3.4 Radioactive Waste Management (RWM) Status in Japan

3.4.1 National Policy for Radioactive Waste Management

The Atomic Energy Commission decided "Framework for Nuclear Energy Policy" in 2005, and the Government decided to respect it as a basic principle for the nuclear energy policy, and promote research, development and utilization of nuclear science and engineering.

It expresses that the generation that has enjoyed the convenience and benefits of nuclear energy assumes the responsibility to expand all efforts for sale disposal of radioactive wastes for the next generation, and shows that there are four principles of treatment and disposal of radioactive waste.

1) the liability of generators
2) minimization of radioactive waste
3) rational treatment and disposal
4) implementation based on mutual understanding with people

Namely,

- Radioactive waste should be safely treated/conditioned and disposed of by the generators. The government should provide guidance to or regulate the generators to ensure that the treatment/conditioning and disposal are carried out properly and safely.
- Steps should be taken to reduce the amount of waste generated and to recycle/reuse of it. Research and development to those ends should be actively pushed forward. Interested parties and the competent authorities should jointly conduct an extensive study on the uses of such waste and the development of systems for that purpose, including satisfactory safety checks.
- Since radioactive waste varies greatly in its level of radioactivity and in the type of radioactive material contained, arrangements should be made to classify the waste by method of disposal, regardless of the facility from which it comes, and take specific measures for its treatment/conditioning and disposal.
- In order to win people's trust in the business of radioactive waste final disposal, efforts are also needed to provide full information on the disposal project and to secure its transparency at all stages.

And, when material below the clearance level (material which has no need to be regarded as radioactive material) is treated, disposed of or reused, the Government and operating entities need to take appropriate measures in line with the amended Nuclear Reactor Regulation Law. In principle, it is important to recycle waste to the fullest extent practical and reasonable.

3.4.2 Practice of Radioactive Waste Management

3.4.2.1 Legal System Related to the Radioactive Waste Management

The treatment, storage and disposal of radioactive wastes generated during operation of nuclear facilities is regulated by either the Law for Regulation of Nuclear Source Material, Nuclear Fuel Material and Reactor (hereinafter referred to as "Reactor Regulation Law") or the Law for the Prevention of Radiation Hazard due to Radioisotopes, etc. (hereinafter referred to as "Radiation Hazard Prevention Law") according to the kind of facilities which generate the wastes. These two laws: Regulation Law and Prevention Law are in conformity with the Atomic Energy Basic Law, which establish the basic policy of nuclear activity as Peaceful uses, Safety Assurance, Democratic management, Autonomy and Publication of results.

Since Reactor Regulation Law enacted in 1957, the treatment, storage and discharge of gaseous or liquid radioactive wastes generated at nuclear facilities (the refining facilities, fabricating facilities, reactor facilities, reprocessing facilities, or other utilization facilities of nuclear source material or nuclear fuel material for research or industrial use, etc.) as well as the management and treatment of solid radioactive wastes have been regulated by Reactor Regulation Law on the basis of management at individual plant site.

In 1986, Reactor Regulation Law was amended to allow for a shallow land disposal of low-level radioactive waste. The Reactor Regulation Law prescribed the provision of the following two types of disposal businesses for radioactive waste:

- To carry out the burial disposal of radioactive waste, and
- To carry out the storage of radioactive waste (storage and treatment prior to the final disposal)

Regarding the standard of the final disposal of the radioactive waste, only a part of low-level radioactive waste from nuclear reactor is prescribed in Japan now.

Concerning the high-level radioactive waste, the fundamental policy is that the high-level radioactive waste remaining after the recovery of plutonium, uranium and other useful materials from spent fuel by reprocessing should be solidified in a stable from and, after being stored for 30 to 50 years for cooling, buried under the ground by the geological disposal method.

The Nuclear Safety Commission has concluded in March 1989 the "Principles for Safety Evaluation of Radioactive Waste Management Facilities" from its consideration to licensing review on high-level radioactive waste. Along with these principles, the Science and Technology Agency and the Nuclear Safety Commission conducted a double check on a

license application for a high-level radioactive waste management facility for 30-50 years in vitrified solid form. Vitrified high-level radioactive waste is already stored at a repository.

According to the "Final Disposal of Designated Radioactive Waste" Program, which was issued on October 2, 2000, under the Law on Final Disposal of Designated Radioactive Waste, final disposal will start sometime in the latter half of the 2030's.

The geological disposal is to be performed in four stages:

- Selection of acceptable geological formations (1st stage)
- Selection of the candidate disposal sites (2nd stage)
- Demonstration of disposal technology at the candidate disposal site (3rd stage)
- Construction, operation and closure of the disposal facilities (4th stage)

On the other hand, Radiation Hazard Prevention Law prescribes that radioactive wastes generated during utilization of radioisotopes have been required to be treated, stored and discharged at individual facility, as well as the legal system of Reactor Regulation Law since 1957. However, Radiation Hazard Prevention Law does not prescribe for the land disposal system.

As for the radioactive waste, which occurs with the medical applications, the Medical Care Law etc. (the Medical Care Law, the Clinical Laboratory Technicians and Health Laboratory Technicians Law, and the Pharmaceutical Affairs Law) are applied.

