

ATOMIC ENERGY COUNCIL



2017

# National Report

as referred to by the Joint Convention on the  
Safety of Spent Fuel Management and on the  
Safety of Radioactive Waste Management



## INDEX

A Section A Introduction.....	8
A.1 Background and Purposes .....	8
A.2 Current Major Nuclear Installations .....	15
A.2.1 Introduction to Taiwan .....	15
A.2.2 Nuclear Power Plants .....	15
A.2.3 Research and Educational Reactor Facilities.....	17
A.3 Radioactive Waste .....	19
B Section B Policies and Practices .....	22
B.1 Spent Fuel Management Policies .....	22
B.1.1 Spent Fuel from Nuclear Power Plants .....	22
B.1.2 Spent Fuel from Research and Educational Reactor Facilities	23
B.2 Spent Fuel Management Practices.....	23
B.2.1 Spent Fuel from Nuclear Power Plants .....	23
B.2.2 Spent Fuel from Research and Educational Reactor Facilities	28
B.3 Radioactive Waste Management Policies .....	30
B.3.1 Radioactive Waste from Nuclear Power Plants .....	32
B.3.2 Radioactive Waste from Medical, Agricultural, Industrial, and Research Activities.....	32
B.4 Radioactive Waste Management Practices .....	33
B.4.1 Radioactive Waste from Nuclear Power Plants .....	33
B.4.2 Radioactive Waste from Medical, Agricultural, Industrial, and Research Activities.....	34
B.5 Criteria for Definition and Classification of Radioactive Waste....	35
C Section C Scope of Application .....	37
C.1 Spent Fuel .....	37
C.2 Radioactive Waste.....	37
C.3 Spent Fuel or Radioactive Waste within Military or Defense Programs.....	38
C.4 Discharges.....	38

D Section D Inventories and Lists .....	39
D.1 Lists of Spent Fuel Management Facilities .....	39
D.1.1 Nuclear Power Plants .....	39
D.1.2 Research and Educational Reactor Facilities .....	40
D.2 Inventories of Spent Fuel .....	40
D.3 Lists of Radioactive Waste Management Facilities .....	42
D.3.1 Nuclear Power Plants .....	42
D.3.2 Medical, Agricultural, Industrial, and Research Activities .....	43
D.4 Inventories of Radioactive Waste .....	45
D.4.1 Radioactive Waste in Storage .....	45
D.4.2 Disposed Radioactive Waste .....	47
D.4.3 Past Practices .....	47
D.5 List of Decommissioned Facilities and Status of Decommissioning Activities .....	47
D.5.1 Nuclear Power Plants .....	47
D.5.2 Research and Educational Reactor Facilities .....	48
E Section E Legislative and Regulatory System .....	50
E.1 Implementing Measures .....	50
E.2 Legislative and Regulatory Framework .....	50
E.2.1 Safety Requirements and Regulations for Radiation Safety ....	52
E.2.2 Licensing .....	56
E.2.3 Prohibition of Operation without License .....	56
E.2.4 Control, Regulatory Inspection, and Documentation and Reporting .....	57
E.2.5 Enforcement .....	58
E.2.6 Allocation of Responsibilities .....	58
E.3 Regulatory Body .....	59
E.3.1 Establishment of a Regulatory Body .....	59
E.3.2 Independence of Regulatory Functions .....	64
F Section F Other General Safety Provisions .....	67
F.1 Responsibility of the License Holder .....	67
F.1.1 The License holder .....	67
F.1.2 Absence of the License Holder .....	68
F.2 Human and Financial Resources .....	68

F.2.1 Qualified Staff .....	69
F.2.2 Financial Resources during Operating Lifetime and Decommissioning.....	69
F.2.3 Financial Provision following Closure of a Disposal Site .....	70
F.3 Quality Assurance .....	71
F.4 Operational Radiation Protection.....	72
F.4.1 Protection from Radiation Exposures .....	72
F.4.2 Control of Discharges .....	73
F.5 Emergency Preparedness .....	74
F.5.1 Emergency Plans .....	75
F.5.2 Emergency Exercises .....	76
F.6 Decommissioning.....	76
F.6.1 Qualified Staff and Adequate Financial Resources .....	77
F.6.2 Radiation Protection.....	78
F.6.3 Emergency Preparedness .....	78
F.6.4 Record Keeping for Information Important to Decommissioning.....	78
F.6.5 Non-reactor Decommissioning .....	79
G Section G Safety of Spent Fuel Management.....	80
G.1 General Safety Requirements .....	80
G.1.1 Subcriticality and Residual Heat Removal of Spent Fuel Management.....	80
G.1.2 Minimization of Radioactive Waste Generation in Spent Fuel Management.....	80
G.1.3 Interdependencies among Different Steps in Spent Fuel Management.....	81
G.1.4 Regulations for Radiation Protection .....	81
G.1.5 Consideration of Biological, Chemical and Other Hazards .....	81
G.1.6 Consideration of Impacts on Future Generations.....	82
G.1.7 Consideration of Burdens on Future Generations .....	82
G.2 Existing Facilities .....	82
G.2.1 Spent Fuel Wet Storage Facilities.....	82
G.2.2 Spent Fuel Dry Storage Facilities .....	83
G.2.3 Research and Educational Reactor Facilities .....	84
G.3 Siting of Proposed Facilities.....	85

G.4 Design and Construction of Facilities .....	86
G.4.1 Limitation of Radiological Impact .....	87
G.4.2 Conceptual Plans and Technical Provisions for Decommissioning.....	87
G.4.3 Technologies Supported by Experience, Testing and Analysis	87
G.5 Assessment of Safety of Facilities .....	87
G.5.1 Safety and Environmental Assessment before Construction ...	88
G.5.2 Updating of Assessments before Operation of Facilities .....	88
G.6 Operation of Facilities .....	89
G.6.1 Operating License.....	89
G.6.2 Operational Limits and Conditions .....	90
G.6.3 Procedures for Operation, Maintenance, Monitoring, Inspection and Testing.....	90
G.6.4 Engineering and Technical Support in Safety Related Fields ..	90
G.6.5 Reporting of Incidents .....	91
G.6.6 Collection and Analysis of Operating Experiences .....	91
G.6.7 Decommissioning Plan .....	91
G.7 Disposal of Spent Fuel.....	92
G.7.1 National Strategy .....	92
G.7.2 Research and Development .....	92
G.7.3 Spent Fuel Final Disposal Plan .....	92
G.7.4 Regulatory Control .....	93
G.7.5 Next Progress Report.....	94
H Section H Safety of Radioactive Waste Management .....	95
H.1 General Safety Requirements .....	95
H.1.1 Subcriticality and Residual Heat Removal .....	95
H.1.2 Minimization of Radioactive Waste Generation.....	96
H.1.3 Interdependencies among Different Steps in Radioactive Waste Management .....	96
H.1.4 Regulations for Radiation Protection.....	96
H.1.5 Consideration of Biological, Chemical and Other Hazards.....	96
H.1.6 Consideration of Impacts on Future Generations .....	97
H.1.7 Consideration of Burdens on Future Generations.....	97
H.2 Existing Facilities and Past Practices .....	97
H.2.1 Safety Review of Existing Radioactive Waste Management Facilities .....	97

H.2.2 Examination of the Results of Past Practices.....	98
H.3 Siting of Proposed Facilities.....	98
H.3.1 Siting Procedures .....	99
H.3.2 Effect on Other Contracting Party .....	105
H.4 Design and Construction of Facilities .....	105
H.4.1 Limitation of Radiological Impacts .....	105
H.4.2 Conceptual Plans and Technical Provisions for Decommissioning.....	105
H.4.3 Technical Provisions for Closure of Disposal Facility .....	106
H.4.4 Technologies Supported by Experience, Testing or Analysis	106
H.5 Assessment of Safety of Facilities.....	106
H.5.1 Safety and Environmental Assessments before Construction	107
H.5.2 Post Closure Safety and Environmental Assessments for a Disposal Site before Construction .....	107
H.5.3 Updating of Assessments before Operation of Facilities.....	107
H.6 Operation of Facilities .....	107
H.6.1 Operating License .....	108
H.6.2 Operational Limits and Conditions .....	109
H.6.3 Procedures of Operation and Updating of Post Closure Safety Assessment of a Disposal Site .....	109
H.6.4 Engineering and Technical Support in Safety-Related Fields	109
H.6.5 Characterization and Classification of Radioactive Waste .....	110
H.6.6 Reporting of Incidents.....	110
H.6.7 Collection and Analysis of Operating Experiences .....	110
H.6.8 Decommissioning Plan for a Facility other than a Disposal Facility.....	111
H.6.9 Closure Plan for a Disposal Facility .....	112
H.7 Institutional Measures after Closure.....	112
H.7.1 Record Keeping.....	113
H.7.2 Active and Passive Institutional Controls .....	113
H.7.3 Intervention Measures If Necessary.....	113
I Section I Transboundary Movement .....	115
I.1 General Requirements.....	116
I.1.1 Prior Notification and Consent of the State of Destination.....	116
I.1.2 Movement through States of Transit .....	116
I.1.3 Requirement as a State of Destination to Consent a	

Transboundary Movement .....	116
I.1.4 Requirements as a State of Origin to Authorize a Transboundary Movement .....	117
I.1.5 Re-entry in case of Non-Conformity .....	118
I.2 Shipment South of Latitude 60 Degrees South.....	118
J Section J Disused Sealed Sources .....	120
J.1 Permanent Disuse of Sealed Sources.....	120
J.2 Management of Disused Sealed Sources .....	120
J.3 Re-entry into territory .....	121
K Section K General Efforts to Improve Safety .....	122
K.1 Plans to Improve Safety of Radioactive Materials.....	122
K.1.1 Strengthening Regulations and Management System .....	123
K.1.2 Improving the Professional Quality of the Management Staff.....	124
K.1.3 Strengthening Information Disclosure and Public Communication.....	124
K.1.4 Ensuring Operation Safety of Facilities.....	125
K.1.5 Careful Planning and Pre-Preparedness for Major Development Projects .....	126
K.2 New Regulatory Requirements for Radioactive Waste Facilities in Taiwan after the Fukushima Accidents .....	128
K.2.1 New Regulatory Requirements for Spent Fuel .....	128
K.2.2 New Regulatory Requirements for Radioactive Waste .....	129
K.3 International Peer Review of Radioactive Waste Programs.....	131
L Section L Annexes .....	132
L.1 List of Relevant Laws and Regulations .....	132
L.2 Taiwan's Radioactive Waste Management Policy.....	136
L.3 Glossary .....	140





## **Section A Introduction**

### **A.1 Background and Purposes**

The “Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management” was made available for signature on September 29, 1997 and entered into force on June 18, 2001. The main objectives of the Convention were (1) to achieve and maintain a high degree of safety worldwide regarding spent fuel and radioactive waste management, (2) to ensure that there are effective defenses against potential hazards so that individuals, society and the environment are protected at present, and in the future, and (3) to prevent accidents and mitigate their consequences should they occur. The above objectives may be achieved by means of a “peer review” of national programs for spent fuel and radioactive waste management. Therefore, Article 32 of the Convention requires that each contracting party shall submit a national report to every review meeting of the Contracting Parties.

Although Taiwan, the Republic of China (R.O.C.), is not a Contracting Party of the Convention, the government, in Article 17 of the domestic law, “Nuclear Materials and Radioactive Waste Management Act”, has committed to following the requirements set forth in the relevant international conventions. Therefore, a national report has been prepared to fulfill the obligations of the Convention, with the form and structure as provided by IAEA INFCIR/604/Rev.3, “Guidelines Regarding the Form and Structure of National Reports.” Sections and annexes in this report have the same titles as prescribed in these guidelines. Table A-1 provides a cross-reference between the sections in this report and specific reporting requirements in the Convention. The data presented in this report has been updated current to June 30, 2017.

A summary matrix of the management of spent nuclear fuel and radioactive waste is shown in Table A-2.

Table A-1 A cross-reference between the sections in the national report and the joint convention reporting requirements

National Report Section	Joint Convention Section
A. Introduction	
B. Policies and Practices	Article 32, Paragraph 1
C. Scope of Application	Article 3
D. Inventories and Lists	Article 32, Paragraph 2
E. Legislative and Regulatory System	Articles 18~20
F. Other General Safety Provisions	Articles 21~26
G. Safety of Spent Fuel Management	Articles 4~10
H. Safety of Radioactive Waste Management	Articles 11~17
I. Transboundary Movement	Article 27
J. Disused Sealed Sources	Article 28
K. General Efforts to Improve Safety	
L. Annexes	

Table A-2 Overview of Spent Fuel and Radioactive Waste Management in Taiwan				
Type of Liability	Long-term Management Policy <sup>14</sup>	Funding of Liabilities	Current Practice/Facilities	Future Facilities
<b>Spent fuel</b>	<p>the management of HLRW, Taiwan's strategies are threefold: short-term – on-site spent fuel pool storage; mid-term – dry storage; and long-term – promoting final disposal</p> <p>See B.1.1,B.2.1,C.1,G.7</p>	<p>According to Article 28 of the “Nuclear Materials and Radioactive Waste Management Act”, the producer shall bear the necessary expenses for treatment, storage, transportation and disposal of spent fuel and radioactive waste, and decommissioning of the facilities.</p> <p>In order to meet the above requirements, a nuclear back-end fund was established in 1987. The fund was redefined as a non-operational fund and the administration of the fund was switched from TPC to the Nuclear Back-end Fund Management Committee under MOEA's supervision</p> <p>See F.2.2, F.2.3</p>	<p>Spent fuel discharged from each nuclear power plant is currently stored in each of the plant's respective spent fuel pools.</p> <p>The TPC has decided to use a dry storage method to provide 40-year storage for the needs of nuclear power plant operation</p> <p>The majority of the Taiwan Research Reactor's (TRR's) spent fuel was transferred to the U.S.A. The remaining spent fuel discharged from TRR is currently stored at INER's centralized warehouse</p> <p>See A.3,B.2.2,D.1.1,D.1.2,D.2, i.1.3</p>	<p>The spent fuel dry storage facility is located on-site of the plant.</p> <p>In Taiwan's “Spent Fuel Final Disposal Plan”, the plan includes five stages which are: potential host rock characterization and evaluation by 2017, candidate site selection and confirmation by 2028, detailed site investigation and testing by 2038, repository design and license application by 2044, and repository construction by 2055.</p> <p>See B.1.1,G.2.1,G.2.2,G.2.3,G.3</p>

<p><b>Nuclear fuel cycle wastes</b> (all LLW included in Non-Nuclear fuel cycle wastes for brevity)</p>	<p>HLW: See above</p> <p>TPC is conducting a project aimed at selecting a site for building a final disposal facility for all low-level radioactive waste arising from electricity generation and medical, agricultural, industrial, and research activities.</p> <p>See B.3,B.3.1,B.4.1,C.2</p>	<p>All: Producer pays</p> <p>According to Article 28 of the “Nuclear Materials and Radioactive Waste Management Act”, the producer shall bear the necessary expenses for treatment, storage, transportation and disposal of spent fuel and radioactive waste, and the decommissioning of the facilities.</p> <p>See F.2.2,F.2.3</p>	<p>HLW: Interim storage</p> <p>The management measures of NPPs' radioactive waste include treatment, storage, transport, off-site storage, and final disposal. All of the NPPs' radioactive waste is stored in on-site storage facilities, except those which have already been shipped to the Orchid Island Storage Site.</p> <p>See A.3,D.3.1,D.4</p>	<p>HLW: See above</p> <p>“Siting for Establishment of Low-Level Radioactive Waste Final Disposal Facility Act (Siting Act)”</p> <p>three potential sites were selected two recommended candidate sites MOEA shall plan and carry out the referendum.</p> <p>See H.3.1,G.3</p>
---	--	---	---	---

Table A-2 Overview of Spent Fuel and Radioactive Waste Management in Taiwan				
Type of Liability	Long-term Management Policy	Funding of Liabilities	Current Practice/Facilities	Future Facilities
<b>Non-Nuclear fuel cycle wastes</b>	<p>Military or defense programs have no nuclear fuel, either fresh or spent fuel</p> <p>INER is responsible for the collection, treatment, and on-site storage of all radioactive waste arising from medical, agricultural, industrial, and research activities.</p> <p>LLRW is classified as Class A, Class B, Class C, and Greater than Class C (GTCC)</p> <p>TPC is conducting a project aimed at selecting a site for building a final disposal facility for all low-level radioactive waste arising from electricity generation and medical, agricultural, industrial, and research activities.</p> <p>See B.3.2,B.4.2,C.2,C.3</p>	<p>According to Article 28 of the “Nuclear Materials and Radioactive Waste Management Act”, the producer shall bear the necessary expenses for treatment, storage, transportation and disposal of spent fuel and radioactive waste, and decommissioning of the facilities.</p> <p>See F.2</p>	<p>The inventories of radioactive waste in storage at TPC (Orchid Island Storage Site included), INER, and NTHU</p> <p>INER has four radioactive waste storage facilities and one low-contaminated soil underground storage facility.</p> <p>NTHU has a radioactive waste storage facility which is only for temporary storage. All radioactive waste produced by NTHU is sent to INER for treatment and storage</p> <p>SeeA.3,D.3.2,D.4</p>	See above

<b>Decommissioning liabilities</b>	<p>NPPs: The decommissioning operations shall be completed within 25 years after the issuance of the decommissioning permit. (INER) owned three research reactors in total. ZPRL, TRR and WBR, of these, WBR has already been decommissioned See A.2.3,F.6,G.6.7,H.4.2,H.6.8</p>	<p>The financial resources for the decommissioning are provided by the Nuclear Back-end Management Fund which is governed by MOEA. See F.6.1</p>	<p>No nuclear power plant has been decommissioned or is being decommissioned. TRR was shut down in 1988 and the reactor was removed from the reactor building, and was then temporarily and safely stored in the dismantling building. The decommissioning plan of WBR has been completed. The building then became an uncontrolled area and is currently used as an exhibition building. ZPRL stopped operation by 2005. Its decommissioning plan was approved. THAR was decommissioned successfully in 1993. The decommissioning of THMER was completed on September 10, 2003. See D.5,D.5.1,D.5.2,F.6.5</p>	<p>Based on the Decommissioning Plan and the Solid Waste Deliverance Operation Plan approved by the AEC, INER successfully carried out the decommissioning and cleanup work for the fuel element recycling facilities See F.6.5</p>
------------------------------------	--	--	--	---

<p><b>Disused Sealed Sources</b></p>	<p>Permanent disuse of sealed sources: the operator shall transport the sealed sources to the receiving organization, INER, within three months</p> <p>Disused sealed sources arising from TPC are currently stored at the nuclear power plants.</p> <p>See A.3,J.1</p>	<p>According to Article 28 of the “Nuclear Materials and Radioactive Waste Management Act”, the producer shall bear the necessary expenses for treatment, storage, transportation and disposal of spent fuel and radioactive waste, and decommissioning of the facilities.</p> <p>See Section J</p>	<p>NPP had received and stored 30, 55, and 17 disused sealed sources</p> <p>INER has received 10,274 disused sealed sources</p> <p>See Section J</p>	<p>“Siting for Establishment of Low-Level Radioactive Waste Final Disposal Facility Act (Siting Act)” specifies siting procedures and relevant measures.</p> <p>Three potential sites were selected and two were recommended as candidate sites.</p> <p>MOEA shall plan and carry out the referendum</p> <p>See H.3.1</p>
--------------------------------------	---	---	--	---



## A.2 Current Major Nuclear Installations

### A.2.1 Introduction to Taiwan

The Republic of China was founded in 1912 and has an effective jurisdiction territory of 36,193.62 square kilometers at present. The shape of Taiwan island is like a spindle with a north-south longitudinal length of 394km and the maximum east-west transversal width of 144 km. The location of Taiwan spans the area between 21 to 26 degrees north latitude.

Up to the end of 2016, Taiwan's total population was about 23.54 million people, mostly living in six special municipalities which hold about 69% of the total population.

Among these six special municipalities, New Taipei City has the largest population of about 3.98 million people. In the jurisdiction area of New Taipei City, there are two operating nuclear power plants (NPPs), four reactor units in total, and one under mothballing, containing two reactor units in total.

A presidential system has been adopted in our country and the president has been directly elected by the eligible citizens of the Republic of China since 1996. Under the central government, there are five Yuans: Executive, Legislative, Judicial, Examination, and Monitor. The Executive Yuan is the country's highest administration department. Under its jurisdiction, there are the Ministry of Economic Affairs (MOEA), the Atomic Energy Council (AEC) and the Environmental Protection Administration (EPA), in addition to other authorities at the cabinet level. The council of the Executive Yuan (the cabinet) has the authority to resolve country's major policy objectives and propose bills to the Legislative Yuan (the Legislature). The Legislature is the country's highest legislative department. The members of the Legislature (the legislators) are directly elected by the eligible citizens and are representative of the people to execute the rights of legislation. The Legislature has the authority to resolve the bills proposed by the Executive Yuan.

### A.2.2 Nuclear Power Plants

There are four nuclear power plants (NPPs) in Taiwan, three plants in operation and one under mothballing. These NPPs are owned and operated by the Taiwan Power Company (TPC), a state-run utility. Unit 1 of the Chinshan NPP started commercial operation in December 1978 when Taiwan entered the era of nuclear power generation. The total electricity generated in Taiwan in the whole year of 2016 was 225.8 Twh in which nuclear power's share was

14%, the others were, mainly, fossil-fueled power, hydropower, and renewable energy sources, as shown in Fig. A-1.

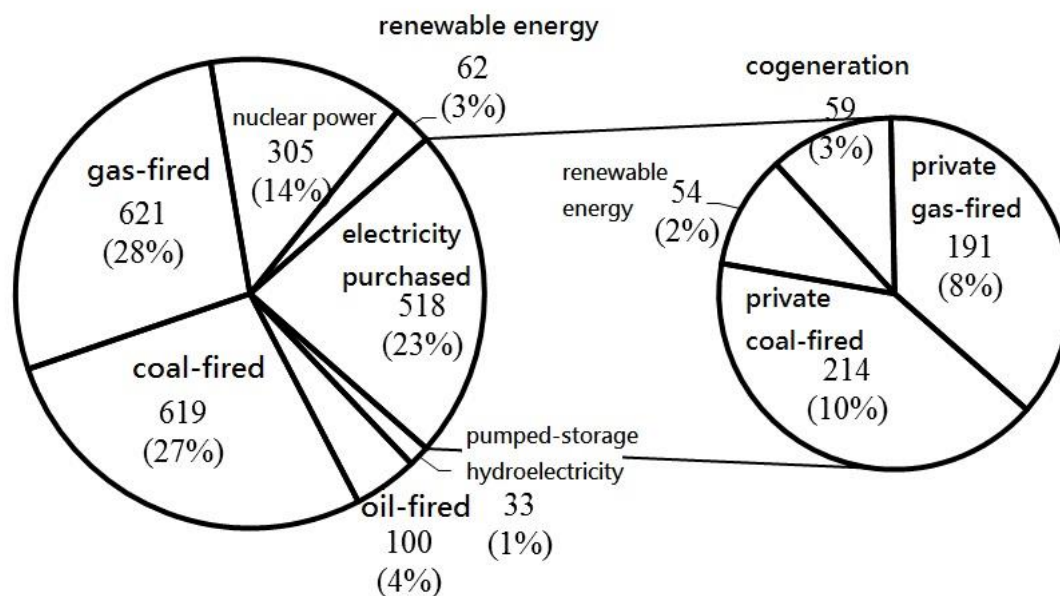


Fig. A-1 The pie chart of the net electricity (225.8 TWh) generated and purchased in 2016<sup>1</sup>

Each of the existing NPPs has two units of light water reactors as shown in Table A-2 and Fig. A-2. The Chinshan and Kuosheng NPPs are located at the coast of northern Taiwan, while the Maanshan NPP is located at the coast of southern Taiwan. Of the three operating nuclear power plants, the Chinshan NPP has GE BWR-4 units; the Kuosheng NPP has GE BWR-6 units; and the Maanshan NPP has Westinghouse three-loop PWR units. The Lungmen NPP, under construction, has GE ABWR units.

Atomic Energy Council (AEC) is the regulatory authorities for the safety of nuclear power plants. Please refer to Section E.3.1(1) for its services, particular portfolio, and task organization.

<sup>1</sup> Reference : The Statistics Summary of the Management, in TPC 2016 Statistical Yearbook, p1, Fig. 2, Taiwan Power Company (Taipei, 2017).

Table A-2 Nuclear Power Plants in Taiwan

Unit	Reactor Type	Installed Capacity	Unit	Reactor Type
Chinshan 1	BWR/4	636	67	Operating
Chinshan 2	BWR/4	636	68	Operating
Kuosheng 1	BWR/6	985	70	Operating
Kuosheng 2	BWR/6	985	72	Operating
Maanshan 1	PWR	951	73	Operating
Maanshan 2	PWR	951	74	Operating
Lungmen 1	ABWR	1,350	-	Mothballing
Lungmen 2	ABWR	1,350	-	Mothballing

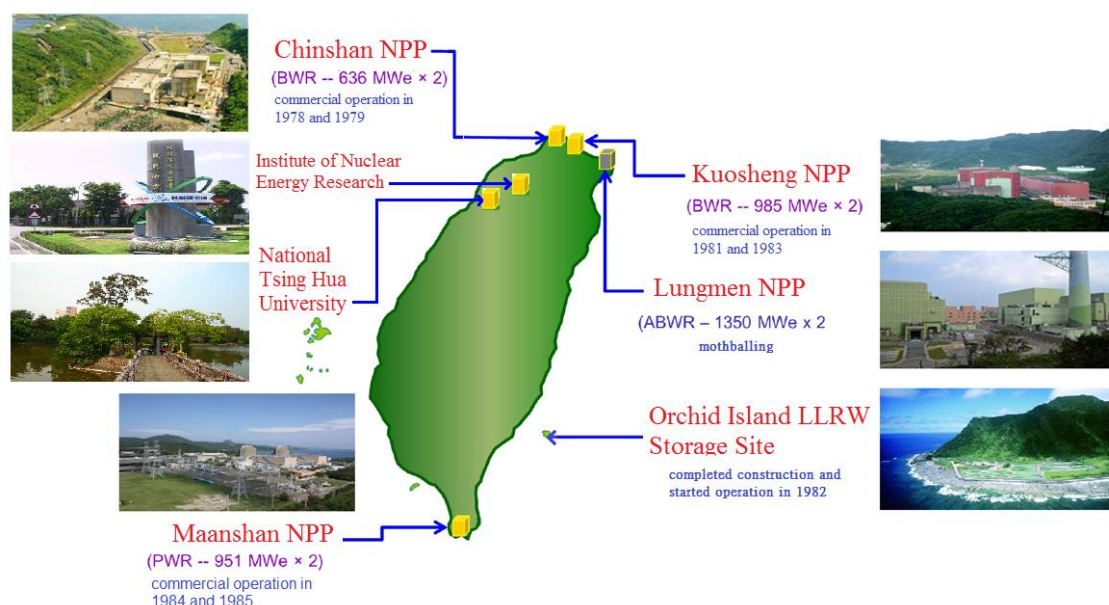


Fig. A-2 The Location of Nuclear Power Plants and Nuclear Material Installations in Taiwan

### A.2.3 Research and Educational Reactor Facilities

#### (1) The Institute of Nuclear Energy Research

The Institute of Nuclear Energy Research (INER) owned three research reactors, the Water Boiler Reactor (WBR), the Taiwan Research Reactor (TRR), and the Zero Power Reactor at Lungtan (ZPRL), none of these are in operation currently. WBR has completely been decommissioned, TRR is

currently under decommissioning, and ZPRL is in the preparation process for decommissioning.

WBR, designed by INER, was a homogeneous liquid fuel type reactor with a 100 kW maximum power capacity and maximum thermal neutron flux of  $8.4 \times 10^{11}$  n/cm<sup>2</sup>-s. The reactor used light water as moderator, graphite as reflector, and uranium oxide sulfate (with 19% <sup>235</sup>U enrichment) as the liquid fuel. Its first criticality was reached in February of 1983 and it stopped operating in April of 1991. In December 1997, the removal of the system equipment, reactor core, and all of the contaminated systems and equipment in the reactor building was executed. Finally, the biological shielding was removed in December 2007 when the decommissioning of WBR was completed.

