English Version

THE PEOPLE'S REPUBLIC OF CHINA

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, decided to access to the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (hereinafter referred to as Joint Convention), which was adopted on 5 September 1997 by a Diplomatic Conference convened by the International Atomic Energy Agency. On 13 September 2006, China sent its submission of accession instrument to the Depositary. The Joint Convention entered into force to China from the day of 12 December 2008 on.

This report is provided, according to the Article 32 of the Joint Convention, as the National Report of the People's Republic of China to the third review meeting of the Contracting Parties. This is the first submission by China to implement the obligations of the Joint Convention.

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 with relevant information as of 31December 2006. Part 2 deals with the implementation of the obligations of the Joint Convention in Hong Kong, which is prepared by the Hong Kong Special Administrative Region of the People's Republic of China.

This report does not include information of Taiwan Province of the People's Republic of China, neither of Macao Special Administrative Region 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.

A-2 With an aim 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, China follows the basic principles of ionizing radiation protection, radiation source safety and radioactive waste management safety to establish and improve legislative system, build and upgrade regulatory capabilities, clarify and allocate safety management responsibilities, control and minimize the generation of radioactive waste, plan and accelerate the stabilization and disposal of radioactive waste.

A.2 Concerned Facilities

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

A.3 Structure

A-4 As required by Guidelines regarding the Form and Structure of National Report, the Part 1 of this report explains China’s fulfillment of the obligations of the Joint Convention in terms of chapters corresponding to the Articles. Each chapter begins with the corresponding Articles, given in the Joint Convention, enclosed with a box and underlying dark lines. The contents, in addition to the Introduction, are as follows:

Section B. Polices and Practices

Section C. Scope of Application

Section D. Inventory and Lists

Section E. Legislative and Regulatory System

Section F. Other General Safety Provision

Section G. Safety of Spent Fuel Management

Section H. Safety of Radioactive Waste Management

Section I. Transboundary Movement

Section J. Disused Sealed Sources

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, the regulations, which are universally applicable, governing the spent fuel management facilities and the radioactive waste management facilities are addressed in Chapter E.

B. POLICIES AND PRACTICES

Section B will address its:

(i) spent fuel management policy;

(ii) spent fuel management practices;

(iii) radioactive waste management policy;

(iv) radioactive waste management practices;

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

B.1 Spent Fuel Management Policy

B-1 China's spent fuel management policy is to implement the reprocessing of spent fuel, 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, was put into commercial operation on 15 September 1991, the total nuclear installed capacity on the China's mainland has reached 12538 MWe as of 31 December 2006, with an annual electrical energy generated of 54.846 TWh. 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 cycle of nuclear fuel 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-3 To ensure the successful implementation of the policy of spent fuel reprocessing, China is studying the options for collecting and managing of back-end fund.

B.2 Spent Fuel Management Practices

B-4 Spent fuel arises from the operations of nuclear power reactors and research reactors, which are stored in pool at reactors. Independent spent fuel storage facility has not yet been built in China.

B-5 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 reactor 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 L1.3. At present, spent fuel at nuclear power plants is in wet-storage. QNPP III, using natural uranium as nuclear fuel, produces a large amount of spent fuel. A dedicated temporary dry-storage facility is currently under construction, which can accommodate all spent fuel during its entire lifetime.

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 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. As required, the management procedures for nuclear fuel and reactor-core components must be prepared, including transfer of irradiated fuel, storage at plant, 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 authorized company can conduct 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 implementation of fuel withdraw plan and option preparation, 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. Clear assignment of responsibility can ensure (1) handling, storage and inspection be carried out following the approved procedures, with approved equipment and within licensed facilities; (2) storage of spent fuel shall follow the approved arrangement; (3) water quality in the spent fuel storage pool shall meet such conditions as prescribed temperature, pH, radioactivity, and physical and chemical properties; (4) before taken away from the storage pool, spent fuel shall be checked for their type and location against the planned transport list; and (5) before delivery, all the required information relevant to spent fuel must be checked according to the transfer procedure.

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 when there is need. 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 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.

B.3 Criteria Used to Define and Categorize Radioactive Waste

B-10 As specified in the Law of the People's Republic of China on Prevention and Control of Radioactive Pollution, radioactive waste is the waste that contains or contaminated with radionuclides at concentrations or radioactivity greater than the clearance level as established by the regulatory body without foreseen further use.

B-11 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 waste treatment, conditioning requirements, 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-12 Predisposal management-based 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 forms of wastes according to their radioactive characteristics as shown in Table 1. It is basically consistent with the basic requirements of waste treatment, 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.

B-13 Disposal-based radioactive waste categorization system divides solid radioactive waste into solid LLW, solid ILW, solid HLW, solid alpha waste and the waste arising from mining and milling of uranium and thorium, and 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 requirement.

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 container bigger than 4×10^6 Bq/kg

Table 2 Disposal-based radioactive waste categorization system

Waste categorization	Disposal approach
Solid HLW	Centralized disposal
Solid α waste	Centralized 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 radioactive waste

B-14 Low and intermediate level radioactive wastes (LILW) arises mainly from nuclear power plant operation and nuclear technology applications.

B-15 Radioactive waste produced in operating nuclear power plants is principally from (1) main process equipment and waste treatment equipment, including secondary waste from loop leakage or drainage and waste treatment system, which includes airborne and liquid radioactive wastes, (2) technical maintenance during operation, (3) protective articles, equipment and miscellaneous scrap replaced during the daily operation.

B-16 The wastes arising from nuclear technology applications refers to contaminants that arise from the applications of radioisotopes and irradiation technology in industry, agriculture, medicine, research and teaching, which contain man-made radionuclides with specific activity higher than 2×10^4 Bq/kg, or naturally occurring radioactive materials (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 Radioactive Waste

B-17 High level radioactive waste (HLW) includes the high-level liquid waste generated from the reprocessing of spent nuclear fuel, and the solidified form of such waste, as well as spent fuel withdrawn from nuclear power reactor or research reactor pending direct disposal.

B-18 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-19 Uranium (Thorium) mining and milling waste means those with radioactive levels exceeding the relevant regulatory levels, which was generated from exploration, mining, milling and closure, mainly covering barren rocks, and tailings characterized by large volume, low activity and simple radionuclide composition.

B.3.4 Naturally-Occurring Radioactive Waste (NORM)

B-20 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 Policy

B-21 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 management.

B-22 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-23 Both the radioactive waste management legislative and regulatory system and the independent radioactive waste safety regulatory systems are established. Licensing system for radioactive waste management activities is implemented, and license holder undertakes the main responsibility for the safety of radioactive wastes and relevant management facilities

B-24 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.

B-25 Relevant radioactive waste treatment capacity should be simultaneous established with the main technological process in their design, construction and operation. License holder should solidify liquid radioactive waste timely and limit the storage duration for both liquid waste and solid waste.

B-26 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 tomb.

B-27 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-28 The research and development of HLW geological 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-29 With the development of nuclear industry, including nuclear power plant, and nuclear technology use, 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 required categorization.

B-30 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 important role in ensuring normal operation and environmental protection.

B-31 All sorts of liquid waste generated in the process of 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-32 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-33 The NPP operators prepared radioactive waste management programs, which specify the assignment of responsibility of radioactive waste management within each NPP. The Chief Manager of each nuclear operational organization acts as the first responsible person of radioactive waste management, who is responsible for provide sufficient resources to ensure the effective implementation of radioactive waste management program, and ensures the national limits of radioactive effluents to be complied with and radioactive waste management arrangement to be maintained and modified in a sustainable manner.

B-34 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.

B-35 In general, concentrated liquid and spent ion exchange resins are cement-solidified, the waste arising from technology process is held in storage after sorting and compression. Cement solidification processes have been established in Daya Bay, QNPP II and Lingao NPPs to carry out cement solidification of liquid LILW, spent ion exchange resins and spent filter cartridge. The spent ion exchange resin produced at QNPP and QNPP III is currently stored temporarily and the related cement solidified waste forms are stored in waste storage facility at such NPPs. The solid radioactive wastes generated at NPPs are mainly stored in storage facilities at various NPPs and liquid waste in tanks. 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 The operators of the NPPs are continuing to carry out technology modifications. QNPP upgraded the cement solidification installation as a result the waste drum filling coefficient increased from less than 79% to more than 90%. Guangdong Daya Bay NPP is testing to improve the formula for cementation of its spent ion exchange resin so as to raise the waste loading capacity.

B-37 Measures to control waste generation are well taken in daily operational practices. Personnel awareness of waste minimization is being reinforced through training and education activities. Suitable operational process is employed and technological and administrative measures are envisaged to make waste generation at a level as low as reasonably achievable. In more detail, these include through detailed working plan and arrangement to control waste generation during maintenance; through control of waste transfer to prevent spreading of contamination spread; through maintain normal operation of the waste treatment system to reduce the generation of the secondary waste generation; minimize the entry of materials into the controlled area; enhance recovery and reuse by dismantling the disused intermediate and high efficiency filter, and returning metal frameworks to manufacturers when the contamination is measured to be below clearance levels. As of 31 December 2006, the volume of solid Lilts generated from China's NPPs amounts to 4773 m^3。

B-38 The tracking management of solid radioactive waste is an important aspect in the safety of solid radioactive waste management. Each nuclear power plant writes specific management procedures to require the tracking management of radioactive waste. Each waste package is tracked by establishing a unique radioactive waste record. The relevant information of the record includes origin of waste, type of waste, date of waste generation, radioactivity level in waste, quantity/volume of waste, temporary storage location, and etc.

B.5.2 Low-and-Intermediate-Level Radioactive Waste Disposal

B-39 In the 1980's, radioactive waste disposal work was initiated in China. The former Ministry of Nuclear Industry (MNI) subsidiary Science and Technology Committee set up a panel of radioactive waste treatment and disposal.

B-40 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 distribution of nuclear facilities at that time. The siting of South China disposal site began in 1991, with 27 candidate areas being preliminarily selected in South China. Of them, 20 candidate areas were investigated on site and 3 candidate sites were identified. In 1998, the initial reconnaissance was carried out within the area of Zhejiang province, East China, with 17 areas surveyed and 5 candidate sites identified. In Northwest China, 2 candidate sites were identified on the basis of 6 surveyed areas. After further comparison, Northwest disposal site was determined. In the Southwest China, siting of disposal site was carried out over the period 1989 to 1991. The site survey was carried out in 10 candidate areas selected from initially considered 38 areas, of which 3 candidate sites were finally recommended.

B-41 The China's Environmental Policy on Disposal of LILWs was issued in 1992 (hereinafter referred to as the Paper 45), which clarify the environmental policy on LILW disposal. The Paper 45 states that national disposal site 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 Paper 45 played an active role in promoting the siting and construction of LILW disposal sites. In 1998, the construction of Northwest disposal site was completed, with planned disposal capacity of 200,000 m^3. The first phase construction was planned to be about 60,000 m^3, so far 20,000 m^3 capacity has been constructed. The Northwest disposal site is currently in the trail operation phase. By the end of 2006, this site received 471 m^3 of LILW with total activity of 3.05×10^{12} Bq. In August 2000, Guangdong Beilong solid LILW disposal site was constructed in the approximate vicinity of GNPS, with planned long term capacity of 240,000 m^3 and planned near term capacity of 80,000 m^3. The total capacity that has been constructed in the first phase was about 8800 m^3 and, by the end of 2006, received waste amounted to 1403.2 m^3. The environmental monitoring results indicate that operation of these two LILW disposal sites has no negative impact posed on the surrounding environmental radiological levels and no radiation accident has occurred to date.

B-42 Under the Law of the People's Republic of China on Prevention and Control of Radioactive Pollution, the relevant agencies of Chinese government are organizing to develop the program on the siting of solid radioactive waste disposal site. The principle is to make 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. Construction of disposal site on the site that has been chosen should be implemented in phases 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.5.3 Geological Disposal of High-Level Radioactive 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 for 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 engineered and geological barriers.

B-45 Under this 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 demonstration 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 assessment of disposal facility construction, disposal facility construction, and safety review for disposal facility operation.

B.5.4 Nuclear Applications Radioactive Waste 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 Urban Radioactive Waste Repository* was issued in 1984. The Methods *on Urban Radioactive Waste Management* was issued in 1987.

B-47 The temporary storage facility for nuclear application 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, teaching, 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 monitor.

B-48 By the end of 2006, a total of 28 radioactive waste temporary storage facilities, together with one centralized storage facility for spent radioactive source, were constructed, with 1,300,000 kg radioactive waste being received in total. Radioactive waste containing only short-lived nuclides may be put into decay storage. When the radioactive level of the waste decays to below clearance level, such waste can be released from the regulatory control in accordance with required procedures.

B.5.5 Recycle and Reuse

B-49 Recycling and reuse of materials is an important initiative to reduce the waste generation and to increase the effectiveness of resources.

B-50 To meet the needs for uranium ore mining and milling and for recovery and reuse of contaminated metals, the former MNI set up, in the 1970’s of 20th century, 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. Pursuant to the national radiation protection requirements, the *Quality Assurance Handbook of Treatment Center on Contaminated Metals in the Uranium Ore Mining and Milling System* and the *Regulations on Management of Recovery and Disposal of Radioactively Contaminated Metals* among others were compiled. It requires that the specific activity in product is less than 600 Bq/kg and uranium content in iron slag is about 922 μg/g. Radioactively contaminated iron slag produced in melting is stored in waste slag storage operating by the treatment center and is transferred to a tailing dam for disposal on a regular basis.

B-51 Radioactively contaminated metals, after being decontaminated, are used for casting package drum or for manufacturing quick-wear parts of mechanical equipment that can be used for uranium ore mining and rock crasher, like lined plate in rotary crasher, breaker in jaw crasher and tooth in bucket excavator.

B-52 From 1998 to 2006, the recovered contaminated metals amounted to 8236 tons, thus achieving the aim of contaminant volume reduction and resource reuse.

B-53 The recovery and reuse of radioactive sources are an important aspect of reducing waste risks and promoting the effective use of resources. As of 31 December 2006, a total of 231 medical cobalt sources with radioactivity of about 8.38×10^{15} Bq（226,538 Ci）and 8 industrial irradiation sources with radioactivity of about 2.04×10^{15} Bq (55,000 Ci) were recovered.

C. SCOPE OF APPLICATION

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

> 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 Qinshan Nuclear Power Plant's commencement of operation in 1991, a total of 10 nuclear power reactor units were connected to electricity grid till 31 December 2006, with additional one in testing and four under construction. These NPPs are mainly distributed in the costal 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 being connected to electricity grid for the nuclear reactors that have been connected to grid for electricity generation. 。

D.1.2 Research Reactor

D-2 As of 31 December 2006, there have been 12 research reactors in operation, as detailed in Annex L. 1. 2. They are distributed over 5 provinces and municipalities across the country, among which 6 research reactors are located in Beijing.

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. Each of NPPs has its own storage facilities, with the data such as designed volume as shown in Annex L.1.3.

D.2 Spent Fuel Inventory

D-4 As of 31 September 2006, there has been a total of 1532.5 tons spent fuel generated, of which 155.3 tons have been transported to the outside and the rest 1377.2 tons are being held in at-reactor storage. See Annex L.3 for more information on spent fuel storage at nuclear power plants. The spent fuel arising from research reactors amounted to 8.3 tons, including 1.9 tons transported to the outside and the rest 6.4 tons in storage at premises

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 activities. 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 enrichment capacity of 1100 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 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 NPP III.

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 receiving 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 Guangdong Beilong LILW Disposal Site (Beilong Site) is located at Dapeng Peninsula, about 5 km away from Guangdong Daya Bay Nuclear Power Plant. The site selection and environmental impact assessment (EIA) began in June 1991. The State Environmental Protection Administration (SEPA) finished review of EIA for siting and approved the site in December 1994. In August 1997, the review of EIA for construction application was finished. In the early of 2000, a disposal capacity of around 8 800 m^3 was built up. The Beilong Site is designated to accept LILW arising from NPP and nuclear technology applications in the southern part of China.