The sea disposal was prohibited in 1994 in accordance with the Convention on the Marine Pollution (London Convention).

3.4.2.2 Organization and Responsibilities for the Waste Management

Regarding the responsibility for treatment and disposal of the waste, it basically lies with the waste generators. The generators who are responsible for disposal shall be required to meet their obligations in that respect in an appropriate and sure manner on the basis of specific working plans and at their own expense.

The national government is responsible for adopting appropriate measures to ultimately ensure that those responsible generators meet their responsibilities concerning the safety. That includes comprehensive formulation of disposal methods, confirmation of the safety of disposal and devising legal and other measures that are necessary for long-term guarantee of meeting of the responsibilities for disposal.

The Ministry of Economy, Trade and Industry (METI) is a competent authority of nuclear administrative functions for energy use. The Nuclear and Industrial Safety Agency (NISA) of METI regulates the safety of nuclear power generation facilities, commercial nuclear fuel cycle facilities and radioactive waste facilities.

The Ministry of Education, Culture, Sports, Science and Technology (MEXT) is a competent authority of nuclear administrative functions for research and development. The Science and Technology Policy Bureau (STPB) of MEXT regulate the safety of research reactor and radiation protection.

The Pharmaceutical and Food Safety Bureau (PFSB) and Health Policy Bureau (HPB) of the ministry of Health, Labor and Welfare (MHLW) regulate, and issue guidance on activities of radioactive waste management facility to ensure the safe management of radioactive wastes produced in medical applications, based on the Medical Care Law, etc.

The Atomic Energy Commission (AEC) and Nuclear Safety Commission (NSC) are in cabinet office independently and properly give directions (if necessary) to the competent authority from higher standpoint. The Nuclear Safety Commission has the authority to plan, deliberate and make decisions on matters concerning the regulation for ensuring safety of atomic energy, of matters concerning the research, development and utilization of atomic energy.

Government organizations related to radioactive management are shown in Fig.3.4-1.

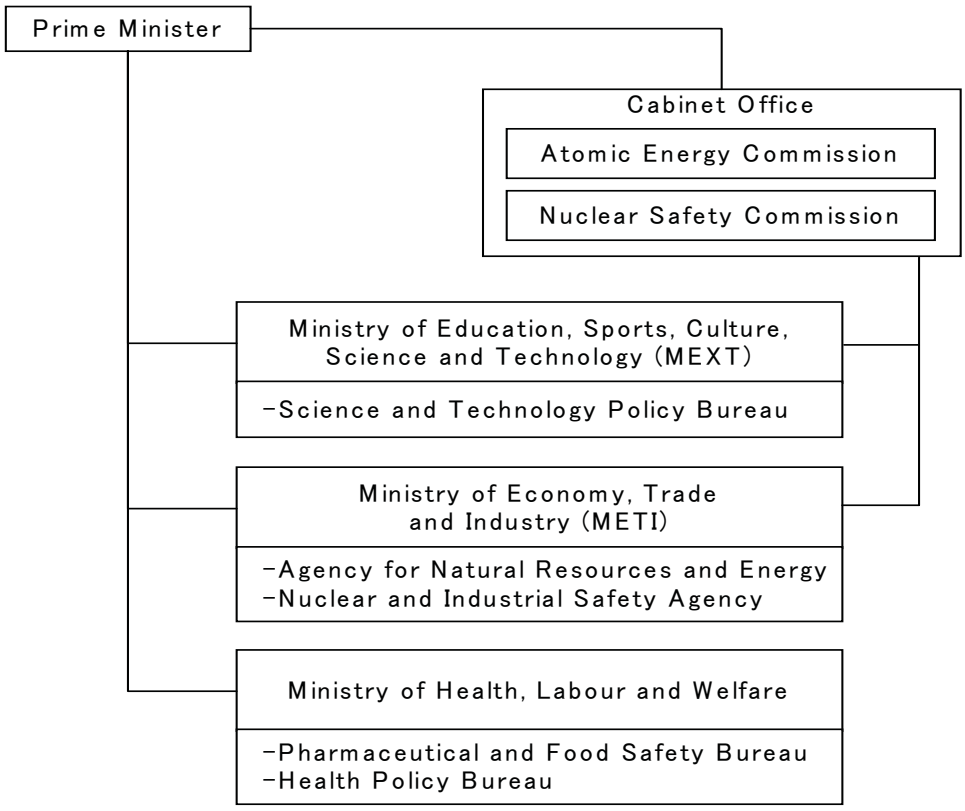

Figure 3.4-1 Gorverment Organizations Related to Radioactive Management in Japan

3.4.2.3 Regulations on Radioactive Waste Management

▪ Regulations on Radioactive Waste Management within the Plant Site:

Generating the radioactive wastes with the business activities of the nuclear business (including commercial nuclear power reactors, fabricating, and other businesses, etc.) operator within the site, the regulations are applied as a part of the regulations concerning each facility. Both of Reactor Regulation Law and Radiation Hazard Prevention Law provide disposal methods based on the properties and types of radioactive waste, as follows.

