and

(3) Installations needed for radioactive wastes arising from decommissioning.

G.4.3 Design and Construction of Spent Fuel Interim Dry-storage Facilities

G-45 The modules for interim dry-storage facility at Qinshan Phase III NPP are designed in a manner of employing natural convection air cooling in order to ensure the effective removal of decay heat arising from spent fuel stored in such modules in both normal and postulated abnormal conditions. The temperatures in wide range of materials, including fuel pellet, cladding, basket, storage drum and concrete, are lower than the corresponding limits, with account taken of modules' maximum static load against the dropping of container. Doses to the public and workers were estimated for both operational and postulated accidental conditions, which can be kept at a very low level. Considerations were also given to physical control of the area where spent fuel is handled, loaded and unloaded to avoid access of unauthorized persons. Arrangement was made for preventing weights that are not parts of the lift from movement over fuels stored. Supporting measures for decommissioning of loading equipment and transport cask are provided on-site.

G-46 Arrangement was made for decommissioning of interim dry-storage facility, allowing for the retrieval of spent fuel, the dismantling and decontamination of modules, and site reclamation, etc. Two types of possible preliminary decommissioning alternatives are provided, either postponing of module dismantling or reclamation to the extent that the site can be unlimitedly used.

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

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

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

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

G-47 *The Law of the People's Republic of China on Prevention and Control of Radioactive Pollution* states that, 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 report and submit them to competent environmental authority under the Stage Council for review and approval. No license and other authorization documents can be granted without approval of the environmental impact report.

G-48 Under the *Regulations of the People's Republic of China on the Safety Control of Civilian Nuclear Installations*, the operator of a nuclear facility shall, prior to its construction, provide the NNSA with both Application for Nuclear Facility Construction and Preliminary Safety Analysis Report, in conjunction with other relevant documents, and shall, prior to its operation, submit to the NNSA both application for nuclear facility operation and final safety analysis report, together with other related documents. No fueling operation can be started for commissioning unless the permission for fueling and commissioning has been granted after review by regulatory authority.

G.5.1 Safety Assessment of Spent Fuel Storage Facilities at NPPs

G-49 Assessment of the handling, storage and management of spent fuel at NPPs is part of safety assessment for NPPs. In designing NPPs, safety assessment must be carried out to confirm that the designs which are in the process of fabrication and construction and/or have been completed meet the safety requirements stated at the beginning of such designs. Safety assessment is also part of design process. At the same time, iteration process may exist between design and confirmative analytical activities and will continue to expand as design plan

advances to ever increasing detailed degree. Such assessment is based on the data obtained from safety analyses, experiences gained previously, supportive results of research, and engineering practices proven by experiences. Prior to submission of safety assessment report to the national nuclear safety regulatory bodies, the operator of a NPP must ensure that demonstration of such assessment shall be carried out by independent individuals or bodies who are not involved in design.

G-50 Deterministic methodology and probability safety analysis method must be applied to safety analysis of NPP design. Based on such analysis, the design basis standards for items significant to safety must be developed and confirmed. It must also be demonstrated that the NPP designed meet all specified limits of radioactive releases and acceptable limits of potential radiation doses under all nuclear operational conditions and that defense-in-depth has played role.

G-51 China has developed detailed procedures for review and approval of safety analysis report. The NNSA is responsible for independent review of the safety analysis report and environmental impact report submitted by applicants. The review and approval procedures are:

(1) The NNSA, within 1 month after the receipt of any application and additional document from applicants, shall make response of whether or not to accept such application. After acceptance of such application, review work shall start immediately;

(2) The NNSA shall delegate nuclear safety technical organizations to review such application, and in turn such organizations shall submit to the NNSA the evaluation report;

(3) The NNSA shall invite the relevant agencies or the representatives or local governments or experts to participate in such review work if involving the issues in respect of health, labor protection, public security and transport;

(4) In the process of review, the applicants must timely answer and explain the questions raised by the NNSA, or make necessary supplementation or revision to such application;

(5) The NNSA shall send “Review Report” to nuclear safety and environmental expert committee for review. Such committee is responsible for providing advisory recommendations to the NNSA; and

(6) The NNSA shall solicit the comments from the responsible agencies of provinces where such nuclear facilities are sited.

G.5.2 Safety Assessment of Spent Fuel Storage Facilities at Research Reactors

G-52 Safety assessment of research reactor, and its spent fuel, is carried out separately in the phases of design and operation. It includes the analyses of the response of such a reactor to a wide range of initiators that would result in expected operational events or accidental conditions. In turn, these analyses can be used as the basis for identifying the operational limits and conditions (OL&C) of a reactor.

G.5.3 Safety Assessment of Spent Fuel Interim Dry-storage Facilities

G-53 In its *Regulations on Civil Nuclear Fuel Cycle Safety (HAF301)*, the NNSA has requirements that prior to construction and operation or in the process of operation, the safety assessments are needed, with safety assessment requirements being set out.

G-54 Prior to authorization to construct nuclear facilities, their design must undergo safety analysis and assessment so as to confirm the design basis standards relating to important safety structures, systems, components (or equipment) and to demonstrate that the design of the entire nuclear fuel cycle facilities can ensure radiation exposure and radioactive releases under all operational conditions and accidental conditions not in excess of the national limits.

G-55 Prior to authorization to operating nuclear fuel cycle facilities, the safety analysis must be carried out to confirm that the rules relating to design, construction, operation and management of such facilities can ensure their operations consistent with design requirements, and no occurrence of detriments affecting the health and safety of offsite persons.

G-56 In its final safety analysis report, the operator must provide sufficient detailed description of the analysis and assessment results of nuclear fuel cycle facilities so that the NNSA can conduct independent review of safety features of such facilities prior to granting construction license.

G-57 During the lifetime of nuclear fuel cycle facilities, the operators must conduct periodic assessment of operational safety of items significant to safety, including records of examination, maintenance and test, operational rules, operational experiences, nuclear criticality, radiation protection practices, and analysis and assessment of investigations and findings of significant abnormal events, and when necessary take corrective measures to ensure the operation of such facilities consistent with design requirements and conditions attached to license.

G-58 In order to facilitate safety assessment of spent fuel storage facilities,

the NNSA issued technical guidance *Safety Assessment of Spent Fuel Storage Facility*, where the content and methodology of safety assessment of such facilities and the content and format of safety assessment report are provided for in detail. It also requires that safety assessment under normal conditions and abnormal conditions be made and that such assessment conforms to potential risks arising during the entire lifetime. It also states that the safety assessment is period-effective and the operators shall regularly carry out review of such safety assessment and, when necessary, make revision to such assessment.

G-59 Prior to construction of spent fuel interim dry-storage facility at Qinshan Phase III NPP, both *Preliminary Analysis Report for Interim Dry-Storage Facility* and *Preliminary Environmental Impact Assessment Report* were submitted on the part of Qinshan Phase III NPP. It includes description of project, including assessments of stratum, geological structure, lithology and bad conditions of the site. As a result, the site is considered appropriate. Both environmental impacts and worker doses were assessed for normal and accidental conditions, with the results fully falling within acceptable limits as specified by the relevant national standards. It was concluded that construction of the project is feasible. The construction license for the project was granted in 2008.

G-60 Both reports, as submitted in 2008, dealt with earthquake and geological nature, earthquake dynamic parameters for use in design, analyzed the potential impacts of events that would result from external natural events and human factors, and proposed engineering prevention measures. In addition, the included are the detailed description of the design scope of the facility, covering fuel cluster, operating equipment, fuel basket, transport cask, shipping equipment, module structure, and auxiliary installation. Assessments were made of the potential radiation exposure to the public and workers after the commencement of facility operation. For the public exposure, the direct exposure to the members of the public from modules has no significant radiation impacts. For occupational radiation exposure, radiation doses are mainly from the transfer of spent fuel into fuel basket in pool and the operation of them in shielded tank, handling of transport cask, and the process in which fuel basket is moved from cask to storage modules. Adequate shielding was considered in design. As showed from calculation, the maximum annual doses to workers are not in excess of 8 mSv. Also monitoring system is provided for the monitoring purpose.

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.6.1 Operation of Spent Fuel Storage Facilities at NPPs

G-61 It is one of licensing conditions for NPP operation that the operators of such NPPs must be responsible for arrangements for all activities involving core and fuel management, to ensure the safety of fuels in reactor and the safety of fuels in the process of on site transfer and storage. For this purpose, the operators of NPPs shall:

(1) prepare technical conditions and procedures for purchase, charging, use, discharging and testing;

(2) develop the fueling and refueling program in accordance with design requirements and submit it to the NNSA;

(3) monitor core state, review and revise the fuel charging and discharging program;

(4) prepare criteria and procedures for treating the fuel defects to reduce radioactivity of fissile products in reactor cooling loop or in gaseous effluent as much as possible;

(5) prepare the procedures for management of fuels and core parts, including un-irradiated and irradiated fuel transfer, onsite storage and preparatory work for shipment to the outside;

(6) submit the option of spent fuel storage to the NNSA for approval;

(7) make the package, transport and shipping of spent fuel to be consistent with national laws and regulations and applicable international standards; and

(8) develop and maintain a comprehensive record-keeping system covering core management, fuel performance, activities handling fuel and core parts and fuel storage;

G-62 The operators of various spent fuel management facilities at the operating NPPs are all collecting and analyze the relevant operational experiences and plans. All safety-related engineering and technical supports are made available during lifetime of such facilities.

G-63 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) 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 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 onto spent fuel;

G-64 Management methods for spent fuel assembly are to:

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

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

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

G-65 Examination and management methods for spent fuel assembly are to:

(1) examine the design, testing, transport option and transport test of spent fuel transport casks and qualification of consignees so as to ensure transport related matters consistent with national laws and regulations;

(2) prepare the transport lists of spent fuel assemblies in accordance with approved plan for transporting spent fuel assemblies in such a manner as to inspect assembly serial number, storage location and storage time;

(3) monitor and record radiation doses associated with spent fuel transport container passing through plant gate and record the resulting dose; determine surface contamination of such containers before departure from plant area so as to ensure national requirements to be met;

(4) sign on the list of spent fuel assembly shipped out of plant, by handover part and takeover part; and

(5) prepare *Nuclear Material Delivery Report Form* and submit to higher authorities and then to IAEA.

G-66 NPPs shall make arrangements for operational safety management and carry out operational safety analysis. All operational rules shall be reviewed and updated and radiation protection program reviewed and amended in accordance with experiences gained. During operation, safety analysis should be conducted and corrective actions should be taken, when necessary.

G-67 Periodic safety review systems have been established on the part of NPPs to maintain high safety level. The carrying out of safety review begins generally at the tenth year after operation of NPPs, later once every ten years until the end of operational life-cycle. The periodic safety review encompasses all aspects of NPP safety, like facilities, structures, systems and components (including spent fuel management facility) and their operation, allocation of human resources and their organizations within plant areas and covered by their operational licenses. Other inclusions are radiation protection, emergency plan and radiation environmental impact, which are safety factors equally important to all nuclear units.

G-68 The NPP operators submit Annual Operation Report to the NNSA

every year in a timely manner. Spent fuel management activity is part of NPP production activity. As required by the *HAF001*, the safety event likely taking place in operation of such facilities shall be reported to the NNSA in a timely manner.

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

G-69 The operators of research reactors are responsible for, and make arrangement for, all activities involving core management and onsite fuel management. Technical specifications relevant to spent fuel safety management should be developed in accordance with design requirements, including discharging and storage of spent fuel. Storage option shall be submitted to the NNSA for approval. The delivery of spent fuel should be consistent with the provisions relevant to package and transport. Comprehensive documentation shall be maintained for recording all information concerning the operation of spent fuel facilities.

G.6.3 Operation of Spent Fuel Interim Dry-storage Facilities

G-70 Under the *Regulations on Civil Nuclear Fuel Cycle Safety (HAF301)*, commissioning program must be developed for the purpose of commissioning nuclear fuel cycle facilities so as to demonstrate that such facilities have been completed in accordance with the approved requirements and are being capable of playing designed functions. The *HAF301* requires that the operators shall, base on final design, safety analysis and environmental assessment, finalize operational limits and conditions in respect of technology and management. Also, operational limits and conditions need to be reviewed and updated in accordance with both operational experiences and changing circumstances in safety features. The *HAF301* also sets out the requirements in respect of operational rules, supervision, inspection, testing and maintenance.

G-71 The *HAF301* requires that, when discovering any deviation from operational conditions, the nature, extent and consequences of incidents or accidents and the remedial actions envisaged shall be reported in accordance with report regime.