TRR, designed by the Atomic Energy of Canada Ltd. (AECL), was a CANada Deuterium Uranium (CANDU) research reactor with a 40 MW power capacity and maximum thermal neutron flux of  $6 \times 10^{13}$  n/cm<sup>2</sup>-s. The reactor used heavy water as moderator, light water as coolant, graphite as reflector, and natural uranium as fuel. Its first criticality was reached in January 1973. The reactor was shut down in January 1988. The TRR decommissioning permit was granted by AEC in April 2004. TRR decommissioning is on-going.

The original rated power capacity of ZPRL was 10 kW. Apart from the control system which was designed by General Atomic (GA), ZPRL was entirely designed and installed by INER itself. The reflector of the reactor was graphite and the moderator was light water. It used the Material Test Reactor (MTR) type fuel with 93% <sup>235</sup>U enrichment. ZPRL was an open-pool type reactor. The construction of ZPRL started in 1968, and its first criticality was reached in February 1971. The power capacity was successfully upgraded to 30 kW in May 1993. In July 2009, all of ZPRL nuclear fuel was shipped back to the United States of America, and it was permanently shut down in January 2010. The decommissioning plan of ZPRL was submitted to the authorities in May 2012 and was approved in July 2013. The status of ZPRL is currently in the preparation process for decommissioning.

## (2) National Tsing Hua University

Originally, the National Tsing Hua University (NTHU) had three research reactors, namely, the Tsing Hua Open-pool Reactor (THOR), the Tsing Hua Argonaut Reactor (THAR), and the Tsing Hua Mobile Educational

Reactor (THMER). Of these three reactors, only THOR still remains in operation. THAR and THMER have been decommissioned, in 1993 and 2003, respectively.

THOR, designed by GE, is a light water research reactor using TRIGA fuel. THOR has a removable reactor core. Its original rated power level was 1 MW. The construction of THOR started in 1958. Its first criticality (in low power operation) was reached on April 13, 1961, and full power operation was achieved on October 24, 1962. In April 1998, AEC approved an uprating of the power level to 2 MW. The first operating license of THOR expired in 2001. A ten-year operating license was renewed subsequently and in 2011 a second renewal was obtained. The current operating license is valid until April 9, 2021.

THAR, with a power level of 10 kW, was donated by the U.S. Argonne National Laboratory. THAR was built at the Argonne National Laboratory, U.S.A. in 1955. Its first criticality was reached in 1974. THAR was given as a gift to the National Tsing Hua University (critical operation was reached in April 1974), provided educational training, shut down temporarily in May 1991. The reactor was decommissioned successfully in 1993.

THMER was a small reactor installed on a trailer and could be driven to different places for education and research purposes. The maximum power level was 0.1 W. The first criticality of THMER was reached in 1975 and the last operation was carried out on November 30, 1990. The reactor was decommissioned successfully in 2003.

### A.3 Radioactive Waste

The radioactive waste in Taiwan is classified into two categories, high-level radioactive waste (HLRW) and low-level radioactive waste (LLRW). The main waste streams for LLRW are from NPPs, about 90% of the total LLRW. The waste streams from non-NPPs, including medical, agricultural, industrial, and research producers, are only about 10% and are collected and treated by the Institute of Nuclear Energy Research (INER). The radioactive waste treatment and storage facilities in INER were built in 1971 for the purpose of treating and storing the radioactive waste produced by INER. In 1978, AEC ordered INER to collect and treat all the radioactive produced by medical, agricultural, industrial and research activities in our country. At present, there are four waste treatment facilities and five radioactive waste storage facilities operated by INER to treat and store radioactive waste, in addition to an early-built liquid waste treatment facility

and four storage facilities which are reserved exclusively for usage during the decommissioning of TRR.

The management measures of NPPs' radioactive waste include treatment, storage, transport, off-site storage, and final disposal. All of the NPPs' radioactive wastes are stored in on-site storage facilities, except those being already shipped to the Orchid Island Storage Site. Each NPP has its own radioactive waste treatment facility in order to treat radioactive waste and control its state. As for the spent fuel discharged from the reactors, the spent fuel is stored in the spent fuel pool at each NPP currently. The Chinshan and Kuosheng NPPs have been operating for over 30 years and recently have developed a problem concerning the situation of an almost fully-loaded spent fuel pool. In order to maintain the storage capacity of the spent fuel pool and the safety operation of NPPs, TPC adopted on-site dry storage for spent fuel to fulfill the storage needs for a 40-year NPP operation, taking into consideration storage safety, a technical feasibility evaluation, social, economic and environmental impacts, etc. The storage capacity of the spent fuel pool at the Maanshan NPP is large enough to store all the spent fuel produced during 40-year operation.

As for the management of HLRW, Taiwan's strategies are threefold: short-term – on-site spent fuel pool storage; mid-term – dry storage; and long-term – promoting final disposal. A team was created in December 1983, with members from AEC, TPC, INER, the Central Geological Survey (CGS) of MOEA and the Institute of Energy and Resources (IER) of the Industrial Technology Research Institute (ITRI), to delineate “Spent Fuel Research Projects” which include four research and development stages for HLRW final disposal. TPC also submitted “Spent Fuel Disposal Plans” to AEC in 2004 and was approved in 2006. At present, TPC is carrying out a study of “Potential Host Rock Characterization and Evaluation”. TPC also submitted the “Preliminary Feasibility Study Report on Spent Fuel Final Disposal” to AEC in 2009 for AEC's review and approval. AEC completed its review in July 2010. According to the report, there exist certain potential host rocks in Taiwan, such as granite, mudstone and Mesozoic bedrock. The current priority option is granite. TPC will submit “Technical Feasibility Study for Final Disposal of Spent Nuclear Fuel” (SNFD2017 report) in 2017, to show the results of characterization and to facilitate disposal technical feasibility determination.

As for the LLRW final disposal, TPC, in August 2006, submitted its “Low-Level Radioactive Waste Disposal Plan” to AEC. AEC completed the

review and approved the plan which includes the requirements of the “Act on Sites for Establishment of Low-Level Radioactive Waste Final Disposal Facility” (in short, the Siting Act) and the siting schedule. Regarding the siting of the facility, MOEA is the sponsor agency for the final disposal facility siting operation, and TPC is the siting operator, according to the Siting Act. MOEA announced that “Daren Township, Taitung County” and “Wuchio Township, Chinmen County” are the potential sites for LLRW disposal on September 10, 2010. Then, MOEA announced on July 3, 2012 that Daren Township and Wuchio Township are the recommended candidate sites. After the announcement period, MOEA had been looking for the cooperation of the local governments to carry out a referendum to decide the candidate site. At present, MOEA is still negotiating with the locals to carry out a local referendum in order to decide the candidate site for LLRW final disposal. To date, the local governments still have not agreed to hold a local referendum on the sites. In order to cope with the delay of the LLRW disposal facility due to the unforeseeable siting referendum, in February 2017 AEC reviewed and approved a contingency plan for a centralized storage facility submitted by TPC. This plan was requested in order to decide on the site of the facility within three years from March 2017, complete the construction and commence operation within eight years, which will allow the facility to act as an interim station for LLRW. In addition, AEC also requests TPC to actively promote the LLRW disposal program and finalize the siting for the disposal facility as soon as possible in order to resolve the issues properly.

## Section B Policies and Practices

### *Article 32, Reporting, Paragraph 1*

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

- (i) spent fuel management policy;*
- (ii) spent fuel management practices;*
- (iii) radioactive waste management policy;*
- (iv) radioactive waste management practices;*
- (v) criteria used to define and categorize radioactive waste.*

### B.1 Spent Fuel Management Policies

#### B.1.1 Spent Fuel from Nuclear Power Plants

When spent fuel has just been discharged from the reactor, the fuel will exhibit conditions of higher activity and heat, and it will first be stored in the spent fuel pool of the nuclear power plant to let the activity and heat decay and then continue follow-up management. The present spent fuel management measures in Taiwan are threefold, “storage in spent fuel pools for the short term; on-site dry storage for the medium term; final disposal for the long term”, as shown in Fig. B-1. The management strategy will be properly adjusted according to the influence of geo-political situations.



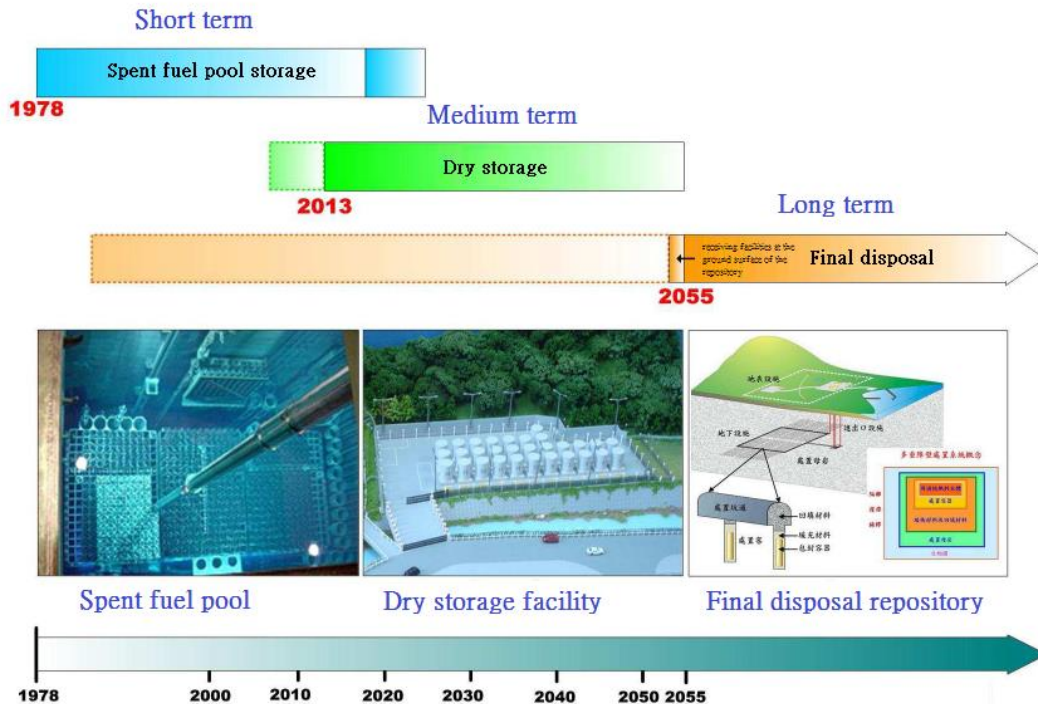


Fig. B-1 Spent fuel management measures in Taiwan

### B.1.2 Spent Fuel from Research and Educational Reactor Facilities

The policy for spent fuel discharged from research and educational reactors (at both INER and NTHU) is to store the spent fuel temporarily and then return the spent fuel to the country of the origin of the manufactured spent fuel.

## B.2 Spent Fuel Management Practices

### B.2.1 Spent Fuel from Nuclear Power Plants

#### (1) Dry Storage Plans

After being discharged from their respective reactor cores, spent fuel should be initially stored in the existing spent fuel pools of each nuclear power plant. The original storage capacity of the spent fuel pools was reported to be too small, and subsequently the Chinshan and Kuosheng spent fuel pools were required to undergo re-racking work twice and the Maanshan



Fig. B-2 The appearance of a dry storage cask (INER-HPS)

was required to undergo re-racking work once to increase the storage capacity of their respective spent fuel pools. Even though the re-racking projects have been completed, TPC is endeavoring to promote the spent fuel dry storage plans for the Chinshan NPP and the Kuosheng NPP so as to accommodate spent fuel generated during their 40-year operation. The spent fuel pools of Maanshan NPP and Lungmen NPP are expected to be able to accommodate spent fuel generated during their 40-year operation.

The Institute of Nuclear Energy Research-High Performance System (INER-HPS), as shown in Fig. B-2, was adopted for Chinshan NPP dry storage facility. The concrete cask was introduced by means of a technology patented by the Nuclear Assurance Corporation (NAC) International, U.S.A. which was designed and improved by INER. The TPC submitted an application for a Construction License to the AEC on March 2, 2007. After the AEC had checked the purpose of facility construction, the qualifications of the applicant, and the completeness of the application documents, the AEC accepted the application for review on March 29, 2007. Then, AEC continued to carry out a detailed technical review, and concluded that the application was in compliance with the safety requirements, and issued the construction license to the TPC on December 3, 2008. The TPC planned to install 30 INER-HPS casks. Each cask had the capacity of 56 spent fuel assemblies. The total capacity of the Chinshan NPP dry storage facility is 1,680 spent fuel assemblies.

The construction of Chinshan NPP dry storage facility started on October 18, 2010. The AEC then carried out the construction inspection to ensure the quality of the facility. The construction project of the facility included the grading for the site's soil and water conservation, the renovation of roads and bridges for safe transport, installation of the concrete pads for the concrete casks, and the fabrication and assemblage of the concrete casks and shielding over-packs. After the completion of the construction project, the AEC granted the commissioning plan proposed by TPC on May 23, 2012, then on September 24, 2013 accepted the "Performance Test and Verification Report" and allowed the TPC to carry out the hot-test operation of the Chinshan NPP dry storage facility. The Chinshan NPP unit 1 is estimated to be filled to capacity in the future. Without approval of the soil and water conservation plan by the local government, operation of a dry storage facility is not a possibility.

The "Kuosheng NPP Spent Fuel Dry Storage Plan" was approved by MOEA on August 10, 2009. The TPC then carried out the tender operation

and made an awarding on November 12, 2010 to entrust the CTCI Machinery Corporation (Taiwan) and NAC International (U.S.A.) to construct the facility. The MAGNASTOR cask system, as shown in Fig. B-3, which was designed by NAC, was adopted by TPC for the Kuosheng NPP dry storage facility. The cask system had already gotten the license for spent fuel dry storage from the U.S.NRC. Each MAGNASTOR cask has the capacity of 87 spent fuel assemblies and the TPC planned to install 27 casks. So, the total capacity of the Kuosheng NPP dry storage facility is 2,349 spent fuel assemblies.

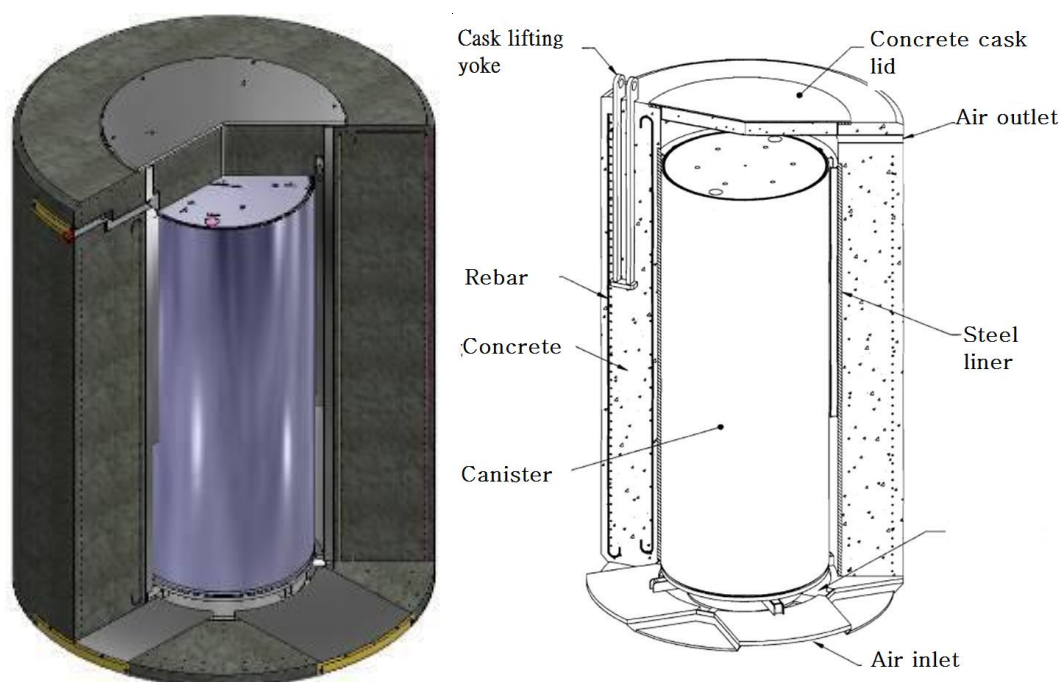


Fig. B-3 Schematic drawing of a Kuosheng NPP dry storage cask (MAGNASTOR)

TPC submitted to the AEC the application for the construction of the Kuosheng NPP dry storage facility on February 14, 2012. The AEC formally accepted the application for review on March 15, 2012. Then a public hearing was held on July 17, 2012. In order to carry out the safety review for the Kuosheng NPP dry storage facility, the AEC invited domestic scholars and experts and organized a review team with ten technical groups which were integrated by, site, operation, criticality, structure, heat transfer, shielding and radiation protection, confinement, accident analysis, and quality assurance. After six rounds of technical review, the AEC in August 2015 approved the

construction license of the Kuosheng NPP dry storage facility.

The dry storage facility is required for the NPP decommissioning as spent fuel has to be moved out of the reactor building and put into dry storage as soon as possible so that the NPP decommissioning and dismantlement can be carried out. In order to ensure TPC carries out the Chinshan NPP decommissioning plan effectively and within the 25-year schedule, AEC has requested TPC to adopt the indoor dry storage facility which is in line with social consensus. This facility will be completed construction and in operation by the end of 2026 so as to facilitate the removal of spent fuel, continuing the NPP decommissioning and dismantlement, and implementing the objectives of the "2025 nuclear-free homeland policy" on time.

## (2) Final Disposal Plans

In compliance with the “Nuclear Materials and Radioactive Waste Management Act”, the TPC submitted the “Spent Fuel Final Disposal Plan” to the AEC for review and approval. The plan includes five stages which are: potential host rock characterization and evaluation, candidate site selection and confirmation, detailed site investigation and testing, repository design and license application, and repository construction. The repository is scheduled to start operation in 2055. Now, our country's plan for high-level radioactive waste final disposal is in stage one, potential host rock characterization and evaluation, as shown in Fig. B-4.

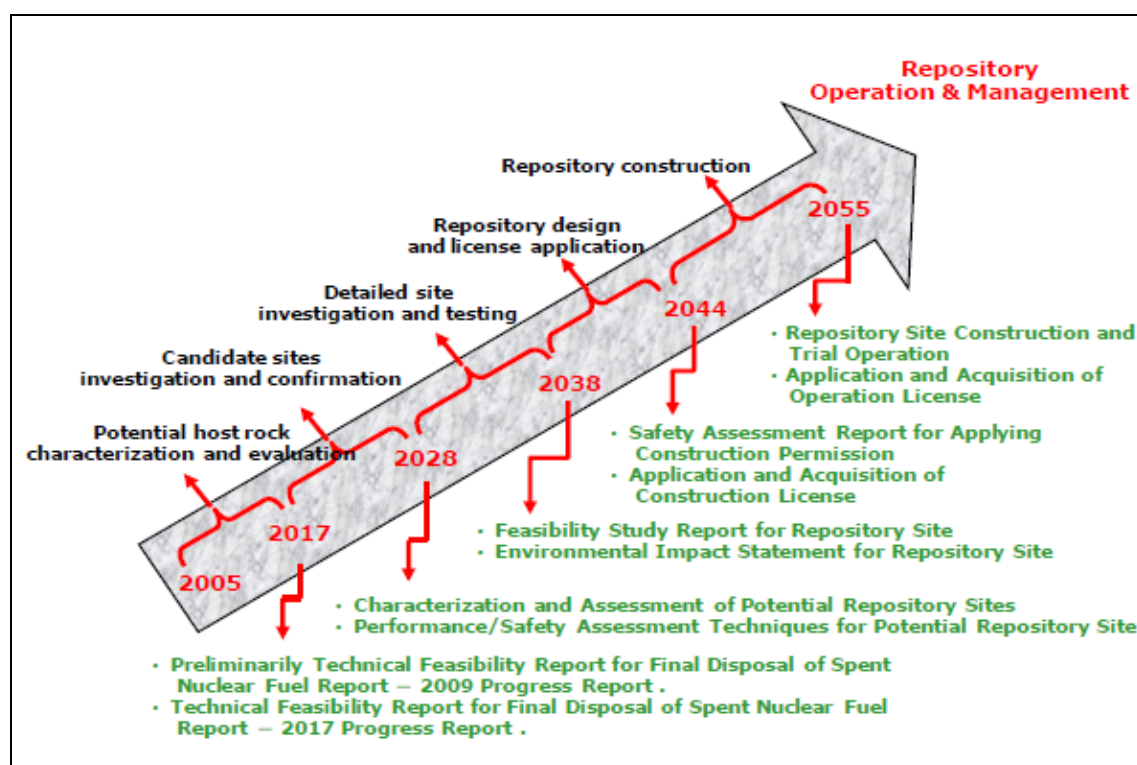


Fig. B-4 The long term plan of the spent fuel final disposal program

The TPC in 2009 proposed the “Preliminary Technical Feasibility Evaluation Report on Taiwan’s Spent Fuel Final Disposal Program”, which compiled the research results from Taiwan’s spent fuel disposal programs over the past 20 years and deliberated upon the final disposal concepts in nuclear-advanced countries. The preliminary technical feasibility evaluation report was completed, and the report confirmed that in Taiwan there are potential host rocks which need further research and exploration. The relevant

reports were published on the AEC's website. In addition, according to the objectives of the first phase (2005~2007) program, TPC should complete the "Technical Feasibility Evaluation Report on Taiwan's Spent Fuel Final Disposal Program" by the end of 2017.

At present, we are carrying out the research of stage one, potential host rock characterization and evaluation. Given that the international promotion of spent fuel disposal programs are subject to hindrance and delayed schedules, TPC in 2014 reviewed and revised the final disposal program by adding a new Chapter 10, the contingency plan. According to the plan, after the completion of the second stage, "candidate site selection and confirmation", if the TPC is still unable to propose a candidate site, they shall in 2029 adopt an alternative option which is a centralized spent fuel storage facility, of which the site shall be confirmed and its environmental impact assessment shall be completed by 2038. The centralized spent fuel storage facility shall be completely constructed and shall start operations by 2044, as shown in Fig. B-5.

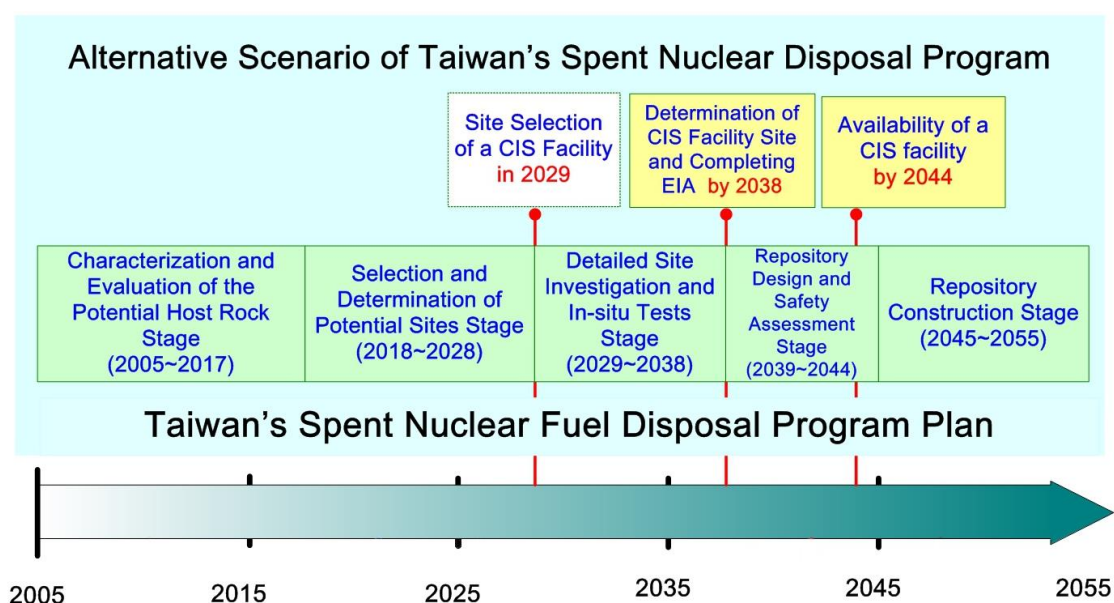


Fig. B-5 Taiwan's long term plan of the spent fuel final disposal program (an alternative contingency plan included)

## B.2.2 Spent Fuel from Research and Educational Reactor Facilities

### (1) Institute of Nuclear Energy Research

Most of the spent fuel discharged from the TRR has been transferred to the U.S.A. The remaining damaged spent fuel and residue were stored in the



spent fuel pool. The damaged spent fuel has had to undergo a stabilization process in order to increase its stability before being moved out of the spent fuel pool. By December 2012, all of the damaged spent fuel was moved out of the spent fuel pool and the stabilization operation has been completed. The stabilized products, after being properly sealed and packaged, were then loaded into a storage cask. Upon receiving IAEA's verification and confirmation, the storage cask was sealed and included in the nuclear safeguards surveillance operation. An IAEA inspector verified and sealed the storage cask, as shown in Fig. B-6. At present, the storage cask is stored in INER centralized warehouse, as shown in Fig. B-7.



Fig. B-6 An IAEA inspector was verifying and sealing the storage cask.



Fig. B-7 The storage cask in safe storage

ZPRL was operated by Material Test Reactor (MTR) fuel with two different  $^{235}\text{U}$  enrichments. The nuclear fuel with 20%  $^{235}\text{U}$  enrichment were transferred from the National Tsing Hua University (NTHU), and were consequently returned to the U.S.A., (their country of origin) in March 1999. Those with 93%  $^{235}\text{U}$  enrichment were returned to the U.S.A., (their country of origin) in July 2009.

The liquid spent fuel discharged from WBR was packed in 20-liter drums for dry storage in the INER centralized warehouse.

## (2) National Tsing Hua University

The MTR type high enrichment fuel with 93%  $^{235}\text{U}$  enrichment used in

THOR in the early years had been gradually withdrawn from the reactor core since August 1987 and had then been stored in the spent fuel pool of THOR. All of the spent fuel, including 35 assemblies, was shipped back to the U.S.A., (its country of origin) in March 1999. The MTR type spent fuel with 20%  $^{235}\text{U}$  enrichment was transported to INER for storage.

Currently, all the fuel used in THOR is TRIGA fuel with 20%  $^{235}\text{U}$  enrichment. There are 50 standard type fuel rods and 92 long-life type fuel rods. The total fuel rods in the core of THOR are 142. The spent fuel is stored in the spent fuel pool, part of the reactor pool. At present, there are three sets of TRIGA fuel elements and a set of experimental fuel elements (including a TRIGA fuel rod), with a total of 13 spent fuel rods being placed next to the reactor pool wall.

At present, THOR is operating at a power level of about 15 MWD/yr. The fuel is consumed at a rate of 0.25% of the total amount of the fuel per year, therefore, regarding THOR there are no problems of spent fuel displacement or re-loading.

After THAR was decommissioned, its MTR spent fuel with 20%  $^{235}\text{U}$  enrichment was first transported to INER for storage in 2004, and was then shipped back to the U.S.A. in 2009.

The spent fuel of THMER is stored at INER. The radioactive waste produced during the decommissioning of THMER is still temporarily stored at NTHU.

### B.3 Radioactive Waste Management Policies

The main purposes of radioactive waste management policies are to treat and store radioactive waste in compliance with specifications and regulatory requirements, to reduce the environmental impacts of radioactive waste, and to comply with the principles of environmental protection and maintaining public health and sustainable development so that NPPs may achieve their goal of safety management. Taiwan's radioactive waste management policies abide by the International Atomic Energy Agency's radioactive management principles which include ensuring human health to an acceptable level, maintaining the environment to an acceptable level, ensuring that the radiation impact to human health, environment, and future generations will not be higher than the present acceptable level, reducing the produced radioactive waste quantity as low as possible, considering and carefully arranging the inter-relationship among each step of waste production and management, and ensuring the safety of each of radioactive waste facility



during its operation period.

In order to strengthen the radioactive waste safety management, the Executive Yuan in 1997 approved the “Radioactive Waste Management Policies” which specifically described Taiwan's policies of radioactive waste management. For full text, please refer to Annex 2, Section L. The radioactive waste management purpose revealed in the Policies is in compliance with the Convention's requirements which are: ensuring the safety management of spent fuel and radioactive waste, taking into consideration of each management step being carefully arranged, and avoiding undue impacts to present and future generations.

Taiwan is looking at the feasibility of reprocessing spent fuel abroad while being in compliance with international nuclear safeguard agreements. “The Agreement for Cooperation between AIT and TECRO Concerning Peaceful Uses of Nuclear Energy” (the Agreement) was signed in Washington on December 20, 2013, and subsequently implemented on June 22, 2014. The Agreement states that TECRO may transfer spent nuclear fuel to France or other countries or destinations as may be agreed upon by both Parties in writing for reprocessing.