- **Gaseous radioactive wastes:**
  - ▫ Treat or discharge through ventilation facilities
  - ▫ Stored in tanks capable of preventing radiation hazard, etc.
- **Liquid radioactive wastes:**
  - ▫ Discharge through discharge facilities (including those for discharge into ocean)
  - ▫ Stored in liquid waste storage tanks capable of preventing radiation hazard
  - ▫ Solidify or enclose in a container, which shall be stored in a storage facility capable of preventing radiation hazards, etc.
- **Solid radioactive wastes:**
  - ▫ Incinerate in an incinerator capable of preventing radiation hazards
  - ▫ Solidify or enclose in a container, which shall be stored in a storage facility capable of preventing radiation hazards, etc.

When gaseous or liquid radioactive wastes are discharged, they are continually monitored to ensure that they do not exceed the concentration levels of radioactive materials in the air or water prescribed by law. The operators of each facility are required to reduce radiation doses based on the ALARA (As Low As Reasonably Achievable) principle at the license examination.

▪ Regulations on Radioactive Waste Management Outside the Plant Site:

Managing the radioactive waste outside the site (including transportation outside the plant site), the following measures must be taken:

- The wastes shall be placed in facilities capable of preventing radiation hazards.
- The record of the wastes must be delivered.
- The imported wastes shall be in conformity with the following standards:

  ▫ Those shall be as solidified in a container for the prevention of radiation hazards;
  ▫ Types（including dimension, weight, strength, and generating power, etc）and quantity shall be those as manageable by the waste management equipment concerned

- The radioactive material shall be those as not disperse or leak easily , and
- There shall be no severe damage, etc.

Outside the plant site management of imported waste shall be carried out after the government's prior confirmation that the operations comply with the above measures.

▪ Regulations on Radioactive Waste Management on Disposal Facility

Basic concept of safety regulations for disposal facility is as follows;
The Nuclear Safety Commission had discussed basic concept of the safety regulation of the burial/disposal of low-level radioactive wastes and made a report entitled "Basic Concept for Safety Regulations for Land Disposal of Low Level Solid Radioactive Wastes" in 1985.

Based on this concept, the Radiation Council has issued a recommendation. The recommendation says that it is quite appropriate to adopt the individual radiation dose of 10 μ Sv/year as a target for the release of disposal site from regulatory control. Safety regulation for burial disposal business of radioactive wastes is carried out based on this target. The concept of safety regulations that apply to burial disposal business can be reduced stepwise with time.

The concept of safety regulations at each stage is summarized as follows:

▫ First stage: (10-15 years, until the placement of the cover soils).

In a disposal facility, a peripheral monitoring area where access is controlled, and a disposal facility preservation area where patrol and inspection are conducted, are established. Leakage radioactive materials out of engineered barrier is monitored, and if leakage occurs remedial measures are taken.

▫ Second stage: (30 years, until the cover soils become stable)

In a disposal facility a peripheral monitoring area where access is controlled, and a disposal facility preservation area where patrol and inspection are conducted, are established. Leakage of radioactive materials out of engineered barrier with groundwater to the biosphere is monitored.

▫ Third stage: (300 years, from the end of the first stage)

A disposal facility preservation area where patrol and inspection are conducted is established. Farming and other specific human activities in this area are restricted or prohibited.

▫ Post closure（After 300 years）

People may enter the area

▪ **Regulation Process**

Based on Reactor Regulation Law, an applicant applies for permission of waste disposal to the Minister of METI.

The Atomic Energy Commission and the Nuclear Safety Commission examine the safety examination report and prove its correctness. Then, the minister of METI grants approval. Whenever any modification is made during any of the phases, an application is made to the government to modify the technical specification, at which time the safety considerations are checked again. When the construction is completed and/or facility is closed, the government checks the completion measures. After the construction of the disposal facility, the METI confirms the facility's compliance with the technical standards and approve the start of operation.

All waste to be disposed of needs approval from the competent authorities. To ensure that the waste to be disposed of is within the specified limits, before the transport of the waste to the facility, the authorities check the documentation and measure the radioactivity concentrations of the waste. The waste can be placed in the facility, after the check of the surface concentrations of containers, weight, identification number and label.

Regulation process on disposal of radioactive wastes is shown in Figure 3.4-2.