G-72 All operational activities at a spent fuel storage facility must be in accordance with the written procedures prepared by the operators themselves and approved by regulatory authorities. The basic operation safety considerations, including sub-criticality, shielding, containment, heat removal, falling object and others, are compatible with both operational condition safety analysis and accidental

condition safety assessment specified in *Assessment of the Safety of Spent Fuel Storage Facility (HAD301/04)*, which includes sub-criticality, radiation protection, integrity of structure, decay heat removal and site conditions. After completion of commissioning, the final commissioning report shall be developed to convince the NNSA that its requirements has been satisfied and to lay reviewing basis for the full scale of subsequent operation of such facilities.

G-73 Prior to granting the operational license for an interim dry-storage facility, wide verity of preparation needs be made to meet the requirements for the operation of the facility. These are the erection and commissioning of system and equipment of safety significance; the equipment, tools, operational procedure and operation simulation within spent fuel preparation zone, transport zone and storage zone; the quality of facility surrounding embankment and module construction; the examination of physical barrier, alarming system and physical protection; the drafting of operational document; and emergency preparedness and exercise. Operational license can be granted only when the above-mentioned requirements have been satisfied and considered by the MEP/NNSA to be qualified after its on-site inspection.

G-74 For the purpose of operating interim dry-storage facility, the plans were developed for examination and maintenance of storage modules, storage drums, fuel basket and shielding operation cell. Equipment that is expected not to be maintained or replaced within the facility life-cycle is storage modules and storage drums. Integrity of fuel basket seal is ensured by the quality of automatic welding within shielding operation cell. Operational procedures were prepared for the examination standards, maintenance, examination period and items, method and quality, test and qualification of the equipment to be involved.

G-75 The designed life-cycle of an interim dry-storage facility is 50 years, during which all safety-related engineering and technical supports can be available. If event or accident deviating from operational conditions occurred, report should be provided, according to reporting system, to regulatory authority with respect to the nature, scope and consequence of an event or accident, in conjunction with remedy measures to be taken. Analysis and assessment of operational experiences should be made mainly through periodic safety analysis in operational period, and, as required, necessary corrective measures should be taken.

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-76 China's policy on spent fuel management is to reprocess spent fuel in order to make full use of nuclear fuel. At present, any type of spent fuel has not been decided to be disposed of directly in China.

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

This section covers the obligations under the following articles:

Article 11. General safety requirements

Article 12. Existing facilities and past practices

Article 13. Siting of proposed facilities

Article 14. Design and construction of facilities

Article 15. Assessment of safety of facilities

Article 16. Operation of facilities

Article 17. Institutional measures after closure

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, laws and regulations and standards on radioactive waste management has been established and a wide range of measures envisaged for implementing the management of radioactive waste.

H-2 *Regulations on Radioactive Waste Management*（*GB 14500-2002*）is the basic standard for radioactive waste management in China. It sets forth the underlying principles that must be adhered to in the field of radioactive waste management in China. These are to protect human, the environment and future generations from hazards from ionizing radiation, take account of transboundary impacts, comply with relevant national laws and regulations, keep the generation of radioactive waste to minimum practicable, and take account of the interdependencies between the different steps in radioactive waste management and the safety of radioactive waste management facilities.

H-3 A series of national standards and technical guidelines on radioactive waste management have been developed to ensure the implementation of underlying principles on radioactive waste management.

H-4 The *Acceptance Criteria for Near Surface Disposal of Radioactive Waste (GB 16933-1997)* requires to limit the content of fissile materials in radioactive waste package so as to prevent criticality risks from taking place in radioactive waste.

H-5 China's laws and regulations require that the quantity of radioactive wastes generated should be kept at the levels that are ALARA. Under *the Law of the People's Republic of China on Prevention and Control of Radioactive Pollution* and the *Regulations on Radioactive Waste Management*（*GB 14500-2002*）, 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 *Regulations on the Safety of Radioactive Waste Management at Nuclear Power Plants*, considerations of keeping the generation of radioactive waste to minimum practicable shall be integrated into the design of a NPP. Varieties of effective

measures are envisaged in China to reduce the quantity generation of radioactive wastes generated at NPPs and other types of nuclear facilities. With upgraded management level, the quantity of radioactive waste generated at NPPs continues to drop.

H-6 China has considered inter-dependency between different steps in radioactive waste management. The *HAF401* requires that any operator must take into due account the inter-dependency between different steps in the generation and management of radioactive wastes.

H-7 A wide spectrum of laws, regulations and standards governing radioactive waste management has been promulgated or issued in China. The MEP/NNSA, together with other agencies, issued a large number of guidelines on radioactive waste management, involving the design and operation of radioactive waste management facilities, discharge of radioactive effluents, and disposal of radioactive wastes. These set out the requirements and criteria for protection of the public, the workers and the environment in respect of several main links in waste management, which are basically consistent with international endorsed standards and criteria. The MEP/NNSA, alongside with the competent authority of nuclear facilities, shall make inspection and supervisory monitoring of compliance of such facilities with standards.

H-8 China has taken full consideration of biological, chemical and other hazards that are likely attributable to the management of radioactive wastes. For this purpose, *the Law of People's Republic of China on Prevention and Control of Solid Waste Pollution* was promulgated in 1995 and updated in 2005. Additionally, the *Regulations on Chemical Hazardous Article Management* and the *Policy on Prevention and Control Techniques for Hazardous Waste Pollution* were issued in 2002.

H-9 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. The *HAF401* states that radioactive waste shall be managed in such a way that no greater adverse health impacts are expected to impose on future generations than the today's acceptable level.

H-10 China in its laws, regulations and standards specify that effort should be made to avoid imposing undue burdens on future generations. For example, *HAF401* requires no undue burdens be imposed on future generations. There have been two solid LILW repositories 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 *Interim Procedures on Collection, Utilization and Management of the Funds for Treatment and Disposal of Spent Fuel from Nuclear Power Plants* was issued on July 12, 2010 (see F.2.2.1). The purpose of these efforts is to avoid imposing undue risks and undue burdens on 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-11 In China, there are three types of radioactive waste management facilities, which are nuclear facility affiliated waste management system, storage facility for the storage of nuclear technology application radioactive waste and LILW disposal site.

H-12 Under the *HAF401*, operators shall comply with the relevant laws, regulations and standards in assessing the new waste management facilities and practices and the major modifications to the existing facilities and practices. Both safety analysis report and environmental impact assessment report should be prepared and submitted to the NNSA and environmental protection agencies.

H-13 Radioactive waste management system is built at each NPPs, research reactors, large nuclear research facilities, uranium enrichment plants and fuel assembly fabrication plants. In addition to meeting general requirements for the safety of nuclear facilities, such a system also should meet radioactive waste management facility specific safety requirements. In accordance with China's laws and regulations, both nuclear facility safety assessment and environmental impact assessment should comprise all factors that likely affect the safety of radioactive waste management system during lifetime of such nuclear facility.

H-14 Since the 1960's, waste storage facilities have been built in succession

in China. The *Criteria on Siting, Design and Construction of Nuclear Technology Application Radioactive waste Storage Facility* was issued in 2005, according to which the majority of the existing nuclear technology application radioactive waste storage facilities have been reconstructed and extended, with a national centralized storage facility for SSRS built newly. Currently, there are a total of 31 provincial nuclear technology application radioactive waste storage facilities and one national centralized storage facility for SSRS. The provincial facilities are mainly for storing short-lived disused/spent radioactive sources and solid radioactive waste generated within these provinces, whereas the national storage facility is primarily indented to store long-lived disused/spent radioactive sources of potentially significant hazards.

H-15 There are currently two solid LILW disposal sites, Beilong Disposal Site and Northwestern Disposal Site. Beilong Disposal Site began its site selection in 1991. The construction of the first phase project of the repository was completed in October 2000. In February 2011, the commercial operation license was granted for the disposal site. The siting work of Northwestern Disposal Site began in 1988. The first phase project, 20 000 m^3 radioactive waste acceptance capacity, was completed in 1998 and put into trail operation in 1999, and begins commercial operation in 2011.

H-16 China's radioactive waste management facilities in operation are always under the supervisory monitoring. The licensees of nuclear facilities are required to carry out periodic monitoring and evaluation of the safety situation in such facilities. Operational monitoring results of the radioactive waste temporary repositories show that accessible environmental radioactivity level and individual dose are consistent with national requirements.

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-17 China 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.3.1.1 Siting of Affiliated Radioactive Waste Management Facilities

H-18 For nuclear facility affiliated radioactive waste management facilities, their siting issues are taken into account at the time of such facility being sited. *The Law of the People's Republic of China on Prevention* and *Control of Radioactive Pollution* states that, for the siting of nuclear facilities, the scientific demonstration should be carried out and licensing process followed. Prior to this process, environmental impact report should be prepared and submitted to the competent

environmental authorities for review and approval. Any relevant agencies can not grant the siting license without approval of the environmental impact assessment report. The NNSA issued *Regulations on NPP Siting Safety* and associated relevant nuclear safety guidelines, such as regulations and standards, to ensure the siting of nuclear facilities consistent with safety requirements.

H-19 The requirements for NPP affiliated solid LILW storage facility are as follow:

(1) A stand-alone storage facility should be 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) The geographical location where the storage facility is sited should be able to prevent a 100 year record high flooding;

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

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

H-20 Consistent with the national laws, regulations and standards, the systematic site characterization had been completed for China's NPPs in operation and under construction prior to their commencement. Evaluations were made of all site-related factors that may have the potential impacts upon the safety of a proposed NPP during the designed lifetime and of the likely effects of such a proposed NPP upon individuals, society and the environment. After review, the MEP/NNSA issued the comments concerning such site evaluations.

H.3.1.2 Siting of Independent Radioactive Waste Storage Facilities

H-21 For independent radioactive waste storage facilities, including nuclear technology application radioactive waste storage facilities and liquid HLW storage facilities, the requirements for siting issues have been set out in China.

H-22 The siting process, that has to be followed for temporary storage facilities for nuclear technology application radioactive waste, is subdivided into initial preliminary selection and site determination. Initial preliminary selection is to select 2-3 candidate sites through preliminary investigation and assessment of the area of interests. In special circumstances, regulatory body can agree to conduct preliminary investigation and assessment of designated sites. Site determination is to determine a site to be recommended through detailed investigation, assessment and demonstration of candidate sites.

H-23 The siting of temporary storage facilities for nuclear technology application radioactive waste should meet the needs of construction, operation, extension and decommissioning thereof, consider the effects on waste storage facility of external human-made events and natural occurrences and the likely impacts of release of radioactive and hazardous materials upon the public and the environment, ensure provision of adequate and excellent containment performance of isolating radioactive waste from the public and the environment to enable regulatory requirements to be met, consider both constraint factors on the local social and economic development and economic reasonability of construction and operation of such waste storage facilities.

H-24 For the siting of the liquid HLW storage facility, the consideration should be given to the local geological, meteorological and social conditions. Geological conditions include seismicity potentials, site lithology, site conditions of engineering geology and hydrology. The site is required to be at the upwind area from the central point of population area with annual minimum wind frequency, where there exists desirable atmosphere dispersion condition, and high frequency of tornado, typhoon, sandstorm and rainstorm should be avoided. In social and economic respects, the site is required to be in the area with low population density, far from city and densely populated area and with no major economic developments in the foreseeable future. The comments from the local government and the public should be taken into account.

H.3.1.3 Siting of Radioactive Waste Disposal Facilities

H-25 Under *the Law of the People's Republic of China on Prevention and Control of Radioactive Pollution*, the competent nuclear facility authority under the State Council (National Atomic Energy Agency), in conjunction with environmental competent authority under the State Council, should develop the program for the siting of solid radioactive waste disposal facility, on a basis of geological conditions and solid radioactive waste disposal needs and of environmental impact assessment. This program can not be implemented without the approval of the State Council. The relevant local governments should, based on such a program, provide construction land for solid radioactive waste repository and take effective steps to support the disposal of such waste.

H-26 The site requirements for the near surface disposal of solid LILWs and deep geological disposal of solid HLW have been issued in China.

H-27 To ensure the siting of radioactive waste disposal facility consistent with the relevant requirements, the siting-related management procedures are

established, including overall requirements on siting management, information collection and management, siting quality assurance and siting criteria application. The overall requirements are:

(1) Siting process begins from deciding construction of a waste repository and concludes with final determination of a site that is considered to satisfy all safety and other requirements;

(2) At each stage of the siting process, the relevant national policy and laws shall be adhered to, taking comprehensive account of social and ecological protection issues. In the process of siting, communication is should be maintained with national regulatory body to notify situational information. Site determination must be subject to the review and approval of the MEP/NNSA;

(3) At the beginning of each stage of siting process, work plan should be made, including the objective and content of task, work procedure, criteria used, schedule of progress, QA program and cost estimates; and

(4) For site recommendation, both environmental assessment and safety assessment should be carried out to reflect the process of decision making and to include the basis for supporting such decision making. Such assessments include not only the current and future likely impacts of such repository on the human health and the environment but also the impacts of the local environment on such repository and the likely avoidance and mitigation measures of such impacts.

