JAPAN
October, 2011

1. NATIONAL FRAMEWORK FOR MANAGEMENT AND REGULATION OF RADIOACTIVE WASTE AND DECOMMISSIONING

1.1 National framework

1.1.1 Overview of national policy

In Japan, disposal of low-level radioactive waste (LLW) originating from nuclear reactor operation has been implemented since 1992. For high-level radioactive waste (HLW), the Designated Radioactive Waste Final Disposal Act (Final Disposal Act), which was enacted by the National Diet on 31 May 2000, defines the procedure for repository site selection, the implementing body and accumulation of funds for the disposal of vitrified waste originating from the reprocessing of spent fuel. Regarding the disposal of other types of radioactive waste such as transuranic (TRU) waste (originating from reprocessing facilities and MOX fuel fabrication facilities), the relevant legislation was amended in 2007 in order to make co-disposal with HLW feasible.

Concerning the disposal of waste generated from research, medical and industrial facilities, including radioisotopes and radiation-generating equipment (referred to as waste from research facilities, etc.), a report documenting the discussions of the Committee on R&D in the Field of Atomic Energy/Subdivision on R&D and Evaluation/Council for Science and Technology was published in September 2006. Based on this report, the Ministry of Education, Culture, Sports, Science and Technology (MEXT) amended the Act on the Japan Atomic Energy Agency(JAEA), Independent Administrative Agency ,) in May 2008, designating JAEA as the implementing organization for disposal of waste from research facilities, etc.

Regarding uranium waste (originating from uranium fabrication facilities), the fundamental concept for safety regulation has not yet been established.

The responsibility for the processing, treatment and disposal of radioactive waste originating from these operations basically lies with the operators themselves.

The Fukushima Dai-ichi Nuclear Power Plant accident※ of Tokyo Electric Power Co. caused by the tsunami associated with the Tohoku District-off the Pacific Ocean Earthquake on March 11, 2011 released radioactive materials into the environment. Nuclear Safety Commission of Japan (NSC) issued “Near-term policy to ensure the safety for treating and disposing contaminated waste around the site of Fukushima Dai-ichi Nuclear Power Plants” on June 3, 2011 as an approach for the immediate future that ensures safety related to the 1) reuse, 2) treatment, transportation and storage, and 3) disposal of wastes affected by this accident. The Act on Special Measures concerning Handling of Radioactive Pollution was enacted by the

※ For the further detail, please go to the following website.
http://www.kantei.go.jp/foreign/incident/index.html
http://www.nisa.meti.go.jp/english/index.html
http://www.tepco.co.jp/en/index-e.html

National Diet on August 26, 2011 in order to reduce the impact of environmental pollution on human health and the environment caused by radioactive materials by instituting measures to be implemented by the national government, local governments and the relevant nuclear power plant operator.

The Japan Atomic Energy Commission (JAEC) began in November 2010 to revise the "Framework for Nuclear Energy Policy" published in October 2005. The new framework takes into consideration the wide range of discussions following the massive earthquake and tsunami and the subsequent nuclear power plant accident and is expected to be published in one year.

1.1.2 Overview of relevant institutions

Japan Nuclear Fuel Ltd. (JNFL) disposes of LLW and stores HLW. The Nuclear Waste Management Organization of Japan (NUMO) was established under the Final Disposal Act on 1 October 2000, as the implementing body for disposal of HLW.

1.2 National regulatory organizations

1.2.1 Regulatory function

The key organizations responsible for regulating nuclear safety are as follows (see Figure 1):

Nuclear Safety Commission of Japan (NSC) under the Cabinet Office (CAO)

- Planning, deliberation and decisions on the basic principles relating to nuclear safety regulation
- Establishment of safety standards
- Review of the results of the safety assessments by regulatory bodies (so-called "double check")

Nuclear and Industrial Safety Agency (NISA), Ministry of Economy, Trade and Industry (METI)

- Regulation of the use of nuclear materials for energy production

Ministry of Education, Culture, Sports, Science and Technology (MEXT)

- Regulation of scientific use of nuclear materials, use of radioisotopes, radiation-generating equipment

Ministry of Land, Infrastructure, Transport and Tourism (MLIT)