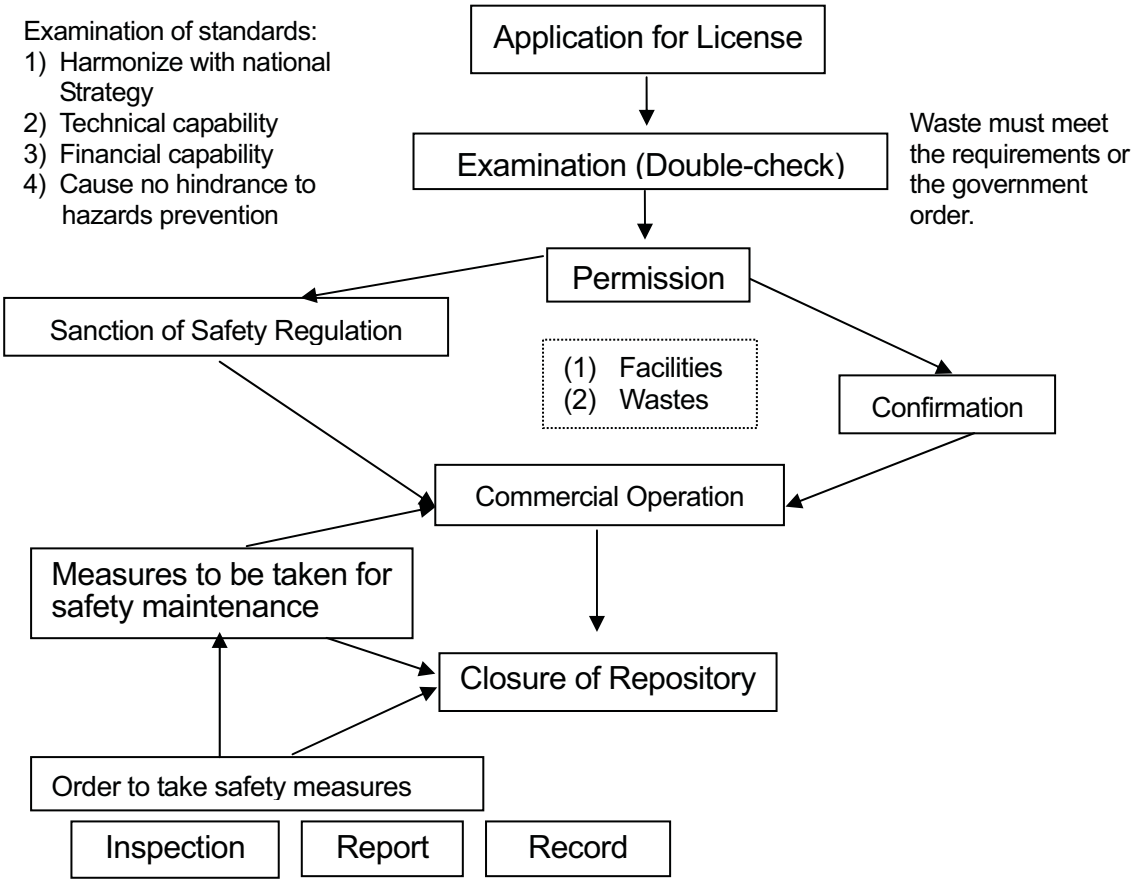

Figure 3.4-2 Regulation Process on Disposal of Radioactive Wastes

3.4.3 Criteria Used to Define and Categorize Radioactive Waste

Radioactive wastes are categorized into two types: high-level radioactive wastes (HLW) and low-level radioactive wastes (LLW). HLW is the high-level liquid waste separated in the reprocessing of spent fuels and its vitrified waste. All wastes other than HLW are LLW.

LLW are further categorized into several types based on the origin of the wastes: power reactor wastes, TRU contaminated wastes, uranium wastes and RI/laboratory wastes. Power reactor wastes are generated from the operation and decommissioning of nuclear power plants. TRU contaminated wastes are generated at overseas/domestic reprocessing plants and MOX fuel fabrication plants. Uranium wastes[1] that are exclusively contaminated with uranium are generated
at front-end facilities such as refining plants, conversion plants, enrichment plants and UO2

[1]) Uranium Wastes means uranium **bearing** wastes, not depleted uranium generated from enrichment down -stream.

fuel fabrication plants. RI/laboratory wastes are generated at the facilities which use radioisotopes, and at research reactors and research laboratories which use nuclear and other radioactive materials.

These LLW from different origins are further grouped into several types based on the composition and level of radioactivity for the purposes of rational waste management and safety of final disposal:

- **Power reactor wastes**
  - Relatively higher LLW with relatively significant amount of β and γ nuclides, such as core internals
  - Relatively lower LLW, such as liquid concentrate
  - Very low-level wastes, such as concrete block

- **TRU contaminated wastes**
  - Ag-adsorbent with high concentration of I-129
  - Hulls and end-pieces with high concentration of C-14
  - Solidified packages of concentrated waste with high nitrate
  - Others

Uranium wastes and RI・laboratory wastes are also grouped into several types based on their characteristics. It should be noted that in RI/laboratory wastes, there exist the wastes which could be categorized into other types.

3.4.4 Radioactive Waste Management Facilities

3.4.4.1 Outline of Radioactive Waste Treatment and Disposal Facilities

The only operational disposal facility for radioactive waste in Japan is Japan Nuclear Fuel Ltd.'s Low-Level Radioactive Waste Disposal Center in the Village of Rokkasho, Aomori Prefecture. It went into service in December 1992, to dispose of low-level waste from nuclear power plants. The center's Disposal Facility 1 has a storage capacity of 200,000 storage drums worth of homogeneous solidified waste, and has received about 137,000 as of September 2006. In October 2000, Disposal Facility 2, able to store 200,000 drums worth of compacted solid waste, commenced operation. The current capacity of Facility 2 is 400,000 200-liter-drums worth, and has received about 53,000 as of September 2006.

Low-level radioactive waste is also stored temporarily at commercial nuclear power plants. Solid waste is first incinerated and compacted, and liquid waste is concentrated, solidified, and treated.