H-28 The above principles and technical standards were followed in siting of radioactive waste disposal facilities in China. To meet the need of nuclear power expansion for radioactive waste disposal, the CAEA and MEP/NNSA jointly caused the *LILW Repository Siting Plan* to be developed, intending to construct LILW repository each in Northwest China, Southwest China, East China, South China and North China, with the environmental assessment completed for the Plan. The results of assessment indicated that target of the Plan is capable of meeting the need of the country concerning LILW waste disposal, that it is appropriate to construct LILW repository each in Northwest China, Southwest China, East China, South China and North China, that stringently complying with the existing national standards is capable of ensuring the safety of LILW disposal, and that overall disposable capacity as proposed by the Plan can meet the expected need of our country in respect of future LILW disposal.

H-29 A series of processes required, consisting of regional survey, site characterization, and site determination, were implemented for both Beilong Disposal Site and Northwestern Disposal Site prior to their construction. The siting

work for the Southwest China disposal site was completed in 2010. In the site screening stage, five candidate sites were preliminarily recommended after data collection and comparison in terms of natural conditions, population distribution, economy and society, and transportation conditions. Based on field reconnaissance on these five sites, three candidate sites were selected for site characterization. Both environmental impact assessment statement and safety analysis report for the site licensing application phase were completed in 2010. After review by the MEP/NNSA, the Southwest China disposal site was finally approved for construction.

H-30 China's research efforts to conduct geological disposal of HLW began in 1985, with focus on the siting and site characterization among other things. At that time, the CNNC, in collaboration with other research institutions and universities, began with pre-siting activities in relation to high level waste repository. Initial comparisons were made among pre-selected regions, such as East China, South China, Southwest China, Inner Mongolia and Xinjiang, with the emphasis on candidate Beishan site located in Gansu province in aspects of geology, hydrogeology, seismology, social and economic conditions. Boring activities were conducted to obtain in-depth rock samples, water samples and other relevant data, thus preliminarily establishing the assessment methodology for granite site. Under the *Guidelines on Planning of Research and Development of High Level Waste Deep Geological Disposal in China*, as issued jointly by the CAEA, the MEP and the Ministry of Science and Technology (MST), the process of site screening will be further strengthened in the next several years, and the decision of determining the candidate site made around 2020 for site characterization, and the final decision of the site made around 2040.

H.3.2 Public Involvement in Process of Siting

H-31 *The Law of the People's Republic of China on Environmental Impact Assessment* states that for the projects that are likely to cause adverse environmental impacts and to directly involve the public environmental right and interest, the public demonstration and hearing meetings should be held or other approaches adopted to solicit the comments on drafted environmental impact assessment statement from the relevant organizations, experts and the public before its submission for review and approval. The constructor and the operator of proposed site should take consideration with the comments provided from the relevant organizations, experts and the public and provide additional explanations to whether these comments have been adopted when submitting environmental impact

assessment report for review. This Law also stipulates that for the construction projects that are likely to cause major adverse impacts and to prepare environmental impact assessment statement, the public demonstration and hearing meetings should be held or other approaches should be adopted to solicit the comments on drafted environmental impact assessment statement from the relevant organizations, experts and the public before its submission for approval. The environmental impact assessment report submitted by the constructor should be accompanied with the additional explanation of the reason why the comments provided by the relevant organizations, experts and the public have or have not been adopted.

H.3.3 Review and Approval of LILW Disposal Sites

H-32 Great importance has always been attached to the review and approval of LILW disposal site in China. The procedures on evaluation and review of radioactive waste disposal site are formulated both in *the Law of the People's Republic of China on Prevention and Control of Radioactive Pollution* and in *Regulations on Supervision and Regulations of the People's Republic of China on the Safety Control of Civilian Nuclear Installations.* The environmental impact assessment statement is required to be prepared in the phase of application for site license and submitted to the MEP/NNSA for review and approval.

H-33 In the process of evaluation and review of the environmental impact assessment statement for such a proposed disposal site, the MEP/NNSA shall entrust professional technical support organizations with reviewing the technical details of the statement and conducting on-the-spot investigation. The comments and suggestions given by the technical support organizations shall be submitted to the expert panel of the nuclear and radiation safety for review. According to the review comments formed by the expert panel and to comprehensive consideration of other related factors, MEP/NNSA will make a decision of whether or not such a site shall be approved.

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

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

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

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

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

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

H-34 China has issued the *Design of Radioactive Waste Management System at NPPs*，the *Siting, Design and Construction of Nuclear Technology Application Radioactive Waste Storage Facility* and the *Regulations on Near Surface Disposal of Solid LILW* to govern the design and construction of the radioactive waste treatment facility, the nuclear technology application radioactive waste storage facility and the LILW repository.

H.4.1 Design and Construction of Affiliated Radwaste Management System

H-35 The targets and requirements of waste management system affiliated to nuclear facilities are to:

(1) Comply with annual limits of radioactive release to the environment and released concentration limits specified by the NNSA;

(2) Keep exposures of radiation to the workers and the public at ALARA level and individual dose below the national limits;

(3) For design of radioactive waste management system, ensure the final waste package to meet the requirements of offsite transport and disposal acceptance specified by the NNSA; consider the consequences of single event likely leading to

major risk, including mis-operation of operating persons;

(4) Separate radioactive waste management system from those of non-radioactive waste management system; and

(5) Radioactive waste management system should be designed practically reasonable to reuse the treated items within the plant, reduce the volume of wastes, reduce the generation of secondary wastes and facilitate future decommissioning.

H-36 Nuclear facilities shall be constructed in accordance with design requirements and detailed QA program prepared, including the associated radioactive waste management facilities. For example, the QA program for a NPP covers fabrication, assembly, installation, loading/unloading, storage, cleanup, washing, examination, testing, modification, repair, maintenance and other related activities. This QA program requires:

(1) To prepare construction plan (including demonstration work) and be documented;

(2) To accomplish the prescribed tasks in accordance with written procedures, directives, instructions, drawings; such written procedures and directives are, prior to issuance, subject to authorization and approval;

(3) To prepare, and implement as required, management requirements and measures;

(4) Implement stringent management of the receipt, storage and handling of material and equipment;

(5) To prepare procedures used to specify the selection, marking, use, calibration requirements and calibration frequency of all measuring and testing equipment; the calibration must be consistent with the authorized procedures and the issued standards; and

(6) To make workers to undergo necessary training and examination, who can not take the position without relevant certificate.

H-37 The design and construction of radioactive waste management systems affiliated to nuclear facilities have complied with the relevant national regulations and standards. Prior to granting construction license, the NNSA organized review and evaluation of preliminary safety report and QA program submitted by the operators. 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 supervision 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.4.2 Design and Construction of Nuclear Technology Application Radwaste Storage Facilities

H-38 The design of nuclear technology application radioactive waste storage facility consists of two stages; preliminary design and construction drawing design. The design of such waste storage facility should be in accordance with the following principles:

(1) Meeting the requirements on radiation protection and radioactive waste management, provide protective measures for workers involving wastes and the public;

(2) Favoring construction, operation, maintenance and decommissioning;

(3) Providing for the ready retrieval of waste; and

(4) Employing the technology, process, equipment and devices proven by past practices to be safe, reliable and effective.

H-39 The overall layout of nuclear technology application radioactive waste storage facility should take account of the quantity, physical property, compositions and concentrations (or percentage), nuclide types and concentrations (or total activity), non-radioactive hazardous compositions and concentrations, package surface dose rate and surface contamination level. The principles are:

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

(2) Reduce transport and portage distance as much as possible; and

(3) Favoring dispersion of airborne effluents

H-40 Process design is required to meet the needs for system, equipment, devices and portage tools required by receipt, transport, storage, emplacement, retrieval shipping, treatment and disposal, and decontamination and dismantling during operation, repair and decommissioning of the waste storage facility.

H-41 The safety and security system should be set up based on design requirement, including access control, closed TV monitoring system, lighting and

alarming system in the surrounding area of such waste storage area.

H-42 The resources and conditions essential to prevention of accident and emergency measures should be taken into account.

H-43 To facilitate future decommissioning, the design considered the following factors, including:

(1) The floor, wall and work table surface that could to be likely contaminated is made of smooth and seamless materials from which contaminants are uneasily absorbed 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 all facilities 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-44 Once non-conformances are found arising from the project under construction, the corrective measures must be taken and reported to the constructor. Such corrective measures, if not achieved, should be reported to the upper level authority. The reporting, treatment and acceptance of non-conformances are recorded in detail.

H.4.3 Design and Construction of LILW Disposal Sites

H-45 By implementing a rang of laws, regulations and standards, such as *the Law of the People's Republic of China on Prevention and Control of Radioactive Pollution*, *Regulations of the People's Republic of China on the Safety Control of Civilian Nuclear Installations* and *Regulations on Near Surface Disposal of Solid LILW (GB 9132-1988)*, the design and construction of LILW disposal site are ensured to be able to meet the safety and technical requirements. Under the Law of the People's Republic of China on Prevention and Control of Radioactive Pollution, the environmental impact assessment statement (including part of safety analysis) among other technical documents for construction application phase shall be prepared and submitted for a full-range review prior to construction of LILW disposal site. The construction license must be obtained before starting construction,

which shall be granted by MEP/NNSA after review completion.

H-46 To enable the design and construction of LILW disposal site to be consistent with the technical requirements, both qualification permission system and supervision system are established in China. It is required that the design, construction, commissioning and environmental impact assessment shall be undertaken by the qualified groups. With supervision system integrated into the construction of LILW disposal site, the qualified supervision bodies are required to implement full-process supervision in construction phase.

H-47 Under *Regulations on Radioactive Waste Management (GB 14500-2002)* and *Regulations on Near Surface Disposal of Solid LILW (GB 9132-1988)*, which are compulsory national standards, the design of disposal facility must ensure that:

(1) Within the time period when waste likely result in unacceptable risks to human, the radionuclides contained in waste are confined within the scope of waste repository so as to prevent such radionuclides from being released into the environment with unacceptable concentrations and quantity that can affect the human health and safety.

(2) For the safety of the workers and the public in the vicinity in normal operational condition and accident condition, radionuclides that could return to the human living environment must be controlled not to exceed permitted level at any time;

(3) Long term stability shall be ensured and the post closure maintenance of such disposal facility should be minimized; and

(4) The design of such disposal facility must be in line with the closure and stabilization plan for such disposal facility and can provide reasonable guarantee for the closure of such disposal site.

H-48 Disposal unit should be designed to be consistent with the overall planning of the entire site. Waste receipt area should include:

(1) Examine apparatus for transport vehicles and containers （including dose rate meters, surface contamination detection meters and accuracy of item lists）;

(2) Tools for unloading and one-by-one verification of waste drum or box;

(3) Radiation monitoring and alarming system;

(4) Installations to fix damaged containers; and

(5) Decontaminating devices used for transport equipment and treatment

installation for decontaminating waste.

H-49 A disposal site should be constructed with engineered barrier to prevent the intrusion of groundwater and surface water and to reduce contact of waste with water as much as possible, with special emphasis on prevention of the surface water and rainwater infiltration into the disposal units. The water-proof design for the disposal facility is dependent on many characteristics such as rock permeability, adsorption property, surface runoff, groundwater table, and so on. Drainage design should ensure accumulated water on ground to be drained smoothly and water in the disposal units exhausted timely.

H-50 In addition, the design of disposal facility should consider backfilling, cover layer structure, surface treatment, plantation, and the groundwater monitoring well or channel set at appropriate locations in the vicinity of disposal units.

H-51 Beilong Disposal Site and Northwestern Disposal Site both meet the design requirements by *Regulations on Near Surface Disposal of Solid LILW*. At Beilong Disposal Site, 8 disposal units with total capacity of 8800 m^3 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 water shed. Below the unit bottom, a drainage collecting system was established.

H-52 In the case of the Northwestern Disposal Site, disposal unit for such site is designed to use reinforced cement structure without bottom. The space, between waste drums and between waste drums 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.

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

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

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

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

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

H-53 Under *the Law of the People's Republic of China on Prevention and Control of Radioactive Pollution*, *Regulations of the People's Republic of China on the Safety Control of Civilian Nuclear Installations* prior to construction, fueling, operation and decommissioning of nuclear facilities, the operators must apply for the construction and operation licenses and for authorizations for fueling and decommissioning. Prior to carrying out such processes, the operators should prepare environmental impact assessment report and submit it to the competent environmental authority under the State Council for review and approval.