D-10 According to the operational license application document, the radioactive wastes to be received is solid LILW, it does not include spent sealed radioactive source, with alpha activity not exceeding 3.7×10^5 Bq/kg and the total radioactivity level being about 5.4×10^{15} Bq. Non-uniformity of nuclide activity in each container is allowed, but the largest shall not be larger than the three times of the average over the package.

D.3.4.2 Northwestern China LILW Disposal Site

D-11 Northwest China LILW Disposal Site (The Northwest Site) is located in Gansu province in the northwest China. It is planned to have a disposal capacity of 200,000 m^3, and phase I of the project is about 60,000 m^3, of which 20,000 m^3 has been built up.

D-12 According to the license for trial operation, solid LILW, excluding disused sealed source, can be disposed of at the site, with alpha activity not exceeding 3.7×10^5 Bq/kg and the total radioactivity level being about 3.2×10^{16} Bq. Non-uniformity of nuclide activity in each container is allowed, but the largest shall not be larger than the three times of the average over the package.

D-13 After many year's of trial operation, the operator of the Northwest China Site has established a proven system of waste disposal operation management (including check and accreditation, oversight of in-situ conditioning, waste package check and receipt, transport, handling, emplacement, backfilling, and capping), the information management system, the environmental and radiation monitoring system, and the emergency preparedness and response system.

D.4 Radioactive Waste Inventory

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

D-14 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.4.1 gives the inventory of wastes stored at each of the NPPs.

D.4.2 Radioactive Waste Accumulation from other Nuclear Facilities

D-15 A certain amount of radioactive wastes with different form and levels have been generated and accumulated due to nuclear research activities, with their inventory shown in Table 3.

Table 3. Radioactive Waste Accumulated in the Major Research Institutions (unit: m^3)

Category	CIAE	NPIC	Tsinghua University	Total
ILLW	1154.0	1089.0	5.0	2248.0
ILSW	189.1	220.6	1.3	411.0
LLLW	1918.6	207.0	254.0	2379.6
LLSW	4034.0	1453.2	27.9	5515.1

Note: ILLW, intermediate-level liquid waste;
ILSW, intermediate level solid waste;
LLLW, low-level liquid waste;
LLSW, low-level solid waste.

D-16 Annex L.4.2 lists the volume of radioactive wastes that have been accumulated and stored at nuclear facilities involving research, uranium enrichment, fuel element manufacture and nuclear power production. Annex L.4.3 gives a list of radioactive wastes and disused radioactive sources being stored in radioactive waste storage facilities for nuclear application waste.

D.4.3 Waste Received by the Disposal Sites

D-17 Now, there are two solid LILW disposal sites in trial operation in China. Annex L.4.4 lists the volume of wastes which have been received for disposal.

E. LEGISLATIVE AND REGULATORY SYSTEM

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

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

> 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 high degree of 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 a main project must be simultaneous with those of the facilities used for preventing pollution and other public hazards. In 1986, the State Council issued the Regulation on the Safety Control for Civilian Nuclear Installations, 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 Safety and Protection of 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 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 radioactive sources. In 1992, the State Council approved and circulated the Environmental Policy on LILW Disposal in China (State Council [1992]45), 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 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 was changed to a unified regulatory system by the environmental protection competent authority of radioactive sources. In 2004, the Basic Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (GB 18871-2002), a Chinese Standards, was issued.

E.2.2 Legislative Framework

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

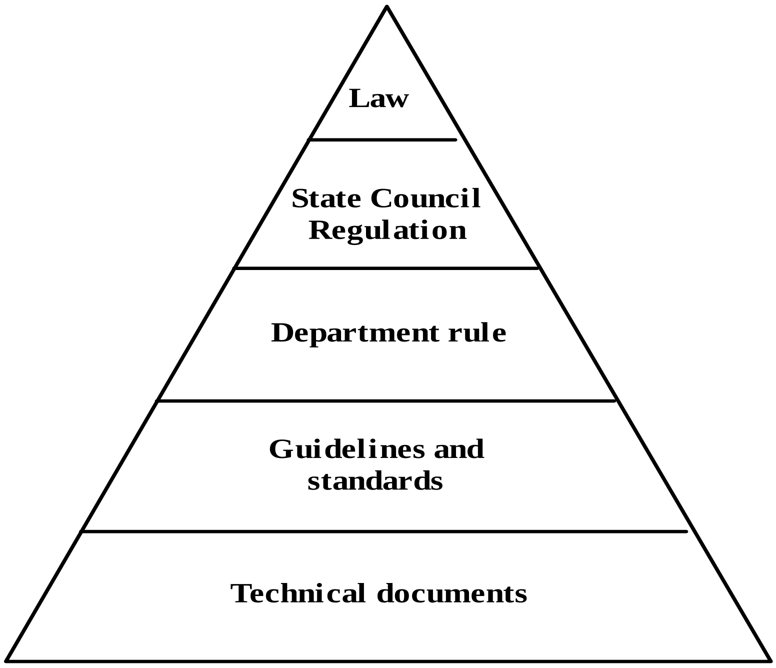

Figure 1. Legislative and standards system in China

E.2.2.1 Laws

E-6 The existing national laws applicable to the field of nuclear safety and radiation safety 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; and
- The Law of the People's Republic of China on Environmental Impact Assessment

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. 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 Contamination was promulgated in 2003 by the Standing Committee of the National People's Congress. 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, mining of uranium/thorium resources and ores associated with radioactivity, 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 spent fuel management safety and radioactive waste management safety are summarized in Annex L.5.1.

E.2.2.2 Regulations

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

- Regulations of the People's Republic of China on the Safety Control for Civilian Nuclear Installations
- Regulations of the People's Republic of China on Nuclear Materials;
- Regulations on Accident Emergency Management at Nuclear Power Plant; and
- Regulations on Safety and Protection against Radioisotope and Ray-generating Installations

E-9 These regulations lay out 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 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 Accident 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 against Radioisotope and Ray-generating Installations 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 spent fuel management safety and radioactive waste management safety are summarized in Annex L.5.2.

E.2.2.3 Department Rules

E-11 The departmental rules applicable to spent fuel management safety and radioactive waste management safety 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 Urban Radioactive Waste Repository; Methods for Management of Urban Radioactive Waste Repository;
- Methods for Radiological Environment Management;
- Regulations on Radioactive Waste Safety (HAF401); and
- Regulations on NPP radioactive waste management safety（HAF0800）.

E-12 Annex L.5.3 gives a list of the department rules applicable to spent fuel management safety and radioactive waste management safety.

E.2.2.4 Standards, Guidelines and Technical Documents

E-13 China’s radioactive waste management standards system comprises national standards (GB series) and departmental standards with inclusion of nuclear industry standards (EJ series), guidelines for nuclear safety laws and rules (HAD series) and guidelines for environmental protection laws and regulations (HJ series).

E-14 For the current GB, EJ, HAD and HJ standards/guidelines, there have been more than 80 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 phased standards (such as generation, pre-treatment, treatment, discharge, conditioning, storage, transport, disposal, decommissioning and environmental remediation) and 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-15 The current standards and guidelines applicable to spent fuel management safety and radioactive waste management safety are provided in Annex L.5.4.

E.2.3 Regulatory Framework

E-16 China has established independent regulatory body for spent fuel management safety and radioactive waste management safety, which implements overall and synchronized regulation with clear division of responsibilities.

E-17 Licensing system, together with systems of supervision, inspection and reporting, are implemented in China for spent fuel management safety and radioactive waste management safety. Under the relevant laws and regulations, the licenses relevant to spent fuel management safety and radioactive waste management safety can be divided into nuclear safety license, radiation safety license and qualification certificates.

E-18 The Regulations of the People's Republic of China on Safety Control of Civilian Nuclear Installations (HAF001) lay out the matters relevant to nuclear safety license, which is applicable to:

(1) Nuclear power plant (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-19 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-20 Regulations on Safety and Protection of Radioisotope and Ray-generating Installations lay out that radiation safety licenses are applicable to the undertakings involving the production，distribution and use of radioisotope and rays-generating installations.

E-21 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 a 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 whose without license for storage and disposal.

E-22 Environmental impact assessment system, discharge permission system and environmental monitoring system are also implemented in respect of spent fuel management safety and radioactive waste management safety in China.

E-23 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 central level or provincial level. The license for the user of Category I radioactive source is reviewed, approved and granted directly by Ministry of Environmental Protection (MEP), while the licenses for Category II, III, IV and V by environmental protection agencies at provincial level.

E.3 Regulatory Body

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-24 In China, the independent regulatory bodies which are relevant to spent fuel management safety and radioactive waste management safety are the MEP (NNSA), Ministry of Health and Ministry of Public Security.

E.3.2 MEP/NNSA

E.3.2.1 MEP/NNSA Organization Structure

E-25 The Map'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, MEP (NNSA) set up a Nuclear and Radiation Safety Center as technical support and guarantee for itself. 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. By the end of 2006, MEP (NNSA) has 310 staff in total and the budget in 2006 amounted to 100 millions RMB.

E-26 In order to ensure and maintain the capability of regulatory staff, it is required that the staff shall meet the follow conditions:

(1) Have a bachelor's degree or above or at the same educational level;

(2) Have gained more than 5 years of practical experiences or more than 3 years of experiences in nuclear safety management, being able to fulfill the task of nuclear safety supervision under the rule of relevant law and regulations independently, and be able to make correct judgment and write qualified report;

(3) Be familiar with national nuclear safety regulations and complying with the relevant national laws and regulations; and

(4) Be honesty, just, devoted and modesty.

E-27 MEP (NNSA）shall select the persons according to the practical need,, those are qualified against the above requirements and for further training and examination. The examination includes both written and oral. The qualified persons then would be granted, by MEP (NNSA), the Certificate for Nuclear Safety Supervision.

E.3.2.2 MEP/NNSA Responsibilities

E-28 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 license holders. Thus it can be ensured that the license holders 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-29 The Ministry of Health has, in the aspects of spent fuel management and radioactive waste management safety, the main responsibilities of:

(1) Developing health related regulations and standards for radiological workers;

(2) Supervising the doses that may be received by the radiological workers;

(3) Reviewing and authorizing occupational health/hygiene assessment; and

(4) 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-30 The Ministry of Pubic Security is, in the aspects of spent fuel management safety and radioactive waste management safety, principally responsible for investigating and recovering the lost radioactive sources, and for the security of road transport of radioactive materials.

E.4 Functions of China Atomic Energy Authority

E-31 In addition to the forgoing mentioned regulatory bodies, the China Atomic Energy Authority (CAEA) is one of the primary governmental agencies relevant to the spent fuel management safety and radioactive waste management safety, 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 and review 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) Security and fire control at NPPs.

F. OTHER GENERAL SAFETY PROVISIONS

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 License holder

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 spent fuel management safety and radioactive waste management safety comprise nuclear safety license, radiation safety license and qualification license.。

F.1.1 General Responsibility of the Nuclear Safety License Holder

F-2 The responsibility of a nuclear safety license holder 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 Safety Control of Civilian Nuclear Installations.

F-3 The nuclear safety license holder 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; 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 License Holder

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

(1) The radiation safety license holder 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 license holder 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 license holder 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 license holder 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 hidden trouble in safety being discovered;

(5) The radiation safety license holder，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 hidden trouble. If a license holder 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 license holder shall make the agreement with the user of radioactive source concerning return of radioactive source to the manufacturer; the user of radioactive source should return disused radioactive source to manufacturer or country of origin in accordance with such agreement. The disused radioactive source that can not be returned to manufacturer or country of origin should be sent to a licensed centralized radioactive storage facility.

(7) The user of radioactive sources of Category IV and V shall, in accordance with the provisions of the SEPA, bring the packaged and conditioned radioactive waste to the licensed centralized 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 lows and regulations.

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

F.1.3 Radioactive Waste Safety Responsibility of the License Holder

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 license holder for the radioactive waste management safety.

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

F-7 A license holder 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. Application shall be made for the waste quantity to be discharged to the environmental protection agency responsible for review and authorization of environmental impact assessment documents. 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 license holder shall transfer, after treatment, generated radioactive waste to disposal facility pursuant to the provisions of competent authority of environmental protection under State Council and bear the cost for disposal.

F.2 Human and Financial Resources

> 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, HAF0500, HAF401, GB14500-2002 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 program for staff education and training 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 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 Registered Nuclear Safety Engineer System

F-19 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 Registration qualifications for 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 enhance the management of the key posts with nuclear safety related responsibility, ensure nuclear and radiation environmental safety, and maintain national and the public's interests. Subsequently, Nuclear Safety Engineer Registration Management Rules was issued in 2004, and the Temporary Regulations on Continued Education of Registered Nuclear Safety Engineer was issued in 2005.

F-20 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 Engineer is granted to the qualifier after his 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-21 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 SEPA (NNNSA) .

F-22 By the end of 2006, the examination for registered nuclear engineers was conducted for three times across the country since the first time examination in 2004.

F.2.1.3 Training and Certificate of Radiation Safety

F-23 Under Article 28 of Regulations on Safety and Protection against Radioisotope and Ray-generating Installations, any undertakings who produce, distribute and use the radioisotope and ray-generating installations shall provide training in nuclear safety and protection knowledge to the workers who is directly associated with production, distribution and use of them. Examination shall be given the trainee. The worker who does not passed the given examination is not fit the job post with radiation safety related responsibility. The training program, in conjunction with training materials, was developed by the MEP in such a way as to have an enhanced training management and consistent training and examination requirements. Training organizations have been accredited with whole process supervision being provided of training and examination.

F.2.2 Financial Resources

F.2.2.1 Financial Resources for Operation

F-24 The cost of 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 associated with safety modification.

F-25 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-26 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-27 Also, the management rules are currently under study and preparation in respect of spent fuel back end management funds and financial arrangements after waste management responsibility has been transferred.

F.2.2.2 Financial Resources for After-closure

F-28 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

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-29 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 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-30 The top-level managements of nuclear facilities hold the overall responsibility for the efficient implementation of the QA program. All personnel involved in the safety and quality management at nuclear facilities are required to be in compliance with the QA program, also having the responsibility and accountability for reporting the issues that have been discovered. Independent QA organization is set up to be responsible for making and managing QA program and validate the QA program implementation by means of inspection, supervision and audit.

F-31 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. The management body of the nuclear facility is responsible for effective implementation of the overall QA program. The main responsibility for the quality of a particular task lies with one who is undertaking the task rather than those for quality verification and validation.

（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-32 Basic QA requirements was provided for under the Regulations on Quality Assurance Safety at NPPs, 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 and implementing effectively the overall QA program and the activity-specific QA program; preparing written procedures, instructions and drawings with periodic review and revision being made, identifying the current status and applicability of QA program and, if necessary, taking corrective action;

(3) 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;

(4) 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;

(5) 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;

(6) 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;

(7) 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;

(8) 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;

(9) 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;

(10) 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;

(11) 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;

(12) Identifying and correcting the conditions that has 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; and

(13) 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-33 In addition, there are ten 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-34 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 Regulations on QA Safety for NPPs 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 Regulations on QA Safety for NPPs and other safety related guidelines

F.3.4 Quality Assurance for Safety of Radioactive Waste Management

F-35 The Regulations on Radioactive Waste Safety (HAF401) was issued by NNSA on 5 November 1997, where QA is defined as taking appropriate measures to provide essential confidences in protecting human health and the environment. 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.3.4.1.1 Development of the QA Program

F-36 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-37 NPP’s operators shall making and implement the overall QA program for NPP’s waste management system under the Regulations on NPP Radioactive Waste Management Safety. Such QA program shall be prepared in accordance with the provision of the Regulations on NPP QA Safety Requirements and applied to every stage from the site characterization, design, procurement, manufacture, construction, commissioning, verification, operation and decommissioning.