High-level radioactive waste is now being stored and managed at two locations. Japan Nuclear Fuel Ltd.'s Rokkasho Storage Facility in Rokkasho, Aomori Prefecture, stores and manages high-level waste generated during reprocessing overseas. At that facility, every step in the handling and inspection process is remotely controlled, and cooling is via natural ventilation. The current capacity of the facility is 1,440 vitrified packages, which will be doubled in the future. 1,180 packages are stored as of September 2006,.

The Vitrification Facility at the Japan Atomic Energy Agency's Tokai Reprocessing Center in the Village of Tokai, Ibaraki Prefecture, stores vitrified packages of high-level radioactive waste from the center's Tokai Reprocessing Plant; those packages were created in the development of vitrification technology. The current capacity of the facility is 420 vitrified packages. 218packages are stored as of September 2006,.

About 180 research institutes and over 5,000 facilities using radioisotopes (RI) also generate radioactive waste. The Japan Atomic Energy Agency's 's Radioactive Waste Treatment Facility, at the institute's Tokai Research Establishment, is one facility dealing with waste from research institutes, incinerating and compacting solid waste, and evaporating and concentrating liquid waste. RI waste is collected by the Japan Radioisotope Association, which is responsible for its treatment/disposal, and treated and stored at the association's Kaya Memorial Takizawa Research Institute in the Village of Takizawa, Iwate Prefecture. Solid waste is incinerated and compacted, and liquid waste is evaporated, concentrated and stir-dried.

Waste is also stored at facilities operated by the Japan Atomic Energy Agency, which is engaged in R&D on new-type power reactors and nuclear fuel cycle technology. As necessary, solid waste is incinerated, compressed and fused, and liquid waste is evaporated, concentrated, solidified and treated.

Table 3.4-1 Major Radioactive Waste Treatment and Disposal Facilities

Name	Location	Purpose	Characteristics
Rokkasho LLW Disposal Center	Rokkasho-mura, Aomori Prefecture	Burial-disposal of low-level radioactive waste	・Concrete pit installed on seismically stable base rock ・Easy drainage through porous concrete layer inside the pit ・Reduced volume of infiltrating water by compacted bentonite ・Current capacity is 400,000 drums
Rokkasho Storage Facility	Rokkasho-mura, Aomori Prefecture	Storage and management of high-level radioactive waste generated in reprocessing overseas, until final disposal	・Handling and inspection by remote operation ・Vitrified packages cooled by natural ventilation ・Current capacity is 1,440 packages, to be increased to 2,880 packages
JAEA Tokai Vitrification Facility (TVF)	Tokai-mura, Ibaraki Prefecture	Development of vitrification technology, and storage of vitrified packages	・Handling by remote operation ・Forced cooling of vitrified packages ・Storage capacity is 420 packages
Radioactive Waste Treatment Facility of JAEA Tokai Research Establishment	Tokai-mura, Ibaraki Prefecture	Treatment and storage of waste from JAEA Tokai and other institutes	・Incineration, melting and compaction of solid waste ・Evaporation and concentration of liquid waste; cementation or bituminization of concentrated liquid waste ・Storage capacity is 139,000 drum 200-liter equivalent
Japan Radioisotope Association's Kaya Memorial Takizawa Laboratory	Village of Takizawa, Iwate Prefecture	Centralized treatment and storage of RI waste	・Incineration and compaction of solid waste ・Evaporation, concentration and stir-drying of liquid waste
Waste storage facilities at nuclear power plants	Each nuclear power plant site	Treatment and temporary storage of waste from its own plant	・Incinerating and compacting solid waste ・Evaporating, concentrating, and solidifying liquid waste ・Temporary storage of post-treatment waste

3.4.5 Inventory of Radioactive Wastes (RW)

3.4.5.1 Inventory of RW in Storage

- **Low-level Radioactive Waste**

Gaseous radioactive wastes and extremely low-level liquid radioactive wastes generated at nuclear facilities are processed so that their radioactivity is reduced to a level below the standards prescribed by law. They are then released into the atmosphere or sea. Other liquid wastes are concentrated solidified and solid wastes are put into containers (following a volume reduction and solidified. These are then safely stored at the facilities temporary. Table 3.4-2 shows the amount of low-level radioactive wastes.

- **High-level Radioactive Waste**

High-level radioactive waste separated from spent fuel is stored in reprocessing facilities.

- Vitrified HLW : 1,100 packages (as of the end of March 2005)
- High level liquid waste : 400 m^3 (as of the end of March 2005)

3.4.5.2 Inventory of RW in Disposal

Low-level radioactive waste from nuclear power plants, about 170,000* drums were disposed (as of the end of March 2005, measured in 200 liter drum-can equivalents).

* Disposal facility: Disposal in concrete pit, shallow land disposal facility for low-level radioactive wastes. Licensee is The Japan Nuclear Fuel Co.

Very low-level radioactive waste generated from Japan Atomic Energy Research Institute Tokai Research Establishment, 1,670* tons were disposed.

* Disposal facility: Disposal in trench, shallow land disposal facility for very low-level radioactive wastes. Licensee is Japan Atomic Energy Agency (former Japan Atomic Energy Research Institute).