H-54 The *Regulations on Radioactive Waste Safety (HAF401)* gives the specific requirements on the safety of radioactive waste management facilities. According to *HAF401*, the operators shall comply with the relevant laws, regulations and standards in assessing the new waste management facilities and practices and the major modifications to the existing facilities and practices. Both safety analysis report and environmental impact assessment report should be prepared. *HAF401* requires that analysis and demonstration be given in such report to both radiation safety and non-radiation safety in normal operational condition and to the potential impacts of incidents and accidents. In the case of normal operational conditions, the radiation and non-radiation effects to the workers, the public and the environment arising from all steps of radioactive waste management should be also analyzed and demonstrated. These assessments should be based on the design of

facilities and technological process. Evaluation, description and analysis should be carried out for potential non-radiological effects of radioactive waste management facilities on the human survival, the environment and the natural resources. The likely consequences of internal and external incidents that could lead to accidents, alongside their impacts on the workers, the public and the environment, should be assessed.

H-55 For LILW disposal facilities, safety analysis and environmental impact assessment should be made, as required, in determining site, construction, operation and closure of such disposal facilities. Also the content and requirements are specified in detail for the safety analysis and environmental impact assessment at different stages.

H-56 For safety analysis and environmental impact assessment at the stages of the application for determination of disposal sites, the following must be included:

(1) Implementation of safety requirements specified in relevant standards, problems encountered and measures taken;

(2) Analyses of the potential transfer of radionuclides into the environment from such disposal facility in respect of quantity and probability, mechanisms of intake into human body, and pathway and rate; preliminary estimation of likely dose to the public from such disposal facility in normal condition, natural event and human-made event and required safety assessment; and

(3) Pre-analysis and pre-assessment of environmental impact at stages of construction, operation and post closure, as well as effects of accessible environment on such disposal site.

H-57 For the safety analysis and environmental assessment at the stages of application for construction, the following must be included:

(1) Description of engineering measures and their reliability; and

(2) Further demonstration of safety analysis report and environmental impact assessment report; estimation based on design parameters of the doses to the public and the workers at operation stage and dose to the public after closure of such disposal site; consideration and assessment of the risks to be posed by proposed disposal facility to the human and the environment in the event of natural disaster and human made event.

H-58 Prior to the operation and closure of the disposal site, the operators are required to carry out environmental impact assessment and safety analysis and can

not proceed without the approval by the MEP/NNSA.

H-59 The assessment results at Guangdong Beilong show that the disposal site was chosen in a closed environment with low population and stable geological condition. 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 of 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 site will not lead to any unacceptable impacts on the environment.

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-60 Under *the Law of the People's Republic of China on Prevention and Control of Radioactive Pollution*, establishing an entity to specially store and dispose of solid radioactive waste shall be conditional on the approval and licensing by the competent department of the State Council responsible for environmental protection, in order to ensure the reliable operation of a radioactive waste management facility. The *Regulations on Radioactive Waste Safety (HAF401)*, together with their associated detailed rules, sets forth the specific requirements for the qualification of an operator of radioactive waste management facility with respect to personnel, equipment and system.

H-61 Under *the Law of the People's Republic of China on Prevention and Control of Radioactive Pollution*, the operator of a nuclear facility shall apply for operating license before its operation in accordance with the provisions of the State Council concerning nuclear facility safety. No operational activity can be carried out unless the operating license or permission documents have been granted. Prior to application to the operating license, the operator of a nuclear facility shall prepare environmental impact assessment statement and submit it to the MEP/NNSA for review and approval. No license and the other documents can be granted without authorization.

H-62 The MEP/NNSA has developed a wide spectrum of regulations and rules ensuring normal operation of the nuclear waste management facilities, encompassing completion acceptance system for environmental protection facilities, supervision and inspection system, supervisory monitoring system, and reporting system.

H-63 Under *the Law of the People's Republic of China on Prevention and Control of Radioactive Pollution*, the radioactive waste management facility, associated with a nuclear facility, should be designed, constructed and operated simultaneously with the main project. 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 trail operation shall be submitted to the MEP/NNSA. No trail operation can be started without approval. After completion of trail 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-64 The supervision and inspection system requires that, during operation of a radioactive waste management facility, MEP/NNSA, and its agencies, shall perform supervision and inspection of the operational status of such a facility,

including routine supervision and inspection, and non-routine inspection in the forms of general inspection, special inspection and on-the-spot inspection. These activities are accomplished typically through field inspection, document inspection, record inspection and dialogue inspection.

H-65 The supervisory monitoring system requires that environmental protection departments shall periodically conduct supervisory sampling, analysis and measurement activities with regard to the operation of a radioactive waste management facility and its impacts on the environment and then submit the monitoring results to MEP/NNSA and to the environmental protection competent department of a province where that facility is sited.

H-66 The reporting system for radioactive waste management facilities states that the operator of a radioactive waste management facility shall periodically provide a comprehensive report to MEP/NNSA about the operational status of that facility, including organizational structure of the operator, the acceptance, treatment and disposal of wastes, the findings and existing problems among others.

H.6.1 Operation of Affiliated Radioactive Waste Management System

H-67 For nuclear facility affiliated radioactive waste management facilities, the operation license was granted, before their operation, complying with the requirements of relevant laws and regulations.

H-68 A wider spectrum of regulations and standards has been issued in China to ensure normal operation of radioactive waste management facilities.

H-69 Radioactive waste management programs must be prepared and implemented by the operators of nuclear facilities and submitted to the NNSA for review and approval before their operation. Such programs should cover the policies governing waste collection, treatment, storage and disposal and policies to restrict discharge of effluent. Test must be made for the process generating waste, as well as characteristics, discharge and treatment of waste.

H-70 The operators of nuclear facilities must prepare and implement environmental monitoring plan.

H-71 The operators of nuclear facilities must periodically provide the NNSA and its local branches with reports relevant to discharge approaches of liquid and gaseous effluents, total activity and content of all nuclides discharged, the generation, treatment and disposal of solid radioactive waste. In the event of safety related incident and accident, the operators should report to the NNSA and its local branches.

H-72 The documents of radioactive waste management programs, together with waste management procedures, are all prepared by the operators of the existing NPPs, research reactors and fuel element production plants. The operators provide, at regular interval, the NNSA and its local branches with report containing the discharge of liquid and gaseous effluents, the generation, treatment and disposal of solid waste and the environmental monitoring information.

H-73 The NNSA and its local branches carry out periodic supervision and field inspection of waste management facilities in these nuclear facilities and address the existing problems found during their inspection and the requirements on improvement or modification.

H-74 The NNSA and the provincial environmental regulatory bodies of the locality where nuclear facilities are located organize periodic supervisory monitoring of the environment in the vicinity of nuclear facilities.

H.6.2 Operation of Nuclear Technology Application Radwaste Storage Facilities

H-75 Under the Chinese laws and regulations, the operator of interim storage facility of nuclear technology application radioactive waste shall obtain the operating license prior to operation. The requirements on operational management of storage facilities for nuclear technology application radioactive waste have been set out in China, covering the receipt and storage of waste and environmental monitoring.

H-76 Radioactive wastes generated due to nuclear technology application may be usually received, and transported, by the operators of waste storage facilities from the producers of wastes. The waste producers should fill out the proposed waste registration card in advance, including the types, form, nuclides and activity of the wasted to be received, waste package shape, surface dose rate, waste producer and other required information. No waste can be received unless it has been checked to be consistent with acceptance criteria.

H-77 Radioactive wastes to be sent to the nuclear technology application radioactive waste storage facility shall be put into standard containers and sealed radioactive sources into package containers.

H-78 Workers after receiving and handing wastes should go through body surface contamination examination and can leave only be checked to be consistent with required standards. Vehicles and tools should be checked for surface contamination and, if with the surface contamination value higher than the limit of

the national standards, have to undergo decontamination.

H-79 Wastes being held in storage should be emplaced in terms of their types and maintained comprehensive record. The record-keeping time period should be longer than the hazardous period. Wastes and sealed radioactive sources that could not decay to clearance levels within a safe storage period have to be stored in such a way to ensure they can be retrieval safely so as to be disposed in a permanent repository in the future.

H-80 Subject to approval of environmental protection agencies of relevant province, autonomous region and municipality directly under the central government, the waste or disused sealed radioactive sources that have been proven through monitoring to have radioactivity lower than clearance level can be buried as ordinary industrial waste.

H-81 Periodical monitoring of waste storage area and its surroundings is conducted using monitoring methods and monitored media consistent with the relevant standards. Monitoring results, which are evaluated once every year, in conjunction with operational condition of such a storage facility, should be reported to the environmental protection agencies of relevant province, autonomous region and municipality directly under the central government. Accident, when occurring, should be responded immediately and reported to upper competent authority.

H-82 There have been currently 32 nuclear technology application radioactive waste storage facilities in China, including a national centralized storage facility for SSRS, which is managed in such a way as to accept and store in accordance with categorization and to have detailed and clear account. As indicated by the environmental monitoring results, the operation of the facility has not imposed contamination to the environment.

H.6.3 Operation of LILW Disposal Sites

H-83 Under the Chinese laws and regulations, the operator of a LILW disposal site shall apply to the MEP/NNSA for the operating license before its operation. The application for the license shall be accompanied with environmental impact assessment statement, summary report of trail operation, radiation protection program, quality assurance program, emergency plan, environmental monitoring plan and nuclear assurance certificates, among others, after being reviewed and approved the facility can be put into operation.

H-84 With reference to the IAEA and other countries' technical standards, the generic Chinese technical standards have been developed, like *Regulations on*

Near Surface Disposal of Solid LILW (GB 9132-1988), *Acceptance Criteria for Near Surface Disposal of Radioactive Waste (GB 16933-1997)* and *General Requirements for Environmental Radiation Monitoring at Near Surface LILW Disposal Site* and so on. The technical requirements provided for in these regulations and criteria are as follows:

(1) The operator of the disposal site shall examine the receipted waste packages to confirm whether or not the package are consistent with the requirements specified and whether or not the waste forms filled by the supplier of the packages are consistent with the content of packages.

(2) In the whole process of handling operation, the safety of the workers and the public should be assured. The emplacement of waste should facilitate closure of disposal units with no adverse impacts on safety isolation (like accumulated water and leakage).

(3) Waste Disposal Operation File should be established, which includes the description of disposal date and location, basic data of waste. The responsibility for conserving the Waste Disposal Operation File rests with the operators of disposal sites, and the copies of such file should be subject to the relevant agency's archive.

(4) The waste disposal facility and units may be set up with permanent warning markers to indicate the location of buried waste and other relevant matters.

(5) The operators are responsible for onsite day-to-day environmental monitoring, including surface contamination, surface waster, groundwater samples, ground surface, rock and soil at certain depths, plants, air, and accessible environmental radiation level and integrity of the disposal unit cover. Monitoring results should be reported to higher competent authorities.

(6) Emergency measures and remedy means should be prepared by the operator of the disposal site to deal with abnormalities. In the event of a contamination incident, the operator should determine location, nuclides, level, scope and course of such contamination incident as soon as possible and decide to take remedy measures.

H-85 Prior to the operation of the disposal site, the operator shall prepare site-specific operating procedures in accordance with the generic technical standards. Such procedures have been prepared under the national requirements for both Beilong Disposal Site and Northwestern Disposal Site, covering QA program, operational and closure procedures (including post-closure surveillance plan and requirements), radiation protection program, environmental monitoring plan, accident emergency plan and the corresponding implementation procedures.

H-86 During the operation of both Beilong Disposal Site and Northwestern Disposal Site continued environmental monitoring is maintained. The MEP/NNSA organizes supervisory inspection and monitoring of both sites twice a year. Monitoring results show that there are no significant variations found concerning the environmental status of these two sites.

H-87 During the operation of both disposal sites, the MEP/NNSA sponsored supervision and inspection of their operational status of Both Beilong Disposal Site and the Northwestern Disposal Site. In 2010, an integrated inspection was made to both sites. The inspection summary stated that both disposal facilities have sound organizational structure, consistent-with-requirement receipt process, and normal operational quality assurance system and that the monitoring results of radiation protection and environmental monitoring are consistent with the requirements provided for by the national laws, regulations and standards. Meanwhile, it is required that the enhanced management should be imposed on checking of the data delivered by waste provider and on the safety during waste transportation.

H-88 In 2011, the MEP/NNSA granted the operating licenses for both sites. The operating license specifies categories and total amount of waste permitted to dispose of, waste disposal activities and permitted time limit. It is also required that the operator of each site shall:

(1) fulfill the all commitments made in license application documents and environmental impact assessment statement, and in the process of evaluation and review;

(2) Stringently implement the documents and procedures related to quality assurance, radiation protection, radioactive waste management, environmental monitoring, computerized management of data and emergency plan, and periodical check and review of the validity of implementing the these documents;

(3) submit the summary report of the previous year to the MEP/NNSA before March 31 every year;

(4) as required by the reporting system, report to MEP/NNSA about nuclear or radiation incidents or accidents arising from the receipt, storage and treatment of radioactive waste, if occurring; and

(5) perform a fixed-period safety analysis every 10 years during the term of validity and submit the analytical results to the MEP/NNSA for review.