F-38 The operators of waste management facilities shall develop and implement a QA program in accordance with both 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-39 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. 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.3.4.1.2 Implementation, assessment and modification of the QA program

F-40 QA is used at NPPs in China as an important tool for effective management. In order to effectively implement a QA program, a throughout analysis of the tasks to be undertaken shall be made in such a manner as to determine the required skills, select and train appropriate staff, employ appropriate equipment and procedures, create excellent work environment, assign the responsibility to the staff undertaking such a task, verify whether the activities undertaken are corrective and to collect written evidence that confirms QA requirements are met.

F-41 QA program is intended to be binding on all kinds of staff as follows:

(1) Management staff who develops serious strategy, allocates reasonable resource, provide guidance and other necessary supports so as to achieve the organizational objective;

(2) Enforcement staff who achieve quality target and make written records in an appropriate environment by utilizing qualified equipment, materials and tools pursuant to authorized procedures and approach; and

(3) Assessment staff who assess the validity of management process and its implementation, and make the information obtained from such assessment available to continuous modification.

F-42 QA department is set up at each NPP in China, which, independent of other departments, is directly under the leadership of the top-level management. This QA department is responsible for development, management, supervision, assessment and revision of such QA program. Through implementation of internal and external supervision, inspection and assessment of QA arrangement, the QA department makes every effort to find the defects in QA system, for which timely revision is necessary. At the same time, strict management is applied to non-conformances and corrective measures in such a manner as to collect information of quality, analyze its tendency and report to top-level management on a regular basis. If necessary, prompt corrective actions shall be taken.

F-43 For QA of radioactive waste management safety, the functions of supervision and assessment are approached through the following activities:

(1) A newly built NPP is required, under nuclear laws and regulations, to develop its applicable QA program and related QA document system in a timely manner, and to establish a well structured organization and functions to ensure that the QA target would be achieved.

(2) A NPP in operation should implements effectively a QA program in an effort to continue improving such QA program and the effectiveness of its implementation through independent review, supervision and assessment of preparatory work of important safety related production activities and their implementation, preparation of QA plan, establishment of controlled points, carrying out of quality supervision, reinforcement of metric management and contractor management. Verification is made to confirm that control requirements for various activities have been correctively implemented and that the objective basis on which such various activities has been satisfied with quality standards.

(3) Review is carried out of qualification of contractors responsible for design, manufacture and installation of nuclear equipment, and supervision is conducted of whether activities meet the requirements of QA program with a view to reinforce the control of quality management and process of such contractors.

F.3.4.1.3 Review by management departments

F-44 All management departments of a contractor involved in QA program for RADIOACTIVE WASTE MANAGEMENT SAFETY shall annually make effective review of the validity of the QA program. Review and assessment are based on the results of annual QA inspection and supervision and on the information gathered by NPP’s other related departments, like quality problems, corrective measures, quality trend, accident and fault, and staff qualification and training. In assessing the validity of concern, the emphasis is placed, against the elements of QA program, on the followings:

(1) Major defects in quality that once existed previously but has been addressed to a large degree over a past one year;

(2) Important corrective measures that have been completed or being performed and are expected to have greater impact upon modification to quality;

(3) Major defects that have not yet been resolved;

(4) Assessment of effectiveness of QA program’s implementation that has been made on the basis of the applicability of such QA program;

(5) Suggestions for specific corrective measures that need to be provided on the basis of discovered defects and analyzed reasons for such defects; and

(6) Notifications to the relevant contractors and relevant departments that are provided after discovering problems inhere in QA program and taking corrective measures.

F.3.4.2 Quality Assurance for LILW Near Surface Disposal

F-45 QA requirements are laid down in the Regulations on Near Surface Disposal of LIIW （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. The QA requirements for near-surface disposal facility at the stages of design, construction and operation are specified in much the same way as other types of nuclear facilities. The QA program is also specified to take due account of each element’s potential impact on disposal safety, in such a manner that the results of safety assessment at the stages of operation and post closure must be used to determine the activity, structure, system and equipment important to safe handling and disposal. Under the Regulations, the operator of such disposal facility shall be responsible for making and implementing overall QA program and, when necessary, can delegate other contractors to make and implement QA sub-programs which, however, must be responsible for the validity of such overall QA program. This would not detract from the obligations and statuary responsibility of the contractors.

F-46 In practice, China implements the overall requirements provided in the Requirements for Near-Surface Disposal Safety of Radioactive Waste, published by the IAEA in 2005, as follows:

(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. This helps to provide an assurance for meeting safety related requirements and criteria.

(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 Activity

F-47 The MEP (NNSA) controls QA arrangements for spent fuel management safety and radioactive waste management safety 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-48 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

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-49 A wide spectrum of laws, regulations and national standards are promulgated in China to ensure the achievement of the goals of radiation protection.

F-50 On 8 June 2003, the Standing Committee of the National People's Congress 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 as low as reasonably achievable. 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-51 On 8 October 2002, the Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (GB18871-2004) was issued to replace the previous Regulations on Radiation Protection (GB8703-88) and Standards on Radiological Health and Protection (GB4792-84). Under the GB18871-2004, the principles and requirements of radiation protection are the same as the basic safety standards recommended by ICRP 60 Recommendations and BSS 105 issued by IAEA together with other international organizations.

F-52 Any nuclear facility is required to set dose limits as management goals under the GB18871-2004 taking account of economic and social factors, which should be lower than the relevant national limits. The GB18871-2004 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 public shall be assessed. The GB18871-2004 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 fee 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-53 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 NPPs;

(2) Full consideration should be given to radiation protection requirements, 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;

(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-54 The Technical Policies Governing Several Important Safety Problems in Design of Newly Built NPPs was issued in August 2002, where 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. Various measures are required to be taken for controlling radiation exposure and reduce possibility of an accident.

F-55 The Regulations on Radiation Protection for NPPs （GB6249-86）, 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:

(1) Effective dose equivalent to any adult individuals of the public arising from a NPP should be less than 0.25 mSv;

(2) In addition to meeting the above provisions, the airborne and liquid radioactive effluent from a PWR NPP should be also less than the control values listed in Table 4.

Table 4. Annual discharge limits under operational conditions of a PWR Nuclear Power Plant (Bq)

Airborne radioactive effluent			**Liquid radioactive effluent**	
Noble gas	Iodine	Particle (half-life≥8d)	tritium	other
2.5×10^{15}	7.5×10^{10}	2.0×10^{11}	1.5×10^{14}	7.5×10^{11}

F.4.2 Occupational Exposure

F-56 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. 6.

F.4.3 Public Exposure

F-57 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 Effluents

F-58 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-59 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-60 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-61 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. Environmental radioactive monitoring data shall be used to assess and analyze the validity of controlling radioactive material release into the environment, the public exposure from nuclear facility' effluent, long term trend in variation in environmental radioactivity, migration and dispersion of radioactive material in the environmental media and the reality of environmental model used for establishing authorized limits.

F-62 Environmental radioactive monitoring includes pre-operation monitoring, routine environmental radiation monitoring, radioactive effluent monitoring and meteorological monitoring.

F-63 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-64 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-65 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 quantity of radioactive effluents discharged is not in excess of national limits. The factions of the quantity of radioactive effluent discharged by NPPs in China during 2004-2006 to the limits of national standards are shown in L. 7.

F-66 Meteorological monitoring aims to atmosphere diffusion monitoring. Meteorological monitoring programs have been prepared with the aim of making continuous monitoring of wind direction, velocity and air temperature, precipitation and air pressure at varying heights above ground at the typical selected locations. In addition, lines of communication are established between

NPPs with meteorological observatory stations in provinces where they are situated so as to obtain the needed meteorological data.

F-67 Accident emergency monitoring means the environmental emergency plan prepared by NPPs prior to their operation, where derived intervention levels are provided for in order to assess monitoring results and decide whether or not to take necessary action as early as possible.

F-68 NPPs are equipped with radiation monitoring meters, radiation surveillance meters, contamination monitoring meters, air sampler and environmental media sampler among others, with regular test and calibration. All emergency equipment is, as required, tested for reliable use.

F-69 Assessment of public dose and environmental impact is performed at NPPs based environmental monitoring data. Accumulated gamma radiation monitoring data at the plant boundary are used, together with data in respects of atmosphere fly dust, terrestrial organisms, soils, water quality and other environmental media, to assess the dose equivalent to the public and environmental impact arising from the operation of NPPs under normal and abnormal conditions

F-70 Effective environmental monitoring and assessment have been completed by NPPs under the auspices of NNSA. The measurement and analysis of samples from biology, air, soils and ocean in the surrounding environment show that NPPs have caused no adverse impacts on the environment.

F.5 Emergency Preparedness

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-71 Under the *National Overall Contingency Emergency Plan of the People's Republic of China*, the emergency planning system includes overall emergency plan, special emergency plan, local emergency plan, facility emergency plan. The emergency arrangements relating to the spent fuel management safety and the radioactive waste management safety are implemented in accordance with the *National Emergency Planning* and the *Radiation Accident Emergency Plan of the MEP*.

F.5.2 Nuclear Emergency

F.5.2.1 Basic requirements for nuclear emergency

F-72 Nuclear emergency planning applies to NPPs and other types of nuclear facilities, which 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-73 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-74 Three-level emergency organizational system which has been established in China, 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-75 National Nuclear Accident Emergency Coordination Committee (NNAECC) 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.

(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-76 If necessary, the State Council shall lead, organize and coordinate country-wide nuclear accident emergency arrangements.

F-77 National Nuclear Accident Emergency Office (NNAEO) 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 NNAECC;

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

(3) Implementing national nuclear accident emergency plan, making aware of, coordinating, and advancing the emergency arrangements made by the members of the NNAECC; 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 NNAECC, and inspecting and reporting the progress achieved; and

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

F-78 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-79 The competent authorities of environmental protection, health, army and other related agencies shall make every effort to implement nuclear accident emergency response arrangement within the scope of their responsibilities.

F-80 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;

F-81 If necessary, provincial governments would lead, organize and coordinate the nuclear accident emergency arrangements within their administrative areas;

F-82 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-83 Up to now, provincial level nuclear accident emergency committees were established respectively in provinces of Zhejiang, Guangdong, and Jiangsu, with deputy provincial governors acting as its director and with participation of provincial agencies and army. The field offices for nuclear accident emergency were also set up as a subsidiary department of Haiyan county in Zhejiang Province, Shenzhen city in Guangdong Province, and Lianyungang city in Jiangsu Province. In 2005, provincial nuclear emergency committee was also set up respectively in Sicuan and Gansu provinces.

F.5.2.3 Emergency event classification and emergency plan areas

F-84 The following four emergency classes are used in China, in order of increasing severity.

(1) Emergency standby: Certain types of special conditions and external events that could endanger the safety of nuclear facilities are expected to have occurred. Nuclear facility emergency personnel are in standby and some of the offsite emergency organization may be notified;

(2) Plant emergency: Radiation consequences is only limited to part of in-plant area. In this case, onsite personnel may take actions under emergency plan

and relevant offsite emergency organizations may be notified;

(3) Plant area emergency: Radiation consequences are only limited to in-plant area. In this case, onsite personnel put into action and offsite emergency organization may receive notifications, also with some have potential to take actions; and

(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.

F-85 NPP emergency planning area is subdivided into plume emergency planning area and intake planning emergency area. NPP plume emergency planning area is centered at the plant site with a radius of 7 to 10 km, where evacuation, shielding and iodine administration are needed. Such planning area can also be divided into inner area and outer area. Evacuation preparedness is generally conducted in the inner area, with a radius of 3 to 5 km. Intake emergency planning area is centered on the NPP site with a radius of 30 to 50 km, where emergency preparedness for foods and drinking water is needed beforehand for an emergency. In addition, during an accident emergency, the protection actions for relocation for the time being and permanent habitation might be taken, as required.

F-86 Emergency planning areas for other types of nuclear facilities shall be determined on the basis of risk analysis.

F.5.2.4 Report of Emergency Status

F-87 When in the emergency standby situation, emergency organization of a nuclear facility shall timely report to higher competent department and MEP (NNSA) and to nuclear accident emergency committee of the province where such nuclear facility is located where appropriate. When any releases of materials are expected to be in process or have occurred, plant emergency or plant area emergency shall be initiated timely where appropriate and shall report to the higher competent department, the MEP (NNSA) and provincial accident emergency committee.

F-88 When radioactive materials are expected to be in process or have dispersed to outside the plant area, suggestions shall be made on entering into plant area emergency situation and taking protection actions. After receiving notification on accident, provincial nuclear accident emergency committee shall take emergency countermeasures and prompt actions and report timely to national nuclear accident emergency committee. Determination to enter into offsite emergency situation is subject to approval from the NNAECC. In some special conditions, provincial nuclear accident emergency committee can determine to enter into offsite emergency situations prior to approval and then report timely to the NNAECC.

F-89 When entering into an offsite emergency situation, the NNAEO, MEP (NNSA) and other agencies involved shall dispatch persons in a timely manner to the field and provide guidance to the nuclear emergency response actions.

F.5.2.5 Emergency Communication with the Public

F-90 The NNAEO establishes information alert network to reinforce information communication with the relevant agencies and committees, local government and nuclear facility operators.

F-91 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-92 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-93 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-94 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-95 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-96 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-97 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-98 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-99 A wide variety of emergency exercises are conducted at NPPs that have been in operation in order to test, modify and reinforce emergency preparedness and response capabilities.

F.5.2.7 International Arrangements of Nuclear Emergency

F-100 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-101 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-102 When a nuclear accident occurs in China to have potential impacts beyond its boundary, the NNAEO 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-103 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. In May 2005, China took part in, for the first time, the IAEA-sponsored international nuclear emergency exercise with the joint effort of eight international organizations and more than 50 countries. In November 2006, China again participated with the IAEA-sponsored the 2006 nuclear emergency exercise.

F.5.3 Radiation Accident Emergency

F.5.3.1 Radiation Accident Emergency System

F-104 *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.5.3.2 Classification of Radiation Accidents

F-105 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-106 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 2. 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.

F-107 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-108 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-109 The license holder shall prepare emergency plan for its facility based on potential accident risk and make emergency preparedness.

F-110 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.