In order to provide more spent nuclear fuel management options and to explore the feasibility of reprocessing, TPC plans to launch a pilot project of overseas reprocessing. This project will also serve as a backup solution if the spent nuclear fuel dry storage facility at each of the Chinshan and Kuosheng Nuclear Power Plants is not commissioned in time.

Taipower plans to transfer 1,200 spent nuclear fuel bundles for overseas reprocessing, of which 480 fuel bundles are from the Chinshan nuclear power plant and 720 fuel bundles from the Kuosheng nuclear power plant. These fuel bundles will be shipped in 4 consignments, each of which will contain about 300 fuel bundles.

The budget for overseas reprocessing was agreed but frozen by the Legislative Yuan (Congress) on June 11, 2015 and is no longer pending the organized legislative decision-making committee's approval. Accordingly, there is no proposed schedule which may be provided at present.

## **Summary of Radioactive Waste Management Policies :**

Article 1 states that the objectives of radioactive waste management are

“strengthening the management of radioactive waste produced by electricity generation and medical, agricultural, industrial, research and other activities to ensure nationals’ safety, maintain environmental and ecological quality, and avoid undue impacts of radioactive waste to present and future generations.”

Article 12 states that the radioactive waste and spent fuel management policies are

- (1) Enhance the safety of LLRW storage and study feasible methods for its long term safe storage.
- (2) Enhance pushing the domestic disposal plan for LLRW and complete the environmental impact assessment and the safety analysis report as soon as possible.
- (3) Continue promoting the overseas disposal plan for LLRW in compliance with international norms and ensure the safety of LLRW transport and disposal operation.
- (4) Promote spent fuel on-site medium term storage plan actively.
- (5) Look for the feasibility of reprocessing spent fuel abroad while being in compliance with international nuclear safeguards agreements.
- (6) Continue to implement spent fuel and HLRW final disposal plan and make a preliminary feasibility plan and an implementation plan as soon as possible

### **B.3.1 Radioactive Waste from Nuclear Power Plants**

The radioactive waste management policies include minimization of waste generation, reduction of waste volume, and safe storage of all waste. It is an unavoidable responsibility for Taiwan to dispose of radioactive waste appropriately to preserve public health and the environment.

### **B.3.2 Radioactive Waste from Medical, Agricultural, Industrial, and Research Activities**

INER is responsible for collection, treatment, and on-site storage of all

radioactive waste arising from medical, agricultural, industrial, and research activities.

INER's radioactive waste management policies are to constantly improve treatment and storage technologies and to develop a recycling system. Improvements will include reduction of waste volume, process integration, mitigation of secondary waste, and modernization of storage facilities. The purpose of the recycling system is to minimize waste generation and recover valuable resources.

## B.4 Radioactive Waste Management Practices

### B.4.1 Radioactive Waste from Nuclear Power Plants

The practices for radioactive waste management include treatment, on-site storage, transportation, off-site interim storage and final disposal.

For treatment purposes, radioactive wastes are divided into two categories: wet wastes and dry active wastes. Wet wastes mainly include evaporator bottom, filter sludge, and spent resins. Most wet wastes are normally cement solidified and packaged in 55-gallon galvanized steel drums. Spent bead resin by exception is first dewatered, and temporarily stored in 55-gallon galvanized steel drums with HDPE (High Density Polyethylene) liners. Dry active wastes mainly consist of paper, clothes, plastic, wood, and metal. In order to reduce volume, combustible and compactable dry active wastes are normally incinerated or compacted, and then packaged in 55-gallon galvanized steel drums.

Currently, the radioactive wastes are stored in the storage facilities within the nuclear power plants, except those which had been sent to Orchid Island Storage Site for interim storage.

In the past, waste shipment normally involved both land and sea transportation. In order to increase the safety of sea transportation, a specially designed ship was built for shipping the radioactive waste to Orchid Island Storage Site, and made its first shipment in October 1991. The ship was suspended in 1996, and parked temporarily at the pier of Keelung Harbor, then decommissioned formally in 2007.

By law TPC is responsible for final disposal of all low-level radioactive waste arising from electricity generation and medical, agricultural, industrial, and research activities around the country.

## B.4.2 Radioactive Waste from Medical, Agricultural, Industrial, and Research Activities

### (1) Institute of Nuclear Energy Research

In order to treat and store the radioactive waste arising from INER itself, radioactive waste treatment and storage facilities were first built in 1971. In 1978, INER was mandated to receive, treat, and store all radioactive waste arising from medical, agricultural, industrial, and research activities. In 1992, INER accepted an assignment from AEC to receive and treat radioactive-contaminated rebar and materials.

INER treats liquid waste by evaporation and then solidifies it with cement, and decontaminates metal scraps with chemical/mechanical decontamination equipment then melts the seriously decontaminated metal in a furnace.

### (2) National Tsing Hua University

The quantity, nuclides, and activities of radioactive waste produced by THOR, a research reactor located at the National Tsing Hua University, are relatively small and simple in comparison with those produced by a typical commercial power reactor.

The radioactive wastes produced by THOR can be classified into three types, i.e., gas, liquid, and solid wastes, which are properly treated and controlled in compliance with regulations. The radioactive gas,  $^{41}\text{Ar}$ , produced during the operation of THOR, is suctioned by a draft fan system, monitored to check if it being in compliance with regulations, and then released and diluted in the atmosphere. The liquid waste produced by THOR is temporarily stored for 50~60 days, then is transferred to the liquid radioactive waste storage facility, and is released after being monitored and being in compliance with regulations. Liquid radioactive waste which cannot be released is collected and sent to INER for treatment. Solid radioactive wastes including ion, cation resins, chemical sludge, irradiated and contaminated items such as aluminum wire, PE cans, plastic gloves, and cotton thread, are packaged according to the provisions of “Notes for Radioactive Waste Receiving and Treatment”, stored temporarily in the radioactive waste storage room, and then sent to INER for treatment.



Fig. B-8 The liquid radioactive waste storage facility at the National Tsing Hua University

## B.5 Criteria for Definition and Classification of Radioactive Waste

Based on the definition given in Article 4 of the “Nuclear Materials and Radioactive Waste Management Act”, radioactive wastes mean discarded materials that are radioactive or are contaminated by radioactive substances, including spent fuel waiting for final disposal. Furthermore, Article 4 of the “Enforcement Rules for Nuclear Materials and Radioactive Waste Management Act” states that radioactive wastes may be classified as High-Level Radioactive Waste (HLRW) and Low-Level Radioactive Waste (LLRW).

HLRW means the spent fuel waiting for final disposal or extraction residuals generated from reprocessing, and LLRW means radioactive waste other than HLRW. Because reprocessing of spent fuel has not been considered, HLRW at present is only spent fuel.

LLRW may be further classified for the purpose of treatment, transportation, and disposal. For treatment, LLRW is mainly divided into two categories: wet waste and dry active waste. For transportation, LLRW is classified based on limits on radioactivity and restriction of materials. Packages acceptable for transportation include excepted, industrial, Type A, Type B, Type C, and fissile packages. The detailed requirements are set forth

in “Regulations for the Safe Transport of Radioactive Material” which are consistent with IAEA Safety Requirements No. TS-R-1. For final disposal, according to the concentration of the radioactive nuclides, LLRW may be classified as Class A, Class B, Class C, and Greater than Class C (GTCC), which is defined in the “Regulations on Final Disposal of Low Level Radioactive Waste and Safety Management of the Facilities”.

Radioactive waste with activity or specific activity below certain values has almost no effects on the public health and the environment. The discharge and exemption from regulatory control of this kind of radioactive waste shall follow the “Administrative Regulations on Radioactive Waste with Activity or Specific Activity below Certain Values” set forth by AEC who also took into consideration of relevant practices of IAEA and nuclear-advanced countries.

Low-level radioactive waste when its activity decays to certain level and meets the requirements for discharge, can be discharged after applicants submit a discharge plan to AEC for review and approval. According to the provisions of the “Administrative Regulations on Radioactive Waste with Activity or Specific Activity below Certain Values”, one of the prerequisites for radioactive waste discharge is that the annual effective dose to a person shall be less than 0.01 mSv and annual collective dose less than 1 person-Sv, or the activity or specific activity of radionuclides in radioactive waste applied for discharge meets the limits set forth by the above-mentioned “Administrative Regulations”. AEC will review the radiation dose evaluation report and the discharge plan submitted by applicants, and upon approval radioactive waste may only be discharged.

## Section C Scope of Application

### *Article 3 Scope of Application*

*1. This Convention shall apply to the safety of spent fuel management when the spent fuel is resulting 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 the management of spent fuel or radioactive waste within military or defense programs, unless declared as spent fuel or radioactive waste for the purposes of this Convention by the Contracting Party. However, the Convention shall apply to the safety management of spent fuel and radioactive waste from military or defense programs if and when such materials are transferred permanently to and managed within exclusively civilian programs.*

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

#### C.1 Spent Fuel

This National Report applies to all spent fuel discharged from operation of civilian reactors, i.e., nuclear power reactors and research reactors. Currently, there is no spent fuel held at the reprocessing facility because reprocessing of spent fuel has not yet been adopted.

#### C.2 Radioactive Waste

This National Report applies to all radioactive waste arising from civilian applications, i.e., radioactive waste generated from nuclear power plants,

research facilities, and other small producers of radioactive waste. However, this Convention shall not apply to waste that contains only naturally occurring radioactive materials (NORM) and that does not originate from the nuclear fuel cycle.

### C.3 Spent Fuel or Radioactive Waste within Military or Defense Programs

The military or defense programs have no nuclear fuel, either fresh or spent. According to the provisions of Article 54 of the “Ionizing Radiation Protection Act”, the radiation protection and control of radioactive materials, equipment capable of producing radiation, and associated practices held by military authorities shall be prescribed with other regulations by the safety authorities in conjunction with the Ministry of Defense (MOD). AEC, in conjunction with MOD, promulgated the “Regulations on Radiation Protection and Control for Military Authorities” on February 26, 2003. The radioactive waste produced by these programs is managed according to these regulations at the moment.

### C.4 Discharges

This National Report also applies to liquid waste released from both spent fuel and radioactive waste management facilities.



## Section D Inventories and Lists

### *Article 32 Reporting, Paragraph 2*

*This report shall also include:*

- (i) a list of the spent fuel management facilities subject to this Convention, their locations, main purposes, 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 locations, main purposes, 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 already 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 Lists of Spent Fuel Management Facilities

#### D.1.1 Nuclear Power Plants

The TPC intends to start the NPP decommissioning for the Chinshan and Kuosheng NPPs in 2018 and 2021, respectively. The key aim of the NPP decommissioning plan is to move away the spent fuel from the reactor building. Therefore, a spent fuel dry storage facility is needed for the NPP decommissioning project. The TPC is planning to build indoor spent fuel dry storage facilities at the Chinshan and Kuosheng NPPs, after assessing technical feasibility and considering storage safety, social, economic, and environmental impacts, in order to facilitate the NPP decommissioning. INER has been entrusted by TPC to install the spent fuel dry storage facility. In a partnership of technology, the NAC-UMS storage cask system was adopted by INER from the renowned NAC International that has optimal operational

achievements. At the same time, a management system for the design and manufacture of the NAC-UMS storage cask system was also implemented. A total of 30 concrete casks have been installed in the dry storage facility. Each concrete cask will be able to store 56 spent fuel assemblies.

The planned storage amount of the Kuosheng NPP dry storage facility will be 2,349 spent fuel assemblies. CTCI Machinery Corporation of Taiwan and NAC International have been entrusted by the TPC to install the facility. MAGNASTOR concrete casks capable of storing 87 spent fuel assemblies will be provided by the two companies.

The spent fuel pool storage capacity of Maanshan NPP and Lungmen NPP are of sufficient capacity to accommodate their 40-year operations.

#### D.1.2 Research and Educational Reactor Facilities

##### (1) Institute of Nuclear Energy Research

The majority of the Taiwan Research Reactor's (TRR's) spent fuel was transferred to the U.S.A. The remaining spent fuel discharged from TRR is currently stored at INER's centralized warehouse, see Section B.2.2(1).

The spent fuel of ZPRL was previously stored at the its reactor pool and was completely transferred to the U.S.A. on July 19, 2009. The liquid spent fuel discharged from WBR is packaged in 20-liter drums and stored at INER's centralized warehouse.

##### (2) National Tsing Hua University

Part of the spent fuel pool for THOR is the only spent fuel management facility in NTHU designated for the storage of MTR and TRIGA spent fuel with 20% <sup>235</sup>U enrichment.

#### D.2 Inventories of Spent Fuel

Up to June of 2017, The inventories of spent fuel from nuclear power plants and research and educational reactor facilities are compiled in Table D-1.

Table D-1 Spent fuel inventory

Taiwan Power Company (data as of June 2017)					
Facility	Fuel type	Maximum burn-up (MWD/MTU)	Uranium weight/bundle (tonne/bundle)	Total uranium weight (tonne)	Storage place
Chinshan (BWR)	GE8X8-1、GE8X8-2、9B、12；SPC 8X8-2；ATRIUM-10	54,000	0.178	1,057	Stored at the spent fuel pool of each NPP.
Kuosheng (BWR)	GE 8X8-2；SPC 8X8-2、9X9-2；ATRIUM-9B、10	54,000	0.178	1,502	
Maanshan (PWR)	17x17 OFA；ZIRLO；VANTAGE+	58,000	0.423	1,167	
Institute of Nuclear Energy Research (data as of June 2017)					
Inventory	Mainly natural uranium 1.380 tonnes, depleted uranium 0.100 tonnes, and low-enriched uranium 0.085 tonnes				
Source	Uranium sludge in the TRR spent fuel pool, stabilized spent fuel, and test samples, etc.				
Storage place	Major storage place is the centralized warehouse. TRR related buildings and hot cells.				
National Tsing Hua University (data as of June 2017)					
Inventory	Total quantity of uranium 0.003 tonnes				
Source	◆ Low-enriched uranium: MTR (never been used before), TRIGA-STD, TRIGA-LL(enrichment 19.8%) ◆ High-enriched uranium: high-enriched uranium fission chamber (HEU F.C.) for neutron detection				
Storage place	THOR spent fuel pool				

## D.3 Lists of Radioactive Waste Management Facilities

### D.3.1 Nuclear Power Plants

#### (1) Treatment Facilities

Every nuclear power plant has its own radioactive waste treatment facility to treat and condition the radioactive waste. Filtration, demineralization, and evaporation are used in the liquid waste treatment. The wet waste (including spent resins and sludge) is solidified and packed into 55-gallon galvanized drums. The high volume reduction solidification system at Kuosheng NPP is shown in Fig. D-1.

In addition, a Volume Reduction Center (VRC) has been installed at the Kuosheng NPP in July 1991 and has been in operation since. The VRC is equipped with an incinerator processing 100 kg of radioactive waste per hour at an average volume reduction factor of about 30. As of June 2017, the incinerator had incinerated 4,509 tonnes of radioactive waste since its inauguration in August 1991. A 1,500 tonne super-compactor has also been installed at the VRC. It has a capacity to compact five waste drums per hour at an average volume reduction factor of about three to four. As of June 2017, the super-compactor had compacted 29,525 drums of radioactive waste since its inauguration in 1993. Since the operation of the VRC, the volume of combustible and compressible radioactive waste byproducts produced from TPC nuclear power plants has been reduced tremendously. In addition to the VRC, a small-scale incinerator with a 30 kg per hour capacity has been in operation at Maanshan NPP since 2002. A radioactive incinerator with a capacity of 100 kg per hour and a 2,000 tonne super-compactor will be set up at Lungmen NPP.

#### (2) Storage Facilities

The TPC has constructed on-site storage facilities at each of its NPPs, which are currently in operation. A storage facility with a storage capacity of 77,800 drums was commissioned at Chinshan NPP in January 2007. The other one, with a 39,100 drum capacity was commissioned at Kuosheng NPP in October 2006. In addition, the construction of an additional on-site storage facility with a capacity of 30,000 drums at Maanshan NPP was started in October 2004 and the facility started operation in 2012. Including the above-mentioned facilities, the storage facilities for the three operating NPPs are a 101,200-drum storage facility at Chinshan NPP, a 91,100-drum storage facility at Kuosheng NPP, and a 30,000-drum storage facility at Maanshan

NPP. In addition, a 40,000-drum storage facility at Lungmen NPP has been constructed. The storage capacity of the facility at each NPP is large enough to accommodate all low-level radioactive waste which will be produced over the NPP's 40-year operation.

The Orchid Island radioactive waste storage site is located in the Lungmen area near the southeastern tip of Orchid Island. The facility started receiving waste in 1982. It contains 23 underground engineered trenches. At present, the total storage amount is 100,277 55-gallon drums. After inspection, consolidation, and re-packaging was performed in 2012 for the previous storage of 97,672 drums of radioactive waste.



Fig. D-1 High volume reduction solidification system at Kuosheng NPP

### D.3.2 Medical, Agricultural, Industrial, and Research Activities

#### (1) Institute of Nuclear Energy Research

##### a. Treatment Facilities

INER has the following four radioactive waste treatment facilities to treat and condition the waste:

- 1) Low Level Liquid Waste Treatment Facility (with 2 m<sup>3</sup>/h evaporation capacity)
- 2) Radioactive Waste Incinerator (with 40 kg/h incineration capacity)
- 3) Low Level Radioactive Experimental Plasma Furnace (with 250 kg/h treating capacity)
- 4) Metal Scraps Melting Equipment (with 1,000 kg/batch melting capacity)

b. Storage Facilities

INER has the following five on-site storage facilities to store radioactive waste while waiting for final disposal:

- 1) No. 1 Radioactive Waste Storage Facility (Building 015V) for TRU waste
- 2) No. 2 Radioactive Waste Storage Facility (Building 015K) for LLRW
- 3) LLRW Storage Facility in Building 067 for LLRW
- 4) LLRW Storage Facility in Building 075 for combustible waste, large irregular waste, and disused sealed sources.
- 5) Very Low Contaminated Soil Underground Storage Facility (Building 066) for low contaminated soil and gravel

The total storage capacity of items 1-4 is 3,913 m<sup>3</sup>, and the storage capacity of the low contaminated soil underground storage facility is 15,808 m<sup>3</sup>. A picture of a low-level radioactive waste storage facility is shown in Fig. D-2.



Fig. D-2 Low-level radioactive waste storage facility at INER

## (2) National Tsing Hua University

There is only one radioactive waste storage facility at the National Tsing Hua University (NTHU). It is for temporary storage. All radioactive waste is sent to INER for treatment and storage because there is no treatment facility at NTHU.

### D.4 Inventories of Radioactive Waste

#### D.4.1 Radioactive Waste in Storage

The inventories of radioactive waste in storage at TPC (Orchid Island Storage Site included), INER, and NTHU are shown in Table D-2.

Each NPP operated by TPC has its own radioactive waste storage facilities. There is also an off-site radioactive waste storage facility, Orchid Island Storage Site. The Orchid Island Storage Site has stored 97,672 drums of radioactive waste shipped from various nuclear facilities in Taiwan since the site started operation in 1982 and continued until May 1996. In December 2007, a full-scale operation of inspection, consolidation, and re-packaging was carried out for the radioactive waste at Orchid Island Storage Site. It took four years for the operation to be completed. At present, there are 100,277 drums in storage. The restoration work for the Orchid Island Storage Site was finished in May 2012 and the site remains as static storage since then.

INER has four radioactive waste storage facilities and a low-contaminated soil underground storage facility.

NTHU has a radioactive waste storage facility which is only for temporary storage. All radioactive waste produced by NTHU is sent to INER for treatment and storage.

Table D-2 Inventories of low-level radioactive waste in storage

Taiwan Power Company (data as of June 2017)			
Facility	Design capacity* (drum)	Stored amount (drum)	Remarks
Chinshan NPP	101,204	44,626	The storage capacity of each NPP is large enough until the decommissioning of each NPP.
Kuosheng NPP	91,133	55,045	
Maanshan NPP	40,000	8,825	
Orchid Island Storage Site	130,816	<ul style="list-style-type: none"> <li>◆ original storage amount 97,672</li> <li>◆ after the operation of inspection, consolidation, and repackaging 100,277</li> </ul>	Mainly solidified low-level radioactive waste drums produced by each NPP and INER during the period from 1981 to 1996
Institute of Nuclear Energy Research (data as of June 2017)			
Facility		Remarks	
Four on-site storage facilities		<ul style="list-style-type: none"> <li>◆ Mainly for TRU radioactive waste, low-level radioactive waste, and disused sealed sources</li> <li>◆ The design capacity is 3,913 m<sup>3</sup> and 2,779 m<sup>3</sup> has been stored.</li> <li>◆ Located at INER Buildings 015V, 015K, 067, and 075</li> </ul>	



Low-contaminated soil underground storage facility	<ul style="list-style-type: none"> <li>◆ for low radioactive contaminated soil and gravel, and 15,569 m<sup>3</sup> of soil in storage</li> <li>◆ Located at INER Building 066</li> </ul>
Nation Tsing Hua University (data as of June 2017)	
Facility	Remarks
A low-level radioactive waste storage facility	For temporary storage only. All of the radioactive waste produced by NTHU is sent to INER for treatment and storage.

\* The capacity is estimated on the basis of 55-gallon drums.

According to the preliminary estimated result from the Decommissioning Plan of the Chinshan NPP, the amount of low-level radioactive waste generated from decommissioning would be around 62,000 drums (14,400 cubic meters). An appropriate container will be assessed and selected for each type of waste by its genre, volume and shape. To accommodate all of the generated low-level waste, a third low-level waste storage warehouse with a storage capacity of 50,000 drums is planned for construction, in addition to the existing 1st and 2nd low-level waste storage warehouses in operation.

#### D.4.2 Disposed Radioactive Waste

Because no final disposal site is available, no radioactive waste has been disposed up to now.

#### D.4.3 Past Practices

There has not been any disposal up to now. Currently, all radioactive waste is in the storage facilities and awaiting final disposal.

### D.5 List of Decommissioned Facilities and Status of Decommissioning Activities

#### D.5.1 Nuclear Power Plants

The operating license of TPC's Chinshan NPP will expire in December of 2018, Chinshan NPP will then permanently shut down to comply with the

nuclear-free homeland policy. In accordance with Article 23 of the "Nuclear Reactor Facilities Regulation Act", TPC submitted the Chinshan NPP decommissioning plan to AEC for review on November 25, 2015. After the procedural review to confirm the completeness of the plan, AEC accepted the application for formal review on December 17, 2015 and held this review program in accordance with the relevant laws and regulations. After three rounds of comprehensive review, AEC, in accordance with the laws and regulations as well as its own professional judgment, confirmed that TPC had been able to clarify all safety concerns, and completed the review of TPC's "Chinshan NPP decommissioning plan" on June 28, 2017.

AEC requests TPC to submit the Kuosheng NPP decommissioning plan and the Maanshan NPP decommissioning plan in accordance with the laws in December 2018 and July 2021, respectively, to fulfill the 2025 nuclear-free homeland policy.

#### D.5.2 Research and Educational Reactor Facilities

##### (1) Institute of Nuclear Energy Research

The decommissioning plan of WBR was approved in May 1997, the demolition of WBR was shortly later initiated. In December 1997, the system equipment was dismantled, the reactor core was removed, and the radioactive contaminated system and equipment in the reactor building were removed as well. The remaining biological shielding was demolished in December 2007 and the decommissioning of WBR was finally completed. After passing all radioactivity tests, the building became an uncontrolled area, and is currently being used as an exhibition building for dry storage system technology development and nuclear facility decommissioning technology research.

TRR was shut down in January 1988. In October 1988, all unnecessary systems of the reactor were removed and the reactor was sealed. In November 2002, the sealed reactor was then removed from the reactor building, and was temporarily and safely stored in the dismantling building, while being monitored by radiation detectors, strain gauges, subsidence meters, inclinometers, and seismographs, and waiting for further dismantling, packaging and storage. In addition, the cleanup of the TRR spent fuel pool is currently ongoing. The decommissioning plan of TRR was approved by the AEC in April 2004. Currently, the TRR decommissioning project is ongoing.

ZPRL (Zero Power Reactor at Lungtan) stopped operation temporarily in December 2005. In July 2009, all of its nuclear fuel was safely shipped back

to the U.S.A. It was permanently shut down in January 2010 and its decommissioning plan was approved in July 2013. Currently, it is in the preparation decommissioning.

## (2) National Tsing Hua University

THAR was decommissioned successfully in 1993. The spent fuel and radioactive waste byproducts were sent to INER after decommissioning. The spent fuel was transferred from INER to the U.S.A. on July 19, 2009. The decommissioning of THMER was completed on September 10, 2003. The spent fuel was sent to INER for storage and the radioactive waste byproducts from decommissioning were temporarily stored on-site.

## **Section E Legislative and Regulatory System**

### ***Article 18 Implementing Measures***

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

#### **E.1 Implementing Measures**

Although Taiwan is not a Contracting Party of the Convention, Article 17 of the “Nuclear Materials and Radioactive Waste Management Act” explicitly stipulates that the construction of spent fuel and radioactive waste treatment, storage, and disposal facilities shall comply with requirements set forth by the relevant international conventions. This implies that the government, within the framework of its national law, will take all the legislative, regulatory and administrative measures and other actions necessary for carrying out its obligations under this Convention.

#### **E.2 Legislative and Regulatory Framework**

### ***Article 19 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 for spent fuel and radioactive waste management activities;***
- (iii) a system of prohibition for the operation of a spent fuel or radioactive waste management facility without a license;***
- (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 license;***
- (vi) a clear allocation of responsibilities of the bodies involved in the different steps of spent fuel and 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.***

The legislative and regulatory framework in Taiwan can be divided into three levels, as shown in Fig. E-1. The first level describes Acts that shall be passed by the Legislative Yuan then signed, and then promulgated by the President. The second level regards Legal Orders which include Enforcement Rules and Regulations that have been laid down by Regulatory Bodies (i.e., AEC) under the authorization of the



Fig. E-1 Chart of regulatory framework in Taiwan

aforementioned Acts. The third level details the Administrative Rules which provide the Guidelines, Points, and Policies written by the Regulatory Body to facilitate the implementation of the Legal Orders.

### E.2.1 Safety Requirements and Regulations for Radiation Safety

According to the stipulations set forth by Taiwan's legal system, the regulatory system for the safe management of spent fuel and radioactive waste, along with the associated legislative and regulatory framework, can be divided into three levels: acts and laws, legal orders, and administrative rules. For acts and laws, the "Nuclear Materials and Radioactive Waste Management Act" is considered the legal authority (competent legal) for radioactive waste, nuclear materials, and nuclear fuel. The "Act on Sites for the Establishment of a Low Level Radioactive Waste Final Disposal Facility" provides procedural requirements for the siting of the final disposal facility. The "Nuclear Materials and Radioactive Waste Management Act" was promulgated in 2002. Since then, 18 legal orders have been successively established to facilitate carrying out detailed regulatory requirements for nuclear materials and radioactive waste with respect to their generation, treatment, storage, final disposal, and operation. There are several administrative rules as well, such as regulatory guides for the safety analysis reports on the radioactive waste facilities, which provide references for the applicants. The regulatory system of nuclear materials and radioactive waste is shown in Fig. E-2.

There are five sections in the “Nuclear Materials and Radioactive Waste Management Act”. Section 1 is the general rules which explicitly stipulate the legislative purpose of managing radioactive waste properly in order to control its radioactive hazards and thereby ensure public safety. Section 2 is the regulatory requirements for nuclear materials and nuclear fuel. Section 3 is the regulatory requirements for radioactive waste. Section 4 is the penalties which adopt both the administrative penalty and the administrative order penalty as an effective means to achieve the regulatory purposes. Section 5 is supplementary. The enforcement rules relating to this Act, and fees and charges of inspection, review, and license were authorized by the Act, as stipulated by the competent authority.

In Taiwan's legislative works, when drafting legal orders involving relevant authorities, the relevant authorities should be consulted to express their views. If necessary, scholars and experts should be consulted too, and workshops or public hearings should be held to solicit opinions in order to ensure the legal orders are circumspect and practical. In practice, when drafting legal orders relating to radioactive waste, safety regulations set forth by the IAEA (International Atomic Energy Agency), the U.S.A. 10CFR (Code of Federal Regulation, Title 10), and Japanese laws are important references. The Atomic Energy Council still reviews the legal orders annually to see whether they are advancing with the times in order to make a timely revisions, if necessary.