- Regulation of transportation of nuclear materials

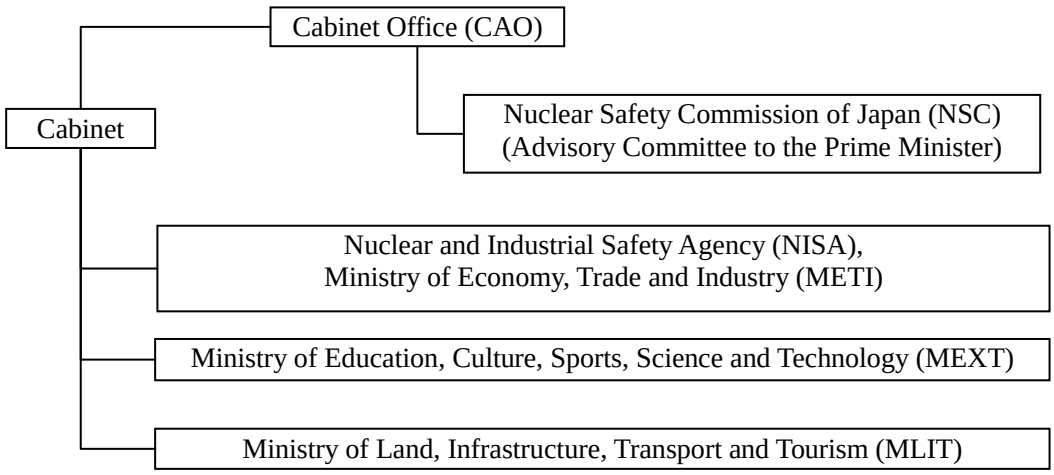


Figure 1 Government Organizations Responsible for Nuclear Safety Regulation

1.2.2 Organizations and resources

The main organizations and resources for regulation of radioactive waste management are as follows (see Figure 2):

Subsequent Regulation Review Division, Secretariat of the Nuclear Safety Commission of Japan (NSC)

- Investigation of basic principles for regulation of radioactive waste management
- Establishment of safety standards for radioactive waste management
- Review of the safety examinations of radioactive waste management facilities by regulatory bodies

Radioactive Waste Regulation Division, Nuclear and Industrial Safety Agency (NISA), METI

- Drafting of regulatory acts and provisions
- Regulation of radioactive waste disposal facilities and storage facilities
- Regulation of off-site radioactive waste management
- Regulation of decommissioning of nuclear facilities

Radioactive Waste Safety Subcommittee, Nuclear and Industrial Safety Subcommittee, Advisory Committee for Natural Resources and Energy, METI

- Investigation of safety policy relating to radioactive waste disposal and storage

Decommissioning Safety Subcommittee, Nuclear and Industrial Safety Subcommittee, Advisory Committee for Natural Resources and Energy, METI

- Investigation of safety policy relating to decommissioning of nuclear installations

Nuclear Safety Division, Science and Technology Policy Bureau, MEXT

- Regulation of management of radioactive waste originating from scientific use of nuclear materials and use of radioisotopes and radiation-generating equipment and decommissioning of research and test reactors.

Technology and Safety Division, Policy Bureau, MLIT

- Regulation of the transportation of radioactive waste

Japan Nuclear Energy Safety Organization (JNES), Nuclear Safety Research Center (NSRC) of the Japan Atomic Energy Agency (JAEA) and the Research Core for Deep Geological Environments (RCDGE) under the National Institute of Advanced Industrial Science and Technology (AIST)