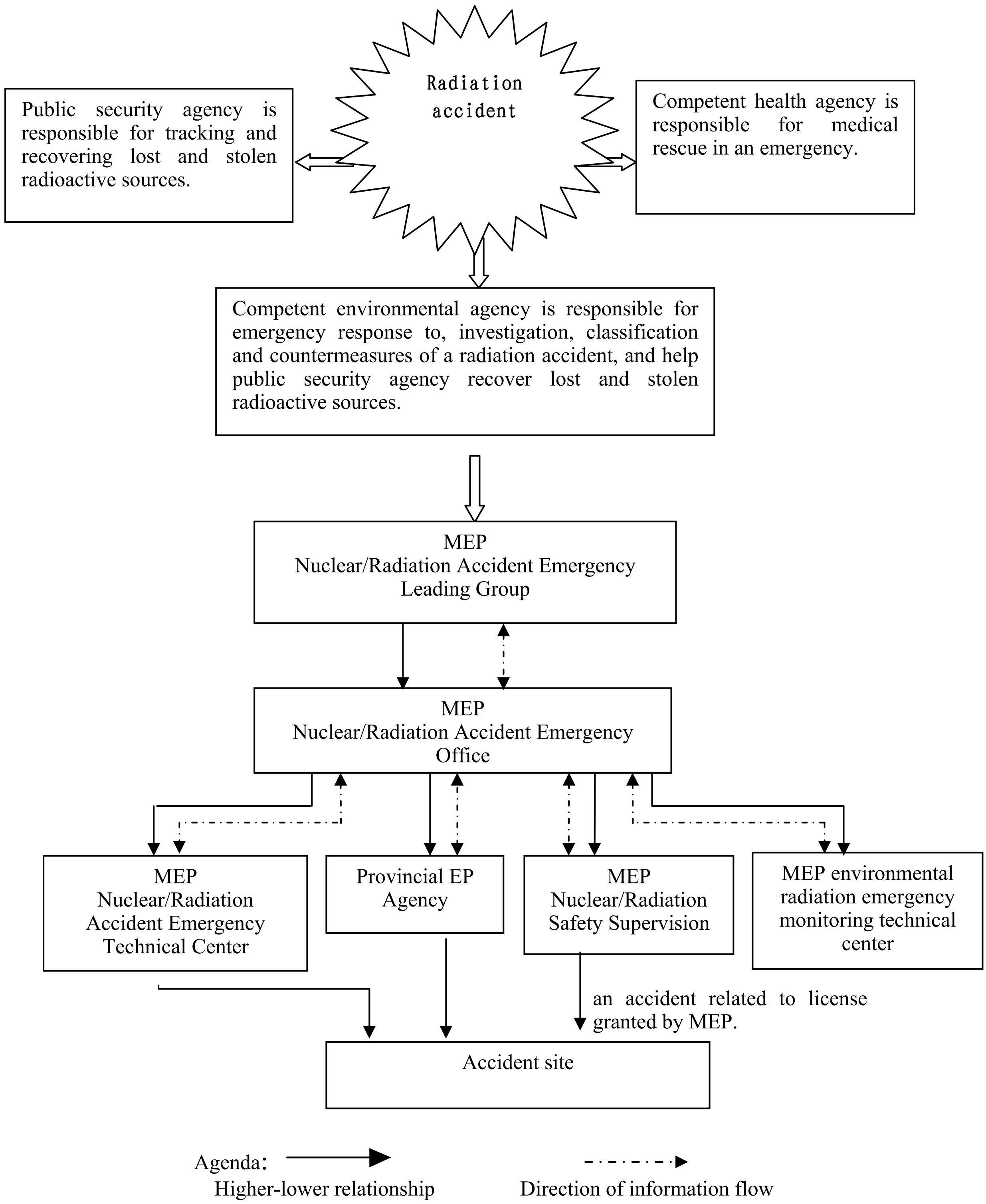

Figure 2. Radiation emergency organizational system

F.5.3.5 Radiation Accident Report and Emergency Response

F-111 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-112 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-113 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-114 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-115 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.6 Decommissioning

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 emergency 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.

G. SAFETY OF SPENT FULE MANAGEMENT

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

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 license holders for the safe management of spent fuel in China include the operators of NPPs, research reactors, and spent fuel storage facilities. 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 hold the overall responsibility for the safety of such facilities, including spent fuel management. Spent fuel is held in storage at reactors. The siting, design and operation of spent fuel storage facilities 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 the Safety of Research Reactor Operation.*

G-3 Other types of spent fuel storage facilities shall implement the provisions of the Design of Spent Fuel Storage Facility（HAD301/020, 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 have overall responsibility for the safety of nuclear facilities they are running, 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 generators of spent fuel shall bear the resulting management cost, thus avoiding undue burden 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, handling and storage within the plant.

(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 measures specific 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.

G.1.2 Requirements for Spent Fuel from Research Reactors

G-12 *The Regulations on the Safety of Research Reactor Operation* 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 Other Spent Fuel Storage Facilities

G-13 Spent fuel storage facilities, as required in the *Operation of Spent Fuel Storage Facility*, should be maintained to:

(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;

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

G-14 Spent fuel storage facilities can be designed in two types, wet pool storage or dry storage. Wet pool storage installations are required to ensure:

(1) To control the total quantity of fuel based on residual heat, reactivity and pool bottom loading;

(2) To protect bottom face and wall face from being impacted by loading;

(3) To control chemical property in pool water, such as radioactivity, temperature and chemical compositions;

(4) To control water level;

(5) Keep ventilation system in normal conditions;

(6) Keep pool heat removal system in normal operating conditions;

(7) Keep hoisting and rigging equipment in normal operation; and

(8) Keep the under water lighting equipment in normal operation.

G-15 Dry storage installations are required to ensure:

(1) To control the total quantity of storage units;

(2) To monitor gamma and neutron radiation field in the vicinity of fuel location in storage area in accordance with the requirements of national and competent safety agencies;

(3) To monitor the discharge and dissipation of heat from fuel to heat well

(atmosphere);

(4) To monitor the integrity of fuel containment (if permitted in design) in a direct way; and

(5) To monitor the inner space of installation, in an indirect way, where sealed containers are held (if possible in design).

G.2 Existing Facilities

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-16 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, currently with wet pool storage approach being employed at NPPs. It should take into consideration, in phases of siting, design, construction, operation, the design capacity of a spent fuel storage facility affiliated to a NPP should accommodate spent fuel withdrawn from such NPP within a certain period of time. The spent fuel storage facilities for research reactors are similar to those at NPPs. Until now, there is no a long-term spent fuel storage facility built up in China.

G.2.1 Safety management of Spent Fuel at NPPs

G-17 In designing NPPs, like Qinshan I, II, III, Tianwan, Daya Bay, 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 Chin'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-18 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-19 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-20 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; the tools inside with hollow could result in radiation hazards that can be avoided through filling, ventilation and bore-drilling.

(4) Correctively operating ventilation system;

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

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

G-21 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 as low as reasonably achievable (ALARA).

G-22 Up to now, the spent fuel stored at reactor amount to a total of 1377.1

tones

G.2.2 Safe management of spent fuel from research reactor

G-23 Safe management of spent fuel withdrawn from research reactor is the same as those at NPPs, only with difference on scale and in quantity.

G.3 Siting of Proposed Facilities

> 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-24 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 Stage Council for approval. No agencies related can issue licensing documents without approval of the environmental impact assessment.

G-25 A wide range of regulations set out the requirements for the siting of proposed spent fuel management facilities. 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 event to take place that are likely to severely affect the safety of nuclear fuel cycle facilities during its lifetime;

(2) In normal operating condition of nuclear fuel cycle facilities, the comprehensive impacts of proposed site and such facilities cause the radiation exposure to the public that are 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 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 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-30 The *Regulations on NPP Siting Safety* states the interactive factors between proposed NPPs and the proposed sites under both operating condition and 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 safety. 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-31 The *Regulations on Research Reactor Design Safety* 1995 describes the requirements for siting of proposed research reactors. 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-32 The *Design of Spent Fuel Storage Facility* (HAD301/02) states the requirements for the dedicated spent fuel storage facilities, that is not as part of NPPs. 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 aircraft crash potential. 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.4 Design and Construction of Facilities

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-33 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 Facility at NPPs

G-34 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-35 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 symbol 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-36 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-37 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-38 All existing spent fuel management facilities at the operating NPPs, such as Qinshan I, II, III, Tianwan, Daya Bay and Linao, have drawn on the experiences learnt from foreign countries at the stages of design and construction. Examples are Daya Bay nuclear power stations, which has drawn on the experiences from France, and QNPP III where Canadian experiences were introduced.

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

G-39 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-40 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 Other Spent Fuel Storage Facilities

G-41 At present, there has not yet been a dedicated spent fuel storage facility in China. Under the Design of Spent Fuel Storage Facility (HAD301/02), in reviewing the acceptability of interim spent fuel storage facility, comments should be solicited from local governments and the public. Spent fuel storage facility should be so designed as to provide appropriate means to control spent fuel under sub-criticality condition, remove spent fuel residual heat, and provide radiation protection and containment of radioactive materials during its lifetime specified in design technology specifications. Such a facility should ensure that no risks to workers, the public and the environment may be resulted from the acceptance, handling, storage and retrieval of spent fuel.

G.5 Assessment of Safety of Facilities

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-42 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-43 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-44 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-45 There has not yet been a dedicated spent fuel storage facility in China. 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-46 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-47 In its preliminary safety analysis report, the operator must provide sufficient detailed description of both the design of nuclear fuel cycle facilities and the results of safety analysis so that the NNSA can conduct independent review of safety features of such facilities prior to granting construction license.

G-48 Prior to authorization to operating nuclear fuel cycle facilities, the safety analysis and assessment 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-49 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-50 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-51 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-52 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 applications and additional documents from applicants, shall make response of whether or not to accept such applications. After acceptance of such application, review work shall start immediately;

(2) The NNSA shall delegate nuclear safety technical organizations to review such applications, 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 with 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 applications;

(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.6 Operation of Facilities

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;

(v) 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-53 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 safe use 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-54 The operators of various spent fuel management facilities at the operating NPPs, such as Qinshan I, II, III, Tianwan, Daya Bay and Linao, 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-55 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,

keep normal water level of pool not lower than 12.15 m and water temperature not exceeding 50℃; carry out periodic water sampling and analysis to keep boron concentrations at 2400 ±50 ppm, pH（25 ℃） at 4.0-8.0, chloride ion ≤0.1 ppm, fluoride ion≤0.1 ppm, SiO_2≤1.0 ppm, specific activity≤$1.8×10^4$ Bq/L, 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-56 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-57 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 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, by health physics department, 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-58 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. At NPPs, such as Qinshan I, II, III, Tianwan, Daya Bay and Linao, the required assessments have been accomplished at stages of design, construction and operation of spent fuel management facilities. The commissioning plan that demonstrates the constructed facilities are consistent with design and safety requirements has been completed. 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-59 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-60 All license holders of the operating NPPs , like Qinshan I, II, III, Tianwan, Daya Bay and Linao, submit Annual Operation Report to the NNSA every year. Spent fuel management activity is part of NPP production activity. As required by the HAF301, the safety event likely taking place in operation of such facilities shall be reported to the NNSA in a timely manner. Up to now, there has been no event above the report level occurred in China's NPPs.

G-61 NPPs, as required by the HAF301, shall make arrangements for operational safety management and carries out operational safety assessment. All operational rules shall be reviewed and updated and radiation protection program reviewed and amended in accordance with experiences gained. During operation, safety assessment should be conducted and corrective actions should be taken, when necessary.

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

G-62 The operators of research reactors are responsible for, and make arrangement for, all activities involving core management and onsite fuel management fuel. 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 Other Spent Fuel Storage Facilities

G-63 At present, there have not yet been other types of spent fuel storage facilities in China. The future spent fuel interim storage facilities will be subject to the *Operation of Spent Fuel Storage Facility*. The operators of any interim storage facilities, before their operation, must prepare the program for periodic maintenance, commissioning, testing and examination of both the operational safety-related safety system and the safety-related structures and components. All activities involving such spent fuel interim storage facility must be carried out in accordance with the written procedures developed by the operators and approved by relevant agencies.

G-64 The basic operation safety considerations, including sub-criticality, shielding, containment, heat removal, falling object and others, are similar to both operational condition safety assessment 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-65 The operational limits and conditions are based on technical specifications, operational parameters, and safety sensitivity of components of system, accuracy of devices and equipment of measuring safety-related parameters, calibration record, and operational experiences.

G.7 Spent Fuel Disposal

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-66 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

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

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; aim to avoid imposing undue burdens on future generations.

H-1 In China, a systematic set of laws, 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 The *Acceptance Criteria for Near Surface Disposal of Radioactive Waste* 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-3 China's laws and regulations require that the quantity of radioactive wastes generated should be kept at the levels that are as low as reasonably achievable (ALARA). Under the *Law of the People's Republic of China on Prevention and Control of Radioactive Pollution* and the *Regulations of Radioactive Waste Safety* (HAF401), 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. Based on experiences internationally gained, 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 upgrading management level, the quantity of radioactive waste generated at NPPs continued to drop. For example at Guangdong Daya Bay Nuclear Power Plant, the volume of solid waste generated by a 1000 MWe unit in 2002 was down to 63.5 m^3.

H-4 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-5 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-6 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 *Regulations on Chemical Hazardous Article Management*, 1987, and the *Law of People's Republic of China on Prevention and Control of Solid Waste*, 1995, were promulgated. For the purpose of implementation of such a law, the *Policy on Prevention and Control Techniques for Hazardous Waste Pollution* was issued.

H-7 In its laws, regulations and standards, China stipulated that every effort 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-8 China in its laws, regulations and standards specify that effort should be made to avoid over burden on future generations. For example, HAF401 requires no overburden to be imposed on future generations. This is true in practices. Examples of this are Guangdong and Gansu provinces where two disposal sites for solid LILW radioactive waste were built. HLW shall be disposed of in deep geological repository, for which the relevant research activities are currently under way, with the aim of dealing with HLW containing long-lived radionuclide as well as alpha waste. The aim is to avoid undue burden to be left on future generations.

H.2 Existing Facilities and Past Practices

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

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

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

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

H-10 Under the HAF401, operators shall comply with the relevant laws, regulations and standards in assessing the major modifications to both new waste management facilities and practices and to the existing facilities and practices. Both safety analysis report and environmental impact report should be prepared and submitted to the NNSA and environmental protection agencies.

H-11 Radioactive waste management system is built at each NPPs, research reactors, large nuclear research facilities, uranium enrichment plant and fuel assembly fabrication plant. 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-12 Since the 1960's, waste storage facilities have been built in succession in China. Currently, there are a total of 28 provincial-level waste storage facilities associated with nuclear technology application, distributed over 28 provinces, autonomous regions and municipalities directly under central government, for use in storing disused radioactive sources and solid radioactive waste arising in the area of these provinces. The *Criteria on Siting, Design and Construction of Nuclear Application Waste Storage Facility* was issued in 2004, which requires the modification and extension to be carried out for the existing nuclear application waste storage facilities to meet the new requirement. At present, special funds has been appropriated for this purpose. It also requires environmental impact assessment to be made prior to such modification and extension, which can not be implemented without approval of relevant agencies.

H-13 There are currently two solid LILW disposal sites, Guangdong Beilong disposal site and Northwest China disposal site.

H-14 Guangdong Beilong disposal site began its site selection in 1990. Under the *Regulations on Shallow Land Disposal of Solid LILW,* the regional investigation, site characterization and site confirmation were conducted in three phases, and both environmental impact statement and safety analysis report were prepared for the stage of site licensing. In 1995, the SEPA formally approved the site of Guangdong Beilong LILW disposal site. The SEPA approved, in March 1998, the environmental impact assessment statement of Guangdong Beilong disposal site at stages of application, design and construction, and in June 1998 granted construction application. The construction of the first phase project of the repository was completed in October 2000 with disposal capacity of 8800 m^3. As of December 31, 2006, the disposal site has received waste of 1403.2 m^3.

H-15 The siting work of Northwest China disposal site began in 1988. Under the *Regulations on Shallow Land Disposal of Solid LILW,* the environmental assessment and the safety analysis were completed in 1994 and proposed site passed the approval by the SEPA. The environmental impact assessment and the safety analysis concerned were completed in 1994. The SEPA granted the construction license of Northwest LILW disposal site in the same year. The first phase project, 20,000 m^3 capacity, was completed in 1998. By the end of 2006, the total quantity volume of solid LILW received amounts to 471 m^3, which is consistent with the receipt criteria of waste repository.

H-16 China's radioactive waste management facilities in operation are always under the supervisory monitoring. The license holders 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-17 The *Basic Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources* (GB 18871-2002) defined the prolonged exposure situations that need, due to the past practices or as justified by regulatory body, to take remedial actions.