The “Ionizing Radiation Protection Act” promulgated on January 30, 2002 is the principal legal to regulate the use of radiation sources, and the competent authority is the Atomic Energy Council (AEC). Regarding radioactive materials and equipment capable of producing ionizing radiation, the proper disposal of nuclear material and the decommissioning of the production facility is specifically provided in this Act which is in coordination with the radioactive waste regulatory system. According to Article 35 of the “Ionizing Radiation Protection Act”, the facility manager should document their radioactive materials or equipment capable of producing ionizing radiation and report to the competent authority. They should then be returned to the original producers or sales agents, transferred or treated as radioactive waste, or treated according to the manners specified by the competent authority after their period of use is completed. The detailed regulatory requirements are set forth in the “Administrative Regulations for Radioactive Material and Equipment Capable of Producing Ionizing Radiation and Associated Practices” which are laid down by the competent authority

authorized by the “Ionizing Radiation Protection Act”.



# Nuclear Materials and Radioactive Waste Management Act system

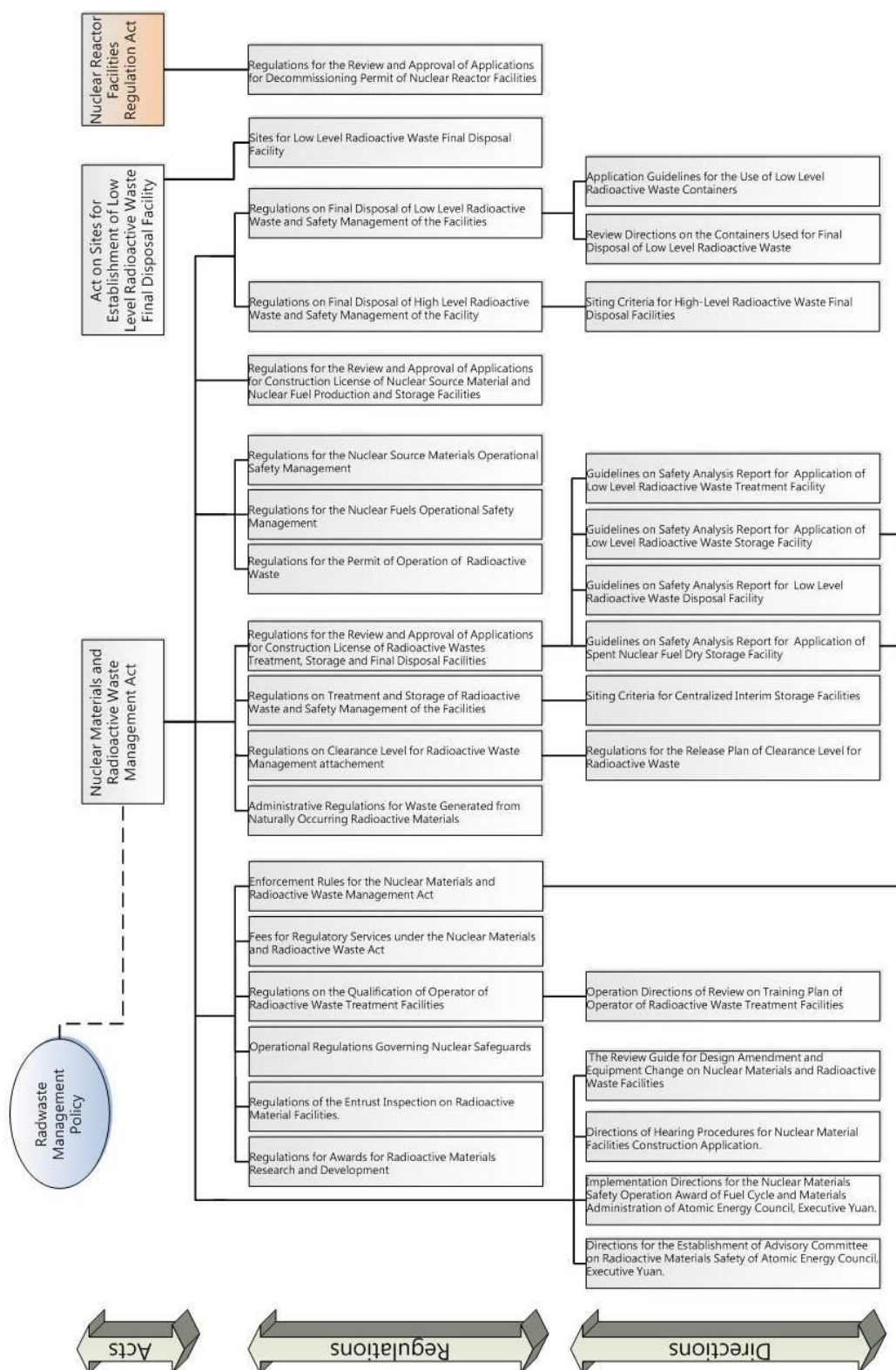


Fig. E-2 The regulatory system chart of the radioactive material management

### E.2.2 Licensing

According to the requirements set forth in the “Nuclear Materials and Radioactive Waste Management Act”, approval by the competent authority (AEC) must be obtained before the construction, operation, decommissioning or closure of a spent fuel or radioactive waste facility.

Article 17 of the Act stipulates that the construction of treatment, storage, and final disposal facilities of radioactive waste shall not commence until the construction license application has been reviewed and approved by the competent authority. Article 23 of the Act stipulates that the decommissioning plan for a spent fuel storage facility or radioactive waste treatment and storage facility shall be implemented after the decommissioning plan is reviewed and approved by the competent authority. Article 23 of the Act also stipulates that the closure of a final disposal facility shall be implemented after both the closure plan and institutional control plan are reviewed and approved by the competent authority.

The longest validity period of the operating license for the production or storage facility of nuclear source materials and nuclear fuel, and for the radioactive waste treatment or storage facility is 40 years, however, for the radioactive waste final disposal facility, the period is extended to 60 years. When the operating license expires and the facility needs to be operated, the facility manager shall apply to the competent authority for renewing the license two years before its expiration. Failing to renew the operating license according to the provisions, the facility shall not continue to be operated.

The competent authority in issuing a license of spent fuel or radioactive waste management facilities must consider the following elements: the equipment and facility capable of protecting public health and safety; the environmental and ecological effects in compliance with the relevant laws and regulations; and the technology and management capability and the financial base being competent to the facility operation. Those elements are set out in Article 8 and Article 17 of “Nuclear Materials and Radioactive Waste Management Act”.

### E.2.3 Prohibition of Operation without License

According to Article 18 of the “Nuclear Materials and Radioactive Waste Management Act”, even after the completion of construction of a treatment, storage, or final disposal facility, the facility shall not be operated until the competent authority has approved and granted the operating license.

#### E.2.4 Control, Regulatory Inspection, and Documentation and Reporting

The particular portfolio of the Atomic Energy Council includes atomic energy related activities: representing the government to engage international cooperation; establishing research institutes and substantiating equipment to advance the research and development of atomic energy science and technology. The facility application, construction, and operation activities involving spent fuel or radioactive waste shall be reviewed, inspected, and approved by the Atomic Energy Council whose detailed portfolio is set in the “Organization Act of Atomic Energy Council, Executive Yuan”.

According to Article 15 of the “Organization Act of Atomic Energy Council, Executive Yuan”, Fuel Cycle and Materials Administration (FCMA) has been established under the authority of the AEC and is in charge of the safety analysis review of radioactive waste treatment, storage, and final disposal facilities, regulating and inspecting radioactive waste operation and final disposal, stipulating radioactive materials related laws and regulations, technical standards and codes, education and propaganda, and public communication, etc. The detailed portfolio of FCMA is set in the “Organization Act of Fuel Cycle and Materials Administration, AEC, Executive Yuan”.

In order to ensure the safety of spent fuel and radioactive waste management facilities, the facility manager and the competent authority must work together in cooperation to achieve their safety goals. The facility manager is responsible for the safe operation of the facility and associated equipment, while the competent authority is responsible for supervising safe management of the operation. Several institutions, besides the operators and the regulatory body (AEC), are actively participating in controlling related activities occurring in the stages of siting, design, construction, operation, decommissioning, closure, and post closure. As examples, the Ministry of Economic Affairs (MOEA), as a supervisory agency of the TPC, is responsible for the development of civil use of nuclear energy and other related application. The Environmental Protection Administration (EPA) is the government agency that ensures the spent fuel and radioactive waste management will not impose adverse impact on the environment. The Ministry of Labor (MOL) is the government authority that ensures labor safety and health. The Ministry of Interior (MOI) is the government authority in charge of fire protection and architectural design and construction.

The AEC, as the regulatory body of nuclear safety, has a mandate to

carry out inspections during the operation of the facility. The inspections are an independent review on the operator and the state of the facility, and provide a high level of confidence that the operation of the facility is in compliance with the safety requirements prescribed or approved by the AEC.

The operators of the spent fuel or radioactive waste management facilities shall abide relevant provisions to: operate, adapt and anticipate improvements in technology, and improve processes in order to ensure the operation safety and the operation information shall be submitted to the competent authority.

#### E.2.5 Enforcement

Based on the “Nuclear Materials and Radioactive Waste Management Act”, the Atomic Energy Council enforces the regulations on the spent fuel and radioactive waste management. Enforcement actions are designed to be in response to non-compliance with specified conditions and requirements. The actions include warnings, penalties, and revocation of licenses. In all cases, the operator shall be required to remedy the non-compliance, to perform a thorough investigation and analysis in accordance with an agreed time-scale, and to take necessary measures to prevent recurrence.

#### E.2.6 Allocation of Responsibilities

In accordance with Article 2 of the “Nuclear Materials and Radioactive Waste Management Act”, AEC takes the responsibility to supervise the activities of spent fuel and radioactive waste management.

According to Article 29 of the Act, the producer or its entrusted entity shall take the responsibility for the treatment, storage, transportation, and final disposal of the spent fuel and radioactive waste.

According Article 28 of the Act, the waste producer shall take the responsibility for the facilities, including financial responsibilities, and for the treatment, storage, transportation, and final disposal of appropriate waste materials.

At present, the Taiwan Power Company (TPC) is responsible for the implementation and cost burden of the safety management of the radioactive waste produced by the operation of nuclear power plants. The safety management includes the medium-term storage of spent fuel, radioactive waste storage and final disposal, and the decommissioning of nuclear power plants.

At present, the Institute of Nuclear Energy Research (INER) is responsible for receiving small producer radioactive waste produced by and collecting the proper fees from the producers. According to Article 30 of the “Nuclear Materials and Radioactive Waste Management Act”, the radioactive waste final disposal facility is prepared for national level contributions and will receive the radioactive waste produced by the TPC and INER.

### E.3 Regulatory Body

#### ***Article 20 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 Establishment of a Regulatory Body

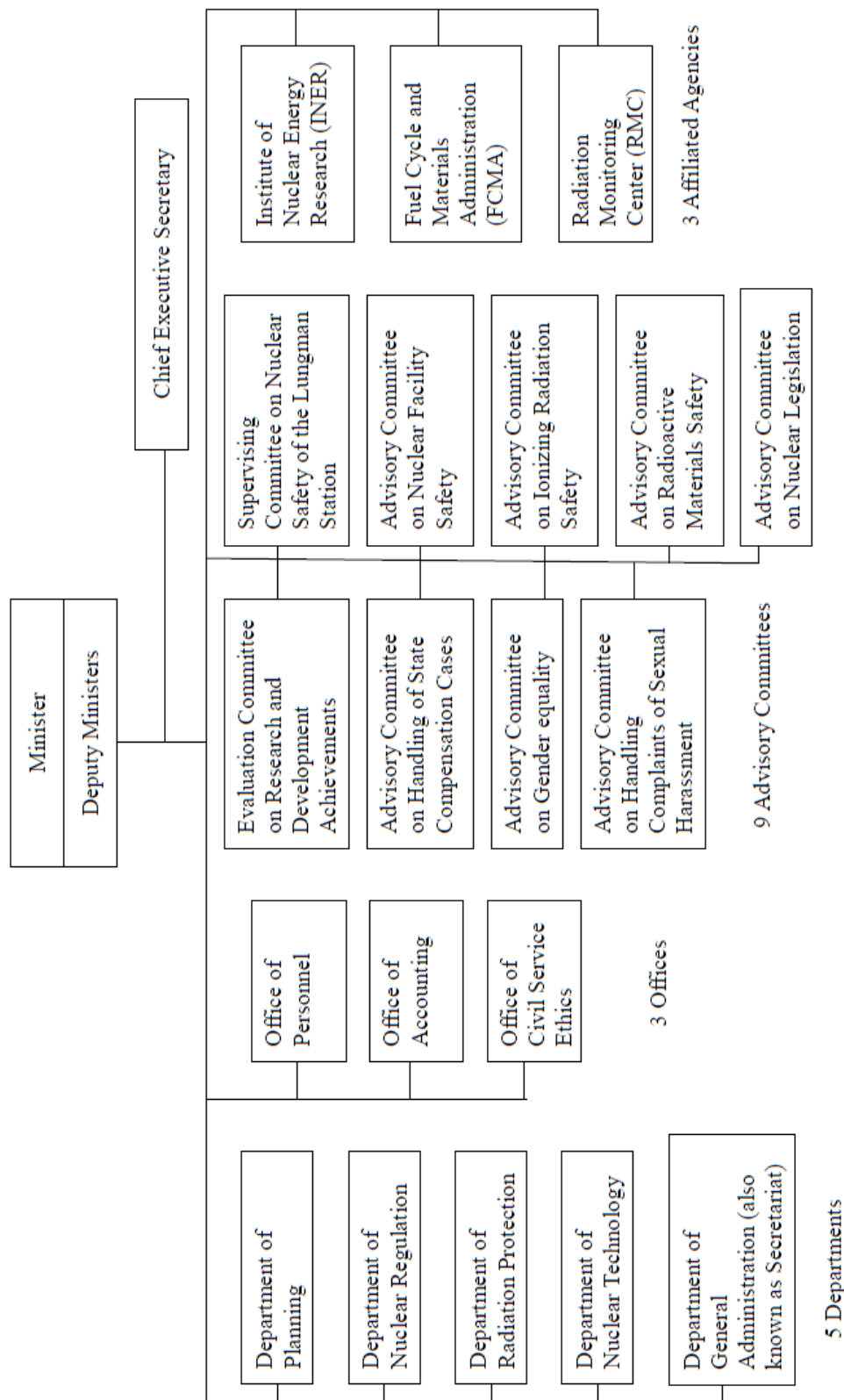
##### (1) Atomic Energy Council

The Atomic Energy Council (AEC) was founded in 1955 at the ministerial level under the Executive Yuan. The AEC is in charge of the safety of peaceful applications regarding atomic energy, including medical, agricultural, industrial, and research applications. Its regulatory aspect focuses include nuclear power generation, radiation protection, nuclear emergency preparedness, and radioactive waste management. AEC’s administrative oversights include environmental radiation monitoring and nuclear technology including the research and development of that needed for safety regulation. AEC consists of more than ten commissioners, mostly representatives of relevant ministries or agencies within the Executive Yuan and experts from academia. The Minister presides over the Council with the assistance of the Senior Deputy Minister, Deputy Minister, and a Chief Executive Secretary to oversee the Council affairs. Directly under their supervision are five departments, three offices, three affiliated agencies, and

nine advisory committees. The five departments are the Departments of Planning, Nuclear Regulation, Radiation Protection, Nuclear Technology, and General Administration (also known as Secretariat). The three offices are the Offices of Personnel, Accounting and Civil Service Ethics. The three affiliated agencies are Fuel Cycle and Materials Administration (FCMA), Institute of Nuclear Energy Research (INER), and Radiation Monitoring Center (RMC). The nine advisory committees are the Advisory Committees on Nuclear Legislation, Nuclear Facility Safety, Ionizing Radiation Safety, Radioactive Materials Safety, Handling of State Compensation Cases, Gender Equality, Handling Complaints of Sexual Harassment, and Supervising Committee on Nuclear Safety of the Lungmen NPP, and Evaluation Committee on Research and Development Achievements. The organization is illustrated in Fig. E-3. In order to promote the safety management of radioactive materials, prevent radioactive hazards, ensure environmental quality and public health, AEC invited and recruited 14 domestic experts in 2017, specializing in environmental protection, public policy, laws, nuclear engineering, geology, radioactive waste, radiation protection, economy, and energy, to form the Advisory Committee on the Radioactive Materials Safety. The Committee will provide recommendations on the strategy, policy, laws, safety regulations, the review of relevant cases, and research and development with regard to radioactive materials.

Within AEC, the Department of Planning oversees the nuclear safeguards related to spent fuel. The Department of Nuclear Regulation oversees the nuclear fuel in an operating reactor and the storage of spent fuel in the spent fuel pools. The Department of Radiation Protection ensures human health and the environment are properly protected from radiation. The Department of Nuclear Technology is responsible for nuclear security and emergency preparedness. The Department of General Administration oversees the archive management.

FCMA is the agency for the supervision of spent fuel moving out of the spent fuel pools and radioactive waste safety management. Its detailed responsibilities are presented in Section E.3.1(2).



## (2) Fuel Cycle and Materials Administration

The Radwaste Administration (RWA) was established in January 1981, as an affiliated agency under AEC, to meet the growing need for radioactive waste management. Its original responsibility included planning, overseeing, and regulating the treatment, storage, and transport of radioactive waste, and operating Lan-Yu Radioactive Waste Storage Facility.

In September 1988, the Taiwan government decided that radioactive waste producers should be responsible for, and bear the cost of, the treatment, storage, transport, and disposal of radioactive waste. In July 1990 the operation of Lan-Yu storage Facility was therefore turned over to TPC, the largest radioactive waste producer, leaving RWA as a purely regulatory agency. With the rapid growth in civilian use of nuclear energy since RWA was set up, and the corresponding growth in the demand for radioactive waste management, RWA's structure and status were no longer in line with its operational needs. In early 1996, the legislative process to restructure RWA was completed. New regulatory standards related to nuclear materials, nuclear fuel, and spent fuel was added. RWA was renamed as the Fuel Cycle and Materials Administration (FCMA) to reflect the regulatory standards changes. FCMA is comprised of three technical divisions, a secretariat, as well as the personnel and accounting functions as shown in Fig. E-4.



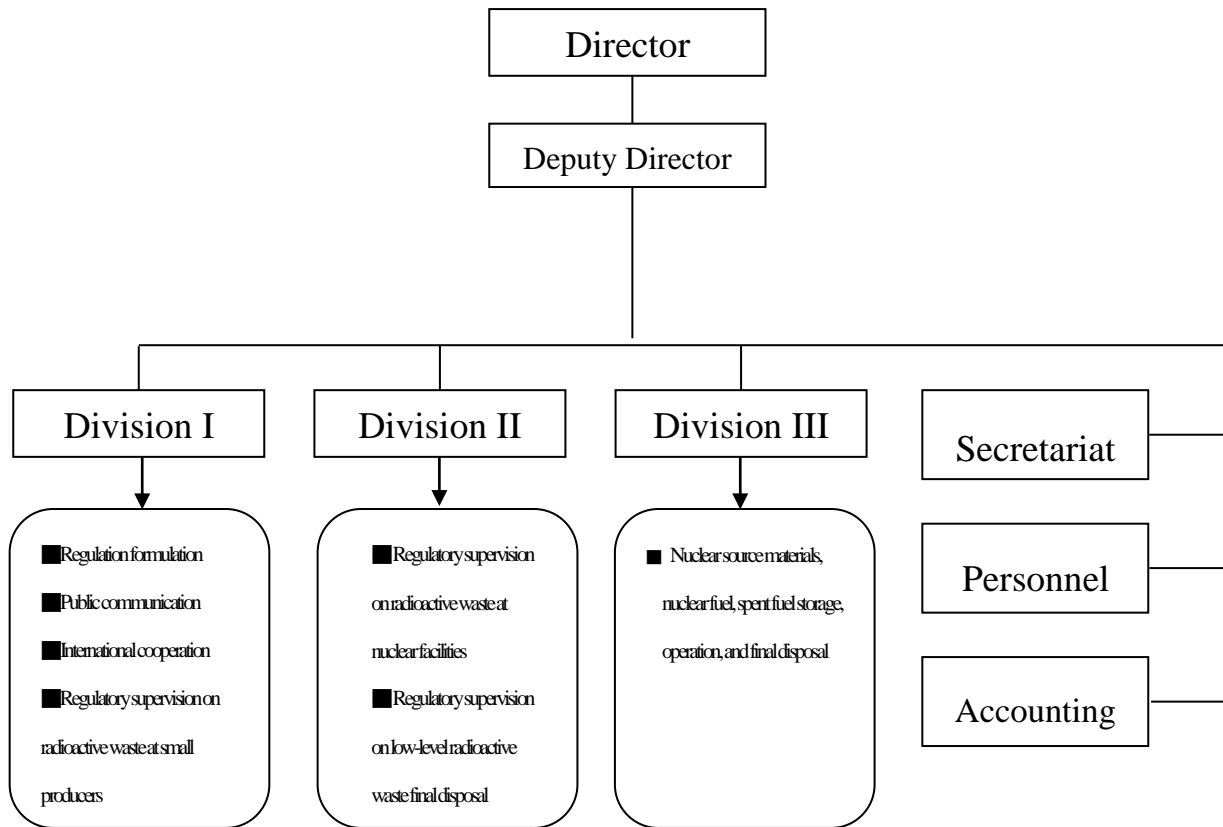


Fig. E-4 FCMA organization chart

Division I is responsible for formulating technical standards for nuclear materials, public communication, international cooperation, and the review, inspection, and supervision of radioactive waste treatment, storage and transport at small producers.

Division II is responsible for the review, inspection, and supervision of radioactive waste reduction, treatment, storage, and transport at nuclear facilities, and the review and regulatory supervision of final disposal of low-level radioactive waste.

Division III is responsible for regulating nuclear source materials, nuclear fuel, disused radioactive sources and spent fuel interim storage and final disposal.

The Secretariat is an ancillary department, which provides secretarial, public communication, and other administrative services.

Regarding human resources, FCMA has a staff of 38, including 31 technical positions and seven administrative positions. In order to enhance staff functions, on-job training is held annually and personnel are selected and sent for professional training.

Regarding civic engagement and public communication, FCMA has invited the local residents from Lan-Yu, as well as delegates from civil societies and local government of Lan-Yu to carry out the Lan-Yu area environmental radiation parallel monitoring operation, and strengthened the information disclosure and civic engagement in supervising the safety management of the radioactive waste facility. The delegates from the local government where spent fuel dry storage facility of Chinshan NPP is located, include: stakeholders of Shimen District, New Taipei City, presidents of community development associations, and environmental groups. These individuals and organizations were also invited to take part in the field survey of the construction quality of the facility, and direct detection of the environmental radiation.

### E.3.2 Independence of Regulatory Functions

The radioactive waste management and regulation organization system in Taiwan is shown in Fig. E-5. The Executive Yuan is the highest administrative organization in Taiwan. The Ministry of Economic Affairs (MOEA), the Environmental Protection Administration (EPA), and the Atomic Energy Council (AEC) are at the ministerial level. The MOEA is responsible for supervising the operation of nuclear power generation, and the Taiwan Power Company (TPC) regarding the construction, operation, and decommissioning of the spent fuel and radioactive waste facilities. The EPA is responsible for the regulatory measures regarding the environmental impact assessment and protection measures related to spent fuel and radioactive waste facilities. The AEC is responsible for supervising and regulating the safety management of spent fuel and radioactive waste. The Fuel Cycle and Materials Administration (FCMA) which is an affiliated agency under AEC, independently exercises and operates its authority in accordance with the "Nuclear Materials and Radioactive Waste Act." Unless otherwise provided by law, FCMA is not subject to the command and supervision of other authorities. The MOEA is the highest authority for the management of spent fuel and radioactive waste. Management and the regulation authorities exercise their duties, respectively. FCMA is responsible for the safety regulation regarding the spent fuel and radioactive waste in Taiwan, including small producers such as medical, agricultural, industrial, and research applications of radioactive materials. The Institute of Nuclear Energy Research (INER), based on a mandate from AEC, is responsible for collecting, treatment, and storage of radioactive waste from the small producers.

In order to enhance both regulation practices and transparent communication between regulation authority and the public, the AEC is actively implementing information disclosure and public participation regarding issues concerned by the public, such as the NPP decommissioning and dry storage. The AEC has set up an exclusive web page for the "NPP decommissioning regulation" on its website to post the Chinshan NPP decommissioning plan as well as a list of the plan review committee members. Opinions on the plan from the local government were also solicited by the AEC. In September 2016 and June 2017, AEC invited New Taipei City Government, Shimen District Office, village chiefs from Shimen District of New Taipei City, local representatives, and environmental groups to hold "Visits to the dry storage facility as well as discussions on the Chinshan NPP Decommissioning Plan", in which one main purpose was to listen to opinions from locals and the environmental groups. As well, the AEC held additional briefing sessions in October 2016 and August 2017 regarding the Chinshan NPP decommissioning plan in order to collect further opinions and suggestions from the locals, so as to properly handle the review of the Chinshan NPP decommissioning plan.

The TPC is the major producer of spent fuel and radioactive waste, producing over 90% of the waste, and is a state-owned enterprise. The MOEA is the competent authority for the TPC, and is responsible for the siting of the low-level radioactive waste disposal facility, according to the "Act on Sites for Establishment of Low-Level Radioactive Waste Disposal Facility". In order to cope with the charges for nuclear power back-end operating, the "Nuclear Power Back-end Operating Fund" was established and the MOEA is responsible for the control of the use and management of the fund.

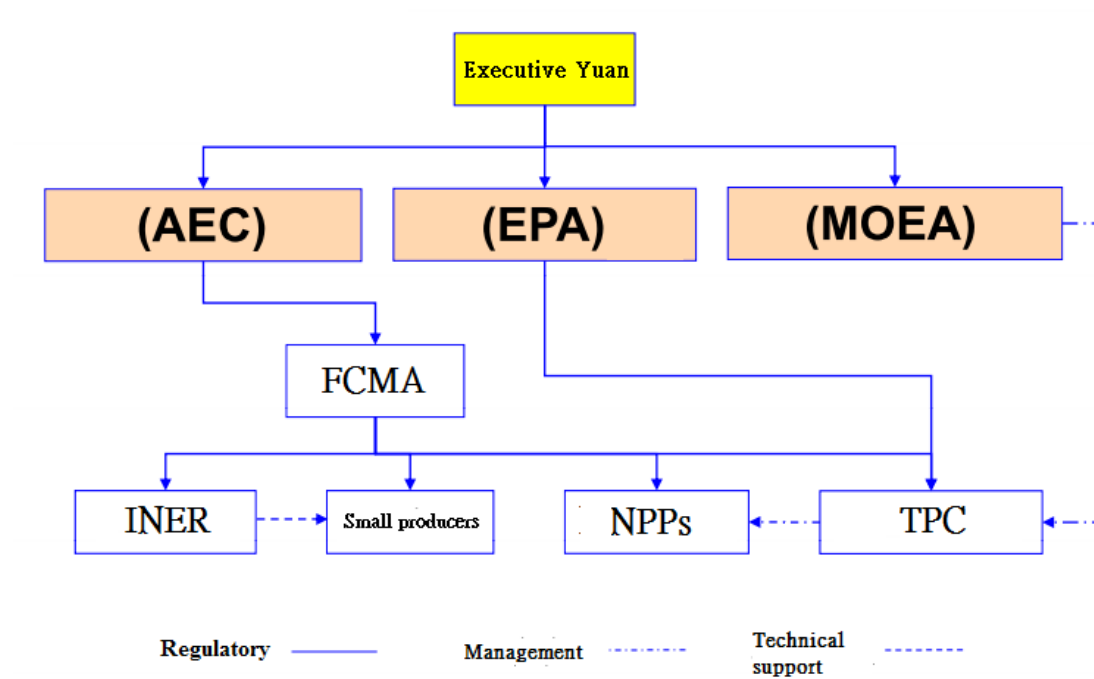


Fig. E-5 The radioactive waste management and regulation organization system in Taiwan

## Section F Other General Safety Provisions

### ***Article 21 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 license and shall take the appropriate steps to ensure that each such license holder meets its responsibility.***

***2. If there is no such license holder or other responsibility party, the responsibility rests with the Contracting Party which has jurisdiction over the spent fuel or over the radioactive waste.***

#### F.1 Responsibility of the License Holder

##### F.1.1 The License holder

###### (1) Primary Responsibility Resting with the License Holder

According to the current regulatory framework, the prime responsibility for the safe management of spent fuel and radioactive waste rests with the license holder (operator) of the facilities. Under the approval of the competent authority, the holder of a construction license shall assume responsibility for properly constructing a spent fuel or radioactive waste related facility. The holder of an operating license shall ensure the facility is being operated in compliance with all regulatory requirements. The holder of decommissioning permit or closure permit shall ensure the installation is being properly decommissioned or closed. In addition, the license holder shall demonstrate compliance with all requirements set forth by the competent authority and make all possible efforts to improve the safety and reliability of the facilities.