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-89 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 for surveillance control and after techniques disposal facility closure. Both *the Law of the People's Republic of China on Prevention and Control of Radioactive Pollution* and the *Regulations on Radioactive Waste Safety (HAF401)* requires that environmental impact assessment statement shall be prepared prior to the closure of disposal site. The site can not be closed without authorization. The institutional surveillance and control shall be maintained after closure as follows:

(1) Prevent inadvertent intrusion of the public into the disposal site;

(2) Prevent movement and disturbance of disposed radioactive materials;

(3) Monitor the performance of the disposal site against design basis standards; and

(4) Implement necessary remedy actions.

H-90 Provincial governments of the localities where disposal facility are located are responsible for post-closure surveillance. The post-closure surveillance, for example, environmental monitoring, access restriction, facility maintenance, archive keeping and likely emergency actions, shall be carried out with the involvement of national and local environmental protection departments. Costs required for carrying out post-closure maintenance, monitoring and emergency measures should be estimated before the operation of such a disposal facility and collected in an appropriate proportion from waste disposal fee.

H-91　Currently, there has not yet been a disposal site at the point of entering closure stage.

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 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 Law of the People's Republic of China on Prevention and Control of Radioactive Pollution*, both radioactive waste and goods contaminated with radioactivity are prohibited from being imported 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 the *Regulations on Safety and Protection of Radioisotope and Ray-generating Installations* 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 imported and exported radioisotopes and the catalog of prohibited radioisotopes for import and export. The radioisotopes being currently listed in the catalog of prohibited 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 Contracting Party to the *Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal*, China shall not authorize the shipment of hazardous wastes or other types of wastes to any area south of latitude 60 degrees for disposal, irrespective as to of whether such wastes are involved with transboundary movement or not.

I-4 Since 2007 to December 31, 2010, there was a typical transboundary movement of radioactive waste to take place, which is the return of waste resulting from repair of hydraulic components of LingAo nuclear power station to China.

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 Sealed Sources Applications

J-1 In China, application of sealed sources started in the 1930's. Documentation has shown that the earliest sealed radioactive source found in China is radium needles used in a hospital in Beijing. With the dramatic expansion of nuclear technology and the increasing development of economy, in particular since the 1980's, the use of sealed radioactive sources is rapidly expanding in China. According to an incomplete statistics, the number and quantity are increasing at 10% rate per year in recent years.

J.2 Requirements on Sealed Sources Management

J-2 The *Regulations on Safety and Protection of Radioisotope and Ray-generating Installations* is the regulations specifically on safety and protection to the production, distribution and use of sealed radioactive sources countrywide, and applies to the production, distribution and use of radioisotopes and ray-generating installations and to the transfer, import and export of radioisotopes. The production, distribution and use of radioisotopes and ray-generating installations are subject to licensing regime and cannot be carried out without licenses or beyond the scope of such licenses. The period of validity of the license is 5 years. Upon expiration of the 5-year period, the licensee, if desired, may continue to submit application, to the original licensing authority, for extended use not later than 30 days before the expiration.

J-3 National ID system is implemented for sealed radioactive sources. The SEPA developed and issued the coding rules for sealed radioactive sources. All sealed radioactive sources existing until 2004 are coded and filed under the responsibility of the competent environmental protection authorities of the localities

where sealed radioactive source are located and these are subject to the archives of the SEPA. Since 2004, all sealed radioactive sources imported are coded by the SEPA.

J-4 The review, approval and file system is implemented in China for the transfer and decommissioning of sealed radioactive sources. The transfer and decommissioning of sealed radioactive source are subject to the approval of the competent environmental protection authority. The user of sealed radioactive sources who wants to transfer it out of or into his facility (including return of SSRS to manufacturer, or state of origin or transfer to licensed storage facility) is required under such system, within 20 days after completion of his transfer activity, to be filed with the competent environmental protection authority of the province or municipality where such a facility is located.

J-5 Recovery system is implemented for disused sealed radioactive sources, which require the producer and exporter of category I, II and III sources to have committed to recover sealed radioactive sources that have ended lifetime. The user of category IV and V sources which have been out of use is required to bring timely the disused sealed sources to the licensed storage facilities.

J-6 For disused sealed sources, requirements are:

(1) The producer and importer of Category I, II and III sources should sign return contract with the user of such sources for sale purpose. The user of Category I, II and III sources should, within 3 months after the source becomes disused, return the disused sealed radioactive source to manufacturer or original importer in accordance with the signed return contract. Those sources under these categories that can not be returned to manufacturer or exporter should be brought to the licensed storage facility.

(2) The user of Category IV and V sources should, within 3 months after the sealed radioactive source becomes disused, carry out conditioning and package for such sources in accordance with the provisions of the competent environmental protection authority concerned and then transfer them to the licensed storage facility for storage.

(3) The user and vendor of sealed radioactive sources should return the existing disused sealed radioactive sources to the manufacturer or exporter before December 2007 or transfer them to the licensed storage facility for storage.

(4) The user of sealed radioactive source should, within 20 days after completion of the return and transfer of such sealed radioactive sources, file these activities and submit such file to the competent provincial environmental protection

authority.

J.3 Storage of Disused Sealed Sources

J-7 To meet the need for the application of sealed radioactive sources, China has since the 1960's invested in constructing a different scale of storage facilities in Beijing, Changchun, Lanzhou and Wuxi to accept and store radioactive waste arising from nuclear technology applications, including disused sealed radioactive sources.

J-8 By the end of 2010, a total of 32 storage facilities for nuclear technology application radioactive waste, including a national centralized storage facility for SSRS, have been established with total storage capacity of 30,000 m^3. Construction of the national centralized storage facility began in 2007 and completed in 2008, with total storage capacity of 2600 m^3. Disused sealed radioactive sources are emplaced in semi-underground pits according to radionuclide categories.

J-9 By the end of 2010, these facilities collected 86 137 disused sealed radioactive sources, among which 14 035 are in the 31 provincial storage facilities, and the remaining 72 102 are in the national centralized storage facility. This achieves a transition from decentralized storage of disused sealed radioactive sources to centralized storage, in such ways as to reduce social management costs, and raises the level of safety and security of disused sealed radioactive source, thus leading to a great improvement to the safety of radiation environment.

J.4 Control of Sealed Sources in Recovery of Scrap Metals

J-10 Under Article 39 of the *Regulations on Safety and Protection of Radioisotope and Ray-generating Installations*, a metal smelting plant shall, when recovering scrap metals, take necessary monitoring measures to prevent radioactive materials from being molten into its products. If any abnormality found, a timely notification shall be provided to the municipal environmental protection department of the locality where that plant is located.

J-11 Based on the management practices in China, the MEP/NNSA developed the *Management Procedures on Safety and Protection of Radioisotopes and Ray-generating Devices*, which has been promulgated in April 2011. More detailed requirements for control of sealed radioactive sources existing in scrap metals are provided for in Articles 35, 36 and 37.

J-12 Article 35 states that a scrap metal recovery or smelting firm shall be

equipped with radiation monitoring system and staffed with adequate radiation monitoring personnel. Radiation monitoring shall be carried out both before scrap metals being molten and prior to finished product leaving factory. Also, radioactive limits shall be integrated into the indicator system of qualified products.

J-13 A newly built or reconstructed or extended building project shall, if containing the technological process of scrap metal recovery or smelting, be equipped with radiation monitoring facility. For any project without radiation monitoring facility equipped, the completion acceptance for its environmental protection facility shall not be implemented by the related environmental protection department.

J-14 Radiation monitoring personnel shall be equipped with personal dosimeter when carrying out radiation monitoring of scrap metals and emergency treatment and do the best in personal protection.

J-15 Article 36 states that a scrap metal recovery or smelting firm shall, if finding and confirming abnormal monitoring results, take prompt control measures timely and report it to the environmental protection department of the locality where the firm is located within 4 hours.

J-16 Having received the report from that firm, the environmental protection department shall verify the radiation monitoring results reported, ascertain the reason why radiation level has been abnormal, and order the firm to take necessary action to prevent radioactive contamination.

J-17 The information about abnormality of radiation monitoring results shall not be reported in a delaying, false and deceiving manner.

J-18 Article 37 states that the costs required for a scrap metal recovery or smelting firm to transport and store disused sealed radioactive sources or radioactively-contaminated articles shall be borne by the original holder, or the supplier, of such sources or articles.

J-19 For unidentified disused sealed radioactive sources or radioactively-contaminated articles, the costs incurred due to their transport and storage shall be born by the related scrap metal recovery or smelting firm. For those firms who have been implementing radiation monitoring, the costs incurred shall be reduced or exempted on the part of the concerned storage facility according to circumstance, after the verification by provincial environmental protection department of the locality where that firm is located, with the consent of provincial financial department.

J-20 The newly-built facilities shall be licensed according to the

above-mentioned requirements whereas the existing facilities shall be modified according to the foregoing requirements in a step-by-step manner.

J.5 Research and Development on the Safety of Sealed Sources Management

J-21 Chinese government has highly been advancing the safety of disused sealed radioactive source management, by causing the research efforts on categorization of radioactive sources to be implemented, developing the network system for regulation of sealed radioactive sources, studying the technical solutions to management and disposal of SSRS and implementing the development and demonstration projects for conditioning technology of SSRS.

J-22 By using the network system for regulation of sealed radioactive sources, the dynamic follow-up management can be achieved for the production, sale, transfer, import and export, use in different areas, and disposal of SSRS.

J-23 The technical solutions to management and disposal of SSRS sets forth the countermeasures and suggestions concerning comprehensive management of SSRS, involving the requirements for safety of long-term storage of sealed radioactive sources, the research on disposal proposals, the management of orphan sources, the technology and management on the recycle and reuse of sealed radioactive sources.

J-24 Both the dismountable conditioning apparatus for spent high activity radioactive sources (SHARS) and the vehicle-mounted conditioning apparatus for long-lived radioactive sources and low activity radioactive sources have been developed according to circumstance. As well, series of capsulation and storage containers are developed. The demonstration projects have shown that these apparatus can meet the engineering requirements.

K. PLANNED ACTIVITIES TO IMPROVE SAFETY

K.1 National Measures

K.1.1 Strengthen Legislative System for Radioactive Waste Safety

K-1 China will continue to strength the efforts to develop the management documents relevant to *the Law of the People's Republic of China on Prevention and Control of Radioactive Pollution*, with focus on fee collection for radioactive waste disposal.

K-2 China will push forward the implementation of the *Regulations on Safety of Radioactive Waste Management*, by developing and issuing more detailed management rules with inclusion of the management procedures on the qualification of the facilities involved in storage and disposal of radioactive waste, and by improving the supervision and management system for near surface disposal of radioactive waste and the management system for geological disposal of radioactive waste.

K.1.2 Strategic Study on Integrated Management of Radwaste and Spent Fuel

K-3 China will actively push forward the implementation of the siting plan for solid LILW disposal site, fully evaluate the demands of the utilization and development of nuclear energy and technology for the safety of spent fuel management and the safety of radioactive waste management, in line with the demands of socioeconomic development for energy sources, and continue to improve the strategy on spent fuel management and optimize the strategy on radioactive waste disposal in accordance with the country's socioeconomic development plan.

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

K.1.3 Promote the Development of LILW Disposal

K-5 LILW disposal is currently a key point in the country's radioactive

waste disposal program. China will firstly guarantee the safe and effective operation of both Beilong Disposal Site and Northwestern Disposal Site and will continue to 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 SSRS on the basis of research efforts focused on radioactive source categorization and disposal options.

K.1.4 Enhance Research on HLW Geological Disposal

K-6 The investigation on geological disposal of solid radioactive waste is a long-term undertaking. Following the work objectives and time table 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 migration, disposal engineering barrier, and the pre-study of underground laboratory related to geological disposal of radioactive waste.

K.1.5 Continuous Implementation of Radioactive Waste Minimization

K-7 Control of radioactive waste generation and achieving a minimization of radioactive waste is one of the fundamental principles and sustainable objectives to be followed in radioactive waste management. A wide range of efforts shall be initiated in China in aspects of controlling waste generation, improving management, introducing advanced waste treatment and volume reduction technology, and facilitating specialization of waste treatment. China will continue to enhance the consciousness of waste minimization in order to facilitate waste minimization management in the full lifetime of a nuclear facility from design, construction and operation through to decommissioning, and will continue to improve waste sorting and clearance by using integrated waste treatment technology and improving operational mechanism.

K.2 International Cooperation

K-8 China will continue to pay attention to the platform role 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 will actively participate in international and regional training courses, forums or workshops and

meetings sponsored by IAEA. In addition, China will expand international cooperation and exchange through IAEA technological cooperation programme, co-sponsor of training courses and meetings.