H.3 Siting of Proposed Facilities

Each Contracting Party shall take the appropriate steps to ensure that procedures are established and implemented for a proposed radioactive waste management facility:

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

(ii) to evaluate the likely safety impact of such a facility on individuals, society and the environment, taking into account possible evolution of the site conditions of disposal facilities after closure;

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

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

In so doing, each Contracting Party shall take the appropriate steps to ensure that such facilities shall not have unacceptable effects on other Contracting Parties by being sited in accordance with the general safety requirements of Article 11.

H.3.1 Siting of facilities

H-18 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-19 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-20 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, 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 water resource preservation area.

H.3.1.2 Siting of Independent Radioactive Waste Storage Facilities

H-21 For independent radioactive waste storage facilities, the requirements for siting issues have been set out in China in with respect of to temporary storage facilities for nuclear application radioactive waste and to liquid HLW storage facilities.

H-22 Siting procedures and general requirements for the temporary storage facilities for nuclear application radioactive waste have been specified in China.

H-23 The siting process, that has to be followed for temporary storage facilities for nuclear 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-24 The siting of temporary storage facilities for nuclear 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 repository.

H-25 For the siting of the solid HLW storage facility, the geological, consideration should be given to the local meteorological and social conditions. Geological conditions include seismicity potentials, site lithology, site conditions of engineering, and 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 governments and the public should be taken into account.

H.3.1.3 Siting of radioactive waste disposal facilities

H-26 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. Disposal of solid radioactive waste on inland river and marine are prohibited.

H-27 The site requirements for the near surface disposal of solid LILWs and deep geological disposal of solid HLW have been issued in China. The siting of a disposal facility is divided into three steps, which are area investigation, preliminary site selection and site confirmation. The siting work is a continuous and iterative assessment process. During this process, inappropriate sites would be excluded one by one. For the likely sites, the in-depth investigation shall be made. After an appropriate site being selected, detailed safety analysis and environmental impact assessment should be made to demonstrate whether or not the findings or conclusions is accurate and what potentially diverse effects will result in on the proposed disposal facility to be constructed.

H-28 The objective of siting for a near-surface disposal site of radioactive waste is to select appropriate waste disposal site to enable itself, together with appropriate design of proposed disposal facility, waste forms, types and quantity of waste package, engineering barrier and post closure institutional control, to be satisfied with radiation protection requirements set out by regulatory body. This objective can be achieved either through screening several candidate sites or through objective assessment of a designated likely site. Site screen approaches can be comprised of four phases such as siting planning, area investigation, site characterization and site determination. In siting of near surface disposal of LILW, the considerations should include irrespective of any approach, earthquake intensity, long term stability, geological formation and lithology, engineering geological conditions, hydrogeology conditions, surface hydrological conditions (distance from open water source), natural disaster, prospective of energy resource exploitation and social conditions.

H-29 The *Law of the People's Republic of China on Prevention and Control of Radioactive Pollution* define that in China HLW shall be disposed of in a centralized deep geological repository. The Guides on Research and Development Planning for Geological Disposal of HLW was issued in 2006, under which the overall objective of HLW geological disposal research is to select a site with stable geological condition and suitable socio-economical environment, aimed at building the national solid HLW geological repository in the mid of this century. The siting work of solid HLW geological repository is currently under way.

H-30 The Guideline on Siting of Radioactive Waste Geological Repository states that the basic aim of radioactive waste geological repository is to select a site suitable for disposal of HLW, where disposal facility and waste package could be able to effectively isolate radionuclide from entering into biosphere during expected time period. The site could provide natural barrier to keep the adverse impacts thereof on the human and the environment at the acceptable level specified by regulatory body.

H-31 The siting process may be such a process as to narrow form a large extent investigation to a defined site, namely, planning siting, area investigation, site characterization, and site determination and also may be such a process as to assess and demonstrate the likely repository proposed by competent national authority. At each stage of siting work, a comprehensive consideration should be given to safety, technology, socio-economic and environmental factors.

H-32 The factors that should be considered are geological environment, natural change, hydrogeology, geochemistry, human activities, construction and engineering conditions, waste transport, social impacts, environmental protection and land use.

H-33 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.3.2 Public involvement in process of siting

H-34 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 meeting 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 meeting 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.4 Design and Construction of Facilities

> 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-35 China has issued the Design of Radioactive Waste Management System at NPPs, the Siting, Design and Construction of Nuclear Application 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 waste storage facility associated with nuclear technology application and the LILW repository.

H.4.1 Design and Construction of Affiliated Radwaste Management System

H-36 The targets and requirements of waste treatment 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 waste, reduce the generation of secondary waste and facilitate future commissioning.

H-37 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 and 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; and

(6) To make workers to undergo necessary training and examination, who can take the position without relevant certificate.

H-38 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, and etc.

H.4.2 Design and Construction of Nuclear Application Radwaste Storage Facility

H-39 The design of a storage facility for nuclear application radioactive waste 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-40 The overall layout of a storage facility for nuclear application radioactive waste 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 repository area is divided into storage area, office area and isolation zone, with a certain distance span existing between storage area and office area to a certain degree. Radioactive buildings or structures should be sited at the downwind direction of prevailing wind. Isolation zone should be around the waste storage area. Storage area is subdivided into radioactive source storage area, waste storage area, receipt and handling area and decay area;.

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

(3) Favoring dispersion of airborne effluents

H-41 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-42 The safety and security system should be set up based on radioactive source terms and the accessible social and security environment and pursuant to the regulations on nuclear material regulation, including access control, closed TV monitoring system, lighting and alarming system in the surrounding area of such waste storage area.

H-43 The resources and conditions essential to prevention of accident and emergency measures should be taken into account.

H-44 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 contaminants or from which contaminants are easily removed;

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

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

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

H-45 Prior to construction, contractors prepare construction plan, covering defined construction and technical options, detailed quality planning and QA measures to identify these points necessary for quality examination and to be repaired. These are subject to approval of reviewer and constructors.

H-46 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-47 Newly built storage facility for nuclear application radioactive waste is designed and constructed in accordance with recently issued criteria. For the existing waste storage facilities, the modification and extension projects are being carried out in accordance with the new criteria. Detailed design documents and environmental impact assessment have been developed and have obtained the approval of the NNSA. In addition, construction supervisory bodies are engaged to make a full range of control the modification and extension projects of such facilities.

H.4.3 Design and Construction of LILW Disposal Site

H-48 The design of disposal site 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;

(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-49 The stratum where the disposal facility is located is important barrier. Engineered barrier should be applied, in design, to improving barrier function of the proposed site and to narrow the gap in natural conditions to ensure the requirements to be met.

H-50 The capacity to be designed for such disposal facility needs to be determined through safety analysis and environmental assessment. Disposal unit should be designed to be consistent with the overall planning of the entire site. Special attention should be given to the arrangement for entry, exit and access , as well as the control of contaminated area and non-contaminated area. Waste receipt area should include:

(1) Examine apparatus for transport vehicles and containers （including dose rate meter, 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-51 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, and groundwater table. Drainage design should ensure accumulated water on ground to be drained smoothly and water in the disposal units exhausted timely.

H-52 In addition, the design of disposal facility should consider backfilling, overburden structure, surface treatment, plantation, and the groundwater monitoring well or channel set at appropriate locations in the vicinity of disposal units.

H-53 Guangdong Beilong disposal site and Northwest China disposal site both meet the design requirements by Regulations on Near-surface Disposal of Solid LILW. At Guangdong 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 active water shed. Below the unit bottom, a drainage collecting system was established.

H-54 In the case of the Northwest China disposal site, the first phase project is designed to have disposal capacity of 60 000 m^3, of which 20 000 m^3 has been competed up to now. Disposal unit for such site is designed to use reinforced cement structure without bottom. Between waste drums and between waste drum and disposal unit would be backfilled with sandy soil., when a disposal unit is full ,it will be poured with reinforced cement to form top plate. After closure, the top of each disposal unit will be finally covered with a 2 m thick overburden.

H.5 Assessment of Safety of Facilities

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

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

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

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

H-55 Under the *Law of the People's Republic of China on Prevention and Control of Radioactive Pollution*, 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-56 The *Regulations on Radioactive Waste Safety* (HAF401) gives the specific requirements on the safety of radioactive waste management facilities. The operators are required to carry out assessment of newly built waste management facilities and new practices and of major modifications to the existing facilities or past practices under the current regulations and standards and to prepare safety analysis report and environmental impact assessment report. 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. Theses 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 survivor and the environment (soils, water, air, and non-human species) and natural resource. 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. Such assessment should employ appropriate model and available experimental data. In assessing the long term performance of disposal facilities, account should be taken of content and chemical and physic-chemical properties of the nuclides potentially accommodated and of the effectiveness of natural barrier provided by such disposal system. Such effectiveness can be determined through field survey by use of pre-determined model established on the basis of experimental data.

H-57 For LILW disposal facilities, safety analysis and environmental impact assessment should be made, as required, in determining site, designing, operation and closure of such disposal facilities. Also the content and requirements are specified in detail for the safety assessment and environmental impact assessment at different stages.

H-58 In application for safety analysis and environmental impact assessment for determination of disposal sites, the followings 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-59 For environmental impact and safety assessment at the stages of application for and construction, the followings are 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 post 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-60 Prior to the operation and closure of the disposal site, the operators are required to carry out environmental impact assessment and safety assessment and can not proceed without the approval by the MEP (NNSA).

H-61 In China, two regional LILW disposal sites have been built, one is in Guangdong and another is in Gansu Provinces, for which both environmental impact assessment report and safety assessment report were prepared at the stages of application for site authorization and construction license. For the Northwest China disposal site, the environmental impact assessment reports for site authorization and construction license were approved by the SEPA in 1994 and 1996 respectively. While for the Guangdong Beilong disposal site, the environmental impact assessment reports for site authorization and construction license were approved by the SEPA in 1995 and 1998 respectively.

H-62 At the stage of application for site authorization, the emphasis is on assessing, based on the results of site selection, survey and test, whether the proposed site meets the national requirements on regional disposal of LILW and on the suitability of the proposed site. According to the site characteristics and conceptual design, the predication should be made, as required, of potential impacts on accessible environment within a post operation and closure 500 year period and assessment of whether the environmental impacts of such disposal facility meets national environmental protection requirements. The assessment results at Guangdong Beilong show that the disposal site was chosen in a closed environment with low population and good regional stability. Natural disaster such as typhoon, flooding and earthquake would not lead to destructive threat to the disposal site. Local geological media, with low permeation rate and strong adsorption onto radionuclide, is in line with national requirements on LILW disposal.

H-63 At the stage of application for construction license, the focus of assessment is paced on (1) predication of accessible environmental impacts within a post operation and closure 300-500 year period based on preliminary design for the disposal facility and available hydro-geological data, (2) assessment of whether environmental impacts of such site meets national environmental protection requirements, and (3) promotion of the public confidence in appreciation and understanding of such repository construction. The assessment results at Guangdong Beilong site indicate that within 500 years post closure only ^{3}H and ^{14}C may enter into groundwater and stream through unsaturated zone and other nuclides are retarded in unsaturated zone. The release of radionuclides through groundwater may result in annual maximum individual dose to the public around 5×10^{-7} Sv/a, far below the national limits

H-64 The inadvertent human intrusion by the member of the public after expiration of post closure period is assessed to consider scenarios such as inhabitation, drilling or excavations. Analytical results show that such scenarios would result in the does to intruder not higher than 1×10^{-4} Sv/a, far less than the national limits.

H-65 A large number of experiments, simulation and calculation based on the characteristics and design of the disposal sites indicates that in normal operational or accidental conditions only a small amount of radionuclides could be released from these two disposal sites into the surrounding environment. The additional doses to the members of the public arising from such releases are much less than the national limits and also lower than management goal specified for these two disposal sites. Therefore, the disposal sites will not lead to any unacceptable impacts on the environment.

H.6 Operation of Facilities

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

(i) the licence to operate a radioactive waste management facility is based upon appropriate assessments as specified in Article 15 and is conditional on the completion of a commissioning programme demonstrating that the facility, as constructed, is consistent with design and safety requirements;

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

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

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

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

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

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

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

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

H-66 Under China's laws and regulations, an operator is required, before operating its nuclear facility, to apply for operation license in accordance with the provisions of the State Council relating to safety regulation of nuclear facilities. No operational activities can be carried out until operational license or authorization documents have been granted. The operators of nuclear facilities are required to prepare environmental impact assessment statement and submit it to the MEP (NNSA) for review and approval prior to applying for operation license. Without approval, the relevant agencies can not grant license and authorization documents.

H.6.1 Operation of Affiliated Radioactive Waste Management System

H-67 For nuclear facility affiliated radioactive waste management facilities , the environmental impact assessment process has been completed and operation license granted, before their operation, complying with the requirements of relevant laws and regulations. For the LILW repository associated with nuclear technology application, the operation licenses have been granted on the basis of environmental assessment and safety assessment.

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 management, storage, disposal and policies to restriction on discharge of effluent.

H-70 Monitoring and measurement must be conducted of the technological process, waste features, discharge of effluents, and waste treatment.

H-71 Monitoring and control must be conducted for radionuclides in gaseous and liquid effluents discharged.

H-72 When there are several options available, the operators of nuclear facilities should make their choice in accordance with the existing waste disposal policy, assess their long term impacts, including waste arising form decommissioning activities.

H-73 The operators of nuclear facilities must prepare and implement environmental monitoring plan.

H-74 The operators of nuclear facilities must periodically provide the NNSA and its local branches with report 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-75 Radioactive waste management programs, together with waste management procedural documents, are all prepared by the operators of the existing NPPs, 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-76 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-77 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 Application Radwaste Storage Facilities

H-78 The requirements on operational management of storage facilities for nuclear application radioactive waste have been set out in China, covering the receipt and storage of waste and environmental monitoring.

H-79 Radioactive waste generated due to nuclear 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 registration card of 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-80 Radioactive waste to be sent to the storage facility shall be put into standard containers and radioactive sources into package containers.

H-81 Workers after receiving and handing waste should go through body surface contamination examination and can leave only be checked to be consistent with required standards. Vehicle and tools should be checked for surface contamination and, if with readings higher than national standards, have to undergo decontamination.

H-82 Waste being held in storage should be emplaced in terms of their types and maintained in good record. The record-keeping time period should be longer than the hazardous period. Waste and radioactive sources that could not decay to clearance levels within a safe storage period have to be held in such storage for the time being pending future disposal in permanent repository.

H-83 Subject to approval of environmental protection agencies of relevant province, autonomous region and municipality directly under the central government, the waste and disused radioactive sources that have proven through monitoring to have radioactivity lower than clearance level can be buried as ordinary industrial waste.

H-84 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 conducted 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-85 At the operational stage, decommissioning plan should be evaluated, refined and updated.

H-86 Waste storage facility for nuclear application radioactive waste has experienced nearly 50 years of operational history. Up to now, a total of 29 such waste facilities are in operation, accommodating 60 000 radioactive sources and 130 000 kg solid waste. During this period, the collections in such facilities are in terms of types, with clear account listings. Continued environmental radiation monitoring results has shown that no environmental contamination has been observed. However, there exist still a number of few problems to be addressed. For example, some storage facilities built in the early stage, due to lower design standard, cannot meet the present safety requirements and some facilities are nearly full. Quite number of disused radioactive sources with high activity and long half life have been held in storage for a long time, which will pose increasing risks with growing storage time. China has taken measures to address these problems. The first is to modify and extending the early constructed waste storage facilities. The second is to establish centralized waste storage facility for the purpose of storing disused radioactive sources with high activity and long life that need for long term storage.

H.6.3 Operation of LILW Disposal Facility

H-87 The operators of disposal sites must comply with the license required conditions and prepare operational rules in accordance with such conditions. The Waste Acceptance Criteria on Near Surface Disposal sets out the waste acceptance requirements and test methods on radioactive waste disposal sites. Waste, after being transported to disposal sites, must pass examination to confirm waste package consistent with required standards and no damage occurring in the course of transport. It also requires that the waste registration cards that have been filled out are same as the content of package. Such card shall be reviewed by the disposal site operator.