###### (2) Steps to Ensure the License Holder Meeting Its Responsibility

AEC, in accordance with the “Nuclear Materials and Radioactive Waste Management Act”, assumes the responsibility to verify, by means of regulatory inspections, that the license holder of a spent fuel or radioactive waste management facility complies with the license conditions during the siting, design, construction, commissioning, operation, decommissioning and/or closure of the facility; i.e., throughout the lifetime of the facility. No construction can be undertaken unless a construction license is granted by AEC. If any violation takes place during the construction, AEC shall immediately request the license holder to take corrective and remedial

measures so as to ensure the safety of the facility. After the completion of the facility construction, an operating license approved and granted by AEC shall be obtained in order to start the facility operation. The operating license applicant shall receive commissioning inspections from AEC to verify that the facility is constructed as previously approved in the Construction License. The holder of an operating license shall receive periodic inspections from AEC to ensure that the operation of the facility is maintained in conformity with the technical standards prescribed in the relevant provisions. If the holder of an operating license fails to meet the license conditions, AEC may request the operator to take corrective actions or order a penalty, including the revocation of the license or the suspension of the operation for a given period of time.

#### F.1.2 Absence of the License Holder

According to the provisions of Articles 8, 9, 17, and 18 of the “Nuclear Materials and Radioactive Management Act”, construction, operation, decommissioning or closure of a spent fuel or radioactive waste management facility shall obtain prior approval from the competent authority. If there is any violation of the provisions, the competent authority may order a punishment such as a criminal penalty, fines, ordered shutdown, or forced removal, depending on the seriousness. In addition, according to the provisions of Article 6 of the Act, the facility shall not be assigned, leased, lent, pledged, or mortgaged unless permitted by the competent authority, in order to avoid the license holder shifting responsibility arbitrarily. Legal norms have been established there in order to avoid the lack of a facility license holder.

#### F.2 Human and Financial Resources

##### ***Article 22 Human and Financial Resources***

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

- (i) qualified staff are 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 Qualified Staff

According to Article 17 of the “Nuclear Materials and Radioactive Waste Management Act”, a mandatory requirement for granting the construction license of a treatment, storage, or final disposal facility of radioactive waste is that the technical and management abilities, as well as the financial arrangements of the applicant shall be adequate to operate the facility. This requirement ensures that qualified staff are available as needed for safety-related activities during the operating lifetime of a spent fuel and a radioactive waste management facility.

In addition, Article 27 of the “Nuclear Materials and Radioactive Waste Management Act” stipulates that spent fuel and radioactive waste treatment facilities shall be operated by qualified operating persons. The qualification shall follow the “Administrative Regulations on Operator Qualification for Radioactive Waste Treatment Facilities” and the operators are required to undergo training in order to obtain a recognized certificate upon passing the examination.

#### F.2.2 Financial Resources during Operating Lifetime and Decommissioning

According Article 28 of the “Nuclear Materials and Radioactive Waste Management Act”, the producer shall bear the necessary expenses for treatment, storage, transportation and disposal of spent fuel and radioactive waste, and decommissioning of the facilities. In addition, Article 3 of the “Regulations for the Review and Approval of Applications for Construction License of Radioactive Waste Treatment, Storage, and Final Disposal Facilities” stipulates that an applicant shall submit an application with a safety analysis report and a financial guarantee statement to the competent authority for review and approval. Furthermore, Article 6 of the above Regulations states that the financial guarantee statement shall include the funding sources and financial planning of the expenses for construction, operation, and decommissioning of the spent fuel and radioactive waste management facilities.

In order to meet the above requirement, a nuclear back-end fund was established in 1987. The fund was administered by TPC until fiscal year 1998. As of fiscal year 1999, the fund was redefined as a non-operational fund and

the administration was switched from TPC to a Nuclear Back-end Fund Management Committee under MOEA's supervision; i.e., it became independent from TPC. The Committee includes eight to 14 members, and the chairman of the Committee is designated by MOEA.

The Nuclear Back-end Fund may be expanded for the following purposes:

- 1) Independent volume reduction, treatment, packaging, transportation, interim storage, and final disposal of the LLRW generated by the nuclear power plant operation,
- 2) Reprocessing of spent fuel,
- 3) Packaging, transportation, interim storage, and final disposal of spent fuel or radioactive waste arising from reprocessing,
- 4) Decommissioning of nuclear power related facilities and their associated waste treatment, packaging, transportation, interim storage, and final disposal, and
- 5) Special tasks approved by the Executive Yuan for improving the nuclear back-end management work.

The total amount of NT\$ 325.323 billion has been set aside as the nuclear back-end fund as of June 30, 2017. The expense for the pool storage of spent fuel and treatment and storage of radioactive waste during the nuclear power plant operation is covered by the plant operation cost. The “Regulations for Revenue, Expenditure, Custody, and Utilization of Nuclear Back-end Management Fund” was promulgated by the Executive Yuan on February 12, 1999. The details of the Regulations and the balance of the Nuclear Back-end Management Fund can be found on the website of the Nuclear Back-end Fund Management Committee, <http://www.nbef.org.tw>.

### F.2.3 Financial Provision following Closure of a Disposal Site

According to Article 28 of the “Nuclear Materials and Radioactive Waste Management Act,” the radioactive waste producer shall bear the necessary expenses for treatment, storage, transportation and disposal of spent fuel and radioactive waste, as well as all expenses for decommissioning of facilities. If there is any monetary shortages of the radioactive waste management fund, TPC shall set aside a grant and to compensate the total cost of the nuclear back-end management fee. Institutional control will be implemented following the closure of the radioactive waste final disposal site. TPC is responsible for the closure of radioactive waste and spent fuel disposal sites and shall carry out institutional control in accordance with the institutional



control plan approved by the competent authority. The nuclear back-end fund covers all costs for the final disposal, including all costs related to institutional control and the closure of the disposal site.

### F.3 Quality Assurance

#### ***Article 23 Quality Assurance***

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

Article 4 of the “Regulations for the Review and Approval of Applications for Construction License of Radioactive Waste Treatment, Storage, and Final Disposal Facilities” stipulates that a quality assurance (QA) program shall be incorporated in the safety analysis report of the application for a construction license for spent fuel or radioactive waste facilities.

The “regulations on Quality Assurance Criteria for Nuclear Reactor Facilities” is the only existing regulation related to quality assurance. Although the regulation only addresses the nuclear reactor facilities, it is normally extended to all spent fuel and radioactive waste facilities because some facilities such as the spent fuel pools, radioactive waste treatment facilities and some on-site storage facilities are considered parts of the nuclear reactor facilities. Because of the lack of details in this regulation, the past and current practices are that for the structures, systems, and components (SSC) important to safety, the QA program stipulated in U.S.NRC 10 CFR 50 Appendix B and ASME NQA-1 shall be referred to, and for the SSC not important to safety, besides 10 CFR 50 Appendix B, the ISO-9000 series is also acceptable.

According to current regulations, the Safety Analysis Report in application for the operating license of a spent fuel management facility shall include a quality assurance program. Currently, there are no specific criteria for the quality assurance program of a spent fuel management facility, but in current practice, the operator is normally referred to the criteria for the quality assurance program of a nuclear reactor facility. According to Article 9 of the “Quality Assurance Criteria for Nuclear Reactor Facilities” , all activities that may impact on the safety of the spent fuel management facility shall be performed in accordance with appropriate quality assurance procedures.

## F.4 Operational Radiation Protection

### ***Article 24 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 workers and the public caused by the facility shall be kept as low as is 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 is 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 Protection from Radiation Exposures

#### (1) ALARA

Article 1 of the “Ionizing Radiation Protection Act” stipulates that ALARA (As Low As is Reasonably Achievable) is the main principle for radiation protection. Therefore, the radiation exposure of workers and the public caused by a spent fuel or radioactive waste facility shall be maintained as low as is reasonably achievable, economic and social factors being taken into account, so that it is kept far below regulatory limits.

## (2) Dose Limits

### a. Dose limits to Workers

Article 7 of the “Safety Standards for Protection against Ionizing Radiation” specifies that the occupational exposure dose limits to the radiation workers are:

- 1) The effective dose equivalent shall not exceed 100 mSv over a cycle of five consecutive years when started on January 1, 2003, and not exceed 50 mSv in any single year,
- 2) A dose equivalent to the lens of the eye shall not exceed 150 mSv in one year,
- 3) A dose equivalent to skin or extremities shall not exceed 500 mSv in one year.

### b. Dose Limits to the General Public

Article 12 of “Safety Standards for Protection against Ionizing Radiation” stipulates that the dose limits to the public due to the radiation practice are:

- 1) An effective dose equivalent shall not exceed 1 mSv in one year,
- 2) A dose equivalent to the lens of the eye shall not exceed 15 mSv in one year,
- 3) A dose equivalent to skin shall not exceed 50mSv in one year.

According to the current regulation, the radiation protection design shall ensure that the annual effective dose equivalent to the general public from a spent fuel or radioactive waste facility does not exceed 0.25 mSv.

## F.4.2 Control of Discharges

### (1) ALARA

Article 1 of the “Ionizing Radiation Protection Act” states that the purpose of the Act is to protect against ionizing radiation and that the principle of ALARA shall always be followed; i.e., ALARA principle shall also be applied to the control of discharges. In addition, Article 9.1 of the same Act stipulates that the facility operator shall not discharge any gaseous or liquid radioactive waste until a radiation safety assessment is reviewed and approved by the AEC.

## (2) Discharge Limits

Columns 4, 5, and 6 of Table 4-2 in the “Safety Standards for Protection against Ionizing Radiation” list the effluent radionuclide concentration limits in air, water, and sewage. The facility operator shall demonstrate that the discharges meet the aforementioned concentration limits.

## (3) Measures to Prevent Unplanned and Uncontrolled Releases

To prevent unplanned and uncontrolled releases, Article 9.1 of the “Ionizing Radiation Protection Act” stipulates that the facility operator shall not discharge any radioactive gaseous or liquid waste until a safety assessment has been reviewed and approved by AEC. In Addition, Article 41 of the same Act states that a fine shall be levied and an order to rectify the situation within a deadline shall be handed down for violation of Article 9.1, release of radioactive gaseous or liquid waste without prior approval. Failure to rectify by the deadline will result in repeated fines for each deadline extension and even an order to suspend the license.

## (4) Corrective Measures Following an Unplanned or Uncontrolled Release

According to Article 9 of the “Ionizing Radiation Protection Act”, an unplanned or uncontrolled discharge of gaseous or liquid radioactive waste is prohibited. However, if there is an accident resulting in the concentration of radioactive materials in air, water, or sewage exceeding the limits set forth in the “Safety Standards for Protection against Ionizing Radiation,” Article 13 of the “Ionizing Radiation Protection Act” stipulates that the operator shall be responsible for reporting the accident to the Competent Authority. The operator shall take necessary protection measures and perform cleanup work; in addition, the operator shall investigate, analyze, record, and submit a report to the Competent Authority within a limit time.

## F.5 Emergency Preparedness

### ***Article 25 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 with 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 Emergency Plans

### (1) Nuclear Power Plants

Because the existing spent fuel and radioactive waste management facilities, except Lan-Yu Storage Facility, are located within the nuclear power plants, their emergency plans are incorporated into the plant emergency plans. The plant emergency plans are governed by the “Nuclear Emergency Response Act”, the “Enforcement Rules for the Implementation of the Nuclear Emergency Response Act”, and their associated regulations and guidelines.

Lan-Yu Storage Facility ceased to receive LLRW in April 1996. All the waste currently stored in the Lan-Yu Storage Facility is in a solidified form and contained in steel drums with a surface contact dose rate less than 20  $\mu\text{Sv/h}$ . There is no need for the off-site emergency plan.

### (2) Research and Educational Reactor Facilities

The existing spent fuel and radioactive waste facilities are located within the research reactor facilities and their emergency plans are incorporated into the facilities' emergency plans. The emergency plans are governed by the “Regulations for Emergency Response of the Research Nuclear Reactor Facility” promulgated on June 4, 2009.

#### a. Institute of Nuclear Energy Research

All the three research reactors have permanently ceased operation. There exit no more official emergency plans as defined by the “Regulations for Emergency Response of the Research Nuclear Reactor Facility”. Based on Article 8 and Article 26 of the “Enforcement Rules of the Nuclear Materials and Radioactive Waste Management Act”, on-site emergency plans have been prepared and incorporated into the Safety Analysis Report (SAR) for the spent fuel and radioactive waste management facilities. The on-site emergency plans are subject to review and approval by AEC.

## b. National Tsing Hua University

Pursuant to Article 12 of the “Regulations for Nuclear Emergency Classification, Response and Notification”, there is no need of off-site emergency plans for research nuclear reactors with thermal power under ten MW. AEC approved the THOR on-site emergency plan in 2017.

### F.5.2 Emergency Exercises

#### (1) Nuclear Power Plants

For the spent fuel and radioactive waste facilities inside nuclear power plants, the emergency exercises are covered under the general exercises for nuclear power plants. According to the provisions of the "Nuclear Emergency Response Act," every three years one of the emergency planning zones shall be chosen for the carrying out of emergency exercises in accordance with the approved emergency response basic plan.

#### (2) Research Reactor Facilities

Article 6 of the “Regulations for Emergency Response of the Research Nuclear Reactor Facility” requires that the on-site emergency exercise shall be performed once every two years. The research reactor licensee shall submit the exercise plan to AEC for approval.

### F.6 Decommissioning

#### ***Article 26 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.***

The regulatory provisions of decommissioning of a nuclear reactor facility are stipulated in the “Nuclear Reactor Facilities Regulation Act”. The

“Enforcement Rules for the Implementation of Nuclear Reactor Facilities Regulation Act” specifies the deadlines of the decommissioning operation of a nuclear reactor facility, the radiation dose limits of a decommissioned site, the scope of changes of a decommissioning plan involving important regulatory events, and the items that shall be included in the environmental radiation monitoring report of a decommissioned site. The “Regulations for the Review and Approval of Applications for Decommissioning Permit of Nuclear Reactor Facilities” stipulates the documents that shall be submitted for the application for a decommissioning permit, the review procedures, and other matters that shall be followed.

In accordance with the “Nuclear Reactor Facilities Regulation Act”, the TPC shall submit to the AEC the decommissioning plan three years before the scheduled permanent shutdown of a nuclear power plant. The AEC will review the plan and issue a decommissioning permit if the plan is bonded to the provisions. The decommissioning operations shall be completed within 25 years after the issuance of the decommissioning permit. The flowchart of regulatory operations for the decommissioning of a nuclear power plant is shown in Fig. F-1 and the regulatory operations can roughly be divided into three phases: preparation phase, decommissioning phase and recovery phase.

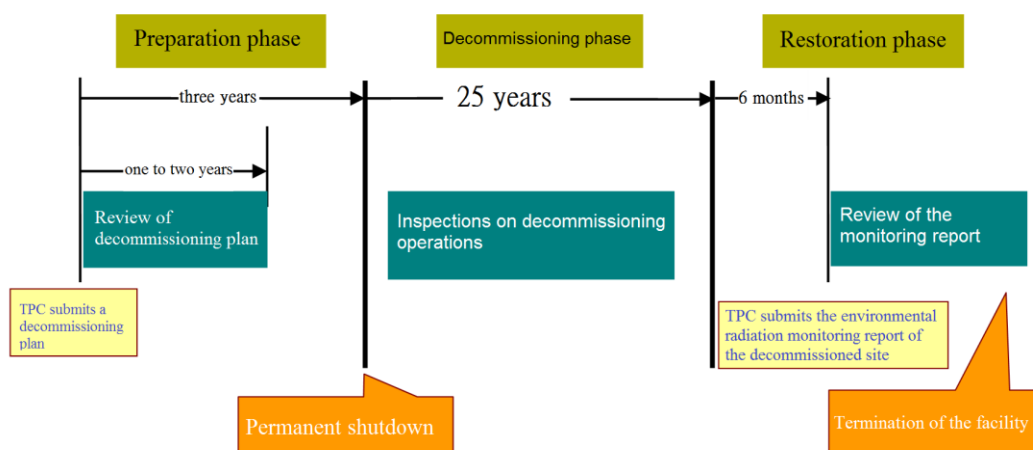


Fig. F-1 The operational flowchart of regulating the decommissioning of a nuclear power plant facility

#### F.6.1 Qualified Staff and Adequate Financial Resources

Article 3 of the “Regulations for Review and Approval of Applications

for Decommissioning Permit of Nuclear Reactor Facilities” stipulates that a section for organization and personnel training shall be included in the Decommissioning Plan. This is to ensure that sufficient and qualified staff will be available during decommissioning.

Article 2 of the “Regulations for Review and Approval of Applications for Decommissioning Permit of Nuclear Reactor Facilities” requires that to apply for decommissioning of nuclear reactor facilities, the operator shall submit an application, with a decommissioning plan and a financial statement enclosed, to the competent authority for review and approval. Article 4 of the same regulation requires that the financial statement shall include the financial planning and resources for decommission of the facilities and management of radioactive waste. The financial resources for the decommissioning are provided by the Nuclear Back-end Management Fund.

#### F.6.2 Radiation Protection

Article 3 of the “Regulations for Review and Approval of Applications for Decommissioning Permit of Nuclear Reactor Facilities” requires that a section for radiological assessment and radiation protection measures shall be incorporated into the decommissioning plan. Requirements stated in the “Safety Standards for Protection against Ionizing Radiation” shall also be complied with for the protection of workers and the general public from radiation. After the completion of decommissioning, the annual effective dose equivalent to the general public from the site shall not exceed one mSv for restricted use of the site and 0.25 mSv for non-restricted use of the site in accordance with Article 17 of the “Enforcement Rules for Implementation of Nuclear Reactor Facilities Regulation Act”.

#### F.6.3 Emergency Preparedness

In accordance with Article 3 of the “Regulations for Review and Approval of Applications for Decommissioning Permit of Nuclear Reactor Facilities”, an emergency preparedness plan shall be prepared and included in the decommissioning plan, which shall be submitted to the competent authority for review and approval before the implementation of decommissioning.

#### F.6.4 Record Keeping for Information Important to Decommissioning

Article 3 of the “Regulations for Review and Approval of Applications for Decommissioning Permit of Nuclear Reactor Facilities” requires that the



decommissioning plan shall include a section for the quality assurance program describing correct methods for information record keeping. Therefore, the facility operator is responsible to keep records of information which are important to decommissioning.

#### F.6.5 Non-reactor Decommissioning

In accordance with Articles 14 and 23 of the “Nuclear Materials and Radioactive Management Act”, for the permanent cease of operation of production and/or storage facilities of nuclear source material and/or nuclear fuel treatment, storage and/or final disposal facilities of radioactive waste, the operator shall prepare a decommissioning plan to the competent authority for review and approval.

Article 20 of the “Enforcement Rules for the Nuclear Materials and Radioactive Waste Management Act” stipulates that a series of sections for personnel training, radiation dosage evaluation and radiation protection measures, and accident response scheme shall be included in the Decommissioning Plan.

Based on the above-mentioned Decommissioning Plan and the Solid Waste Deliverance Operation Plan approved by the AEC, INER successfully carried out the decommissioning and cleanup work for the fuel element recycling workshop in Building 017B, the fuel element waste warehouse in Building 40, the uranium dioxide fuel manufacturing laboratory in Building 021, the radiochemistry laboratory in Building 016, the uranium dioxide fuel manufacturing laboratory in Building 016, and the decontamination laboratory as well as solidified waste quality testing laboratory in Building 039.

## Section G Safety of Spent Fuel Management

### *Article 4 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 frame work 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 General Safety Requirements

#### G.1.1 Subcriticality and Residual Heat Removal of Spent Fuel Management

In accordance with Article 13 of the “Regulations on Treatment and Storage of Radioactive Waste and Safety Management of Facilities,” the design of spent fuel storage facilities shall ensure that the safety requirements for the removal of residual heat and the maintenance of subcriticality are complied with.

#### G.1.2 Minimization of Radioactive Waste Generation in Spent Fuel Management

No reprocessing or disposal facility associated with spent fuel management exists currently or will be built in the near future. Spent fuel are currently stored in the spent fuel pools. Both Chinshan NPP and Kuosheng NPP dry storage facility projects are going on. Generation of radioactive waste due to operation of the spent fuel storage facilities will be insignificant. Nevertheless, minimization of the radioactive waste generated due to the operation and decommissioning of the wet and dry storage facility is still requested by the competent authority.

### G.1.3 Interdependencies among Different Steps in Spent Fuel Management

Currently, spent fuel are generated from the reactor core after burnup and then transferred to the spent fuel pool for wet storage. After the constructions of dry storage facilities are completed, spent fuel may be transferred to the dry storage facilities. Finally, spent fuel will be shipped to the final disposal site or reprocessing facility. All design, construction, and operation of the spent fuel management facilities shall keep the spent fuel retrievable so that they can be removed from the wet storage pool to the dry storage facilities and then to the disposal site.

### G.1.4 Regulations for Radiation Protection

Because the spent fuel storage pool is part of the nuclear reactor facility, its radiation protection program is governed by the Act and regulations for the nuclear reactor facility

The radiation protection program of the spent fuel dry storage facilities installed at Chinshan NPP and Kuosheng NPP shall ensure that the general public's annual effective dose equivalent is less than 0.25 mSv, and the principle of ALARA is followed.

### G.1.5 Consideration of Biological, Chemical and Other Hazards

Based on current practice, potential biological, chemical and other hazards that may adversely impact on the safety of a spent fuel management facility shall always be taken into account in the design, construction, operation, decommissioning and closure of the facility. Since reprocessing has not been adopted, the concerns about potential biological, chemical and other hazards are limited.

## G.1.6 Consideration of Impacts on Future Generations

The safety standards of Taiwan's regulatory provisions to current and future generations are the same. However, the government and operators follow the principles given in IAEA Safety Series No. SF-1, "Fundamental Safety Principles." Therefore, the impacts on the future generations of spent fuel management shall be assessed, and proper design and protection measures shall be provided to ensure proper protection of future generations.

## G.1.7 Consideration of Burdens on Future Generations

For ethical reasons and following the principles set forth in IAEA Safety Series No. SF-1, "Fundamental Safety Principles," spent fuel shall be managed in such a way that will not impose an undue burden on future generations. Government policy calls for NPPs' operator to bear the responsibility for managing spent fuel generated from the operation of nuclear power plants. The design, construction, operation, decommissioning, closure and funding of spent fuel management facilities shall follow this policy.

## G.2 Existing Facilities

### ***Article 5 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.2.1 Spent Fuel Wet Storage Facilities

The existing facilities related to spent fuel management are the on-site spent fuel storage pools at nuclear power plants, as shown in Fig. G-1. The spent fuel storage pools were constructed as part of reactor facilities, and the old storage racks were replaced with neutron-poisoned high-density racks to increase the storage facility. AEC reviewed the safety of the spent fuel storage pools when TPC applied for a license to do re-racking work for the ten-year re-evaluation as well as AEC's routine inspection, which all concluded that the storage pools met the safety standards.

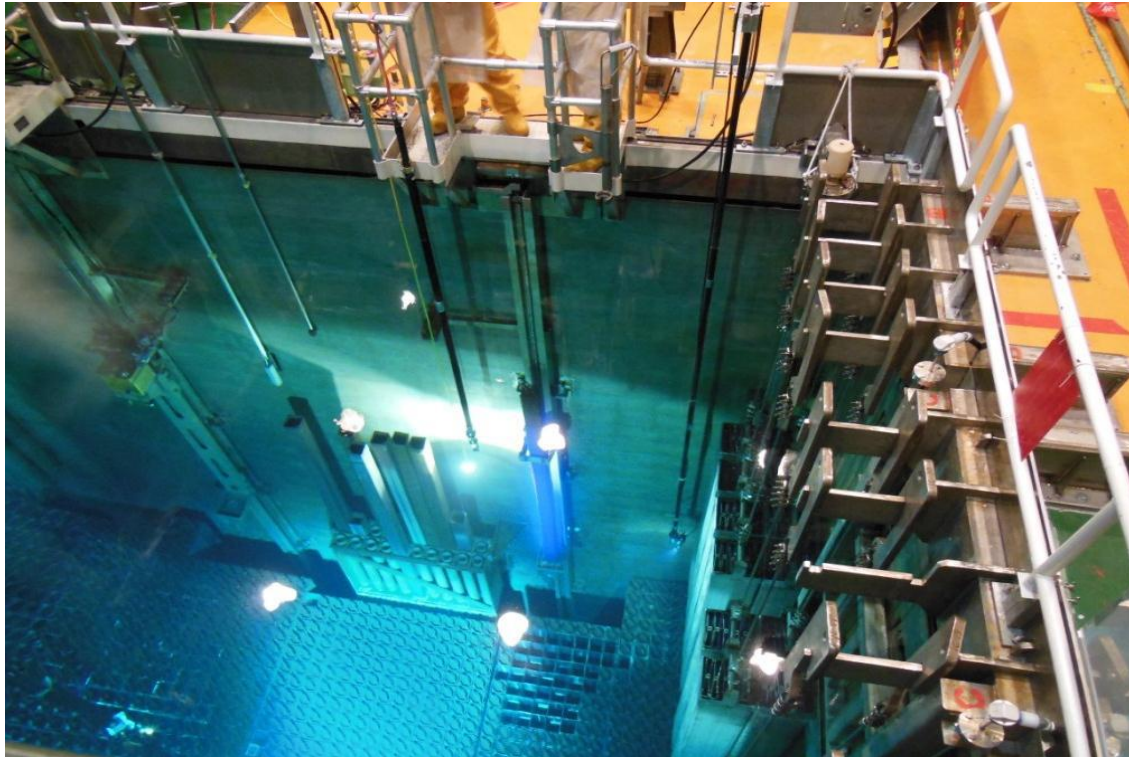


Fig. G-1 The current storage status of the spent fuel pool at Kuosheng NPP

### G.2.2 Spent Fuel Dry Storage Facilities

The TPC intends to start the NPP decommissioning for the Chinshan and Kuosheng NPPs in 2018 and 2021, respectively. The key point of the NPP decommissioning plan is the removal of spent fuel from the reactor buildings. Therefore, a new spent fuel dry storage facility is needed for the NPP decommissioning project. The TPC is planning to build indoor spent fuel dry storage facilities at both Chinshan and Kuosheng NPPs after assessing technical feasibility and considering storage safety, as well as social, economic, and environmental impacts, in order to facilitate the NPP decommissioning.

The spent fuel dry storage facility of TPC's Chinshan NPP is located on-site in the southwest of the plant and on the left bank of Chienhua creek downstream. Thirty concrete casks are planned to be installed. Each concrete cask can store 56 bundles of spent fuel. The facility can store 1,680 bundles of spent fuel, as shown in Fig. G-2. The spent fuel dry storage facility of Kuosheng NPP is located at an on-site space north of the plant. Twenty seven concrete casks are planned to be installed with each concrete cask being able to load 87 bundles of spent fuel. The facility can store a total of 2,349 bundles



of spent fuel, as shown in Fig. G-3. For detailed information, see Section B.2.1 (1).



Fig. G-2 The current status of the spent fuel dry storage facility of Chinshan NPP



Fig. G-3 The completion schematic diagram of the spent fuel dry storage facility of Kuosheng NPP

### G.2.3 Research and Educational Reactor Facilities

(1) Institute of Nuclear Energy Research

AEC reviewed and inspected TRR spent fuel pool, ZPRL reactor pool, WBR spent fuel drums and its Central Warehouse and inspection facility (hot cell), and concluded that all spent fuel stored at INER met safety standards.

(2) National Tsing Hua University

AEC reviewed and inspected the spent fuel pool (part of the reactor pool) of THOR and concluded that safety standards were met.