Table 3.4-2 Amount of Low-Level Radioactive Wastes Managed in Nuclear Facilities

Category	Facility	Major Materials	Total Volume[1]
Waste managed in nuclear power plant	Generated by operation and decommissioning of nuclear power reactor	<Generated by operation> Concentrated waste, miscellaneous solid waste, control rod, ion exchange resin, etc. <Generated by decommissioning> Concrete, metal of reactor structure, etc.	About 560,000 (as of the end of Mar. 2005)
Waste containing TRU nuclides	Generated by reprocessing and MOX fuel fabrication	Concentrated waste, miscellaneous solid waste, covering material, ion exchange resin, filter, etc.	About 87,000[2] (as of the end of Mar. 1998)
Uranium waste	Generated by uranium conversion and fabrication and uranium enrichment	Ash, miscellaneous solid waste, filter, etc.	About 81,000 (as of the end of March 1998)
RI waste, research institute and other waste	Generated from facilities using radioisotopes and research institutes and similar entities using nuclear materials	<RI Waste> Paper, plastic, concrete, metal, filter, radiation sources, etc. <Research Institute & Other Waste> Solidified liquid, miscellaneous solid waste, metal, concrete, etc.	<RI Waste> About 109,000 <Research Institute and Other Waste> About 283,000[3] (as of the end of Mar. 1998)

[1] Measured in 200-liter drum-can equivalents

[2] Other waste containing TRU nuclides that from abroad reprocessing are planed to return future

[3] Include some of the waste containing TRU nuclides and Uranium waste

3.4.6 Nuclear Facilities in the Process of Being Decommissioned and the Status of Decommissioning Activities at those Facilities

The regulatory policy for dismantling or decommissioning of reactor facilities has been investigated and discussed, resulting as following three reports;

(1) "Basic Philosophy to Assure Safety for the Dismantling Nuclear Reactor Facilities" (December 1985, Decision by the NSC, revised in August 2001),

(2) "Aiming at Decommissioning of Commercial Nuclear Power Facilities" (January 1997, Nuclear Energy Subcommittee, Advisory Committee for Natural Resources and Energy),

(3) "Philosophy for Safety Assurance and Safety Regulation on the Decommissioning of Commercial Power Reactor Facilities" (August 2001, Decommissioning Safety Subcommittee, Nuclear and Industrial Safety Subcommittee, Advisory Committee for Natural Resources and Energy).

Based on these reports, in order to ensure the safety during the decommissioning of commercial nuclear power reactors, the regulation was implemented by applying existing provisions in the Reactor Regulation Law, such as "notification of dismantling" or "modification of Operational Safety Program, by the operators.

So far, the decommissioning of reactor facilities was implemented at the Power Demonstration Reactor of the Japan Atomic Energy Research Institute (JPDR) and the Tokai Power Station of Japan Atomic Power Co. Inc., etc. and the development and application of dismantling technologies have been progressed, and the know-how for decommissioning have been accumulated through these processes.

Under such a circumstance, in October 14, 2004, the NSC pointed out, that "it is required to investigate the development of a graded approach in safety regulation system to cope with the progress of dismantling processes, as the main activities during the period after the cease of operation are safety management of spent fuels, dismantling works and the radiation control, and handling of radioactive wastes, and the regulatory experiences concerning dismantling and decommissioning of test and research reactors have been accumulated", as the conclusion of the regulatory activities investigation concerning the safety regulation system during the period after the cease of operation of reactor facilities.

The Decommissioning Safety Subcommittee has investigated appropriate regulatory system of decommissioning, based on the regulatory experiences on decommissioning of reactor facilities under the current system, aiming for amendment of legislations, with the principle of ensuring safety.

The investigation is conducted from view points of ensuring transparency of regulations, and graded regulatory approach to cope with the progress of the decommissioning process, the diversity of each facilities, reflecting the experiences of decommissioning, and

development of technology in the near future, and reported in "The Way of the Decommissioning Regulation of the Nuclear Facilities" (December 9, 2004)). In this investigation, the Subcommittee recognized that the decommissioning of nuclear reactors is becoming to a routine, and the amendment of legislation must cope with graded approach by regulatory body and clarification of the responsibilities of operators with the principle of ensuring safety, and it is considered to be important (i) to clarify the requirement in decommissioning regulations, (ii) to keep the transparency on procedures for the operators, and (iii) to obtain in the understanding and confidence of the national people and local residents on decommissioning regulations.

The Subcommittee proposed the way of decommissioning regulations, as;

(1) Replacing “dismantling notification by operator”, to the “approval of the operator’s decommissioning plan of dismantling processes, methods etc. by regulatory body “,

(2) Implementation of the decommissioning as approved in the plan,

(3) Completion of decommissioning is confirmed by regulatory body

(4) After the confirmation of the completion of decommissioning, operator can dismiss the operation license

(5) The regulatory activities during the decommissioning process (example: Periodical Inspections, Nuclear Safety Inspections etc.) should be changed in accordance with the changes of the functions of the facilities and safety operation activities as the decommissioning is proceeded (graded regulatory approach)

In the proposal, it is stated that

(1) The operator apply the decommissioning plan including process of decommissioning, methods of dismantling, method of managing the radioactive waste generated during the dismantling, the safety analysis, financial plan.