H-88 The handling operations involved in waste disposal sites comprise waste portage, waste emplacement, and sealing of disposal unit. 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).

H-89 Waste Disposal Operation File includes the description of disposal date and location, basic data of waste such as serial number, producer, major nuclides, total activity, specific activity, radiation level, volume and quality of waste drums or tanks, as well as problems encountered in the process of disposal operations. 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.

H-90 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.

H-91 The operators are responsible for onsite day-to-day environmental monitoring, including periodic monitoring of 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.

H-92 External environmental monitoring plan for a disposal facility shall be implemented by the environmental agencies of locality where such a site is located, along with the operator of such a site. Abnormality, if occurring, should be at once reported to the upper competent authority. The operators should provide periodic assessment of monitoring results and the results of assessment should be reported to the upper competent authority, as prescribed.

H-93 Emergency measures and remedy means should be prepared to deal with abnormalities, with through preparing emergency measures and remedy means, like unclear waste registration card, unqualified package, ruptured package, scattered waste and abnormal release of radioactive materials, and to prevent, or reduce, contamination from spreading. 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. If incident is so serious that certain disposal unit has to be opened, stringent plan should be prepared in advance for taking necessary measures to control contamination spread (including air pollution, water pollution and material contamination). If there are evidences that the environment has already been contaminated, the operator should be responsible for eliminating contamination and identifying incident causes under the supervision of environmental agencies at national and/or provincial levels.

H-94 Before operation of the Guangdong Beilong disposal site and the Northwest China disposal site, waste disposal operational rules were prepared pursuant to national requirements, 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 procedural documents.

H-95 The operating flow processes at such sites includes waste examination and measurement, waste receipt, hoisting location determination, disposal unit filling, unit top plate casting, and cover. At Guangdong Beilong site, a total of 55 operational procedures and documents were developed in respect of management, operational technology, handling, maintenance and repair. Computer based information management systems are established at both sites.

H-96 Following receipt of waste at both sites, continued environmental monitoring are maintained. The NNSA organize 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.7 Institutional Measure after Closure

> 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
>
> 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-97 Requirements on surveillance control of disposal facility after closure was laid down in China. The Regulations of Radioactive Waste Safety (HAF401) requires that, after closure of disposal site, institutional surveillance and control should be maintained to ensure:

(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-98 The period following closure of disposal facility generally includes closed, semi-closed and open phases. Closed phase means such a period that disposal facility that has just been closed is kept under closed condition and that no one can access it unless they are for the purpose of supervisory task. Semi-closed phase means such a period that when waste is covered with well structured cover and associated hazards has proven very small, and people are allowed to assess but without any activities relevant to drilling and excavations. Open phase means such a period that radioactivity of waste has reduced to the level at which radiation protection is no longer needed following expiration of required controlled period and such site can be fully open to the outside.

H-99 Provincial governments of the localities where disposal facility are located are responsible for post-closure surveillance. 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. Re-estimation, and necessary adjustment, shall be made for such costs to meet the changing circumstance.

H-100 Post closure supervision, such as environmental monitoring, access restriction, installation maintenance, file preservation and possible emergency actions, should be carried out under the auspice of the environmental protection agencies at national and provincial levels.

H-101 Both Beilong disposal site and the Northwest China disposal site are in the stage of operation, and far away to their closure.

I. TRANSBOUNDARY MOVEMENT

Each Contracting Party involved in transboundary movement shall take the appropriate steps to ensure that such movement is undertaken in a manner consistent with the provisions of this Convention and relevant binding international instruments.

In so doing:

(i) a Contracting Party which is a State of origin shall take the appropriate steps to ensure that transboundary movement is authorized and takes place only with the prior notification and consent of the State of destination;

(ii) transboundary movement through States of transit shall be subject to those international obligations which are relevant to the particular modes of transport utilized;

(iii) a Contracting Party which is a State of destination shall consent to a transboundary movement only if it has the administrative and technical capacity, as well as the regulatory structure, needed to manage the spent fuel or the radioactive waste in a manner consistent with this Convention;

(iv) a Contracting Party which is a State of origin shall authorize a transboundary movement only if it can satisfy itself in accordance with the consent of the State of destination that the requirements of subparagraph (iii) are met prior to transboundary movement;

(v) a Contracting Party which is a State of origin shall take the appropriate steps to permit re-entry into its territory, if a transboundary movement is not or cannot be completed in conformity with this Article, unless an alternative safe arrangement can be made.

A Contracting Party shall not licence the shipment of its spent fuel or radioactive waste to a destination south of latitude 60 degrees South for storage or disposal.

Nothing in this Convention prejudices or affects:

(i) the exercise, by ships and aircraft of all States, of maritime, river and air navigation rights and freedoms, as provided for in international law;

(ii) rights of a Contracting Party to which radioactive waste is exported for processing to return, or provide for the return of, the radioactive waste and other products after treatment to the State of origin;

(iii) the right of a Contracting Party to export its spent fuel for reprocessing;

(iv) rights of a Contracting Party to which spent fuel is exported for reprocessing to return, or provide for the return of, radioactive waste and other products resulting from reprocessing operations to the State of origin.

I-1 Under Article 47 of the *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. In 2006, a total of 890 applications for import and export of radioisotopes were approved, with an accumulated 2757 sealed radioactive sources imported.

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 As of December 21, 2006, China has not yet any transboundary transport activity for either spent fuel or radioactive waste.

J. DISUSED SEALED SOURCES

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 Source Applications

J-1 In China, application of sealed sources started in the 1930's. Documentation has shown that the earliest 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 the recent years. As of December 31, 2006, the total number of the producers, vendors and users of radioisotopes amount to about 13051 across the country, with more than 140,000 of sealed sources involved in total.

J.2 Requirements on Sealed Source 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 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.

J-3 National ID system is implemented for radioactive sources. The SEPA developed and issued the coding rules for radioactive sources. All radioactive sources existing until 2004 are coded and filed under the responsibility of e competent environmental protection authorities of the localities where radioactive source are located and these are subject to the archives of the SEPA. Since 2004, all 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 radioactive sources. The transfer and decommissioning of radioactive source are subject to the approval of competent environmental protection authority. The user of radioactive source who want to transfer it out of or into his facility (including return of disused sources to manufacturer, or state of origin or transfer to licensed storage facility) is required under such system, 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 radioactive sources, which require the producer and exporter of category I, II and III sources to have committed to recover 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 source to the licensed storage facilities.

J-6 For disused radioactive 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 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 source becomes disused, carry out conditioning and package for such sources in accordance with the provisions of competent environmental protection authority concerned and then transfer them to the licensed storage facility for storage.

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

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

J.3 Storage of Disused Sealed Source

J-7 To meet the need for application of 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 sources.

J-8 By the end of 2006, a total of 29 waste storage facilities for nuclear application radioactive waste (including a national centralized storage facility for disused radioactive sources) were established with total storage capacity of 30,000 m^3. By the end of 2006, these facilities collected 64,572 disused sealed sources, among which 49,741 are in the 28 provincial storage facilities, and the rest 14831 are in the national centralized storage facility.

K. PLANNED ACTIVITIES TO IMPROVE SAFETY

K.1 Safety Concerned and the National Measures

K.1.1 Strengthen Legislative System for Safety of SF and RW

K-1 Chinese government is currently developing the regulations governing radioactive waste management safety and spent fuel management safety in accordance with the *Law of the People's Republic of China on Prevention and Control of Radioactive Pollution*. Furthermore, the Regulations on Safe Management Radioactive Waste would provide in detail the licensing process for radioactive waste management, specify the requirements and regulatory procedures for radioactive waste disposal, and further clarify the responsibilities of relevant agencies.

K-2 The Collect and Management of Nuclear Facility Decommissioning Fund and Radioactive Waste Disposal Fund would specify the approach, ratio and use of the fund. This would provide a financial assurance for the long-term safety of spent fuel and for the development of radioactive waste disposal.

K.1.2 Promote Disposal of LILW

K-3 In accordance with the *Law of the People's Republic of China on Prevention and Control of Radioactive Pollution*, Chinese government is organizing to develop the siting program for solid radioactive waste disposal. This will help analyze the demands for solid LILW disposal in a comprehensive manner and direct the development trend of solid LILW disposal and promote the development of regional disposal site for LILW.

K.1.3 Enhance Research on HLW safety

K-4 The geological disposal of HLW and long term safety of spent fuel is very important matter affecting the expansion of nuclear power. Chinese government, under the joint effort of multi-agencies, has issued Guideline on Research and Development of Geological Disposal of HLW. Chinese government will actively promote the implementation of this guideline. There is still a long way to go for spent fuel reprocessing in China. To meet the need of the expansion of nuclear power, Chinese government will promote, in an active but prudent manner, the development of spent fuel reprocessing from the standpoint of nuclear fuel cycle strategy.

K.1.4 Ensure Safety of Long Term Storage of Spent Fuel

K-5 Implementing spent fuel reprocessing is the basic policy for China’s spent fuel management, but it still needs a relatively long time before the availability of reprocessing. Therefore the storage of spent fuel prior to its reprocessing is an important aspect for safety of spent fuel management. The type of reactor varies considerably from one plant to other in the existing NPPs in China. The QNPP III produces large amount of spent fuel compared with others, for which additional spent fuel storage options are being prepared. In addition, the rapid expansion of nuclear power in China will result in generation of spent fuel at an increasing rate. Therefore, a comprehensive consideration is being taken to long term storage of spent fuel to assure the safety in this regard.

K.1.5 Promote Minimization of Radioactive Waste

K-6 One of the principles and objectives for radioactive waste management is to control the generation of radioactive waste so as to achieve the minimization of radioactive waste in China. The expansion of nuclear power in China raised a high requirement for safety of radioactive waste management. As a result, facilitation of radioactive waste minimization is a sustainable work Chinese government faces. Compared with advanced countries, there are sill larger potentials to reduce waste generated at NPPs. However, the minimization of radioactive waste is a combined effort balancing factors of technology, safety and economy. China will take more action in controlling generation of waste, upgrading management, introducing advanced waste reduction technology, promoting specialization and socialization in radioactive waste treatment service.

K.1.6 Develop Conditioning Capability for Spent Radioactive Source

K-7 Spent radioactive sources are currently held in the provincial nuclear application wastes storage facilities and in the centralized radioactive source storage facility or at user’s premises. These radioactive sources have not been conditioned into a stable form, which occupy large storage space and pose high potential risk. China is making effort to establish a research and development base to develop radioactive source conditioning technology as soon as possible for the purpose to improve the safety of radioactive source storage. At the same time, China is exploring options for disposal of spent radioactive sources, it is expected to seek a long term solution for spent radioactive sources.

K.2 International Cooperation

K-8 Chinese government pays attention to the platform role the IAEA has played in promoting international cooperation in respect of spent fuel management safety and radioactive waste management safety. China actively participates in international and regional training courses, forums or workshops and meetings sponsored by IAEA. In addition, China promotes international cooperation and exchange through IAEA technological cooperation programme, co-sponsor of training courses and meetings.

K-9 Taking advantage of the opportunity of rapid nuclear power growing, Chinese government actively import advanced nuclear fuel cycle technology and radioactive waste treatment technology while importing nuclear power, with a view to raising the technical level of spent fuel management safety and radioactive waste management safety.

K-10 Chinese government has been actively participating regional safety cooperation and share with Member States the experiences and lessons gained in China in respect of spent fuel management safety and radioactive waste management safety through Asian Nuclear Safety Network and Forum of Nuclear Cooperation in Asia.

L. ANNEXES

L.1 List of Spent Fuel Management Facilities

L.1.1 Nuclear Power Plants

Name	Unit No.	Location	Reactor Type	Nominal Power (MWe）	Date of the First Connection to the Grid
Qinshan NPP	CN-1	Haiyan, Zhejiang	PWR	310	1991-12-15
Guangdong Daya Bay NPP	CN-2 CN-3	Shenzheng, Guangdong	PWR PWR	984 984	1993-08-31 1994-02-07
Qinshan Phase II NPP	CN-4 CN-5	Haiyan, Zhejiang	PWR PWR	650 650	2002-02-06 2004-03-11
Guangdong LingAo NPP	CN-6 CN-7	Shenzheng, Guangdong	PWR PWR	990 990	2002-02-26 2002-09-14
Qinshan Phase III NPP	CN-8 CN-9	Haiyan, Zhejiang	CANDU CANDU	700 700	2002-11-19 2003-06-12
Jiangsu Tianwan NPP	CN-10	Lianyungang, Jiangsu	PWR	1060	2006-05-12

Note：As of 31 December 2006.

L.1.2 Research Reactors

No.	Name	License holder	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 WM
7	Pulse reactor	NPIC	1991	1 MW
8	Mingjiang Reactor	NPIC	1992	5 WM
9	High-flux engineering test reactor	NPIC	1979	125 kW
10	ShengDa Mini reactor	Shenzhen University	1988	27 kW
11	JiNan Mini reactor	Shandong Geological Research Institute	1989	27 kW
12	Mini reactor	Shanghai Metrology Institute	1992	27 kW

Note：As of 31 December 2006.

L.1.3 Spent Fuel Storage at NPPs

Facility Name	Affiliation	Design Capacity （t）	Time to commission
Spent fuel pool 1	Qinshan NPP	112	1990
Spent fuel pool 2	Qinshan NPP	112	
Spent fuel pool 1	Qinshan Phase II NPP	317	2001
Spent fuel pool 2	Qinshan Phase II NPP	317	2002
Spent fuel pool	Qinshan Phase III NPP	1920	2002
Spent fuel pool	Guangdong Daya Bay NPP	638	1993
Spent fuel pool	Guangdong LingAo NPP	1108	2003
Spent fuel pool 1	Jiangsu Tianwan NPP	325	2005

Note：As of 31 December 2006.

L.2 List of Radioactive Waste Management Facilities

L.2.1 Other Major Radioactive Waste Generating Facilities

Type of facility	Operator	Location
Uranium enrichment	Shanxi Uranium Enrichment Plant	Shanxi 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	Sicuan Province
Research	CIAE	Beijing
Research	NPIC	Sicuan Province
Research	Tsinghua University	Beijing

Note：As of 31 December 2006.

L.2.2 Nuclear Application Radioactive Waste Storage Facilities

No.	Facility Name	Location	Design Capacity (m^3)	Start of Operation
1	Anhui radioactive waste storage facility	Anhui	400	1999
2	Beijing radioactive waste storage facility	Beijing	1800	1962
3	Fujian radioactive waste storage facility	Fujian	340	1990
4	Gansu radioactive waste storage facility	Gansu	500	1991
5	Guangdong radioactive waste storage facility	Guangdong	600	1999
6	Guangxi radioactive waste storage facility	Guangxi	500	2002
7	Guizhou radioactive waste storage facility	Guizhou	500	1986
8	Hebei radioactive waste storage facility	Hebei	400	1990
9	Henan radioactive waste storage facility	Henna	1185	1987
10	Heilongjiang radioactive waste storage facility	Heilongjiang	108	1987
11	Hubei radioactive waste storage facility	Hubei	500	2000
12	Henna radioactive waste storage facility	Hunan	8000	1999
13	Jilin radioactive waste storage facility	Jilin	1200	1998
14	Jiangsu radioactive waste storage facility	Jiangsu	600	1992
15	Jiangxi radioactive waste storage facility	Jiangxi	600	1987
16	Liaoning radioactive waste storage facility	Liaoning	600	1989
17	Inner Mongolia radioactive waste storage facility	Inner Mongolia	180	1985
18	Ningxia radioactive waste storage facility	Ningxia	300	1988
19	Qinghai radioactive waste storage facility	Qinghai	300	1989
20	Shandong radioactive waste storage facility	Shandong	991	2004
21	Shanxi radioactive waste storage facility	Shanxi	400	1986
22	Shaanxi radioactive waste storage facility	Shanxi	208	1997
23	Shanghai radioactive waste storage facility	Shanghai	1185	1985
24	Sicuan radioactive waste storage facility	Sicuan	500	1992
25	Tianjin radioactive waste storage facility	Tianjin	1800	1989
26	Xinjiang radioactive waste storage facility	Xinjiang	1090	1987
27	Yunnan radioactive waste storage facility	Yunnan	325	1989
28	Zhejiang radioactive waste storage facility	Zhejiang	2000	2002

No.	Facility Name	Location	Design Capacity （m^3）	Start of Operation
29	Centralized radioactive source repository	Centralized storage site	2800	2004

Note：As of 31 December 2006.