G.3 Siting of Proposed Facilities

***Article 6 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 facility shall not have unacceptable effects on other Contracting Parties by being sited in accordance with the general safety requirements of Article 4.***

In order to cope with the safety issues of Taiwan's spent fuel final disposal, and in compliance with the “Nuclear Materials and Radioactive Waste Management Act” as well as the “Enforcement Rules for the Nuclear Materials and Radioactive Waste Management Act”, TPC had submitted the “Spent Fuel Final Disposal Program” to AEC for review and received approval from the AEC. The TPC's promotion of technical development of spent fuel final disposal is described in Section B.2.1(1). Because all of the existing spent fuel management facilities are located within the premises of

nuclear power plants or research reactor facilities, there has been no site selection activity undertaken for spent fuel management facilities in recent years.

TPC has implemented relevant research and development work according to the Spent Fuel Final Disposal Program approved by AEC.

Stepwise implementation and planning for high-level radioactive waste (including spent nuclear fuel) final disposal programs has been adopted by many countries, in the light of program progress and social acceptance, as well as of retaining flexibility in decision-making. The SNFD plan of Taiwan also refers to this approach, which has five stages in the plan. It is currently in the “potential host rock characterization and evaluation stage” (2005-2017), and consequently, has not yet entered the siting process.

There is still no legislation for siting the final disposal repository of high-level radioactive waste in Taiwan. According to the development experiences of other countries, the key point of repository siting is garnering acceptance of such a repository by local communities and to develop appropriate disposal technology. TPC has promoted the disposal plan in reference to international experience. Local outreach programs conducted in the two counties which host the LLRW potential candidate sites, as well as nationwide outreach has garnered experience regarding the legal siting process for the LLRW disposal site. Once the siting process of the spent fuel disposal plan is reached, a consent based siting approach would be highly beneficial.

#### G.4 Design and Construction of Facilities

##### ***Article 7 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 environment, including those from discharges or uncontrolled releases;***
- (ii) at the design stage, conceptual plans and, as necessary, technical provisions for the decommissioning of a spent fuel management facility are taken into account;***
- (iii) the technologies incorporated in the design and construction of a spent fuel management facility are supported by experience, testing or analysis.***



#### G.4.1 Limitation of Radiological Impact

The spent fuel pool is considered part of the nuclear reactor facility. Its design, construction, and operation are governed by the Acts and regulations related to the nuclear reactor facility. Its radiation protection measures shall allow the entire reactor facility to meet dose limits and ALARA requirements prescribed for the nuclear reactor facility. Based on Article 12 of the “Safety Standards for Protection against Ionizing Radiation,” the annual dose limits to the general public are: 1) an effective dose shall not exceed 1 mSv in one year, 2) an equivalent dose to the lens of the eye shall not exceed 15 mSv, and 3) a equivalent dose to the skin shall not exceed 50 mSv. In addition, Article 10 of the “Enforcement Rules for the Implementation of Nuclear Reactor Facilities Regulation Act” stipulates that an annual external radiation dose to the general public from a nuclear power plant shall not exceed 0.5 mSv or shall not exceed 0.02mSv in an hour.

The constructing spent fuel dry storage facility is considered as an independent spent fuel storage installation (ISFSI), although it will be located inside the existing nuclear power plant site. Its radiation protection program shall ensure that annual effective dose to the general public from the spent fuel dry storage will not exceed 0.25 mSv.

#### G.4.2 Conceptual Plans and Technical Provisions for Decommissioning

There are plenty of international experiences regarding spent fuel pool decommissioning. By applying the lessons learned from those experiences, spent fuel pools can be decommissioned safely.

A section to address the conceptual plan and technical provisions for decommissioning of the dry storage facilities is requested to be incorporated in the Safety Analysis Report as part of the application for the construction license.

#### G.4.3 Technologies Supported by Experience, Testing and Analysis

In order to facilitate the license application, the applicants always follow the practice that the technologies provided by the designers or contractors are supported by experience, testing and analysis. This practice is anticipated to be continued in the future.

#### G.5 Assessment of Safety of Facilities

### ***Article 8 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.5.1 Safety and Environmental Assessment before Construction**

According to Article 17 of the “Nuclear Materials and Radioactive Waste Management Act,” a systematic safety and environmental assessment shall be carried out before construction of a spent fuel management facility to demonstrate satisfaction of the following criteria:

- 1) The construction is consistent with the prescription of the relevant international conventions;
- 2) The structures, systems and components are sufficient to secure public health and safety;
- 3) The impact on the environment complies with the prescription of relevant laws, statutes, and decrees; and
- 4) The technology, management ability and financial basis, etc., of the applicant are competent to operate the facility.

#### **G.5.2 Updating of Assessments before Operation of Facilities**

According to Article 18 of the “Nuclear Materials and Radioactive Waste Management Act,” a spent fuel management facility shall not be formally operated until the competent authority has approved and issued an operating license. Article 26 of the “Enforcement Rules for Nuclear Materials and Radioactive Waste Management Act” stipulates that an updated Safety Analysis Report shall be submitted to the competent authority with the application for the operating license.

## G.6 Operation of Facilities

### ***Article 9 Operation of Facilities***

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

- (i) the license to operate a spent fuel management facility is based upon appropriate assessment as specified in Article 8 and is conditional on the completion of a commissioning program 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 license to the regulatory body;***
- (vi) programs to collect and analyze relevant operating experience are established and that the results are acted upon, where appropriate;***
- (vii) decommissioning plans for a spent fuel management facility are prepared and updated, as necessary, using information obtained during the operating lifetime of that facility, and are reviewed by the regulatory body.***

### G.6.1 Operating License

According to Article 26 of the “Enforcement Rules for the Nuclear Materials and Radioactive Waste Management Act,” after the completion of construction, a spent fuel management facility shall not be operated until the competent authority has approved and issued the operating license. Before applying for the operating license, the applicant shall submit a commissioning plan to the competent authority to apply for a permit for conducting the commissioning. After the commissioning, the following documents shall be submitted to apply for the operating license:

- 1) Updated Safety Analysis Report;
- 2) Operation technical specifications;
- 3) Commissioning report;

- 4) Emergency response plan; and
- 5) Other documents designated by the Competent Authority.

#### G.6.2 Operational Limits and Conditions

According to current regulations, the operational limits and conditions derived from tests, operational experience and assessments shall be incorporated into the Facility Operating Technical Specifications and shall be submitted to AEC for review and approval before the operating license is granted. In addition, in accordance with Article 19 of the “Nuclear Materials and Radioactive Waste Management Act,” any design amendment or equipment change that may modify the Facility Operating Technical Specifications shall not be made without prior approval from the AEC.

#### G.6.3 Procedures for Operation, Maintenance, Monitoring, Inspection and Testing

According to the current regulatory provisions, a quality assurance program shall be included in the Safety Analysis Report which is needed in the application for the operating license of a spent fuel management facility. At present, there is no specific regulation on the quality assurance program of a spent fuel management facility. The current regulatory measures refer to the regulatory provisions on the quality assurance program of a nuclear reactor facility. Based on the provisions of Article 9 of the “Guidelines on Nuclear Reactor Facility Quality Assurance,” all operations which will affect the quality shall comply with appropriate procedures.

AEC applies its regulations, licensing and inspection programs to authorize the storage of spent fuel at ISFSI sites; to approve the storage cask modification; and to ensure safe operation of the ISFSI. Inspections focus on safe operation and continued integrity of the fuel in the storage casks.

Regarding the inspection of the spent fuel management facility, AEC issued specific Inspection Guidance (IG-1) and Checklist of Inspection (IG-2) on each important inspection items.

#### G.6.4 Engineering and Technical Support in Safety Related Fields

Article 17 of the “Nuclear Materials and Radioactive Waste Management Act” provides that, for the construction license application, AEC shall review the technological, management, and financial capabilities of the license applicant to ensure that the applicant is competent to operate spent fuel management facilities. AEC has actually applied this practice through the operating lifetime of the facility to ensure engineering and technical supports

in all safety-related fields are available.

#### G.6.5 Reporting of Incidents

According to Article 30 of the “Enforcement Rules for the Nuclear Materials and Radioactive Waste Management Act,” notification of and report on an incident (including abnormal or emergency event) related to spent fuel management facilities shall follow these requirements:

- 1) If the facility is located inside the nuclear reactor site, the notification and report shall follow the relevant requirements stipulated for a nuclear reactor site; and
- 2) If the facility is located outside the nuclear reactor site, notification of AEC shall be made within two hours after finding the incident, and a written report shall be prepared and submitted to AEC within 30 days after finding the incident.

Article 7 of the “Enforcement Rules for the Nuclear Reactor Facilities Regulation Act” stipulates that notification of the Competent Authority shall be done within one hour after finding the emergency event, and a written report shall be prepared and submitted to the Competent Authority within 30 days after finding the emergency event.

#### G.6.6 Collection and Analysis of Operating Experiences

Article 20 of the “Nuclear Materials and Radioactive Waste Management Act” requires that the operator of spent fuel treatment, storage and final disposal facilities shall regularly submit to the Competent Authority the reports related to operation, radiation protection, environmental radiation monitoring, abnormal or emergency events, and others designated by the Competent Authority. Therefore, the operator has the responsibility to collect and analyze the operational experiences and report to the Competent Authority.

#### G.6.7 Decommissioning Plan

According to Article 23 of the “Nuclear Materials and Radioactive Waste Management Act,” the decommissioning of a spent fuel management facility shall be completed within 15 years after its permanent cessation of operation. Before the implementation of the decommissioning work, a decommissioning plan shall be prepared and submitted to the Competent Authority for review and approval. In accordance with Article 11 of the “Enforcement Rules for the Nuclear Materials and Radioactive Waste Management Act,” the

decommissioning plan shall include the following:

- 1) Organization of the decommissioning executor;
- 2) Description of the facility to be decommissioned;
- 3) Radiation evaluation of the facility to be decommissioned;
- 4) Classes and quantities of the radioactive waste;
- 5) Manpower and technology planning for each decommissioning stage;
- 6) Work specifications and schedule of each stage of decommissioning;
- 7) Evaluation of radiation dosage and protection measures; and
- 8) Other matters designated by the Competent Authority.

## G.7 Disposal of Spent Fuel

### ***Article 10 Disposal of Spent Fuel***

***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 Section C relating to the disposal of radioactive waste.***

#### G.7.1 National Strategy

The present spent fuel management measures are “storage in spent fuel pools for the short term, on-site dry storage for the medium term, and final disposal for the long term.” The management strategy will be properly adjusted according to the development of international situation.

#### G.7.2 Research and Development

Since December 1983, AEC, TPC, INER, Central Geological Survey (CGS), and Energy and Resources Laboratories (ERL) of Industrial Technology Research Institute (ITRI) have organized a task force to draft the “Research Plan on Disposal of Spent Fuel” and carried out four stages of HLRW final disposal research and development, and progress has been made.

#### G.7.3 Spent Fuel Final Disposal Plan

According to the “Nuclear Materials and Radioactive Waste Management Act,” TPC submitted the “Spent Fuel Final Disposal Program” in 2004, which was approved by AEC in 2006. At this stage, “Potential Host Rock Characterization and Evaluation” is being carried out. TPC submitted the “Preliminary Technical Feasibility Report for the Spent Fuel Final Disposal” in September 2009 for AEC's review and approval. AEC approved

this report in July 2010. According to Article 37 of the “Enforcement Rules for the Nuclear Materials and Radioactive Waste Management Act,” the high-level radioactive waste final disposal plan shall be reviewed and amended every four years. TPC submitted the “Spent Fuel Final Disposal Program 2010 revision and 2014 revision” to AEC for review on May 27, 2010 and on September 26, 2014, respectively, and AEC approved the program on January 24, 2011 and on March 30, 2015, respectively.

#### G.7.4 Regulatory Control

Key points of regulatory control in the future include review and approval of the construction and operation license and of design change and/or alteration of equipment. During the construction or operation period, inspectors will be dispatched for inspection.

##### (1) Site Requirements

According to the “Regulations on the Final Disposal of High Level Radioactive Waste and Safety Management of the Facilities,” the site of the disposal facility for HLRW shall not be located at areas of active faulting or high population density, or where the geochemical conditions are unfavorable for effectively suppressing the diffusion of radioactive nuclides, or where the surface or underground hydrologic conditions and geological conditions are likely to endanger the disposal facility.

In addition, according to Article 5 of the “Regulations on the Final Disposal of High Level Radioactive Waste and Safety Management of the Facilities,” the choice of the disposal site for HLRW shall avoid areas with probability of landslide, land subsidence and volcanic activities, or where the geological structure or hydrologic conditions could easily change, or the host rock has obviously deteriorated, or the lithosphere is obviously raised or corroded. In case the aforesaid conditions exist, the operator shall provide solutions for ensuring the HLRW disposal facility is in accordance with the safety requirements.

##### (2) Site Characterization Investigation Application

According to Article 6 of the “Regulations on the Final Disposal of High Level Radioactive Waste and Safety Management of the Facilities,” operators of the HLRW disposal facility shall submit to AEC a detailed site investigation plan. Detailed investigations can only be started after the plan is approved. The site investigation plan shall provide a detailed regional

description for the site, conceptual design of the operating area, necessity and planning for drilling and excavation, research and testing plan, counter measures for investigation activities that may deteriorate the capability of isolation, quality assurance plan, rehabilitation plan, and financial statement for the plan as well as other matters designated by the Competent Authority.

### (3) Design Requirements

According to Article 8 of the “Regulations on the Final Disposal of High Level Radioactive Waste and Safety Management of the Facilities,” the HLRW disposal facility shall adopt multi-barrier design so as to ensure the annual effective dose equivalent caused to the general public outside the facility is less than 0.25 mSv (Article 9 of the Regulation), and the annual risk is less than  $10^{-6}$  for a representative individual in the off-site critical group (Article 10 of the Regulation).

#### G.7.5 Next Progress Report

According to the first phase (2005~2017) goals of the "Spent Fuel Final Disposal Program", TPC shall complete the “Technical Feasibility Assessment Report on Spent Fuel Final Disposal,” which will be confirmed after international peer review by 2017 in order to demonstrate the technical capability of spent fuel final disposal.



## Section H Safety of Radioactive Waste Management

### *Article 11 General Safety Requirements*

*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 the criticality and removal of residual heat generated during radioactive waste management are adequately addressed;*
- (ii) ensure that the generation of radioactive waste is kept to the minimum practicable;*
- (iii) take into account interdependencies among the different steps in radioactive waste management;*
- (iv) provide for effective protection of individuals, society and the environment, by applying at the national level suitable protective methods as approved by the regulatory body, in the framework of its national legislation which has due regard to internationally endorsed criteria and standards;*
- (v) take into account the biological, chemical and other hazards that may be associated with radioactive waste management;*
- (vi) strive to avoid actions that impose reasonably predictable impacts on future generations greater than those permitted for the current generation;*
- (vii) aim to avoid imposing undue burdens on future generations.*

### H.1 General Safety Requirements

According to the “Nuclear Materials and Radioactive Waste Management Act,” AEC is designated as the Competent Authority to review and approve applications for construction, operation, decommissioning, closure, institutional control, and exemption from institutional control for a radioactive waste management facility. AEC also performs inspections and enforcement at each stage to confirm that the regulations and commitments have been complied with and appropriate steps taken to ensure that individuals, society and the environment are adequately protected against radiological and other hazards.

#### H.1.1 Subcriticality and Residual Heat Removal

Because in Taiwan there is no nuclear source material, nuclear fuel production facility or high-level radioactive waste from spent fuel

reprocessing, criticality is normally not a concern for radioactive waste (other than spent fuel) management. The decay heat of low-level radioactive waste is also very low, while that of spent fuel is significant.

#### H.1.2 Minimization of Radioactive Waste Generation

Article 29 of the “Nuclear Materials and Radioactive Waste Management Act” prescribes that the producer shall be responsible for minimizing the volume of radioactive waste generation. In addition, the same Article also requires the producer to be responsible for the treatment, transportation, storage, and disposal of radioactive waste generated or to entrust an entity which is capable of doing so. As requested by AEC, TPC, which generates about 90% of total radioactive waste, has been implementing a waste minimization program.

#### H.1.3 Interdependencies among Different Steps in Radioactive Waste Management

The regulations for different steps including treatment, transportation, storage, and disposal of radioactive waste and decommissioning, closure, and institutional control of a radioactive waste management facility have been set up. AEC is responsible for ensuring that interdependencies among the different steps are taken into account in the design, construction and operation of a radioactive waste management facility.

#### H.1.4 Regulations for Radiation Protection

Articles 5 and 14 of the “Regulations on Treatment and Storage of Radioactive Waste and Safety Management of the Facilities” provide that the radiation protection design of the treatment and storage facilities shall ensure that the annual effective dose equivalent to the general public outside the facility is less than 0.25 mSv, and that the ALARA principle is met.

Article 8 of the “Regulations on Final Disposal of Low Level Radioactive Waste and Safety Management of the Facilities” provides the same requirement that the radiation protection design of the final disposal facilities shall ensure that the annual effective dose equivalent to the general public outside the facility is less than 0.25 mSv, and that the ALARA principle is met.

#### H.1.5 Consideration of Biological, Chemical and Other Hazards

According to current regulations for the design, construction, operation,

decommissioning, and closure of a radioactive waste management facility, the operator shall evaluate the potential biological, chemical and other hazards that may have an adverse impact on the public.

#### H.1.6 Consideration of Impacts on Future Generations

The safety standards of Taiwan's regulatory provisions to current and future generations are the same. However, the government and operators follow the principles given in IAEA Safety Series No. SF-1, "Fundamental Safety Principles." Therefore, the impacts on future generations due to radioactive waste management shall be assessed, and proper design and protection measures shall be provided to ensure adequate protection of future generations.

#### H.1.7 Consideration of Burdens on Future Generations

For ethical reasons and following the principles set forth in IAEA Safety Series No. SF-1, "Fundamental Safety Principles," radioactive waste shall be managed in such a way that it will not impose an undue burden on future generations. The government policy is that the waste generators shall bear the responsibility for managing the radioactive waste. The design, construction, operation, decommissioning, closure, and funding of a radioactive waste management facility shall follow this policy.

### H.2 Existing Facilities and Past Practices

#### ***Article 12 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 enter into force for that Contracting Party and to ensure that, if necessary, all reasonably practicable improvements are made to upgrade the safety of such a facility;***
- (ii) the results of past practices in order to determine whether any intervention is needed for reasons of radiation protection bearing in mind that the reduction in detriment resulting from the reduction in dose should be sufficient to justify the harm and the costs, including the social costs, of the intervention.***

#### H.2.1 Safety Review of Existing Radioactive Waste Management Facilities

## (1) Nuclear Power Plants

The existing facilities related to radioactive waste management are the on-site treatment facilities, volume reduction center (VRC), on-site storage facilities, and the Lan-Yu Storage Facility. AEC has reviewed those facilities through project reviews, routine inspections, annual reports, and ten-year re-licensing, which all concluded that all radioactive waste management facilities meet the safety standards.

## (2) Research and Educational Reactor Facilities

### a. Institute of Nuclear Energy Research

AEC has reviewed and inspected the treatment and storage facilities at INER and concluded that they meet the safety standards.

AEC implements quarterly inspection at the Institute of Nuclear Energy Research. The inspection activities focus on safety control of nuclear fuel and nuclear materials facilities, including safe storage, material inventory, and nuclear safeguards.

### b. National Tsing Hua University

AEC has reviewed and inspected the one temporary storage facility in NTHU and concluded that it meets the safety standards.

AEC implements annual inspection at National Tsing Hua University. The inspection activities focus on safety control of nuclear fuel and nuclear materials facilities, including safe storage, material inventory, and nuclear safeguards.

## H.2.2 Examination of the Results of Past Practices

AEC has reviewed the past practices and concluded that there is no need of intervention. All the radioactive waste arising from nuclear power plants as well as medical, agricultural, industrial and research activities are either on-site or off-site storage. There was no disposal in the past.

## H.3 Siting of Proposed Facilities

### ***Article 13 Siting of Proposed Facilities***

***1. 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 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.*

***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 11.***

All of the existing radioactive waste management facilities except the Lan-Yu Storage Facility are located within the originating nuclear power plants or research reactor facilities. The Lan-Yu Storage Facility has been operated since 1982. Only the low-level radioactive waste disposal facility has required siting activity recently. Therefore, this subsection will concentrate on the siting of the low-level radioactive waste disposal facility.

### H.3.1 Siting Procedures

#### (1) Low-Level Radioactive Waste Final Disposal Program

In order to properly solve the problems of low-level radioactive waste produced by all of the civil nuclear energy applications, including nuclear power plants, research facilities, and other small producers, the government in 1988 promulgated the “Radioactive Waste Management Policy,” which prescribes one of the radioactive waste final disposal strategies, “for radioactive waste final disposal, the operator shall consider the principles of disposal of waste both domestically and abroad, and promote it actively; no matter whether disposing of waste abroad is practical, the operator shall domestically site an area and be ready for radioactive waste final disposal.”

Multi-barrier concept has been adopted by the countries around the world for the design of a low-level radioactive waste final disposal facility in

order to isolate radioactive waste from the human living environment. The protective measures include: engineering and natural barriers such as solidified radioactive waste, waste containers, buffer and back-filled materials, etc. This kind of final disposal method has been recognized and recommended by the IAEA. At present, around the world, there are 77 operating final disposal facilities belonging to 34 countries and there are no practical problems with this method currently. The final disposal concept is shown in Fig. H-1.

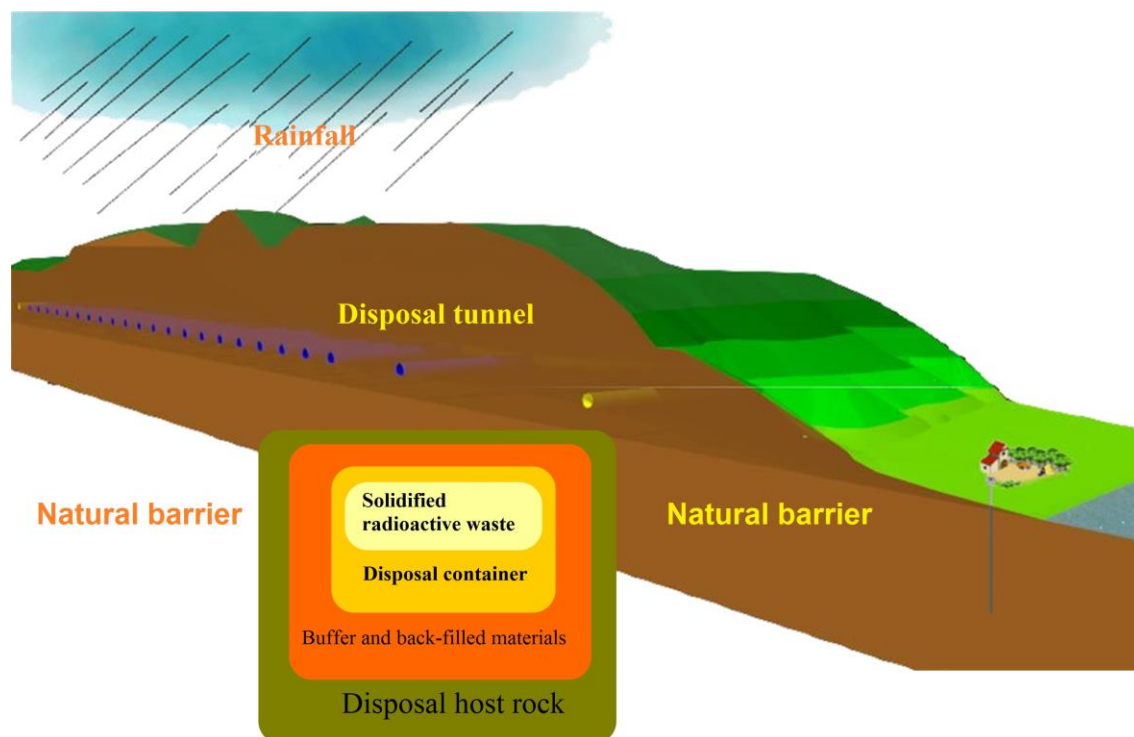


Fig. H-1 Multi-barrier design concept of a low-level radioactive waste final disposal facility

“Act on Sites for Establishment of Low-Level Radioactive Waste Final Disposal Facility” was promulgated on May 24, 2006 and became effective on the day. This Act specifies siting procedures and relevant measures. The Act designates MOEA as the implementing authority and according to the Act MOEA selected TPC as “site selection operator.” Site survey, test, and public communication work are going on. In August 2008, three potential sites were selected for further survey; MOEA declared two recommended candidate sites in March 2009, but later one recommended candidate site was declared by local government to be “Basal Reservation Area.” Because the Act specifies at least two recommended candidate sites are needed to hold a local referendum, siting operation was restarted immediately. On September 10, 2010, MOEA

declared Daren Township of Taitung County and Wuchiou Township of Kinmen County to be Potential Sites. During the next four months, there wasn't any community to submit volunteer host plan.

On March 29, 2011, the "Report on the Selection of Recommended Candidate Sites" of Nantien Village Daren Township and Shaochiou Village Wuchiou Township was released for public comments. Total 76 comments were collected and handled. The MOEA announced Nantien and Shaochiou Villages as two recommended candidate sites on July 3, 2012.

The MOEA on August 17, 2012 requested local governments of Taitung and Kinmen Counties to agree to hold local referendums on low-level radioactive waste siting. However, to date, neither of the counties have agreed to hold these referendums. The MOEA will continue to communicate with the counties with the hope of obtaining their consent in accepting the commission to hold local referendums. The AEC is monitoring the development of this event closely and will, in due course, urge the MOEA and the TPC to communicate with the public more actively. As well, the AEC will request the MOEA to plan and carry out the referendum on their own in accordance with both the provisions of the Act on "Sites for Establishment of Low Level Radioactive Waste Final Disposal Facility" as well as the suggestions from the Central Election Commission so as to hold the referendum successfully.

## (2) Act on Sites for Establishment of Low-Level Radioactive Waste Final Disposal Facility

In order to lay a legal foundation for the selection of the site of a final disposal facility of low-level radioactive waste and to be in compliance with the requirements of environmental protection, the "Act on Sites for Establishment of Low-Level Radioactive Waste Final Disposal Facility" was promulgated on May 24, 2006.

Firstly, the Act defines the jurisdictions and responsibilities of the Competent Authority, AEC, and the implementing authority, MOEA; secondly, it empowers MOEA to invite scholars and experts to organize a site selection committee and designate the major waste producer, TPC, to carry out site selection activities; thirdly, the site selection must be conducted pursuant to the principles of transparency, justice, openness, respectful feedback, communicating and collecting civil opinions; and fourthly, the Act explicitly prescribes the time limit for selection as well as the necessary conditions for land acquisition. The siting flow chart of the Act is shown in Fig. H-2.

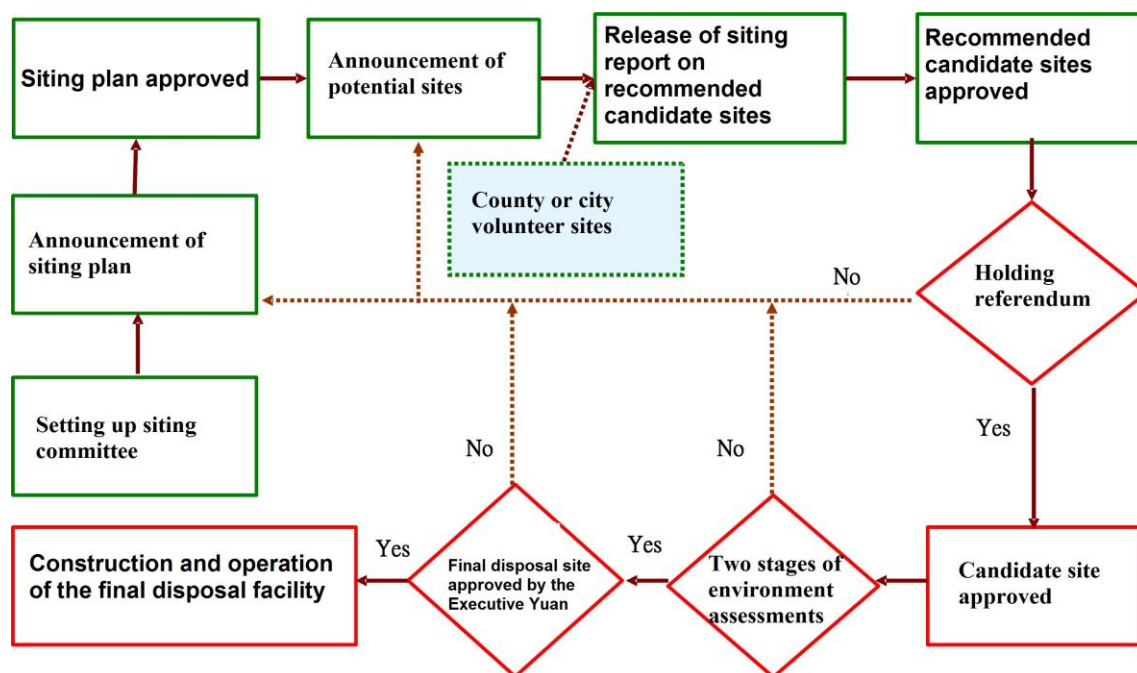


Fig. H-2 The siting flow chart for the low-level radioactive waste final disposal facility

Following the promulgation of the Act, a revised Final Disposal Plan for LLRW was submitted to AEC for review in August 2006 and AEC approved the revised Plan in April 2007. This revision incorporates the requirements stipulated by the “Act on Sites for Establishment of Low-Level Radioactive Waste Final Disposal Facility” and a revised siting schedule.