K-9 With the development of China's nuclear power program, China has been actively broadening the exchange and cooperation with the outside in the safety of spent fuel management and the safety of radioactive waste management so as to raise continuously the technical and management level of the country in this field.

K-10 China is active in participating in regional safety cooperation, which includes the cooperation among China, Republic of Korea, and Japan in the field of nuclear safety, Asian Nuclear Safety Network (ANSN) and Forum of Nuclear Cooperation in Asia (FNCA). Through 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 Nuclear Power Plants

Unit No.	Name	Location	Reactor Type	Nominal Power (MWe）	Date of the First Connection to the Grid
CN-1	Qinshan NPP	Zhejiang Province	PWR	310	1991-12-15
CN-2	Daya Bay NPP	Guangdong Province	PWR	984	1993-08-31
CN-3	Daya Bay NPP	Guangdong Province	PWR	984	1994-02-07
CN-4	Qinshan Phase II NPP	Zhejiang Province	PWR	650	2002-02-06
CN-5	Qinshan Phase II NPP	Zhejiang Province	PWR	650	2004-03-11
CN-6	LingAo NPP	Guangdong Province	PWR	990	2002-02-26
CN-7	LingAo NPP	Guangdong Province	PWR	990	2002-09-14
CN-8	Qinshan Phase III NPP	Zhejiang Province	CANDU	700	2002-11-19
CN-9	Qinshan Phase III NPP	Zhejiang Province	CANDU	700	2003-06-12
CN-10	Tianwan NPP	Jiangsu Province	PWR	1 060	2006-05-12
CN-11	Tianwan NPP	Jiangsu Province	PWR	1 060	2007-05-14
CN-12	LingAo NPP	Guangdong Province	PWR	1 080	2010-09-20
CN-13	Qinshan Phase II NPP	Zhejiang Province	PWR	650	2010-10-20

Note：As of 31 December 2010.

L.1.2 Research Reactors

No.	Name	Licensee	First criticality	Nominal Power
1	101Heavy Water Reactor	CIAE	1958	10 MW
2	49-2 Research Reactor	CIAE	1964	3.5 MW
3	Prototype Mini Reactor	CIAE	1984	27 kW
4	Shield Experimental Reactor	Tsinghua University	1964	1 MW
5	Low Temperature Heat Supply Reactor	Tsinghua University	1992	5 MW
6	HTR-10 High Temperature Gas-Cooled Research Reactor	Tsinghua University	2000	10 MW
7	China Pulse Reactor	NPIC	1991	1 MW
8	Mingjiang Reactor	NPIC	1992	5 MW
9	High-flux Engineering Test Reactor	NPIC	1979	125 MW
10	Mini Reactor	Shenzhen University	1988	27 kW
11	Hospital Neutron Irradiator	Beijing Capture Tech Co., Ltd	2010	30 kW
12	China Experiment Fast Reactor	CIAE	2010	65 MW

Note：As of 31 December 2010.

L.1.3 Spent Fuel Storage at NPPs

Facility Name	Affiliation	Design Capacity （t）	Time to commission
Spent fuel pool1	Qinshan NPP	152[1]	1991
Spent fuel pool 2	Qinshan NPP	192[1]	2010
Spent fuel pool 1	Qinshan Phase II NPP	317	2001
Spent fuel pool 2	Qinshan Phase II NPP	317	2002
Spent fuel pool 3	Qinshan Phase II NPP	317	2010
Spent fuel pool 1	Qinshan Phase III NPP	960	2002
Spent fuel pool 2	Qinshan Phase III NPP	960	2002
Spent fuel dry storage facility	Qinshan Phase III NPP	8 216	2009
Spent fuel pool 1	Daya Bay NPP	319	1992
Spent fuel pool 2	Daya Bay NPP	319	1993
Spent fuel pool 1	LingAo NPP	554	2001
Spent fuel pool 2	LingAo NPP	554	2002
Spent fuel pool 1	Tianwan NPP	325	2005
Spent fuel pool 2	Tianwan NPP	325	2006

[1]: Initial design capacity was 112 t but here is the data for extended capacity.

Note：As of 31 December 2010.

L.2 List of Radioactive Waste Management Facilities

L.2.1 Other Major Radioactive Waste Generating Facilities

Type of facility	Operator	Location
Uranium enrichment	Shaanxi Uranium Enrichment Plant	Shaanxi Province
Uranium enrichment	Gansu Uranium Enrichment Plant	Gansu Province
Fuel fabrication	Northern China Nuclear Fuel Assembly Plant	Inner Mongolia
Fuel fabrication	China Jianzhong Nuclear Fuel Corporation	Sichuan Province
Research	CIAE	Beijing
Research	NPIC	Sichuan Province
Research	Tsinghua University	Beijing

Note：As of 31 December 2010.

L.2.2 Nuclear Technology Application Radwaste Storage Facilities

No.	Facility Name	Location	Design Capacity（m^3）	Start of Operation
1	Anhui Radioactive Waste Storage Facility	Anhui	960	2009
2	Beijing Radioactive Waste Storage Facility	Beijing	2 453	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	200	2001
6	Guangxi Radioactive Waste Storage Facility	Guangxi	500	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	400	1990
10	Henan Radioactive Waste Storage Facility	Henna	800	1983
11	Heilongjiang Radioactive Waste Storage Facility	Heilongjiang	800	1989
12	Hubei Radioactive Waste Storage Facility	Hubei	500	1999
13	Henna Radioactive Waste Storage Facility	Hunan	800	1999
14	Jilin Radioactive Waste Storage Facility	Jilin	1 200	1998
15	Jiangsu Radioactive Waste Storage Facility	Jiangsu	1 200	2010
16	Jiangxi Radioactive Waste Storage Facility	Jiangxi	457	1987
17	Liaoning Radioactive Waste Storage Facility	Liaoning	542	1989
18	Inner Mongolia Radioactive Waste Storage Facility	Inner Mongolia	800	2009
19	Ningxia Radioactive Waste Storage Facility	Ningxia	400	2008
20	Qinghai Radioactive Waste Storage Facility	Qinghai	400	2010
21	Shandong Radioactive Waste Storage Facility	Shandong	991	2005

No.	Facility Name	Location	Design Capacity（m^3）	Start of Operation
22	Shanxi Radioactive Waste Storage Facility	Shanxi	800	2009
23	Shaanxi Radioactive Waste Storage Facility	Shaanxi	480	1997
24	Shanghai Radioactive Waste Storage Facility	Shanghai	600	2008
25	Sichuan Radioactive Waste Storage Facility	Sichuan	500	2009
26	Tianjin Radioactive Waste Storage Facility	Tianjin	1 300	2004
27	Tibet Radioactive Waste Storage Facility	Tibet	300	2010
28	Xinjiang Radioactive Waste Storage Facility	Xinjiang	600	2008
29	Yunnan Radioactive Waste Storage Facility	Yunnan	800	2008
30	Zhejiang Radioactive Waste Storage Facility	Zhejiang	800	2008
31	Chongqing Radioactive Waste Storage Facility	Chongqing	600	2009
32	Centralized Spent Sealed Radioactive Source Storage Facility	Gansu	2 600	2008

Note：As of 31 December 2010.

L.2.3 Radioactive Waste Disposal Facilities

No.	Facility name	Location	Operator
1	Northwestern China LILW Disposal Site	Gansu	Everclean Environmental Engineering Corp, CNNC
2	Guangdong Beilong LILW Disposal Site	Guangdong	Guangdong Nuclear Power environmental protection co. Ltd

L.3 List of Nuclear Facilities Decommissioned or Being Decommissioned

Name	Type	Location	Start time	Ending time	Current state
Shanghai Mini Reactor	Research reactor	Shanghai	1992	2004	Unlimited open after decommissioning
Jinan Mini Reactor	Research reactor	Shandong	1989	2008	being decommissioned

L.4 Inventory of Spent Fuel

Facility name	NPP	Capacity （t）	Existing spent fuel（t）
Spent fuel pool 1	Qinshan NPP	152	126.6
Spent fuel pool 2	Qinshan NPP	192	11.4
Spent fuel pool 1	QNPP Phase II NPP	317	114.4
Spent fuel pool 2	Qinshan Phase II NPP	317	97.9
Spent fuel pool 3	Qinshan Phase II NPP	317	0.0
Spent fuel pool 1	Qinshan Phase III NPP	960	615.0
Spent fuel pool 2	Qinshan Phase III NPP	960	596.0
Spent fuel pool 1	Daya Bay NPP	319	232.5
Spent fuel pool 2	Daya Bay NPP	319	204.0
Spent fuel pool 1	LingAo NPP	554	169.1
Spent fuel pool 2	LingAo NPP	554	180.1
Spent fuel pool 1	Tianwan NPP	325	65.6
Spent fuel pool 2	Tianwan NPP	325	65.2
Inventory of wet-storage at reactor			**2 477.8**
Interim dry-storage facility	Qinshan Phase III NPP	8216	211.0
Total			**2 688.8**

Note：As of 31 December 2010.

L.5 Inventory of Radioactive Waste

L.5.1 Inventory of NPP Radioactive Waste

（Unit：m^3）

Name	Concentrate	Spent ion exchange resin	Sludge	Water filter	Technological waste	Other	Total
Qinshan NPP	1 100.8	318.2	0.0	86.6	443.9	188.8	2 138.3
Qinshan Phase II NPP	352.4	465.0	3.1	130.0	629.7	0.0	1 580.2
Qinshan Phase III NPP	0.0	389.8	0.0	61.2	270.8	14.6	736.4
Daya Bay NPP	654.0	636.0	30.0	279.0	1 095.0	463.2	3 157.2
LingAo NPP	90.0	236.0	8.0	141.7	449.0	276.3	1 201.0
Tianwan NPP	425.0	449.3	0.0	0.0	261.6	26.0	1 161.9
Total	**2 622.2**	**2 494.3**	**41.1**	**698.5**	**3 150.0**	**968.9**	**9 975.0**

Note：As of 31 December 2010，calculated in terms of volume after being conditioned.

L.5.2 Inventory of Radioactive Waste Other Than NPPs

（Unit：m^3）

Type	Research	Uranium enrichment	Fuel Fabrication	Total
Intermediate level liquid waste	694.6	0.0	0.0	694.6
Intermediate level solid waste	500.7	0.0	0.0	500.7
Low level liquid waste	2 068.0	150.3	14.1	2 232.4
Low level solid waste	5 990.8	670.8	230.7	6 892.3

Note：As of 31 December 2010.

L.5.3 Inventory of Nuclear Technology Application Radwaste Storage

No.	Province	Disused radioactive source	Radioactive Waste (kg)
1	Anhui	612	300
2	Beijing	1 728	13 231
3	Fujian	206	192
4	Gansu	242	23
5	Guangdong	350	1 318
6	Guangxi	87	0
7	Guizhou	212	0
8	Hainan	121	523
9	Hebei	0	0
10	Henan	909	13 600
11	Heilongjiang	82	3 846
12	Hubei	326	7 692
13	Hunan	259	0
14	Jilin	315	10 000
15	Jiangsu	152	558
16	Jiangxi	11	0
17	Liaoning	117	0
18	Inner Mongolia	229	6
19	Ningxia	111	0
20	Qinghai	45	3 230
21	Shandong	3 831	423
22	Shanxi	191	0
23	Shaanxi	425	1 519
24	Shanghai	48	33 831
25	Sichuan	1 033	153 846
26	Tianjin	1 165	34 307
27	Tibet	3	0

No.	Province	Disused radioactive source	Radioactive Waste (kg)
28	Xinjiang	250	3
29	Yunnan	105	0
30	Zhejiang	794	7 630
31	Chongqing	76	1 077
32	Centralized SSRS Storage Facility	72 102	0
33	Total	86 137	287 149

Note：As of 31 December 2010.

L.5.4 Inventory of Waste for Disposal

Disposal Site	Waste Received （m^3）
Northwestern China LILW Disposal Site	6 467
Guangdong Beilong LILW Disposal Site	788
Total	7 255

Note：As of 31 December 2010.