(2) Regulatory body reviews the plan on the conformity with technical criteria and approve it.

(3) The operator conduct the decommissioning in accordance with the decommissioning plan, usually the decommissioning takes a long time and consists of several steps, it is allowed to modify the program at the beginning of each step with the prospect that the completion of decommissioning is ensured, following the approval for the modification of decommissioning plan.

The amendment of the Reactor Regulation Law was enacted in May 2005, including the following requirement;

(1) Human and Financial Resources

(2) Radiation Protection at the Decommissioning Stage

(3) Emergency Preparedness

(4) Keeping Records of Information Important to Decommissioning

Nuclear facilities in the process of being decommissioned include Tokai Power Station of the Japan Atomic Power Co., and JRR-2 of JAEA.. Nuclear facilities scheduled to be decommissioned include the advanced thermal reactor Fugen Nuclear Power Plant of JAEA. The status of decommissioning activities, etc. is listed in Tables 3.4-3 and 3.4-4.

Table 3.4-3 List of Nuclear Facilities in the Process of being Decommissioned and Planned to be Decommissioned

Status of Decommissioning Activities at These Facilities

(With Respect to Power Reactors)

Name of facility	**Location**	**Reactor type**	**Electrical output (MW)**	**Commercial operation**	**Status of decommissioning**
Japan Atomic Power Co., Tokai Power Plant	Ibaraki Pref.	GCR	166	Jul 1966 - Mar 1998	Decommissioning started in 2001
Japan Atomic Energy Agency, the advanced thermal reactor Fugen Nuclear Power Station	Fukui Pref.	ATR	165	1979 - Mar 2003	Termination of operation in March 2003. Continue taking out of spent fuels and preparation for decommissioning.

Table 3.4-4 List of Nuclear Facilities in the Process of Being Decommissioned and Planned to be Decommissioned
Status of Decommissioning Activities at These Facilities
(With Respect to Research Reactors)

Name of facility	Location	Reactor type	Thermal output (kW)	Service period*	Status of decommissioning
Japan Atomic Energy Agency, Tokai Research Establishment JRR-2	Ibaraki Pref.	Heavy-water moderated cooling tank reactor	10000	Oct 1960 - Dec 1996	The following activities for decommissioning have been completed. Shipment of spent fuel and heavy water, isolation of reactor cooling system and reactor body, removal of secondary cooling system and experimental equipment.
Japan Atomic Energy Agency, Tokai Research Establishment VHTRC	Ibaraki Pref.	Graphite-moderated reactor	0.01	May 1985 - Jun 1999	Dismantling and removal of the reactor body and leveling of reactor (including resin painting) have been completed.
Japan Atomic Energy Agency, Mutsu Establishment The Reactor Facilities of the First Nuclear Ship (Mutsu)	Aomori Pref	Pressurized light-water moderated and cooled reactor, PWR	36000	Aug 1974 - Feb 1992	Dismantling has been completed. Accessory land facilities are currently being maintained for the purpose of storing solid waste and processing liquid waste .
Japan Atomic Energy Agency, Oarai Engineering Center Deuterium Criticality Assembly (DCA)	Ibaraki Pref.	Heavy-water moderated reactor	1	Dec 1969 - Sep 2001	Deactivation has been completed. Carry out heavy-water and remove cooling system
Hitachi Ltd. Power & Industrial Systems Nuclear System Division Ozenji Hirachi Training Reactor Centor	Kanagawa Pref.	Light-water moderated and cooled reactor	100	Dec 1961 - Feb 1975	Dismantling has been completed. Currently being proceeding are the maintenance of the pool storing spent fuel and the storage and maintenance of radioactive waste.
Musashi Institute of Technology	Kanagawa Pref.	Light-water cooled reactor	100	Jan 1963 - Mar 1985	Under dismantling
Toshiba Corporation Research Reactor Center Toshiba Training Reactor-1 (TTR-1)	Kanagawa Pref.	Light-water moderated inhomogeneous reactor	100	Mar 1962 - Jan 2001	Permanent suspension of operational functions and removal of reactor cooling system facilities. Carry out spent fuel.

Rikkyo University Institute for Atomic Energy	Kanagawa Pref.	Zirconium hydride moderated light-water cooled reactor	100	Dec 1961 - Dec 2001	Extended-shutdown, carry out spent fuel.

3.4.7 Clearance

It must be useful to prepare the regulatory frame on clearance levels and its monitoring and verification procedures for proper waste management in decommissioning; it makes possible to dispose and/or reuse the waste arising from nuclear energy research and decommissioning nuclear facilities.

The Atomic Energy Commission (AEC) issued the report "Policy on Processing and Disposal of Radioactive Wastes" in August 1984 about the concept of the clearance level. In response to the policy, the NSC presented a basic concept of "Materials not requiring consideration of particularities as radioactive wastes" in 1985. Afterwards, the concept, derivation methods, etc. of the "clearance level" were provided in IAEA-TECDOC-855, in January 1996.

In such a situation, the NSC has obtained the clearance level (radionuclides concentrations) using the calculation method considering IAEA-TECDOC-855, and referring to the dose criteria shown in the recommendation by the International Commission on Radiological Protection (ICRP) (Pub. 46, 1985), report of the Radiation Council (1987), report of the NSC (1988), IAEA-TECDOC-855, and other IAEA reports.