- Implementing regulatory research for NISA

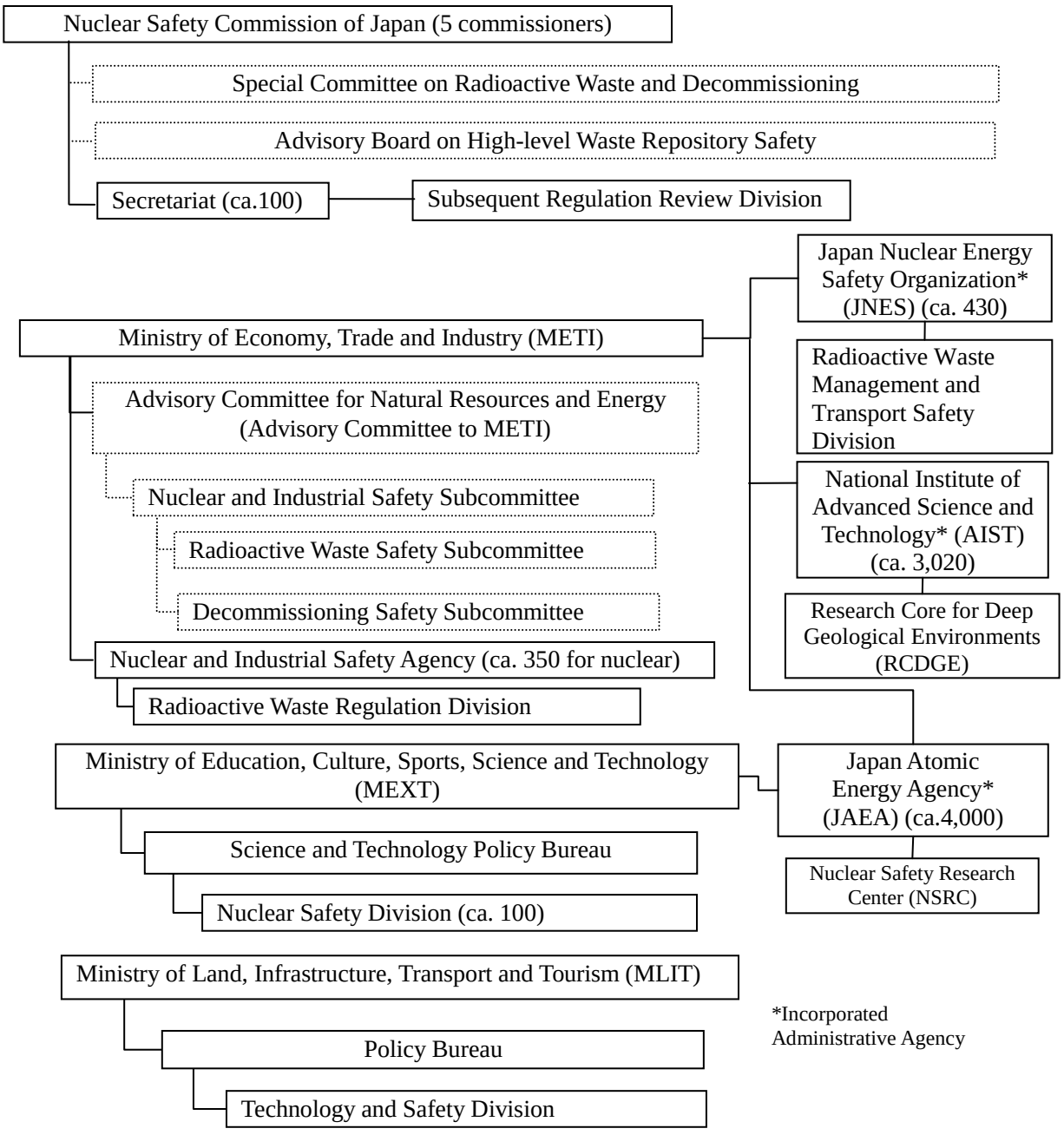


Figure 2 Governmental Organizations Involved in Regulating Radioactive Waste Management (number indicates persons in the organization in total)

1.3 National implementing organizations

1.3.1 Scope of responsibility

The research, development and utilization of nuclear energy in Japan are conducted solely for peaceful purposes in accordance with the Atomic Energy Basic Act. On the basis of this Act, JAEC plans, deliberates and makes decisions on national policies relating to the utilization of nuclear energy for peaceful purposes, including radioactive waste management and decommissioning. In order to clarify the fundamentals for the utilization and development of nuclear energy, the Commission has been formulating "Long-Term Programs" since 1956 and the "Framework for Nuclear Energy Policy" in 2005. Based on the policy set out in these documents, the Agency for Natural Resources and Energy (ANRE) of METI and MEXT establish implementation plans for utilization of nuclear energy for power generation and related fuel cycle activities and for use of nuclear technology in science, technology and radioisotopes.

Near-surface disposal of solidified liquid waste and compacted and solidified non-combustible wastes began in 1992 at the disposal facility of JNFL in Rokkasho Village in Aomori Prefecture.

The nuclear industry established NUMO, the implementing organization for HLW disposal approved by the government, on the basis of the Final Disposal Act.

JAEA is designated as the implementation organization for disposal of waste from research facilities, etc.