L.2.3 Radioactive Waste Disposal Facilities

No.	Facility name	Location	Operator
1	Northwest China Disposal Site	Gansu	Everclean Environmental Engineering Corp, CNNC
2	Guangdong Beilong Disposal Site	Guangdong	Guangdong Nuclear Power environmental protection co. Ltd

L.3 Inventory of Spent Fuel

Facility name	NPP	Capacity （t）	Existing spent fuel（t）
Spent fuel pool 1	QNPP	112	102.9
Spent fuel pool 2	QNPP	112	0.0
Spent fuel pool 1	QNPP II	317	64.8
Spent fuel pool 2	QNPP II	317	35.4
Spent fuel pool	QNPP III	1920	642.4
Spent fuel pool	GNPS	638	393.3
Spent fuel pool	LingAo NPP	1108	138.3
Spent fuel pool 1	Tianwan NPP	325	0.0
Total			1377.1

Note：As of 31 December 2006.

L.4 Inventory of Radioactive Waste

L.4.1 Inventory of NPP Radioactive Waste

（Unit：m^3）

Name	Concentrate	Spent ion exchange resin	Sludge	Water filter	Technological waste	Other	Total
QNPP	1061.6	42.2	0.0	76.8	359.7	62.1	1602.4
QNPP II	284.0	122.0	0.0	82.7	285.2	0.0	773.9
QNPP III	0.0	32.4	0.0	37.7	132.4	4.3	206.8
GNPS	578.0	480.0	14.0	226.5	859.8	4.1	2162.3
Tianwan NPP	2.0	6.0	0.0	0.0	15.0	5.0	28.0
Total	1925.6	682.6	14.0	423.7	1652.1	75.5	4773.4

Note：As of 31 December 2006.

L.4.2 Inventory of Radioactive Waste other than NPPs

（Unit：m^3）

Type	Research	Uranium enrichment	Fuel Fabrication	NPP	Total
Intermediate level liquid waste	2248.0	0.0	0.0	0.0	2248.0
Intermediate level solid waste	411.0	0.0	0.0	0.0	411.0
Low level liquid waste	2379.6	0.0	20.0	0.0	2399.6
Low level solid waste	5515.1	550.7	259.0	4773.4	11098.2

Note：As of 31 December 2006.

L.4.3 Inventory of Nuclear Application Waste Storage

No.	Province	Disused radioactive source	Radioactive Waste（kg）
1	Anhui	1493	2000
2	Beijing	12127	684000
3	Fujian	618	442
4	Gansu	737	0
5	Guangdong	847	3100
6	Guangxi	803	0
7	Guizhou	710	6000
8	Hebei	1235	5000
9	Henna	2196	5000
10	Heilongjiang	1383	270000
11	Hubei	1100	16000
12	Hunan	424	2300
13	Jilin	981	8647
14	Jiangsu	3881	2364
15	Jiangxi	702	225
16	Liaoning	2613	28495
17	Inner Mongolia	1119	3598
18	Ningxia	700	3697
19	Qinghai	681	4739
20	Shandong	1657	550
21	Shanxi	1617	8000
22	Shaanxi	750	3335
23	Shanghai	2321	29627
24	Sicuan	2256	22200
25	Tianjin	2820	173640
26	Xinjiang	806	8600
27	Yunnan	1584	4500
28	Zhejiang	1580	800
29	Centralized storage site	14831	0
30	Total	64572	1296859

Note：As of 31 December 2006.

L.4.4 Inventory of Waste for Disposal

Disposal Site	Waste Received （m^3）
the Northwest China Disposal Site	471
Guangdong Beilong Disposal Site	1403
Total	1874

Note：As of 31 December 2006.

L.5 List of relevant law, regulation, standard and guidance

L.5.1 Relevant Laws

Title	Issued by	Entry into force
The Law of the People’s Republic of China on Environmental Protection	the Standing Committee of the National People’s Congress	1989
The Law of the People’s Republic of China on Prevention and Control of 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（修订）
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

L.5.2 Relevant Administrative Regulations

Title	No.	Entry into force
Regulations of the People's Republic of China on Safety Control of Civilian Nuclear Installations	HAF 001	1986
Regulations of the People's Republic of China on Nuclear Materials	HAF 501	1987
Regulations on Accidental Emergency Management at Nuclear Power Plant (station)	HAF 002	1993
The Detailed Rules of the People's Republic of China on Air Pollution Prevention	State Council Decree No. 284	2000
Regulations on Safety and Protection of Radioisotope and Ray-generating Installations	State Council Decree No. 449	2005

L.5.3 Relevant Rules

Name	Issued by	Entry into force
Methods for categorization of radioactive sources	SEPA	2005
Methods for Radiological Environment Management	SEPA	1990
Methods for Licensing of Radioisotopes and Ray-generating Installations Safety	SEPA	2005
Regulations on Radioactive Waste Safety (HAF401)	NNSA	1997
Methods for Radioactive Drugs Management	MH	2004
Hygiene Requirements for Medical Radioactive Waste Management	MH	1996
Regulations on radiological accident management	MH	2001
Temporary Regulations on Road Transport of NPP Spent Fuel	CAEA, MPS, MT and MH	2003
Temporary Regulations on Construction of Urban Radioactive Waste Repository	SEPA	1984
Criteria for Siting, Design and Construction of Radioactive Waste Repository in relation to Nuclear Technology Applications	SEPA	2005
Emergency Preparedness and Response of NPP Operators	NNSA	1998
Regulations on Training in NPP Accident Emergency	NNAEO	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	NSTC, MH	2003

Name	Issued by	Entry into force
Sources and Radiation Technology Applications		
Detailed Rules of the People's Republic of China on Regulating Civil Nuclear Facility Safety I - Application and Granting of NPP Safety Licenses (HAF001/01)	NNSA	1993
Detailed Rules of the People's Republic of China on Regulating Civil Nuclear Facility Safety I - Granting and Management Procedures of NPP Operator License (HAF001/01/01)	NNSA	1993
Detailed Rules of the People's Republic of China on Regulation of Civil Nuclear Facility Safety II – Regulation of Nuclear Facility Safety (HAF001/02)	NNSA,	1995
Detailed Rules of the People's Republic of China on Regulation of Civil Nuclear Facility Safety I, Annex 1 – Reporting System of NPP Operators (HAF001/02/01)	NNSA,	1995
Detailed Rules of the People's Republic of China on Regulation of Civil Nuclear Facility Safety II, Annex 2 – Reporting System of Research Reactor Operators	NNSA,	1995
Detailed Rules of the People's Republic of China on Regulation of Civil Nuclear Facility Safety II, Annex 2 – Reporting System of Nuclear Fuel Cycle Facilities	NNSA,	1995
Detailed Rules for Regulations on NPP Accident Emergency Management – Emergency Preparedness and Response of NPP Operators	NNSA,	1998
Regulations on NPP Quality Assurance	NNSA,	1991
Regulations on NPP Siting Safety	NNSA,	1991
Regulations on NPP Design Safety	NNSA,	1991
Regulations on NPP Operation Safety	NNSA,	1991
Regulations on NPP Operation Safety, Annex 1 – Management of NPP during Refueling, Modification, and	NNSA,	1994

Name	Issued by	Entry into force
Accidental Shutdown		
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
Regulations on Regulation of radioactive waste	NNSA	1997
Detailed Rules for the Regulations of the People's Republic of China on Regulating Nuclear Materials	NNSA, ME, NDSTC	1990

MMEI: Ministry of Mechanism and Electronic Industry
ME: Ministry of Energy
NDSTC: National Defense Science and Technology Committee

L.5.4 Relevant Standards and Guidelines

Generic series
Basic Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources，GB 18871-2002，National Technology Supervision Bureau（NTSB），2002
Exemption Principles on Management f Radiation Source and Practices，GB 13367-1992，NTSB，1992
Radiation Protection Regulations on Open Radioactive Materials，GB 11930-1989，NTSB，1989
Program on Radiation Protection Optimization，GB/T 14325-1993，NTSB，1993
Regulations on Radiation Safety Training in Environmental Protection Standards，GB 11924-1989，SEPA，1990
Nuclear power plant series
Regulations on Radiation Protection for NPPs，GB 6249-1986，SEPA，1986
Radiations on Radiation Protection for Nuclear Heat-Electricity Co-generation Plan，GB 14317-1993，National Technology Supervision Bureau，1993
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, MoH，1990
Intervention Principle and Level for the Public Radiation Protection in an Event of Nuclear Emergency，HAD 002/03，NNSA, SEPA，1991
Derived Intervention Principle for the Public Radiation Protection in an Event of Nuclear Emergency，HAD 002/04，NNSA, SEPA，1991
Medical Emergency Preparedness and Response in an event of Nuclear Accident，HAD 002/05，NNSA, MoH，1992
Research Reactor Emergency Planning and Preparedness，HAD 002/06，NNSA，1991
Emergency Planning for Operators of Civil Nuclear Facilities，HAD 002/07，NNSA，1993
Quality Assurance Program for NPPs，HAD003/01，NNSA，1988
Quality Assurance Organization of NPPs，HAD003/02，NNSA，1989

Quality Assurance for Items Serve and Procurement for NPPS，HAD003/03，NNSA，1986
Quality Assurance Record System for NPPs，HAD003/04，NNSA，1986
Supervision and Inspection of Quality Assurance for NPPs，HAD003/05，NNSA，1988
Quality Assurance for Design of NPPs，HAD003/06，NNSA，1986
Quality Assurance during Construction of NPPs，HAD003/07，NNSA，1987
Quality Assurance during Items Manufacture for NPPs，HAD003/08，NNSA，1986
Quality Assurance during Commissioning and Operation of NPPs，HAD003/09，NNSA，1988
Quality Assurance during Procurement, Design and Construction of Nuclear Fuel Elements，HAD003/10，NNSA，1989
Seismic Issues in Design of Siting NPPs，HAD101/01，NNSA，1986
Atmospheric Dispersion Problems in Siting NPPs，HAD101/02，NNSA，1987
Population Distribution Problems in Siting and Assessment of NPPs，HAD101/03，NNSA，1987
External Human-made Event in Siting NPPs，HAD101/04，NNSA，1989
Hydrological Dispersion Problems of Radioactive Materials in Siting NPPs，HAD101/05，NNSA，1991
Relevance of NPPs Siting to Hydrology，HAD101/06，NNSA，1991
Site Survey of NPPS，HAD101/07，NNSA，1989
Determination of Design Basis flooding for Costal NPP Site，HAD101/08，NNSA，1989
Determination of Design Basis flooding for Costal NPP Site，HAD101/09，NNSA，1990
Extreme Meteorological Event related to NPP Siting, HAD101/10，NNSA，1991
Design Basis Tropical Cyclone for NPPs，HAD101/11，NNSA，1991
Issues relating to Safety of NPP Base，HAD101/12，NNSA，1990
Safety Principle of NPP Design，HAD102/01，NNSA，1989
Design and Evaluation of Anti-earthquake Design for NPP，HAD102/02，NNSA，1989
Safety Function and Graded Components for BWRs, PWRs and Pressurized Tube Reactors ，HAD102/03，NNSA，1986
Flying Object and Secondary Effect Protection inside NPPs，HAD102/04，NNSA，1986
External Human-made Event relating to Design of NPPs，HAD102/05，NNSA，1989
Design of NPP Reactor containment system，HAD102/06，NNSA，1990
Design of NPP Reactor Core Safety，HAD102/07，NNSA，1989
NPP Reactor Cooling System and Related Systems，HAD102/08，NNSA，1989
Final Heal Well of NPP and Directly related Heat Conduction System，HAD102/09，NNSA，1987
NPP Protection System and Related Facilities，HAD102/10，NNSA，1988
Fire Protection at NPPs，HAD102/11，NNSA，1996
Radiation Protection Design for NPPs，HAD102/12，NNSA，1990
NPP Emergency Power System，HAD102/13，NNSA，1996
NPP Safety Related Instrument and Control System，HAD102/14，NNSA，1988
NPP Spent Fuel Handling and Storage System，HAD102/15，NNSA，1990
NPP Operational Limits and Conditions，HAD103/01，NNSA，1987
NPP Commissioning Procedures，HAD103/02，NNSA，1987
NPP Reactor Core and Fuel Management，HAD103/03，NNSA，1989
Radiation Protection during Operation of NPP，HAD103/04，NNSA，1990
Staffing, Recruitment, Training and Delegation，HAD103/05，NNSA，1996
Management of Safe Operation of NPPs，HAD103/06，NNSA，1990
In-commissioning Examination of NPPs，HAD103/07，NNSA，1988

Repair and Maintenance of NPPs，HAD103/08，NNSA，1993
Supervision of Important Safety Items at NPPs，HAD103/09，NNSA，1993
Research Reactor Series
Format and Contents of Research Reactor Safety Analysis Report，HAD201/01，NNSA，1996
Operational Management of Research Reactor，HAD202/01，NNSA，1989
Management of Criticality Installation Operation and Experiment，HAD202/02，NNSA，1989
Application and Modification of Research Reactor，HAD202/03，NNSA，1996
Decommissioning of Research Reactor and Criticality Installation，HAD202/04，NNSA，1992
NUCLEAR FUEL CYCLE INSTALLATION SERIES
Format and Content of Safety Analysis Report of Uranium Fuel Fabrication Installation，HAD301/01，NNSA，1991
Design of Spent Fuel Storage Installation，HAD301/02，NNSA，1998
Operation of Spent Fuel Storage Installation，HAD301/03，NNSA，1998
Safety Assessment of Spent Fuel Storage Installation，HAD301/04，NNSA，1998
NUCLEAR MATERIALS REGULATION SERIES
Nuclear Fuel Balance Budget for Low Enriched Uranium Conversion and Element Fabrication Plant，HAD501/01，NNSA，1997
Guidelines on Physical Protection for Nuclear Power Plant，HAD501/02，NNSA，1998
RADIOACTIVE WASTE MANAGEMENT SERIES
FUNDAMENTAL DOCUMENT
Regulations on Radioactive Waste Management，GB 14500-2002，NTSB，1993
Glossary of Nuclear Science and Technology: Radioactive Waste Management，GB/T 4960.8-1996，NTSB，1996
Regulations on Categorization of Radioactive Waste，GB 9133-1995，1995
Categorization of Radioactive Waste，HAD401/04，NNSA，1998
GENERATION, PRE-TREATMENT, TREATMENT AND DISCHARGE
Technical Regulations on Solid Radioactive Waste Treatment System at BWR Nuclear Power Plant，GB 9134-1988，NTSB，1988
Technical Regulations on liquid Radioactive Waste Treatment System at LWR Nuclear Power Plant，GB 9135-1988，NTSB，1988
Technical Regulations on Gaseous Radioactive Waste Treatment System at LWR Nuclear Power Plant，GB 9136-1988，NTSB，1988
Normalized Discharge Management Limits on Radioactive Effluents from Nuclear Fuel Cycle Installations，GB 13695-1992，NTSB，1992
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
Technical Regulations on Liquid Radioactive Waste Discharge from LWR Nuclear Power Plant，GB 14587-1993，NTSB，1993
Radioactive Surface Decontamination and Textile Detergent Test Methods，GB/T 115850-1995，NTSB，1995
Technical Regulations on LILW Volume Reduction System，EJ/T 795-1993，CNNC，1993
Management of Radioactive Effluents and Waste Arising from Nuclear Power Plant，HAD401/01，NNSA，1990
Design of Radioactive Waste Management System for Nuclear Power Plant，HAD401/02，NNSA，1997