The results are reported as "Clearance Level for Major Nuclear Facilities" (March, 1999), "Clearance Level for Heavy Water Reactors, Fast Neutron Reactors, etc." (July, 2001), and "Clearance Level for Nuclear Fuel Use Facilities (Facilities dealing with irradiated fuels and materials" (April, 2003).

In 2004, IAEA issued the Safety Guide "Application of the Concepts of Exclusion, Exemption and Clearance", Safety Standards Series No. RS-G-1.7 (2004). The NSC has made a re-evaluation of the above mentioned three reports on the clearance level taking the latest findings about application concepts of exemption level and evaluation methods shown in RS-G-1.7 into account. The results were issued as a report "Radionuclides Concentrations for Materials not Requiring Treatment as Radioactive Wastes, Generated from Dismantling etc. of Reactor Facilities and Nuclear Fuel Use Facilities" in December, 2004. The NSC concluded that though the former values are comparable to the re-evaluated values, it is necessary to use the latter values since new findings are incorporated. In addition, it was concluded that though the re-evaluated values and the values of exemption level provided in the IAEA safety guide are comparable, it is suitable to use the latter values to keep the international consistency. The Radioactive Wastes Safety Subcommittee of the Nuclear and Industrial Safety Subcommittee also studied this matter and concluded that it is essentially

suitable to use the values of the IAEA safety guide ("Establishment of the Clearance System for Nuclear Facilities (December, 2004)).

Moreover, the Radioactive Waste Safety Subcommittee led conclusions about the validation of clearance level in the report that the party who generated the waste should judge that their waste concerned is below the clearance level, and then, the government should be appropriately involved in the confirmation. The involvement by the government should be composed of two steps, i.e., the first step includes authorization of "methods of measurement for concerned materials and clearance judgment based on the measurement values" prepared by the operator, and the second step includes confirmation that the actual measurements and judgment are properly done by the authorized methods by checking records and by sampling measurement as required.

As the results of these studies, the Reactor Regulation Law was amended in May 2005 to provide for clearance and rule for technical standard of clearance level verification procedure was established in November 2005.

According to the above regulatory system, JAPC submitted licensing application to METI for clearance of 2,000 tons of wastes generated from the dismantling of GCR in June 2006 and was approved in September 2006 for the first time in Japan.

As for the NORM and TENORM, the General Administrative Group of the Radiation Review Council examined the exemption of NORM and reported "Exemption of NORM from Regulations" in October, 2003. In this report, the basic concept on regulation of NORM and classification of NORM-containing substances and response to the substances shown in Table 3.4-5 were described.

Table 3.4-5 Classification of NORM-containing Substances and Proposed Response to the Substances

Category		Cases required for review	Exclusion, Practice or Intervention	Law-based regulation	Action to be taken	Dose target /criteria for action
1	Substances that are not treated to increase a ratio of NORM-containing minerals and ores (Excluding Categories 2, 3, 4, 5, 6)	Garden stone, mineral samples for research and education, mineral samples owned by museums, ores from construction sites and rivers	Exclusion	Not Subject		
2	NORM-containing residues that were disposed of in the past	Residues disposed of from titanium plants or illegally dumped	Intervention	Not Subject	Measures level	Future review (1 to 10mSv/y)
3	Ash and scale generated from industries (raw material substances whose concentration is below an exemption level)	Coal ash (including fly ash), scale from gas and oil fields, slag from steelmaking plants	Intervention	Not Subject	Measures level	Future review (1 to 10mSv/y)
4	Surplus soil form operating mines, residues after industrial use (disposal)	Monazite, bastnaesite (abrasive), zircon, tantalite, phosphorus ore, samarium, uranium ore, thorium ore, titanium ore, coal ash (including fly ash), other raw materials for consumer goods	Practice/ Intervention	Subject	-Identify substances whose concentration could exceed a certain level. -Require proper control for radiation protection in proportion to dose received by workers or the public when specific substances are used.	1mSv/y (Review regulation or intervention if this level is exceeded.)
5	Industrial raw materials (fabrication, energy production, mining)(excluding Category 7)		Practice/ Intervention	Subject	Same as in Category 4	1 mSv/y (ditto)
6	Consumer goods (use)	Spa bathing element, health appliances, bedclothes, clothes, paint, mantel, automobile catalyst, refractor, abrasive, fertilizer, flowers of sulfur	Practice	Consider whether substances are subject to Practice by commodity.	The BSS exemption level is basically applied.	10mSv/y
					Review a system equivalent to type approval.	1mSv/y
7	Nuclear fuel substances and radium sources that were refined for radiation use and substances used as radiation sources	Nuclear fuel materials (uranium and thorium), radium, etc.	Practice	Subject	The BSS exemption level is basically applied.	10 mSv/y
8	Radon	Radon generated from radium sources under regulation	Practice	Subject	The BSS exemption level is basically applied.	—
		Occupational radon in mines for nuclear raw material	Practice	Under the Mine Safety Law	—	—
		Radon in houses and general occupational environment, except radon in the above box	Intervention	Not Subject.	Measures level	Future review