In order to advance the work of selecting the site of disposal facility, the MOEA may allocate NTD 5 billion from the Nuclear Back-end Management Fund as feedback subsidies. Based on the draft regulation on the use of feedback subsidies laid down by the MOEA, the first subsidies is expected to dispatch to local community only after the Executive Yuan approve the site.

To accelerate the site selection process, MOEA also set up a draft encouragement regulation on the site investigation of LLRW final disposal program. After the site investigation application approved by local community and the first geological drill performed by TPC, NTD 10 million subsidies from the Nuclear Back-end Management Fund will be dispensed to the local community. These additional subsidies can be used in public construction, business renaissance, social welfare, education, culture, and medical aid. Welfare measures such as free lunches for students and job opportunities are reserved to local tribal people also considered.

Since the NIMBY effect is a major disincentive during the site selection of LLRW waste disposal facility, it is essential to mitigate this effect in order to promote the site selection process.



Local economic development is thought as a contributor for potential host community, therefore MOEA has proposed a compensative subsidy program, aiming at enhancing the local economy and quality of residential life. The host community and municipality have continuously been influenced by the implementation of public engagement work in order to facilitate acceptance of the LLRW repository. It is expected that the compensative subsidy program could be an incentive in site selection. However, collecting over 50% of the registered voters, a statutory threshold of a countywide referendum will still be a daunting challenge.

Currently, there is no veto mechanism designed in our site selection procedure for host community or municipality in order to avoid complications to the LLRW disposal program, and there is a low possibility of this mechanism being set up in the future.

### (3) Evaluation of Site-Related Factors Likely to Affect Safety

Site conditions that may affect the safety of a low-level radioactive waste disposal facility during its lifetime and after closure shall be evaluated. Furthermore, Article 4 of the “Act on Sites for Establishment of Low-Level Radioactive Waste Final Disposal Facility” and Article 7 of the “Regulations on Final Disposal of Low-Level Radioactive Waste and Safety Management of the Facility” stipulate that the selection of a site for disposal of low-level radioactive waste shall meet the following criteria:

- 1) Areas in active faulting or other geological conditions likely to influence the safety of the disposal facility must be avoided;
- 2) Areas must be avoided where the geochemical conditions are unfavorable for effectively suppressing the diffusion of radioactive nuclides, and are likely to endanger the disposal site;
- 3) Areas must be avoided where the surface and underground hydrographic conditions and geology are likely to endanger the disposal facility;
- 4) Areas with high population density must be avoided;
- 5) Areas where development is forbidden by the relevant laws must be avoided.

### (4) Evaluation of Likely Safety Impact on Individuals, Society and the Environment

The existing regulatory provisions request the readiness of four reports which are: “the Siting Report on Recommended Candidate Sites” according to the requirements of Article 9 of the “Act on Sites for Establishment of Low-Level Radioactive Waste Final Disposal Facility”; the “Investment

Feasibility Study” according to the requirements of Article 6 of the “Editorial Highlights on the Fixed Asset Investment Project Conducted by the Utilities under MOEA Supervision”; the “Environmental Impact Assessment Report” according to the requirements of Article 30 of the “Recognized Standards on the Breakdown and Scope of the Environmental Assessment Which Shall Be Carried Out for the Development Activities”; and the “Safety Analysis Report” according to the requirements of Article 3 of the “Review Regulations on Applications for the Construction License of Radioactive Waste Storage and Final Disposal Facilities.” Those reports describe in detail the siting process, investment feasibility study, environmental impact assessment, and safety analysis of the low-level radioactive waste final disposal facility and shall be prepared and submitted respectively to Competent Authorities for review and approval of the site to be selected for constructing a low-level radioactive waste final disposal facility. In those reports the likely safety impact on individuals, society and the environment will be evaluated.

#### (5) Information on Safety Available to the Public

According to the “Administrative Procedure Act” promulgated on February 3, 1999 and amended on December 28, 2005, all information held or kept in custody by an administrative authority shall in principle be made available to the public upon request unless reasons for non-disclosure apply.

Furthermore, there are several regulations that require making information on the safety of nuclear facilities available to the public. Safety is one of the most important factors in the site selection, for MOEA to approve the investment feasibility study, for EPA to approve the environmental impact assessment, and for AEC to approve the safety analysis report. Transparency of the site selection to the public is the current policy.

In order to enhance the information disclosure of and public understanding of the final disposal regulation, the AEC has set up a section within its official website to post relevant information about the review of the final disposal program.

#### (6) Consultation with Contracting Parties in Vicinity of the Facility

Given the geographical location of the country and the stringent design, construction, and operation requirements, no neighboring country would be affected by the low-level radioactive waste final disposal facility. However, if there is any country in the vicinity requiring general data to evaluate the likely

safety impact of the facility on their territory, the government agrees to provide them.

### H.3.2 Effect on Other Contracting Party

Since Taiwan is surrounded by ocean without any border with other countries, and given the nature of low-level radioactive waste final disposal, the facility will not have any unacceptable effect on other countries. Moreover, in the case when a safety significant event should occur at a facility in our country, Taiwan will provide prompt and comprehensive information to the neighboring countries.

## H.4 Design and Construction of Facilities

### ***Article 14 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.4.1 Limitation of Radiological Impacts

According to the provisions of Article 5 of the "Regulations on Treatment and Storage of Radioactive Waste and Safety Management of the Facilities" and Article 7 of the "Safety Standards for Protection against Ionizing Radiation", the design and construction of a radioactive waste management facility shall assure that : (1) annual effective dose to the general public will not exceed 0.25 mSv, (2) effective dose for a worker shall not exceed 100 mSv over a cycle of five consecutive years as well as not exceed 50 mSv in any single year, and (3) the principle of ALARA will be followed.

### H.4.2 Conceptual Plans and Technical Provisions for Decommissioning

Currently, there is no regulation that requires conceptual plans and technical provisions for decommissioning of the radioactive waste management facilities to be provided during design and construction periods. However, there is plenty of international experience with decommissioning of radioactive waste management facilities. By drawing on the lessons learned from that experience, the safe decommissioning of radioactive waste management facilities should be feasible. Furthermore, if there is any new radioactive waste management facility to be built, conceptual plans and technical provisions for decommissioning will be taken into account in compliance with the requirements of the “Review Regulations on Applications for the Construction License of Radioactive Waste Storage and Final Disposal Facilities.”

#### H.4.3 Technical Provisions for Closure of Disposal Facility

According to the “Guidelines for Safety Analysis Report of Low-Level Radioactive Waste Final Disposal Facility,” the preliminary closure plan and institutional control plan for the final disposal site shall be incorporated into Chapter 11 of the Safety Analysis Report. Therefore, technical provisions for the closure of a disposal facility will be prepared at the design stage.

#### H.4.4 Technologies Supported by Experience, Testing or Analysis

In order to facilitate the license application, the applicants always follow the practice that the technologies provided by the designers or contractors are supported by experience, testing or analysis. This practice is anticipated to be continued in the future.

#### H.5 Assessment of Safety of Facilities

##### ***Article 15 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 environment assessment for the period following closure shall be carried out and the results evaluated against the criteria established by the regulatory body;***

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

#### H.5.1 Safety and Environmental Assessments before Construction

To ensure a systematic safety analysis and an environmental assessment are implemented before the construction of a radioactive waste management facility, Article 17 of the “Nuclear Materials and Radioactive Waste Management Act” stipulates that:

For the construction of radioactive waste treatment, storage, or final disposal facilities, an application for the construction license shall be filed with the competent authority, and the construction shall not start until the application has been reviewed and approved to satisfy the following prescriptions:

- 1) The construction is consistent with the prescription of relevant international conventions;
- 2) The equipment and facilities are sufficient to secure public health and safety;
- 3) The impact on the environment complies with the prescription of relevant laws, statutes, and decrees; and
- 4) The technology, management ability, and financial basis, etc., of the applicant are competent to operate the facility.

#### H.5.2 Post Closure Safety and Environmental Assessments for a Disposal Site before Construction

Post closure safety analysis and environmental assessment are required to be incorporated in the safety analysis report for application for the construction license and the environmental impact assessment for the approval of project development.

#### H.5.3 Updating of Assessments before Operation of Facilities

EPA does not require the Environmental Impact Assessment (EIA) report to be updated before the operation of a radioactive waste management facility. However, updating of SAR is required to apply for an operating license, and the contents of the SAR cover not only safety issues but also major environmental concerns.

#### H.6 Operation of Facilities

## ***Article 16 Operation of Facility***

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

- (i) the license 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 program 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 procedure. 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 classification of radioactive waste are applied;***
- (vi) incidents significant to safety are reported in a timely manner by the holder of the license to the regulatory body;***
- (vii) programs to collect and analyze 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.6.1 Operating License**

According to Article 26 of the “Enforcement Rules for the Nuclear Materials and Radioactive Waste Management Act,” after the completion of construction, a radioactive waste management facility shall not be operated until the Competent Authority has approved and issued the operating license.

Before applying for the operating license, the applicant shall submit a commissioning plan to the Competent Authority to apply for a permit for conducting the commissioning. After the commissioning, the following documents shall be submitted to apply for the operating license:

- 1) Updated Safety Analysis Report;
- 2) Technical Specifications for Facility Operation;
- 3) Commissioning Report;
- 4) Accident Response Plan; and
- 5) Other documents designated by the Competent Authority.

#### H.6.2 Operational Limits and Conditions

Operational limits and conditions shall be addressed in the Technical Specifications for Facility Operation, which is one of the operating license documents. Revision of the Technical Specifications is subject to review and approval by the Competent Authority.

#### H.6.3 Procedures of Operation and Updating of Post Closure Safety Assessment of a Disposal Site

According to the current regulations, the SAR for the operating license of a radioactive waste management facility shall include a quality assurance program. Because there is no specific regulation for the quality assurance program of a radioactive waste management facility, in current practice, the regulation for the quality assurance program of a nuclear reactor facility is normally referred to. According to Article 9 of the “Regulations on Quality Assurance Criteria for Nuclear Reactor Facility,” all activities that may have impact on the quality shall be performed in accordance with appropriate procedures.

Article 17 of the “Regulations on Final Disposal of Low-Level Radioactive Waste and Safety Management of Facilities” requires the operator of the low-level radioactive waste disposal facility to renew the SAR every five years during the operating period. The main purpose of such a renewal is to further verify the post-closure safety assessment by reviewing the operational data and validity of assumptions provided in the SAR.

#### H.6.4 Engineering and Technical Support in Safety-Related Fields

Article 17 of the “Nuclear Materials and Radioactive Waste Management Act” stipulates that, for the construction license application, AEC shall review the technological, management, and financial capabilities of the license

applicant to ensure that the applicant is competent to operate radioactive waste management facilities. AEC has actually applied this practice through the operating lifetime of the facility to ensure engineering and technical support is available in all safety-related fields.

#### H.6.5 Characterization and Classification of Radioactive Waste

Because different characteristics of the radioactive waste may entail different treatment processes, different transportation packages, and disposal methods, etc., procedures for characterization and classification of radioactive waste have been developed in Articles 3 and 4 of the “Regulations on Final Disposal of Low-Level Radioactive Waste and Safety Management of Facilities.”

#### H.6.6 Reporting of Incidents

According to Article 30 of the “Enforcement Rules for the Nuclear Materials and Radioactive Waste Management Act,” notification and report of an accident (abnormal or emergency event) related to radioactive waste management facilities shall follow the following requirements:

- 1) If the facility is located inside the nuclear reactor facility, the notification and report shall follow the relevant requirements stipulated for a nuclear reactor facility; and
- 2) If the facility is located outside the nuclear reactor facility, notification of the Competent Authority shall be done within two hours after finding the incident, and a written report shall be prepared and submitted to the Competent Authority within 30 days after finding the incident.

Article 7 of the “Enforcement Rules for the Implementation of Nuclear Reactor Facilities Regulation Act” stipulates that notification of the Competent Authority shall be done within one hour after finding the emergency event, and a written report shall be prepared and submitted to the Competent Authority within 30 days after finding the emergency event.

#### H.6.7 Collection and Analysis of Operating Experiences

To ensure that the operator will properly collect and analyze the operating experiences, Article 30 of the “Enforcement Rules for the Nuclear Materials and Radioactive Waste Management Act” requires:

- 1) Annual reports on operation, radiation protection and environmental radiation monitoring shall be submitted to AEC within three months



after the end of a year;

- 2) The quarterly report on environmental radiation monitoring shall be submitted to AEC within 60 days after the end of a season; and
- 3) The monthly report on the quantity of treatment, generation or storage of radioactive waste shall be submitted to AEC by the end of the following month.

In addition, Article 17 of the “Regulations on Treatment and Storage of Radioactive Waste and Safety Management of Facilities” requires that the operator shall re-evaluate the storage facilities every ten years and submit the report to AEC for review and approval, and Article 17 of the “Regulations on Final Disposal of Low-Level Radioactive Waste and Safety Management of Facilities” requires that the operator shall update the safety analysis report every five years during the operation period and submit the updated SAR to AEC for review and approval.

#### H.6.8 Decommissioning Plan for a Facility other than a Disposal Facility

In the current regulations, there is no requirement for submission of a decommissioning plan for radioactive waste management facilities other than a disposal site before or during the operation of the facility. Instead, the operator shall submit a decommissioning plan to apply for decommissioning within six months after permanent cessation of the facility operation. According to Article 20 of the “Enforcement Rules for the Nuclear Materials and Radioactive Waste Management Act,” the decommissioning plan shall include the following:

- 1) Facility overview;
- 2) Decommissioning objectives and time schedule;
- 3) Decommissioning methods and radioactive waste reduction measures;
- 4) Class, characteristics, quantity, treatment, transportation, and storage of decommission waste;
- 5) Dose assessment and radiation protection measures;
- 6) Environmental radiation monitoring;
- 7) Personnel training;
- 8) Material and accounting records management of nuclear source material or nuclear fuel;
- 9) Facility or land re-utilization plan;
- 10) Quality assurance program;
- 11) Accident response plan; and

12) Other matters designated by the competent authorities.

According to Article 14 of the “Nuclear Materials and Radioactive Waste Management Act,” the decommissioning shall be completed within 15 years after permanent cessation of the operation of the radioactive waste management facility. After the decommissioning, the annual effective dose equivalent to the general public shall not exceed 0.25 mSv.

#### H.6.9 Closure Plan for a Disposal Facility

According to “Guidelines for Safety Analysis Report of Low-Level Radioactive Waste Final Disposal Facility,” the preliminary closure and institutional control plan for a radioactive waste disposal facility shall be included in Chapter 11 of the SAR. In accordance with Article 17 of the “Regulations on Final Disposal of Low-Level Radioactive Waste and Safety Management of the Facilities,” the SAR shall be updated every five years during the period of operation.

#### H.7 Institutional Measures after Closure

##### ***Article 17 Institutional Measures 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***
- (iii) if, during any period of active institutional control, an unplanned release of radioactive materials into the environment is detected, intervention measures are implemented, if necessary.***

In order to ensure the safe management of a disposal facility after closure, Article 23 of the “Nuclear Materials and Radioactive Waste Management Act” requires an institutional control plan to be submitted simultaneously with the closure plan to AEC for review and approval prior to the closure of the disposal facility. Furthermore, Article 33 of the “Enforcement Rules for the Nuclear Materials and Radioactive Waste Management Act” stipulates that the institutional control plan shall include the following:

- 1) Organizational structure of the implementer;
- 2) Plan for site security;
- 3) Environmental radiation monitoring;

- 4) Quality assurance program;
- 5) Record and archive management; and
- 6) Other matters designated by the Competent Authority.

In addition, Article 24 of the “Nuclear Materials and Radioactive Waste Management Act” states that an environmental impact assessment approved by EPA and a radiation safety assessment approved by AEC are required for the cessation of institutional control of a disposal facility. Article 34 of the “Enforcement Rules for the Nuclear Materials and Radioactive Waste Management Act” stipulates that the operator may apply for land re-utilization and cessation of institutional control, only when the annual effective dose equivalent to the general public caused by the disposal facility is less than 0.25 mSv. The same Article also specifies that the radiation safety assessment report submitted for cessation of institutional control shall include the following:

- 1) Description of disposal facility and its vicinity;
- 2) Environment radiation monitoring data during the operation, closure, and institutional control periods;
- 3) Natural and human activities impacting the disposal facility and its vicinity during operation, closure, and institutional control periods;
- 4) Land re-utilization plan;
- 5) Radiation safety assessment for land re-utilization; and
- 6) Other matters designated by the Competent Authority.

#### H.7.1 Record Keeping

According to Article 33 of the “Enforcement Rules for the Nuclear Materials and Radioactive Waste Management Act,” the operator shall submit an institutional control plan for AEC's review and approval before the closure, and the plan shall include “Records and Archives.”

#### H.7.2 Active and Passive Institutional Controls

According to Article 33 of the “Enforcement Rules for the Nuclear Materials and Radioactive Waste Management Act,” the operator shall submit an institutional control plan for AEC's review and approval before the closure, and the plan shall include sections on “Environmental Radiation Monitoring” and “Site Security” to address active institutional control and a section on “Records and Archives” to address passive institutional control.

#### H.7.3 Intervention Measures If Necessary

Although no specific regulation stipulates intervention measures, it is understood that any incident occurs, the operator is responsible for implementing intervention measures, and AEC shall ensure that the intervention measures are properly implemented.

## Section I Transboundary Movement

### *Article 27 Transboundary Movement*

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

*In so doing:*

- (i) a Contracting Party which is a State of origin shall take appropriate steps to ensure that transboundary movement is authorized and takes place only with the prior notification and consent of the State of destination;*
- (ii) transboundary movement through States of transit shall be subject to those international obligations which are relevant to the particular modes of transport utilized;*
- (iii) a Contracting Party which is a State of destination shall consent to a transboundary movement only if it has the administrative and technical capacity, as well as the regulatory structure, needed to manage the spent fuel or the radioactive waste in a manner consistent with this Convention;*
- (iv) a Contracting Party which is a State of origin shall authorize a transboundary movement only if it can satisfy itself in accordance with the consent of the State of destination that the requirements of subparagraph (iii) are met prior to transboundary movement;*
- (v) a Contracting Party which is a state of origin shall take the appropriate steps to permit re-entry into its territory, if a transboundary movement is not or cannot be completed in conformity with this Article, unless an alternative safe arrangement can be made.*

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

*3. Nothing in the 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 are 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 General Requirements**

At present, the regulatory provisions for the transboundary movement of radioactive waste are stipulated in the “Regulations for the Operation Permit of Radioactive Waste,” and the regulatory provisions for the transboundary movement of spent fuel are stipulated in the “Regulations for the Nuclear Fuel Operational Safety Management.” The transport operation of both spent fuel and radioactive waste shall comply with the “Regulations for the Safe Transport of Radioactive Material.”

### **I.1.1 Prior Notification and Consent of the State of Destination**

Article 11 of the “Regulations for the Nuclear Fuel Operational Safety Management,” and Article 11.1 of the “Regulations for the Operation Permit of Radioactive Waste” stipulate that to apply for export of spent fuel or radioactive waste, an import permit granted by the receiving country shall be submitted to the Competent Authority. This will ensure that transboundary movement of spent fuel or radioactive waste is authorized and takes place only with the prior notification and consent of the State of destination.

### **I.1.2 Movement through States of Transit**

There is no experience of a transboundary movement of spent fuel discharged from nuclear power plants or radioactive waste passing through other States. There is currently no regulation pertaining to a transboundary movement through States of transit. However, if there is a transboundary movement requiring transit through other States in the future, the international requirements pertaining to the particular modes of transport utilized will be followed.

### **I.1.3 Requirement as a State of Destination to Consent a Transboundary Movement**

Article 13 of the “Regulations for the Operation Permit of Radioactive Waste” stipulates that to apply for an export permit of radioactive waste, an operator shall submit an application form enclosed with a transport plan and

the following documents to the Competent Authority for review and approval:

- 1) Photocopy of import permit granted by the receiving country and certified in written form by the overseas representative office of Taiwan;
- 2) The Chinese translation of the aforementioned certificate certified in written form by the overseas representative office of Taiwan or the domestic notary public;
- 3) Photocopy of the certificate of the receiver's operating capacity;
- 4) Assessment report to demonstrate that the requirements set forth in the “Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management” are met;
- 5) Photocopy and Chinese translation of the receiver's operating license;
- 6) Photocopy and Chinese translation of the written contracts signed by the applicant (exporter) and the importer as well as other related documents; and
- 7) For the receiving country, relevant regulations on and test requirements for the control of radioactive waste (in original language and English or Chinese translation), as well as the assessment documents of the safety-related requirements.

In accordance with the above regulations, radioactive waste will only be exported to a State of destination having administrative and technical capacity, as well as the regulatory structure, needed to manage the radioactive waste in a manner consistent with this Convention.

The export of nuclear fuel not for the purpose of final disposal shall comply with the “Regulations for the Nuclear Fuel Operational Safety Management.” To apply for an export permit of spent fuel, an operator shall submit an application form enclosed with an original document of the import permit granted by the receiving country or its photocopy certified by notary public to the Competent Authority for review and approval. In the past, Taiwan did have experiences sending spent fuel, discharged from research and educational utilization, arising from INER and NTHU back to the originating country, the U.S.A., in accordance with the requirements set forth by the U.S.A. and IAEA.

#### I.1.4 Requirements as a State of Origin to Authorize a Transboundary Movement

Article 11 of the “Regulations for the Operation Permit of Radioactive

Waste” prescribes that to apply for an import permit for radioactive waste, the application form enclosed with a transport plan and the following documents shall be submitted to the Competent Authority for review and approval:

- 1) Photocopy of the export permit granted by the exporting country and certified in written form by the overseas representative office of Taiwan;
- 2) The Chinese translation of the aforementioned certificate certified in written form by the overseas representative office of Taiwan or domestic notary public;
- 3) Photocopy and Chinese translation of the written contracts signed by the applicant (importer) and the exporter as well as related documents;
- 4) The purpose of importing radioactive waste and the treatment method;
- 5) Types, characteristics, quantities, radionuclide activities, and the packaging of the radioactive waste; and
- 6) Photocopy of the receiver's facility operating license, and estimation of the receiver's operating capacity and the secondary waste produced, and disposal plan for the secondary waste.

In accordance with the above regulation, Taiwan will consent to a transboundary movement only if it has the administrative and technical capacity, as well as the regulatory structure, needed to manage the radioactive waste in a manner consistent with this Convention. To date, Taiwan has no experience allowing the import of any radioactive waste.

Taiwan has already promulgated the “Regulations for the Nuclear Fuel Operational Safety Management” and the “Regulations for the Operation Permit of Radioactive Waste” to regulate the import of spent fuel, but currently Taiwan has no intention of allowing the import of spent fuel.

#### I.1.5 Re-entry in case of Non-Conformity

Re-entry of non-conforming spent fuel or radioactive waste has never been required. No explicit written regulation allowing the re-entry of non-conforming spent fuel or radioactive waste is currently available.

#### I.2 Shipment South of Latitude 60 Degrees South

The “Nuclear Materials and Radioactive Waste Management Act” stipulates that an applicant may apply for and obtain an Export Permit from the Competent Authority for the export of spent fuel or radioactive waste.



However, the Export Permit shall not be granted for the export of spent fuel or radioactive waste to a destination south of latitude 60 degrees south for storage or disposal.

## Section J Disused Sealed Sources

### *Article 28 Disused Sealed Sources*

- 1. Each Contracting Party shall, in the framework of its national law, take the appropriate steps to ensure that the possession, re-manufacturing or disposal of disused sealed sources takes place in a safe manner.*
- 2. A Contracting Party shall allow for re-entry 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 Permanent Disuse of Sealed Sources

When a facility operator considers permanent disuse of sealed sources and treating them as radioactive waste, he/she shall fill out an application form and submit it to the AEC for review and approval. After getting the permit, the facility operator shall transport the sealed sources to the receiving organization, the INER, within two months. As of June 30, 2017, the INER of the AEC has received 11,073 disused sealed sources from domestic medical, educational, agricultural, and industrial activities. Disused sealed sources arising from the TPC are currently stored at the nuclear power plants. As of June 2017, No. 1 Storage Facility of Chinshan NPP, No. 1 Storage Facility of Kuosheng NPP, and No. 2 Storage Area of Maanshan NPP had received and stored 30, 100, and 39 disused sealed sources, respectively. With accurate calculation of the concentration of the radioactive nuclides, a small amount of those sealed sources may be co-solidified with sludge, and packed into 55-gallon galvanized drums at nuclear power plants.

When a facility operator considers permanent disuse of sealed sources and exporting them for further treatment, he/she shall fill out an application form, submit the documents relating to the transport details and make an application to the Competent Authority for review and approval. After getting the export permit, the facility operator shall export the disused sources within 30 days. Then, the facility operator may cancel the original registration certificate (permit) by sending the photocopy of export certificate, radiation monitoring certificate of operating places, etc., to the AEC.

#### J.2 Management of Disused Sealed Sources

Regarding the management of the disused and sealed radioactive sources, the sources owned by the TPC should respectively be sent back their designated nuclear power plants (Chinshan, Kuosheng, and Maanshan) and be solidified along with the NPP radioactive waste for storage. The sources owned by civilian facility operators will be sent to the INER for centralized storage and treatment. In order to ensure safe management of the disused sealed sources, the AEC carries out on-site verification of safe management in addition to the review of documents filled in by the facility operators. For sources owned by the TPC, on-site verification will be carried out simultaneously along with regular inspections on the NPPs. For the sources owned by the INER, the on-site verification will also be carried out during regular inspections of the institute. As for the sources owned by the civilian facility operators, immediately two months after AEC's approval of the source disuse and if the sources are unable to be sent to the INER by the civilian operators, the AEC will dispatch staff members to the facility to carry out on-site confirmation of radiation safety of the sources storage management and the storage location.

INER, following a mandate of the AEC, is responsible for receiving and managing the disused sealed sources that are owned by small producers in Taiwan in field such as medical, agricultural, industrial, and research activities in Taiwan, and of which the disuse sealed sources have been approved by the competent authority. Prior to receiving the disused sealed sources, INER will review the information provided by the applicants to confirm and verify the radionuclide and activity data of the sources. After receiving the sources, INER will keep their original packaging containers and store the sources inside a radioactive waste storage facility at the Institute. INER will complete monthly report to the competent authority on the relevant receiving information of the sources. As of June 30, 2017, the INER had received and stored 11,073 disused sealed sources.

### J.3 Re-entry into territory

Currently, there is only a single manufacturer, the Institute of Nuclear Energy Research, of sealed sources in Taiwan, and the produced sealed sources are mainly in use for domestic applications in hospitals. Taiwan has never exported sealed sources before, therefore, there are no re-entry issues in Taiwan.

## **Section K General Efforts to Improve Safety**

### **K.1 Plans to Improve Safety of Radioactive Materials**

The Fuel Cycle and Materials Administration (FCMA) of the Atomic Energy Council (AEC) began in 2009 promoting the “Enhanced Development Scheme for Radioactive Waste Management,” considering the construction of basic environment, ensuring of safe operation, and improved regulatory operations. For the “construction of basic environment,” three aspects are carried out, including to build the whole regulatory and management system, to enhance the professional quality of management personnel, and to enhance the disclosure of regulatory information as well as communication with the public. For “ensuring safe operation,” the following are carried out: to promote betterment of the performance and safety of the old treatment facilities; to urge the operator of the nuclear power plants to process or recycle the radioactive waste in storage; and to proceed volume reduction and stabilization for the existing radioactive waste in storage. As for the “improved regulatory operations,” the following are carried out: to promote regulatory professional technical capability, to establish expert database, and to perform careful planning and pre-preparedness for major development projects in order to proceed the related activities smoothly. All of the aforementioned measures are for a safer, progressive and rational development of the radioactive waste management based on the existing foundation in order to promote people's confidence on the safety of radioactive waste management.