Design and Operation of Radioactive Waste Incineration Installation，HAD401/03，NNSA，1997
General Regulations on Nuclear Environmental Quality Assessment，GB 11215-89，SEPA，1989
General Requirements for Quality Assurance Program for Nuclear Facility Effluent and Environmental Radioactivity Monitoring，GB 11216-1989，SEPA，1989
Evaluation of Characteristics of Radioactive Waste Forms and Waste Package，EJ 1186-2005，NDSTC，2005
Standards on Health and Protection for Medical Radioactive Waste Management，GBZ133-2002，MEP，2002
Environmental Protection Drawings-marked Discharge Outlet (source)，GB 155621.1-1995，SEPA，1995
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，SEPA，1991
Requirements on Solidified LILW Forms: Cement-solidified Forms，GB 14569.1-1993，SEPA，1993
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
Reinforced Container for Solid LILW，EJ/T 914-1994 (1999)，CNNC，1994
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
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
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
WASTE DISPOSAL
Regulations on Shallow Land Disposal of Solid LILW，GB 9132-1988，SEPA，1988
Regulations on Cave Disposal of Solid LILW，GB 13600-1992，NTSB，1992
General Requirements on Environmental Radiation Monitoring for Near Shallow Disposal of LILW，GB/ T 15950-1995，SEPA，1995
Criteria on Waste Acceptance for Radioactive Waste Near Surface Disposal，GB 16933-1997，NTSB，1997
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
Siting of Radioactive Waste Near Surface Disposal Facility，HAD401/05，NNSA，1998
Siting of Radioactive Waste Geological Repository，HAD401/06，NNSA，1998
Environmental Protection Drawing Marker: Solid Waste Storage（Repository），GB 15562.2-1995，SEPA，1995

NUCLEAR FACILITY DECOMMISSIONING AND ENVIRONMENTAL RECLAMATION
Radiation Protection Regulations on Decommissioning of Nuclear Power Plant and large Sized Reactor，GB 11850-1989，NTSB，1989
Safety Requirements on Decommissioning of Nuclear Facility，GB/T 19597-2004，SEPA，2004
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

L.5.5 Other documents relevant to radioactive sources

No.	Title	Serial Number
1	General Regulations on Sealed Radioactive sources	GB4076-83
2	Standards on Health and Protection for Use of Sealed Sources	GBZ114-2002
3	Standards on Health and Protection for Use of Non-sealed Sources in Oil or Gas Field	GBZ118-2002
4	Standards on Health and Protection for Radioactive luminous Paint	GBZ119-2002
5	Standards on Health and Protection for After-loading Source Brachtherapy	GBZ121-2002
6	Standards on Health and Protection for Ion Flame Detector	GBZ122-2002
7	Standards on Health and Protection for Meter Containing Sealed Source	GBZ125-2002
8	Standards on Health and Protection for Gamma Rays Non-destructive Detection	GBZ132-2002
9	Monitoring Criteria on Health and Protection for Meter Containing Sealed Source	GBZ137-2002
10	Monitoring Criteria on Protection against Gamma Rays and Electronic Beam Irradiation Installations	GBZ141-2002
11	Standards on Radiation Protection for Use in Non-sealed Sources in Oil or Gas Field	GBZ142-2002
12	Radiological Health and Protection on Container Examination System	GBZ143-2002
13	Radiological Health and Protection for X/Rays Head Oriented Stereo Surgery Therapy	GBZ168-2005

L.6 NPP Occupational Exposure in China (2004-2006)

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	2004	0.11	3.53	0.064	0.024
	2005	0.69	10.3	0.932	0.396
	2006	0.40	8.05	0.538	0.217
Guangdong Daya Bay NPP	2004	0.674	12.14	1.817	0.13
	2005	0.486	8.146	1.307	0.085
	2006	0.436	5.921	1.205	0.078
Qinshan Phase II NPP	2004	0.353	5.443	0.590	0.068
	2005	0.362	7.210	0.738	0.073
	2006	0.335	6.318	0.713	0.086
Guangdong LingAo NPP	2004	0.417	8.05	1.006	0.069
	2005	0.433	8.910	1.088	0.072
	2006	0.284	7.155	0.722	0.046
Qinshan Phase III NPP	2004	0.369	8.015	0.81	0.077
	2005	0.594	9.350	1.368	0.135
	2006	0.272	5.990	0.519	0.045

Notes: The annual collective effective dose is the sum of the two units, for Guangdong Daya Bay NPP, Guangdong LingAo and Qinshan Phase III NPP, respectively.

L.7 NPP Radioactive Effluents

Percent of Radioactive Effluents to the Regulatory Discharge Limits（%）

（From 2004 to 2006）

Plant	Year	Gaseous Effluents			Liquid Effluents	
		Noble gas	**Halogen**	**Aerosol**	**Tritium**	**Other nuclide**
Qinshan NPP	2004	3.44E-04	0	0	1.63E+00	8.05E-03
	2005	1.80E-04	0	0	4.13E+00	5.64E-02
	2006	2.70E-04	0	0	2.06E+00	2.91E-02
Guangdong Daya Bay NPP（2 units）	2004	5.04E-01	1.65E-01	5.90E-04	3.21E+01	1.96E-01
	2005	9.16E-02	1.67E-02	2.74E-03	4.16E+01	1.70E-01
	2006	9.36E-02	2.25E-02	2.56E-03	3.81E+01	1.19E-01
Qinshan Phase II NPP（2 units）	2004	9.08E-07	5.00E-02	2.69E-03	7.07E+00	3.00E-01
	2005	4.72E-06	7.00E-03	1.37E-03	1.38E+01	2.40E-01
	2006	4.88E-08	1.35E-03	1.81E-03	1.79E+01	4.12E-01
Guangdong LingAo NPP（unit 1 and 2）	2004	4.44E-01	8.79E-02	6.75E-04	2.65E+01	4.27E-02
	2005	7.20E-02	9.85E-03	3.78E-03	2.85E+01	3.47E-02
	2006	7.60E-02	8.00E-03	3.20E-03	3.34E+01	3.88E-02
Qinshan Phase III NPP（2 units）	2004	1.30E+00	<DL	<DL	NA	1.60E-01
	2005	2.35E+00	2.02E-02	<DL	NA	1.93E-01
	2006	1.08E-02	<DL	8.25E-04	NA	2.20E-01

Notes:

1. The discharge of radioactive effluents is dependent of the power level of the reactor units.
2. Different NPP operators treat values less than the detection limits differently when calculating the effluent discharge. Qinshan NPP assumes it 0, while Guangdong Daya Bay NPP and Guangdong LingAo NPP use the detection limits.
3. DL, detection limit.
4. NA，Not applicable. No regulatory limit is available for tritium discharge for CANDU type nuclear power plant.

L.8 References

L.8.1 Documents

[1]	National Report of the People's Republic of China to the Convention on Nuclear Safety, 2001
[2]	The Fourth National Report of the People's Republic of China to the Convention on Nuclear Safety, April 2007
[3]	National Report of the People's Republic of China to the Behavior Criteria on the Safety and Security of Radioactive Source, NNSA, August 2007
[4]	Annual Report on China Nuclear Power Operation，CAEA，2002
[5]	Annual Report on China Nuclear Power Operation，CAEA，2003
[6]	Annual Report on China Nuclear Power Operation，CAEA，2004
[7]	Annual Report on China Nuclear Power Operation，CAEA，2006.
[8]	Annual Report of Nuclear Safety, NNSA，2004
[9]	Annual Report of Nuclear Safety, NNSA，2005
[10]	Annual Report of Nuclear Safety, NNSA，2006
[11]	Long and Intermediate Period Development Planning of Nuclear Power, National Development and Reform Commission (2005-2020)，2006

L.8.2 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
[3]	CNNC	www.cnnc.com.cn

L.9 Abbreviation

Abbreviation	Full name
Joint Convention	The Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management
Beilong Disposal Site	Guangdong Beilong LILW Disposal Site
CAEA	China Atomic Energy Authority, P.R.China
CIAE	China Institute for Atomic Energy
CNNC	China National Nuclear Corporation
HLW	High-level radioactive waste
ILW	Intermediate-level radioactive waste
LILW	Low-and-intermediate-level radioactive waste
LLW	Low-level radioactive waste
MEP	Ministry of Environmental Protection, P.R.China
NDSTC	National Defense Science and Technology Committee
NNAEO	National Nuclear Accident Emergency Office
NNSA	China National Nuclear Safety Administration, P.R.China
Northwest China Disposal Site	North-western China LILW Disposal Site
NPIC	Nuclear Power Institute of China
NPP	Nuclear Power Plant
Radwaste	Radioactive waste

Part 2

A Overview

1.1 Hong Kong Special Administrative Region (hereinafter: Hong Kong SAR) does not produce spent fuel. There are also no facilities related to spent fuel management.

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) (please refer to Annex I.1) and the associated licensing system form the legal basis for the control of radioactive substances and radioactive wastes in Hong Kong SAR. The Hong Kong SAR Radiation Board ("the Board") is established as the regulatory authority under the Radiation Ordinance.

B.1 Definition of Radioactive Wastes

2.2 As defined in the Radiation Ordinance, all disused radioactive substances or wastes contaminated by radioactive substances should be regarded as radioactive wastes. Any person who works and undertake activities involving radioactive substances (including radioactive wastes) are required to be covered by a valid licence issued by the Board.

2.3 Any premises where radioactive substances are handled are subject to radiation safety assessment and on-site inspection of the Board to ensure that legal requirements and conditions of licence are fully met before a licence is granted. The Board will also conduct review assessment at such premises during the licence period and before the renewal of licence to ensure that requirements on radiation safety are effectively maintained.

B.2 Criteria for the Categorization of Radioactive Wastes

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

i) Solid waste;
ii) Liquid waste;
iii) Gaseous waste; and
iv) Exempt waste.

2.5 Solid radioactive waste mainly includes disused sealed sources and solid wastes contaminated by radioactive substances, etc. Sealed sources are widely used in medical and industrial sectors. Sealed sources in medical applications based on the Categorization of Radioactive Sources of International Atomic Energy Agency (IAEA) include the higher activity Category 1 and Category 2 sources, such as caesium-137 in blood irradiator systems and cobalt-60 in gamma knife radiosurgery system, as well as those Category 3 or lower sources that are used in brachytherapy and calibration of radiation detectors. Sealed sources for industrial applications include Category 2 and Category 3 sources such as iridium-192 and cobalt-60, etc., that are used in non-destructive testing, as well as sealed sources of lower categories that are used in quality inspection instruments, such as americium-241/beryllium neutron sources in the measurement of moisture and density in concrete, strontium-90 and thallium-201 β-sources in the measurement of material thicknesses as well as nickel-63 β-sources in electron capture devices.

2.6 Sealed sources for scientific research and educational purposes primarily belong to the lower radioactivity Category 5. Radioactive substances used in other products include americium-241 in lightning conductors and smoke detectors as well as tritium in luminous watches and indicator lights, etc.

2.7 Liquid radioactive waste mainly refers to disused liquid or solution containing radioactive substances. Liquid radioactive substances include radio-pharmaceuticals used in nuclear medicine for the treatment and diagnosis of diseases, such as iodine-131, technetium-99m, thallium-201, strontium-90, fluorine-18, and phosphorus-32; as well as radioactive compounds used in clinical tests and scientific research, such as iodine-125, phosphorus-32, carbon-14 and uranium-238, etc.

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

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

C. Radioactive Waste Management Policies and its Practices

C.1 Radioactive Waste Management Policy

3.1 The fundamental principle of Hong Kong SAR's radioactive waste management policy is to minimise the waste arising at source. The Board adopts the following management policies to commensurate with the properties and categories of radioactive wastes –

i) Sealed sources: the licensed user is required to return disused sealed sources to their original manufacturer. In case that the manufacturer has wound up or there are justifiable reasons proving that such measure is impracticable, the licensed user may seek approval from the Board for transferring the waste sources to the Storage Facility;

ii) Solid contaminated wastes: the licensed user is required to store such wastes to allow for radioactive decay for a period of time as specified in the conditions of licence, after which the wastes should be disposed of as exempt wastes. Subject to the conditions of licence, some wastes that present biological hazards may be disposed of by incineration. Subject to the approval of the Radiation Board, wastes exceeding the permitted discharge level after delay storage may be transferred to the Storage Facility;

iii) Liquid wastes: the licensed user is required to store such wastes to allow for radioactive decay for a period as specified in the conditions of licence, after which the wastes should be disposed of as exempt liquid wastes. Subject to the approval of the Radiation Board, wastes exceeding the permitted discharge level after delay storage may be solidified and transferred to the Storage Facility for suitable processing and storage; and

iv) Gaseous wastes: the licensed user is required to recover such wastes or discharge them through a purpose-designed exhaust system according to the principles specified in the conditions of licence.

C.2 Discharge of Effluents

3.2 The permitted discharge level of different wastes is determined with reference to the Annual Limit on Intake of the individual radionuclide. The user concerned should record in detail the date on which the waste is produced, its activity, storage duration and the date of discharge. Any disposal of wastes exceeding the limit permitted by the licence shall only be carried out after satisfactory assessment of the impact on the public and environment caused by the proposed disposal method in conjunction with the radioactivity and the radiation level of such wastes and subject to the approval of the Board.

D Safety of Radioactive Waste Management

4.1 As stated in paragraph 3.1, the basic principle for the management of radioactive wastes of Hong Kong SAR is to proactively minimise the quantity of wastes at the source of waste arising. This is further complemented by the formulation and implementation of relevant disposal policies and regulations commensurate with the properties of various categories of wastes so as to minimize the risks caused by such wastes on humans, society and the environment.

D.1 Safety Management Practices of the Storage Facility

4.2 The Storage Facility, with a designed storage capacity of $140m^3$, has been commissioned in Hong Kong SAR since mid-2005. Presently the total volume of waste in store is about $64m^3$. 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 B.

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, which reflects the quality of the management system and the commitment to continual improvement.

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 transhipment operations, import of radioactive substances for local use and return of disused sealed sources to their places of origin. According to the existing regulations, any import of radioactive substances into 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.

I Annex

I.1 References

[1] Guidance on the Import and Export of Radioactive Sources, IAEA (2005)
[2] Code of Conduct on the Safety and Security of Radioactive Sources, IAEA (2004)
[3] Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, IAEA (1998)
[4] Categorization of Radioactive Sources, IAEA-TECDOC-1344 (2003)
[5] International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources, Safety Series No. 115, IAEA (1997)
[6] Regulations for the Safe Transport of Radioactive Material, Safety Standards Series No. TS-R-1, IAEA (2005)
[7] IAEA Safety Glossary (2007)
[8] Radiation Ordinance (Cap. 303 of the Laws of Hong Kong SAR)
[9] Import (Radiation) (Prohibition) Regulations (Cap. 60 of the Laws of Hong Kong SAR)

I.2 List of Major Isotope in Store

Isotope	Total Activity (MBq)	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	2.3×10^4	Medical radiation sources
gadolinium-153	1.1×10^4	Medical radiation sources
americium-241	5.7×10^3	Radioactive check sources, smoke detectors
thorium-232	1.2×10^3	Rayon mantles for kerosene lanterns