L.6 List of Relevant Law, Regulation, Standard and Guidance

L.6.1 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 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 Air Pollution	the Standing Committee of the National People's Congress	2000
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	1984
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 Marine Environment Protection	the Standing Committee of the National People's Congress	2000
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 Occupational Disease	the Standing Committee of the National People's Congress	2002
The Law of the People's Republic of China on Safety of Operation	the Standing Committee of the National People's Congress	2002

L.6.2 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 on Accidental Emergency Management at Nuclear Power Plant (station)	the State Council	1993
The Detailed Rules of the People's Republic of China on Water Pollution Prevention	the State Council	2000
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

L.6.3 Relevant Rules

Name	Issued by	Entry into force
Rules for Categorization of Radioactive Sources	SEPA	2005
Rules for Radiological Environment Management	SEPA	1990
Licensee for Licensing of Radioisotopes and Ray-generating Installations Safety	SEPA	2005
Regulations on Radioactive Waste Safety (HAF401)	NNSA	1997
Regulatory Procedures for Radiological Protection Devices and Radioactivity-containing Products	MH	2002
Regulations on Management of Radiodiagnosis and Radiotherapy	MH	2006
Temporary Regulations on Road Transport of NPP Spent Fuel	CAEA, MPS, MT and MH	2003
Temporary Regulations on Construction of Nuclear Technology Application Radwaste Storage Facility	SEPA	1984
Criteria on Siting, Design and Construction of Nuclear Technology Application Radwaste Storage Facility	SEPA	2005
Emergency Preparedness and Response of NPP Operators	NNSA	1998
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, MH	2003
Detailed Rules (I) of the People's Republic of China on Regulating Civil Nuclear Facility Safety - Application and Granting of NPP Safety Licenses (HAF001/01)	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 (HAF001/01/01)	NNSA	1993
Detailed Rules (II) of the People's Republic of China on Regulation of Civil Nuclear Facility Safety – Regulation of Nuclear Facility Safety (HAF001/02)	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 (HAF001/02/01)	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

Name	Issued by	Entry into force
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 Response of NPP Operators	NNSA	1998
Regulations on NPP Quality Assurance Safety	NNSA	1991
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
Regulations on Research Reactor Design Safety	NNSA	1995
Regulations on Research Reactor Operation Safety	NNSA	1995
Regulations on Civil Nuclear Fuel Cycle Safety	NNSA	1993
Detailed Rules for the Regulations of the People's Republic of China on Regulating Nuclear Materials	NNSA, ME, CAEA	1990
Regulations on Radiological Health and Protection at Nuclear Facility	MH	1992
Criteria on Monitoring and Assessment of the Public Exposure during Normal and Accidental Conditions	MH	1992
Regulatory Procedures on Transfer and Transboundary Movement of Nuclear Products (trail)	CAEA	2000
Reporting System on Accident Emergency at NPPs	CAEA	2001
Criteria on Medical Treatment of Radiological Injury	MH, CAEA	2002
Regulatory Procedures on Emergency Exercise for NPP Accident	CAEA	2003
Management Procedures for Occupational Health of Radiological Workers	MH	2007
Regulations on Management of Special Revenue for NPP Accident Emergency Preparedness	MF, 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

L.6.4 Relevant Guidelines

Name	Issued by	Entry into force
1 Nuclear Power Plant Series		
Emergency Preparedness for Nuclear Power Plant, HAD 002/01	SEPA	1989
Emergency Preparedness by Local Government for Nuclear Power Plant, HAD 002/02	NNSA, SEPA, MH	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, MH	1992
Research Reactor Emergency Planning and Preparedness, HAD 002/06	NNSA	1991
Emergency Planning for Operators of Civil Nuclear Facilities, HAD 002/07	NNSA	1993
Quality Assurance Program for NPPs, HAD 003/01	NNSA	1988
Quality Assurance Organization of NPPs, HAD 003/02	NNSA	1989
Quality Assurance for Items Serve and Procurement for NPPs, HAD 003/03	NNSA	1986
Quality Assurance Record System for NPPs, HAD003/04	NNSA	1986
Supervision and Inspection of Quality Assurance for NPPs, HAD 003/05	NNSA	1988
Quality Assurance for Design of NPPs, HAD 003/06	NNSA	1986
Quality Assurance during Construction of NPPs, HAD 003/07	NNSA	1987
Quality Assurance during Items Manufacture for NPPs, HAD 003/08	NNSA	1986
Quality Assurance during Commissioning and Operation of NPPs, HAD 003/09	NNSA	1988
Quality Assurance during Procurement, Design and Construction of Nuclear Fuel Elements, HAD 003/10	NNSA	1989
Seismic Issues in Design of Siting NPPs, HAD 101/01	NNSA CEA	1994
Atmospheric Dispersion Problems in Siting NPPs, HAD 101/02	NNSA	1987
Population Distribution Problems in Siting and Assessment of NPPs, HAD 101/03	NNSA	1987
External Human-made Event in Siting NPPs, HAD101/04	NNSA	1989
Hydrological Dispersion Problems of Radioactive Materials in Siting NPPs, HAD 101/05	NNSA	1991
Relevance of NPPs Siting to Hydrology, HAD 101/06	NNSA	1991
Site Survey of NPPS, HAD 101/07	NNSA	1989

Name	Issued by	Entry into force
Determination of Design Basis flooding for Costal NPP Site, HAD 101/08	NNSA	1989
Determination of Design Basis flooding for Costal NPP Site, HAD 101/09	NNSA	1990
Extreme Meteorological Event Related to NPP Siting, HAD 101/10	NNSA	1991
Design Basis Tropical Cyclone for NPPs, HAD 101/11	NNSA	1991
Issues relating to Safety of NPP Base, HAD 101/12	NNSA	1990
Safety Principle of NPP Design, HAD 102/01	NNSA	1989
Design and Evaluation of Anti-earthquake Design for NPP, HAD 102/02	NNSA	1996
Safety Function and Graded Components for BWRs, PWRs and Pressurized Tube Reactors, HAD 102/03	NNSA	1986
Flying Object and Secondary Effect Protection inside NPPs, HAD 102/04	NNSA	1986
External Human-made Event relating to Design of NPPs, HAD 102/05	NNSA	1989
Design of NPP Reactor Containment System, HAD102/06	NNSA	1990
Design of NPP Reactor Core Safety, HAD 102/07	NNSA	1989
NPP Reactor Cooling System and Related Systems, HAD 102/08	NNSA	1989
Final Heal Well of NPP and Directly Related Heat Conduction System, HAD 102/09	NNSA	1987
NPP Protection System and Related Facilities, HAD 102/10	NNSA	1988
Fire Protection at NPPs, HAD 102/11	NNSA	1996
Radiation Protection Design for NPPs, HAD 102/12	NNSA	1990
NPP Emergency Power System, HAD 102/13	NNSA	1996
NPP Safety Related Instrument and Control System, HAD 102/14	NNSA	1988
Design of Loading/Unloading and Storage System at Nuclear Power Plant, HAD 102/15	NNSA	2007
Computer-based System Software of Safety Significance for Nuclear Power Plant, HAD 102/16	NNSA	2004
Safety Analysis and Verification for Nuclear Power Plant, HAD 102/17	NNSA	2006
OL&C and Operational Procedure for Nuclear Power Plant, HAD 103/01	NNSA	2004
NPP Commissioning Procedures, HAD 103/02	NNSA	1987
NPP Reactor Core and Fuel Management, HAD 103/03	NNSA	1989
Radiation Protection during Operation of NPP, HAD 103/04	NNSA	1990
Staffing, Recruitment, Training and Delegation at NPPs, HAD 103/05	NNSA	1996
Organization and Operational Management of Operators of Nuclear Power Plant, HAD 103/06	NNSA	2006

Name	Issued by	Entry into force
In-commissioning Examination of NPPs, HAD 103/07	NNSA	1988
Repair and Maintenance of NPPs, HAD 103/08	NNSA	1993
Supervision of Important Safety Items at NPPs, HAD 103/09	NNSA	1993
Fire Protection for NPPs, HAD 103/10	NNSA	2004
Periodic Safety Review for NPPs, HAD 103/11	NNSA	2006
2 Research Reactor Series		
Format and Contents of Research Reactor Safety Analysis Report, HAD 201/01	NNSA	1996
Research Reactor Operation Management, HAD 202/01	NNSA	1989
Management of Criticality Installation Operation and Experiment, HAD 202/02	NNSA	1989
Application and Modification of Research Reactor, HAD 202/03	NNSA	1996
Decommissioning of Research Reactor and Criticality Installation, HAD 202/04	NNSA	1992
3 Nuclear Fuel Cycle Installation Series		
Format and Content of Safety Analysis Report of Uranium Fuel Fabrication Installation, HAD 301/01	NNSA	1991
Design of Spent Fuel Storage Installation, HAD 301/02	NNSA	1998
Operation of Spent Fuel Storage Installation, HAD 301/03	NNSA	1998
Safety Assessment of Spent Fuel Storage Installation, HAD 301/04	NNSA	1998
4 Nuclear Materials Regulation Series		
Nuclear Fuel Balance Budget for Low Enriched Uranium Conversion and Element Fabrication Plant, HAD 501/01	NNSA	2008
Guidelines on Physical Protection for Nuclear Power Plant, HAD 501/02	NNSA	2008
Alarming System against Intrusion to Nuclear Facility, HAD 501/03	NNSA	2005
Access Control of Nuclear Facility, HAD 501/04	NNSA	2008
Physical Protection of Nuclear Materials Transportation, HAD 501/05	NNSA	2008
Format and Content of Safety Analysis Report of Physical Protection and Nuclear Materials Accountancy and Control, HAD 501/06	NNSA	2008
Nuclear Materials Accountability for Nuclear Power Plant, HAD 501/07	NNSA	2008
5 Radioactive Waste Management Series		
5.1 Fundamental Document		
Categorization of Radioactive Waste, HAD 401/04	NNSA	1998
5.2 Generation, Pre-treatment, Treatment and Discharge		
Management of Radioactive Effluents and Waste Arising from Nuclear Power Plant, HAD 401/01	NNSA	1990
Design of Radioactive Waste Management System for Nuclear	NNSA	1997

Name	Issued by	Entry into force
Power Plant, HAD 401/02		
Design and Operation of Radioactive Waste Incineration Installation, HAD 401/03	NNSA	1997
5.3 Waste Disposal		
Siting of Radioactive Waste Near Surface Disposal Facility, HAD 401/05	NNSA	1998
Siting of Radioactive Waste Geological Repository, HAD 401/06	NNSA	1998

L.6.5 Relevant Standards

Name	Issued by	Entry into force
1 Generic Series		
Basic Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources, GB 18871-2002	NTSB	2002
Exemption Principles on Management of Radiation Source and Practices, GB 13367-1992	NTSB	1992
Radiation Protection Regulations on Open Radioactive Materials, GB 11930-1989	NTSB	1989
Regulations on Radiation Safety Training Relevant to Environmental Protection Standards, GB 11924-1989	SEPA	1990
Program on Radiation Protection Optimization, GB/T 14325-1993	NTSB	1993
2 Nuclear Power Plant Series		
Regulations on Radiation Protection for NPPs, GB 6249-2011	SEPA，AQSIQ	2011
Radiations on Radiation Protection for Nuclear Heat-Electricity Co-generation Plan, GB 14317-1993	NTSB	1993
3 Radioactive Waste Management Series		
3.1 Fundamental Document		
Regulations on Radioactive Waste Management, GB 14500-2002	NTSB	2002
Regulations on Categorization of Radioactive Waste, GB 9133-1995	SEPA，NTSB	1996
Glossary of Nuclear Science and Technology: Radioactive Waste Management, GB/T 4960.8-1996	NTSB	1996
3.2 Generation, Pre-treatment, Treatment and Discharge		
Technical Regulations on Solid Radioactive Waste Treatment System at BWR Nuclear Power Plant, GB 9134-1988	SEPA	1988
Technical Regulations on Liquid Radioactive Waste Treatment System at LWR Nuclear Power Plant, GB 9135-1988	SEPA	1988
Technical Regulations on Gaseous Radioactive Waste Treatment System at LWR Nuclear Power Plant, GB 9136-1988	SEPA	1988