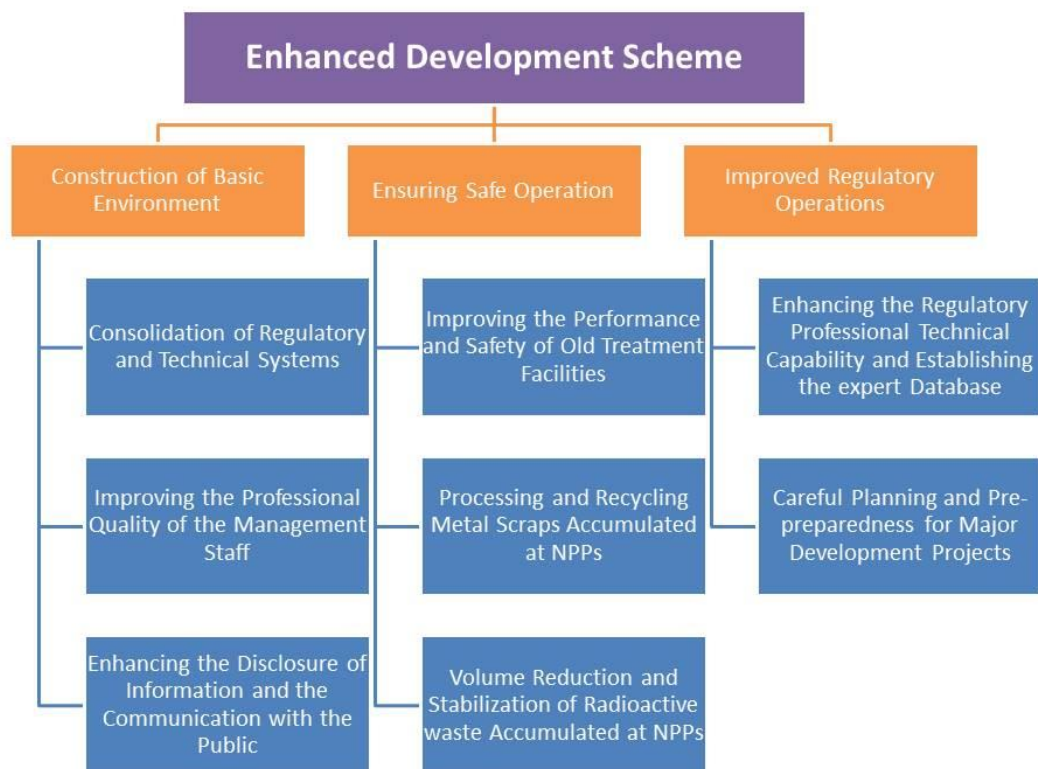


Fig. K-1 Enhanced development scheme for radioactive waste management

Up to now, the implementation activities of this enhancement scheme are as follows:

#### K.1.1 Strengthening Regulations and Management System

The “Nuclear Materials and Radioactive Waste Management Act” is under review and amendments to become as a regulatory act and to include the establishment of the nuclear back-end management fund, as well as to urge the facility operators enhancing the interaction and communication with the locals. Besides, the draft amendment of the “Act

On Sites for Establishment of Low-Level Radioactive Waste Final Disposal Facility” is under elaboration in order to facilitate taking forward the siting operations of the low-level radioactive waste final disposal facility. Also, the “Environmental Impact Assessment of Radioactive Waste Management Policy” is under drafting to assess the environmental impacts due to the important management policy on radioactive waste management in the future and their reduction counter measures. In addition, the technical specifications will be deliberated and revised at any time with the relevant

organizations according to their necessity and applicability in the regulatory activities.

#### K.1.2 Improving the Professional Quality of the Management Staff

In accordance with the "Administrative Regulations on Operator Qualification for Radioactive Waste Treatment Facilities", the AEC holds the "Examination for Operators of Radioactive Waste Treatment Facilities" and issue senior operator and standard operator licenses in order to improve the professional quality of the facility operators and management staff.

The "Training Courses for Radioactive Waste Management Inspectors" have been held annually. The courses include core courses (regulations and inspection techniques), experience feedback and sharing, and readiness for future operations. The courses are total 40 hours and are lectured by inspectors and relevant experts. The qualification certificates for senior inspectors and inspectors are issued according to the "Qualifications Procedures for Radioactive Waste Management Inspectors" in order to facilitate the regulatory operations on the safety of radioactive waste management facilities. When necessary, members of the staff are sent to take relevant professional training courses like non-destructive examination, etc. Also, because of task needs, domestic and overseas experts are invited to hold the workshops on decommissioning, spent fuel dry storage, and radioactive waste final disposal in order to enhance the professional quality of the management staff.

#### K.1.3 Strengthening Information Disclosure and Public Communication

To fulfill the requirements of the Convention, Taiwan will carry out effective regulations on the management of spent fuel and radioactive waste, as well as take all measures to prevent any potential hazards. In order to implement the disclosure of radioactive material regulatory information, the nuclear energy related facility regulatory tables, facility evaluation reports, review reports and regulatory annual reports are disclosed on the Internet monthly, quarterly, or annually. Besides, an exclusive web page for the construction of the "Spent Fuel Dry Storage Facility" is set up to provide the information of the construction permit review, the inspection report on the storage cask fabrication, and the problems of public concerns.

As of 2017, the AEC has invited locals and representatives of all concerned groups to participate in the "Lan-Yu Storage Facility Environmental Radiation Parallel Monitoring Program" for seven straight

years. Environmental samples such as soil, drinking water, and agricultural products from the six tribes at Lan-Yu are taken together by the participants. Analysis results throughout these 7 years have remained normal, signifying the environment is intact. All measurements and analysis reports throughout these years have been posted online on the AEC website.

#### K.1.4 Ensuring Operation Safety of Facilities

Ensuring operation safety of facilities in order to reach the goal of zero accident is achieved through strict quality control of the application cases, promoting operators' self-management, increasing facility inspection frequency, and the implementation of early warning safety control measures. The ad hoc flood control inspection is carried out in order to ensure the facilities maintaining safe operation under climate anomalies. As for the improvement of old facilities, the Chinshan NPP was urged to improve the performance of its low-level radioactive waste treatment system, while the Kuosheng NPP was urged to introduce stabilization treatment technology in order to improve the volume reduction effect on ion-exchange resin waste. In addition, treatment and recycling plans for the accumulated waste were promoted in order to seize actively of metal waste. The effects of volume reduction, quantity reduction and recycling were reached through decontamination. The operators of nuclear facilities and the small producers of radioactive waste were urged to propose release plans for clean waste, as well as the volume reduction and stabilization treatment plans for the accumulated waste in order to implement waste reduction requirements. The volume reduction measures were carried out through reducing waste from waste streams, improving the performance of treatment facilities, and introducing new treatment technologies so that their excellent effects had been achieved. The reduction rate of solidified low-level radioactive waste from the three nuclear power plants had been analyzed and the result was 0.013, showing consistent strides towards sustainable development. As for improving regulatory professional technical capability and establishing an experts database, the "Examination for Operators of Radioactive Waste Treatment Facilities" was carried out according to the "Qualification Procedures for the Operators of Radioactive Waste Treatment Facilities," as well as senior operator and operator licenses for radioactive waste treatment facilities were issued so that the operation and management of the facilities may be institutionalized. Besides, the database of domestic and overseas personnel of the related operational, including experts majoring in nuclear

energy, mechanical engineering, civil engineering, radiation protection, laws and public communication, was established. Those experts stay connected to establish communication pipes and can be consulted at any time in order to facilitate future review operation and consultation.

Based on years of TRR decommissioning management and implementation, INER has accumulated considerable decommissioning experiences, such as the planning and implementation of site characterization, decontamination, dismantling plans, safety analyses, radioactive waste management, radiation protection, and environmental protection. INER has also incorporated special technology such as using steel wire rigging for dismantlement, material decontamination, clean waste clearance, etc. Special techniques for radioactive waste packaging and storing has been adopted, and the accumulation of these experiences feedback have been applied to many projects.

#### K.1.5 Careful Planning and Pre-Preparedness for Major Development Projects

Planning and pre-preparedness steps taken by Taiwan in response to the issues of the spent fuel dry storage and the radioactive waste final disposal are described as follows:

##### (1) Challenge of Promoting Dry Storage

Spent fuel has to first be moved out of the reactor building in order to facilitate carrying out the NPP dismantlement. With regard to the spent fuel dry storage facility, the construction of Chinshan NPP's first-phase dry storage facility has been completed and its performance test has been successfully finished. On September 24, 2013, the AEC granted the approval for TPC to carry out the facility hot test which had not previously been carried out due to the New Taipei City Government having not yet issued the soil and water conservation certificate so that Chinshan NPP's decommissioning and dismantlement will be affected. The AEC has asked for the New Taipei City Government to actively carry out a soil and water conservation review for the first-phase dry storage facility, and in the meantime has requested the MOEA and TPC to actively communicate and coordinate with the New Taipei City Government in order to obtain the soil and water conservation completion certificate for the first-phase dry storage facility such that the spent fuel can be moved out of the reactor building in order to ensure the safety of the NPP.

Taking into account social consensus and public acceptance levels, and



to ensure the Chinshan NPP decommissioning plan will be completed in quality and on schedule within 25 years (by 2044), the AEC has requested the TPC to adopt indoor dry storage for Chinshan NPP's second phase dry storage facility, shall which has social consensus among the public. This facility shall be completed construction and shall commence operations by 2026, in order to facilitate moving spent fuel out of the reactor building and continuing the subsequent decommissioning and dismantlement, and to actively implement the nuclear-free homeland policy. In the meantime, while spent fuel still remains in the nuclear reactor core and the spent fuel pool, the AEC will continue strict regulation on its storage safety to ensure public health and environmental quality.

## (2) Challenges for High-Level Radioactive Waste Final Disposal

In accordance with the provisions of the "Nuclear Materials and Radioactive Waste Management Act," the TPC has submitted to the AEC the "Spent Fuel Final Disposal Program" which consists of five phases. Currently, the TPC is carrying out the first phase (2005~2017) of the program, the "Potential Host Rock Characterization and Evaluation" and also includes the submission in 2017 to the AEC of "Report on Taiwan's Spent Fuel Final Disposal Technical Feasibility Evaluation" (SNFD 2017 Report), which shall go through an international peer review, and will establish deep geological disposal technology that will meet international standards.

In order to effectively carry out the preparations for "Candidate Site Selection and Approval"(the second phase of the spent fuel final disposal program), the AEC in October 2017 requested the TPC to follow three principles: 1)to be fair organizer; 2)to include public participation in process; and 3)to use objective criteria. As well the AEC requested the TPC to finalize as soon as possible the draft of the "Act on Siting for High Level Radioactive Waste Final Disposal Facility" as well as to submit the finalized draft through the MOEA to the Executive Yuan Nuclear-Free Homeland Task Force for discussions in order to reach a social consensus and to complete the legislation of the siting act as soon as possible.

## (3) Challenge of Low Level Radioactive Waste Final Disposal

In order to cope with the delay issues with regard to the low level radioactive waste final disposal facility due to no siting referendum, the AEC in February 2017 reviewed and approved a contingency program for a centralized interim storage facility. The TPC has been requested to finalize the siting for the facility within three years of March 2017. The facility shall be

completed and commence operations within eight years, and shall be a "Relay Station" for low level radioactive waste. In addition, the AEC has also requested the TPC to continue actively promoting the low level radioactive waste final disposal program and to obtain a review and approval of disposal facility sites within five years of March 2017, in order to properly resolve the nuclear waste disposal issues.

## K.2 New Regulatory Requirements for Radioactive Waste Facilities in Taiwan after the Fukushima Accidents

On March 20, 2011, in the fifth meeting of the 311 project discussed in the National Security Council presided by the President of Taiwan, the President ordered that “the three operating nuclear power plants and the one under construction shall be totally examined.” Taking the order, the AEC, MOEA, TPC, FCMA, and INER, etc., reviewed jointly the capability of the existing nuclear units in response to the accidents, and the potential possibility of dangerous key elements for the equipment losing functions. Relevant programs were proposed taking into consideration improvement measures for the existing nuclear units, adopted by international organizations and the nuclear-advanced countries in the world.

### K.2.1 New Regulatory Requirements for Spent Fuel

The AEC has requested to re-examine the integrity and the cooling capacity of the spent fuel pools at the operating nuclear power plants. The examined items include seismic endurance and cooling capacity of the spent fuel pools, preventing the fall of heavy objects into the spent fuel pools, and the inspection of redundancy capability as well as the dealing manners and improving methods when it loses this capability.

In the wake of Japan's Fukushima Daiichi Nuclear Power Plant accidents due to intense natural disasters, the Atomic Energy Council has asked Taiwan's Nuclear Power Plant operator (TPC) to re-examine and re-evaluate the seismic and anti-tsunami design of the dry storage facility at Chinshan NPP, considering natural disasters such as earthquakes, tsunami, strong rainfall, and landslides. The TPC submitted the re-assessment report to AEC in May of 2011. The re-assessment results show that the protections against these situations are stable and safe. The protection measures against disasters and the contingency procedures have been formulated to cope with all types of assumed accident emergency events. As for the dry storage facility at Kuosheng NPP, the TPC submitted an ad hoc report on the facility in April

2012. Assessment results show that if at the facility site can endure beyond design basis seismic, or tsunami accident events, or any accident events resulting in casks to tip over or to be buried, the facility based on the safety analysis can maintain its design basis requirements and will not have any significant adverse impact. In addition, for any accidents that may possibly exceed design criteria, TPC has also planned corresponding emergency measures and retrieval procedures to cope with damages to the dry storage facility due to accident events in order to ensure the public health and safety.

In accordance with the provisions of Article 18 under the "Nuclear Materials and Radioactive Waste Management Act" and Article 27 of the "Enforcement Rules for the Nuclear Materials and Radioactive Waste Management Act", the competent authority will issue an operating license of a radioactive waste storage facility for a maximum length of 40 years. If the facility is needed to continue operations, the operator shall submit the license renewal application to the competent authority for review and approval two years before the license expiry date. The AEC will strictly supervise operational safety of the dry storage facility, and will take into account public acceptance levels to relieve any public safety concerns, which will allow the public to feel at ease and have peace of mind. Referencing earlier licensing practices for dry storage facilities in the U.S.A., the AEC in the future will initially grant a 20-year storage license. The TPC will be able to apply for license renewal two years before the license expiry date.

### K.2.2 New Regulatory Requirements for Radioactive Waste

AEC has requested to re-examine the seismic design of radioactive waste treatment and storage facilities, and calculate the design values corresponding to the current building codes. Total examination on the disaster prevention and resilience of radioactive waste treatment and storage facilities shall be carried out in order to guard against and prepare for the coming of similar complex disasters. Re-evaluation and re-calculation have been carried out in order to assure the emergency contingency capability for complex disasters. Emergency handling drills shall be carried out annually for each nuclear power plant in order to build up the capability to handle anomalies and accidents. The preventive mechanism against landslides and anti-disaster capability of the slope construction shall be assured. Sufficient drainage design and flood control capacity are required for each radioactive waste storage building. The AEC will continuously urge the operator of each nuclear power plant to implement radioactive waste reduction, to promote volume

reduction and stabilization treatment of accumulated radioactive waste at each NPP, and to deregulate the radioactive waste with activities or specific activities below certain values in order to achieve the reduction goals of all types of radioactive waste, as well as to promote effective use of storage space and enhance storage safety. AEC urges the operator of each nuclear facility to improve the performance and safety of his/her radioactive waste treatment facilities, and enhance operation safety and efficiency. AEC will build up a sound legal system for radioactive materials and specifically address the problem of domestic radioactive materials by combining technical R & D and practice needs. AEC will enhance the disclosure of radioactive waste management information and public communication, as well as the promotion of public correct understanding of radioactive waste management and safety.

Regarding safety regulations for the Lan-Yu Storage Facility, as the TPC is unable to determine candidate sites for the low level radioactive waste disposal facility, the AEC requested the TPC to submit "Lan-Yu Storage Facility Relocation Plan Report", including two implementation options: 1) "Shipping Back the Waste to Where it was Produced" and 2) "Sending the Waste to a Centralized Storage Facility" by the end of 2016. The review of the relocation plan was completed in February 2017. The TPC is required to go through the MOEA to submit the relocation plan to the Nuclear-Free Homeland Task Force, the National Council of Sustainable Development, and to the Executive Yuan, for deliberation, finding social consensus, and determining the best possible solution in order to implement the relocation plan as soon as possible.

In order to cope with the delay issues mentioned above, the AEC in February 2017 reviewed and approved the contingency program for a centralized interim storage facility. The TPC has been requested to finalize the siting for the facility within three years outset from March 2017. The facility shall be completed and in operation within eight years and shall be a "Relay Station" for low level radioactive waste. In addition, the AEC also requested the TPC to actively continue promoting the low level radioactive waste final disposal program and to obtain a review and approval of the disposal facility site in order to properly resolve the issues.

In accordance with objectives of the government's indigenous peoples policy, the AEC reviewed and revised relevant regulations on the potential sitings of radioactive waste facilities. The regulations clearly specify that the

government is not to violate the will of the indigenous peoples by constructing radioactive waste facilities onto their lands. An amendment of the regulations was completed in March 2017.

### K.3 International Peer Review of Radioactive Waste Programs

The AEC requests TPC to submit reports on the radioactive waste disposal programs for LLRW and HLRW, the "Report on LLRW Final Disposal Technical Evaluation" (referred to as LLWD 2016 report) and the "Report on Taiwan's Spent Fuel Final Disposal Technical Feasibility Evaluation" (referred to as SNFD 2017 report) for international peer review. The LLWD 2016 report successfully passed the international review process in May 2016. The SNFD 2017 report is scheduled to complete the international peer review by October 2017.

## Section L Annexes

### L.1 List of Relevant Laws and Regulations

Remarks:

1. The information in the following tables is updated to June 30, 2017.
2. Laws and regulations about radioactive materials control and radiation safety can be found from the regulation query system on the website of the Competent Authority, the Atomic Energy Council.  
(<http://erss.aec.gov.tw/law/EngLawQuery.aspx>)
3. Laws and regulations about environmental protection can be found from the regulation query system on the website of the Environmental Protection Administration. (<http://ivy5.epa.gov.tw/epalaw/>)

Table L-1 List of laws and regulations for spent fuel and radioactive waste

Regulation level	Title	Date of revision/promulgation
Act	Atomic Energy Act	Revised and promulgated on December 24, 1971
Act	Nuclear Materials and Radioactive Waste Act	Promulgated on December 25, 2002
Act	Act on Sites for Establishment of Low-Level Radioactive Waste Final Disposal Facility	Promulgated on May 24, 2006
Legal order	Enforcement Rules for the Nuclear Materials and Radioactive Waste Act	Revised and promulgated on April 22, 2009
Legal order	Regulations on the Final Disposal of High-Level Radioactive Waste and Safety Management of the Facilities	Revised and promulgated on January 18, 2013
Legal order	Regulations for the Operation Permit of Radioactive Waste	Revised and promulgated on September 19, 2014
Legal order	Fees for Regulatory Services under the Nuclear Materials and Radioactive Waste	Revised and promulgated on November 25, 2015

	Act	
Legal order	Regulations on the Final Disposal of Low-Level Radioactive Waste and Safety Management of the Facilities	Revised and promulgated on July 9, 2012
Legal order	Regulations for the Nuclear Fuel Operational Safety Management	Revised and promulgated on October 30, 2009
Legal order	Regulations for the Nuclear Source Materials Operational Safety Management	Revised and promulgated on October 30, 2009
Legal order	Administrative Regulations on Operator Qualification for Radioactive Waste Treatment Facilities	Promulgated on April 22, 2009
Legal order	Regulations for the Review and Approval of Applications for Construction License for Radioactive Waste Treatment, Storage and Final Disposal Facilities	Revised and promulgated on April 13, 2009
Legal order	Regulations on Treatment and Storage of Radioactive Waste and Safety Management of the Facilities	Revised and promulgated on October 22, 2008
Legal order	Administrative Regulations for Review and Approval of Applications for the Construction License for the Production or Storage Facilities of Nuclear Source Materials or Nuclear Fuel	Revised and promulgated on January 24, 2008
Legal order	Administrative Regulations for Waste Generated from Naturally Occurring Radioactive Materials	Promulgated on January 5, 2007
Legal order	The Scope and Identification Standards for the Forbidden Area of the Low-Level Radioactive Waste Final Disposal Facility	Revised and promulgated on March 23, 2017

Legal order	Site Administrative Regulations for Radioactive Waste with Activity or Specific Activity below Certain Values	Promulgated on December 29, 2004
Legal order	Administrative Regulations on Nuclear Source Material Mines and Minerals	Revised and Promulgated on April 15, 1998
Legal order	Operational Regulations Governing Nuclear Safeguards	Promulgated on September 10, 2003

Table L-2 List of laws, regulations and safety requirements relevant to radiation safety

Regulation level	Title	Date of revision/promulgation
Act	Ionizing Radiation Protection Act	Promulgated on January 30, 2002
Legal order	Enforcement Rules for the Ionizing Radiation Protection Act	Revised and promulgated on February 22, 2008
Legal order	Administrative Regulations for Radioactive Materials and Equipment Capable of Producing Ionizing Radiation and Associated Practice	Revised and promulgated on December 24, 2012
Legal order	Environmental Radiation Standards for Severe Pollution	Revised and promulgated on January 7, 2011
Legal order	Administrative Regulations for Operators of Radioactive Material or Equipment Capable of Producing Ionizing Radiation	Revised and promulgated on April 17, 2009
Legal order	Regulations for the Safe Transport of Radioactive Material	Revised and promulgated on December 31, 2007
Legal	Safety Standards for Protection Against	Revised and promulgated



order	Ionizing Radiation	on December 30, 2005
Legal order	Exemption Standards for Radioactive Source Material	Revised and promulgated on June 20, 2016

Table L-3 List of laws, regulations and safety requirements relevant to environmental safety

Regulation level	Title	Date of revision/promulgation
Act	Environmental Impact Assessment Act	Revised and promulgated on January 8, 2003
Legal order	Implementation Rules for the Environmental Impact Assessment Act	Revised and promulgated on July 3, 2015
Legal order	Environmental Impact Assessment Items and Screening Criteria for Development Activities	Revised and promulgated on September 12, 2013
Legal order	Environmental Impact Assessment Operation Standards for Development Activities	Revised and promulgated on July 3, 2015
Act	Waste Disposal Act	Revised and promulgated on June 14, 2017
Legal order	Implementation Rules for the Waste Disposal Act	Revised and promulgated on November 20, 2002

## L.2 Taiwan's Radioactive Waste Management Policy

Revised on September 2, 1997

### **Section 1 Objectives**

1. This policy is set forth to enhance the management of radioactive waste produced by nuclear power generation as well as medical, agricultural, industrial, educational, research and other applications in order to protect people's safety, maintain environmental and ecological quality, and avoid the adverse effects of radioactive waste on the present and future generations.

### **Section 2 Strategies**

2. The treatment, transport, storage and final disposal of radioactive waste as well as the decommissioning of treatment and storage facilities shall base on the presently available technologies and continue to research and develop according to Taiwan's actual needs in order to ensure the safety.
3. The producers of the radioactive waste shall actively reduce the quantity and volume of the radioactive waste.
4. The treatment, transport, storage and final disposal of the radioactive waste shall be carried out by the producers themselves or commissioned to an organization approved by the government, and the producers shall bear the cost of all the related expenses.
5. The management of radioactive waste shall take into account of people's safety and environmental protection as well as comply with the relevant international conventions.
6. The management of radioactive waste shall enhance the promotion of research and development, education and public communication in order to strengthen the foundation of the radioactive waste management.
7. The management of radioactive waste shall improve legal regulations, management and information systems in order to facilitate the radioactive waste management.

8. The disposal of radioactive waste shall actively be promoted and consider in principle both the domestic disposal site as well as overseas. No matter if the overseas disposal is feasible, a domestic disposal facility shall be sited and ready for disposal.

### **Section 3 Measures**

9. Improving legal regulations and management systems
  - (1) Reviewing and revising legal regulations and enhancing the management of radioactive waste produced by nuclear power generation as well as medical, agricultural, industrial, educational, research and other applications of radioactive materials.
  - (2) Improving the commissioned system for treatment, transport, storage and final disposal of radioactive waste.
  - (3) Establishing a fund system – the producers of radioactive waste shall amortize the fund in order to cover all the expenses of the radioactive waste management.
  - (4) Improving the management safety of the waste from naturally occurring radioactive materials in order to avoid adverse effects to the environment.
10. Protecting natural, social and human resources
  - (1) Radioactive waste storage or disposal facilities shall be located at an area with low population density.
  - (2) The establishment of radioactive waste storage or disposal facilities shall not interfere with the sustainable use and conservation of the resources around their surrounding areas.
  - (3) The transport of large amount of radioactive waste shall take marine transport instead of and reduce the amount of land transport.
  - (4) The decommissioning of radioactive waste treatment or storage facilities shall in principle adopt demolition methods in order to let the land resources of the sites be re-used and developed.
11. Improving the implementations of safety analysis and environmental impact assessment

- (1) During the development stage of a radioactive waste management facility, the operator shall submit a safety analysis report on the facility to the Competent Authority. In addition, the operator shall also submit an environmental impact assessment according to the “Environmental Impact Assessment Act”, if he/she is required to do so by law.
  - (2) An environmental radiation monitoring system shall be set up at a radioactive waste management facility.
  - (3) Improving inspection system and enhancing inspection operation in order to ensure the safety of radioactive waste treatment, transport, storage and final disposal.
12. Enhancing the storage and final disposal plans
- (1) Improving the safety of low-level radioactive waste storage and studying the feasibility of long-term safe storage methods.
  - (2) Enhancing the promotion of a domestic final disposal plan for low-level radioactive waste as well as completing the environmental impact assessment and safety analysis report as soon as possible.
  - (3) Continuing the promotion of the overseas disposal plan for low-level radioactive waste in compliance with international norms in order to ensure the safety of transport and disposal operations.
  - (4) Actively promoting spent fuel mid-term storage at NPPs.
  - (5) Looking for the feasibility of reprocessing spent fuel abroad in compliance with international safeguards agreements.
  - (6) Continuing to carry out spent fuel and high-level radioactive waste final disposal programs and proposing a preliminary feasibility plan and an implementation plan.
13. Enhancing the research and development, education and public communication for radioactive waste management
- (1) Training domestic medium and high level human resources for radioactive waste management and recruiting overseas high-level experts to take part in the research and development work for radioactive waste management.

- (2) Integrating research resources in academic, research and radioactive waste producing organizations in order to strengthen the radioactive waste management research.
- (3) Establishing a nationwide information system for radioactive waste management and promoting social education and public communication.
- (4) Actively participating in international cooperation and international symposiums on radioactive waste management as well as absorbing and introducing techniques and experiences.
- (5) Promoting and encouraging civil engagement in radioactive waste management as well as research and development work.
- (6) Raising financial assets in order to facilitate the research and development work for radioactive waste management technologies.

### L.3 Glossary

ABWR	Advanced Boiling Water Reactor
AECL	Atomic Energy Canada Limited
ALARA	As Low As is Reasonably Achievable
BWR	Boiling Water Reactor
CANDU	Canada Deuterium Uranium
EPA	Environmental Protection Administration
FCMA	Fuel Cycle and Materials Administration
GA	General Atomics
GE	General Electric Company
HDPE	High Density Polyethylene
IAEA	International Atomic Energy Agency
kW	kilowatt
MOEA	Ministry of Economic Affairs
MOI	Ministry of Interior
MOL	Ministry of Labor
MW	Megawatt
NORM	Naturally Occurring Radioactive Material
NTHU	National Tsing Hua University
PWR	Pressurized Water Reactor
RMC	Radiation Monitoring Center
SSC	Structures, Systems and Components
THAR	Tsing Hua Argonaut Reactor
THOR	Tsing Hua Open-pool Reactor
THMER	Tsing Hua Mobile Educational Reactor
TPC	Taiwan Power Company
TRIGA	Training, Research, Isotopes, General Atomics
TRR	Taiwan Research Reactor
VRC	Volume Reduction Center
WBR	Water Boiler Reactor
Westinghouse	Zero Power Reactor Longtan
ZPRL	Advanced Boiling Water Reactor