Name	Issued by	Entry into force
Normalized Discharge Management Limits on Radioactive Effluents from Nuclear Fuel Cycle Installations, GB 13695-1992	NTSB	1992
Technical Regulations on Liquid Radioactive Waste Discharge from LWR Nuclear Power Plant, GB 14587-1993	NTSB	1993
General Regulations on Nuclear Environmental Quality Assessment, GB 11215-1989	SEPA	1989
General Requirements for Quality Assurance Program for Nuclear Facility Effluent and Environmental Radioactivity Monitoring, GB 11216-1989	SEPA	1989
Environmental Protection Drawings-marked Discharge Outlet (source), GB 155621.1-1995	SEPA	1995
Standards on Health and Protection for Medical Radioactive Waste Management, GBZ 133-2002	MEP	2002
Radioactive Source Terms under Operational Conditions at Power Nuclear Power Plant, GB/T 13976-1992	NTSB	1992
Experiment of Radioactive Surface Decontamination and Difficulty Assessment Methods, GB/T 14057-1993	NTSB	1993
Radioactive Surface Decontamination and Textile Detergent Test Methods, GB/T 115850-1995	NTSB	1995
Evaluation of Characteristics of Radioactive Waste Forms and Waste Package, EJ 1186-2005	NDSTC	2005
Technical Regulations on LILW Volume Reduction System, EJ/T 795-1993	CNNC	1993
3.3 Waste Conditioning		
Long Term Leaching Experiment for Solid Radioactive Waste Solidified Form, GB 7023-1986	SEPA	1986
Standards on LILW Solid Radioactive Waste Package Safety, GB 12711-1991	NTSB	1991
Requirements on Solidified LILW Forms: Cement-solidified Forms, GB 14569.1-2011	NTSB	2011
Requirements on Solidified LILW Forms: Plastics-solidified Forms, GB 14569.2-1993	NTSB	1993
Requirements on Solidified LILW Forms: Bitumen -solidified Forms, GB 14569.3-1995	NTSB	1995
Package Container for Solid LILW: Steel Drum, EJ 1024-1996	CNNC	1996
Package Container for Solid LILW: Steel Drum: Steel Box, EJ 1076-1998	CNNC	1998
Reinforced Container for Solid LILW, EJ/T 914-1994 (1999)	CNNC	1994
3.4 Waste Storage		
Solid LILW Interim Storage Regulations, GB 11928-1989	NTSB	1989
Regulations on Design of Liquid HLW Storage Plant, GB 11929-1989	NTSB	1989

Name	Issued by	Entry into force
Technical Regulations on Design of Liquid HLW Storage Plant at Nuclear Power Plant, GB 14589-1993	NTSB	1993
Requirements on Safety Analysis Report for Solid LILW Interim Storage, EJ 532-1990	CNNC	1990
3.5 Waste Disposal		
Regulations on Near Surface Disposal of Solid LILW, GB 9132-1988	SEPA	1988
Regulations on Cave Disposal of Solid LILW, GB 13600-1992	NTSB	1992
Acceptance Criteria for Near Surface Disposal of Radioactive Waste, GB 16933-1997	NTSB	1997
Environmental Protection Drawing Marker: Solid Waste Storage（Repository）, GB 15562.2-1995	SEPA	1995
General Requirements on Environmental Radiation Monitoring for Near Shallow Disposal of LILW, GB/T 15950-1995	SEPA	1995
Criteria on Design of LILW Near Surface Disposal Facility: Non-cave Disposal, EJ 1109.1-1999	CNNC	1999
Format and Contents of Environmental Impact Report for Near Surface Disposal of Solid Radioactive Waste, HJ/T 5.2-1993	SEPA	1993
Siting of LILW Near Surface Disposal Facility, HJ/T 23-1998	SEPA	1998
3.6 Nuclear Facility Decommissioning and Environmental Reclamation		
Radiation Protection Regulations on Decommissioning of Nuclear Power Plant and Large Sized Reactor, GB 11850-1989	NTSB	1989
Technical Regulations on Environmental Management of Reactor Decommissioning, GB 14588-1993	SEPA	1993
Clearance Level on Recycle and Reuse of Steel and Aluminum Arising from Nuclear Facility, GB 17569-1998	NTSB	1998
Safety Requirements on Decommissioning of Nuclear Facility, GB/T 19597-2004	SEPA	2004
3.7 Management of Radioactive Waste from Uranium Mining and Milling		
Regulations on Safety of Radioactive Waste Management Techniques for Uranium/thorium Mining and Milling, GB14585-1993	SEPA	1994
Regulations on Environmental Management Techniques for Uranium/thorium Mining and Milling Facility Decommissioning, GB14586-1993	SEPA	1994
Regulations on Radiation Environmental Monitoring of Uranium/thorium Mining and Milling Facility, GB 23726-2009	SEPA, AQSIQ	2010
Regulations on Radiation Protection and Environmental Protection for Uranium/thorium Mining and Milling, GB 23727-2009	AQSIQ, SAPRC	2009
Regulations on Environmental Impact Assessment of Uranium/thorium Mining and Milling, GB 23728-2009	SEPA, AQSIQ	2009

Name	Issued by	Entry into force
Regulations on Radiation Protection Technique for Uranium Heap Leaching and In-situ Leach Mining, EJ 1007-1996	CNNC	1996
Regulations on Siting of Uranium Mining and Leaching Facility, EJ 1171-2004	CAEA	2004

L.7 NPP Occupational Exposure

NPP 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	2007	6.50 E-01	8.45 E+00	9.97 E-01	4.50 E-01
	2008	1.53 E-01	3.58 E+00	1.49 E-01	5.70 E-02
	2009	3.36 E-01	4.26 E+00	4.53 E-01	1.92 E-01
	2010	3.05 E-01	4.81 E+00	4.00 E-01	1.72 E-01
Daya Bay NPP	2007	3.78 E-01	9.48 E+00	1.05 E-00	6.80 E-02
	2008	3.07 E-01	5.99 E+00	8.26 E-01	5.10 E-02
	2009	2.78 E-01	5.24 E+00	7.15 E-01	4.40 E-02
	2010	3.43 E-01	1.08 E+01	9.46 E-01	6.00 E-02
Qinshan Phase II NPP	2007	3.47 E-01	8.16 E+00	7.85 E-01	8.80 E-02
	2008	3.00 E-01	4.88 E+00	5.88 E-01	5.90 E-02
	2009	3.45 E-01	7.90 E+00	7.10 E-01	7.10 E-02
	2010	2.18 E-01	4.94 E+00	4.40 E-01	4.20 E-02
LingAo NPP	2007	4.56 E-01	8.53 E+00	1.23 E-01	8.30 E-02
	2008	6.00 E-01	1.22 E+01	1.77 E-01	1.16 E-01
	2009	5.02 E-01	1.06 E+01	1.53 E-01	9.90 E-02
	2010	3.34 E-01	9.90 E+00	9.25 E-01	5.80 E-02
Qinshan Phase III NPP	2007	2.77 E-01	5.90 E+00	5.72 E-01	4.95 E-02
	2008	3.64 E-01	9.10 E+00	7.88 E-01	7.01 E-02
	2009	3.27 E-01	6.42 E+00	7.48 E-01	6.38 E-02
	2010	3.29 E-01	5.43 E+00	7.27 E-01	6.40 E-02
Tianwan NPP	2007	1.36 E-01	2.69 E+00	3.27 E-01	3.26 E-02
	2008	2.09 E-01	3.46 E+00	5.57 E-01	3.96 E-02
	2009	2.44 E-01	3.20E+00	5.48 E-01	3.84 E-02
	2010	1.74 E-01	2.16 E+00	4.26 E-01	2.71 E-02

L.8 NPP Radioactive Effluents

Percent of Radioactive Effluents to the Regulatory Discharge Limits（%）

（From 2007 to 2010）

Plant	Year	Gaseous Effluents			Liquid Effluents	
		Noble gas	Halogen	Aerosol	Tritium	Other Nuclides
Qinshan NPP	2007	1.40 E-01	5.75 E-03	2.18 E-03	2.43 E+00	7.55 E-02
	2008	2.24 E-01	1.60 E-02	5.45 E-03	1.92 E+00	4.81 E-02
	2009	1.74 E-01	1.28 E-02	4.25 E-03	2.47 E+00	7.53 E-02
	2010	1.82 E-01	1.13 E-02	3.95 E-03	2.07 E+00	4.59 E-02
Daya Bay NPP	2007	6.20 E-02	9.30 E-03	1.97 E-03	4.74 E+01	1.44 E-01
	2008	5.08 E-02	5.33 E-03	1.23 E-03	4.37 E+01	7.45 E-02
	2009	4.36 E-02	5.73 E-03	1.31 E-03	3.99 E+01	6.68 E-02
	2010	3.78 E-02	5.75 E-03	1.25 E-03	4.01 E+01	2.73 E-02
Qinshan Phase II NPP	2007	1.88 E-01	5.36 E-03	5.75 E-04	1.58 E+01	3.95 E-01
	2008	3.22 E-01	3.17 E-03	6.10 E-04	2.48 E+01	3.91 E-01
	2009	3.47 E-01	3.09 E-03	8.50 E-04	1.90 E+01	1.89 E-01
	2010	5.80 E-01	3.88 E-03	2.05 E-03	2.02 E+01	1.45 E-01
LingAo NPP	2007	5.52 E-02	7.53 E-03	2.99 E-03	3.15 E+01	3.37 E-02
	2008	2.34 E-01	3.48 E-02	2.24 E-03	3.38 E+01	2.87 E-02
	2009	4.44 E-02	1.67 E-02	1.89 E-03	3.25 E+01	3.40 E-02
	2010	3.84 E-02	4.64 E-03	1.63 E-03	3.62 E+01	1.75 E-02
Qinshan Phase III NPP	2007	6.00 E-02	4.75 E-04	1.03 E-03	*	2.12 E-01
	2008	8.72 E-02	7.81 E-04	1.38 E-03	*	3.88 E-01
	2009	1.00 E-01	8.69 E-04	1.38 E-03	*	5.65 E-01
	2010	7.12 E-02	7.71 E-04	1.35 E-03	2.84 E+01	7.65 E-01
Tianwan NPP	2007	3.00 E-01	3.25 E-02	4.04 E-03	7.47 E+00	5.57 E-01
	2008	1.60 E-01	5.53 E-03	1.62 E-02	1.18 E+01	6.35 E-01
	2009	1.51 E-01	1.01 E-02	3.42 E-03	1.37 E+01	3.88 E-01
	2010	1.38 E-01	1.48 E-02	7.65 E-03	1.53 E+01	1.77 E-01

Notes:

1. The release amount of radioactive effluents is dependent on power of nuclear units.
2. In the case of lower detection limit, the analytical methods used in calculating the release amount of gaseous and liquid effluents vary somewhat from plant to plant. (For example, the detection limits are taken as sample values at Tianwan NPP, whereas the 1/2 of detection limits are taken as sample values at other NPPs).
3. *The National Standards (GB 6249-86) is not applicable here because of no release limits for HWR tritium provided for hereof.

L.9 References

L.9.1 Documents

[1]	The Fourth National Report of the People's Republic of China to the Convention on Nuclear Safety, April 2007
[2]	The Fifth National Report of the People's Republic of China to the Convention on Nuclear Safety, May 2010
[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]	Annual Report on China Nuclear Power Operation, CAEA, 2007
[5]	Annual Report on China Nuclear Power, CAEA, 2008
[6]	China Nuclear Power Report, NEA, 2009
[7]	China Nuclear Power Report, NEA, 2010
[8]	Annual Report of Nuclear Safety, NNSA，2007
[9]	Annual Report of Nuclear Safety, NNSA，2008
[10]	Annual Report of Nuclear Safety, NNSA，2009
[11]	Long and Intermediate Period Development Planning of Nuclear Power, National Development and Reform Commission (2005-2020)，2006
[12]	IAEA Integrated Regulatory Review Service (IRRS) Mission to China，2010

L.9.2 Websites

For more information about the above-mentioned documents or other information or data，please access to the following websites:

[1]	MEP	www.mep.gov.cn
[2]	CAEA	www.caea.gov.cn

L.10 Abbreviation

Abbreviation	Full name
ALARA	as low as reasonably achievable
AQSIQ	General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China
Beilong Disposal Site	Guangdong Beilong LILW Disposal Site
CAEA	China Atomic Energy Authority
CEA	China Energy Administration
CIAE	China Institute of Atomic Energy
CNNC	China National Nuclear Cooperation
HLW	High level waste
ILW	Intermediate level waste
Joint Convention	The Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management
LILW	Low and intermediate level waste
LLW	Low level waste
ME	Ministry of Energy
MEP	Ministry of Environmental Protection, P. R. of China
MF	Ministry of Finance
MH	Ministry of Health
MMEI	Ministry of Mechanism and Electronic Industry
MPS	Ministry of Public Security
MT	Ministry of Transport
NDSTC	National Defense Science and Technology Committee
NNAERO	National Nuclear Accident Emergency Response Office
NNSA	National Nuclear Safety Administration
NORM	Naturally occurring radioactive materials
Northwestern Disposal Site	Northwestern China LILW Disposal Site
NPIC	Nuclear Power Institute of China
NTSB	National Technology Supervision Bureau
SAPRC	Standardization Administration of the People’s Republic of China
SEPA	State Environmental Protection Administration

Part 2

A. Overview

1.1 No spent fuel is generated nor exists spent fuel-related facility in Hong Kong Special Administrative Region (hereinafter referred to as 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 I and Category II sources, such as caesium-137 in blood irradiator systems and cobalt-60 in gamma knife radiosurgery system, as well as those Category III or lower sources that are used in brachytherapy and calibration of radiation detectors. Sealed sources for industrial applications include Category II and Category III 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 V. 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 Policies

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 140 m^3, has been commissioned in Hong Kong SAR since mid-2005. Presently the total volume of waste in store is about 68 m^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 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)