1.3.2 Organizations and resources

The main organizations and resources for the implementation of radioactive waste management are as follows:

Japan Atomic Energy Commission (JAEC) under the Cabinet Office (CAO)

- Establishment of basic policy on atomic energy based on the Atomic Energy Basic Act since 1956 and the Framework for Nuclear Energy Policy of 2005

Agency for Natural Resources and Energy (ANRE), Ministry of Economy, Trade and Industry (METI)

- Implementation of policy for management of radioactive waste from nuclear power plants

Atomic Energy Division, Research and Development Bureau, Ministry of Education, Culture, Sports, Science and Technology (MEXT)

- Implementation of policy for management of radioactive waste from research facilities, etc.

Japan Nuclear Fuel Ltd (JNFL)

- License-holder for near-surface disposal of low-level radioactive waste

Nuclear Waste Management Organization of Japan (NUMO)

- Implementation of geological disposal of HLW and TRU waste in the future

Geological Isolation Research and Development Directorate (GIRDD), Japan Atomic

Energy Agency (JAEA)

- Implementation of disposal of waste from research facilities, etc. in the future

2. LEGAL FRAMEWORK

2.1 Primary legislation and general regulations

The framework for the regulation of nuclear activities is provided by the following:

The Atomic Energy Basic Act (Basic Act):

Basic policy (peaceful use, safety assurance, democratic management, autonomous activities, publication of results)

The Act on Regulation of Nuclear Source Material, Nuclear Fuel Material and Reactors (Reactor Regulation Act):

Ensures the peaceful and safe use of nuclear source materials, nuclear fuels and nuclear reactors

The Act on Prevention of Radiation Disease due to Radioisotopes, etc. (Radiation Disease Prevention Act):

Regulation of radioisotopes and radiation-generating equipment

2.2 Regulations concerning specific activities or facilities

No site-specific regulations exist in Japan.

2.3 Guidance on implementation

Rules and standards are established for each nuclear facility under the Reactor Regulation Act. Safety regulatory guidelines established by the NSC are used to conduct safety assessments for a nuclear facility. In addition, appropriate academic society and association standards are used if necessary.

2.3.1 Radioactive waste management

Fundamental guidelines for licensing review of the land disposal facility for LLW

Basic philosophy for assessing the safety of waste management facilities

Guidelines and rules of the Atomic Energy Society of Japan: Measurement method for sorption distribution coefficient - basic batch method for barrier materials for near-surface disposal

2.3.2 Decommissioning

Safety Regulatory Guideline of the NSC: Basic guides for safety review on dismantling of nuclear reactor installations

Guidelines and rules of the Atomic Energy Society of Japan: Planning of the decommissioning of nuclear facilities, 2009

3. WASTE MANAGEMENT STRATEGY AND CURRENT PRACTICE

3.1 Waste classification and volumes

The volumes of stored radioactive wastes are as follows:

Waste category		Cumulative waste volumes as of March 2011
High-level radioactive waste (vitrified waste)		1,703 canisters (vitrified waste) 380 m^3
Long half-life, low heat-production radioactive waste		110,277 drums (200L) 4,009 m^3
Waste generated by nuclear reactors	Waste from core structures (relatively higher-level waste)	control rods: 8,590 channel boxes :47,471
	Low-level waste (relatively lower-level waste)	504,297 drums (200L) at nuclear power plants 229,147 drums (200L) disposed of at the Rokkasho Disposal Facility
	Very low-level waste	1,670 t disposed of at JAEA's Tokai site
Uranium waste		49,066 drums (200L)
Waste from research facilities, etc.		approximately 560,000 drums (200L)

3.2 Waste management strategy

In its Long-Term Program and other documents, JAEC states that the current generation, which receives the benefits of nuclear energy is obliged to do its utmost to ensure the safe disposal of the radioactive waste generated by the research, development and utilization of nuclear energy and should invest continued efforts in achieving this goal, that the waste producers have the primary responsibility for safe processing and disposal of the waste and that the government has responsibility for taking the necessary measures to ensure that processing and disposal are carried out appropriately and safely by the producers, through providing adequate guidance and establishing the necessary regulations. Furthermore, JAEC states that the government should play an appropriate role in implementing the disposal program for radioactive waste, particularly HLW, and ensuring long-term safety, in addition to its activities related to promotion of research and development activities and safety regulation.

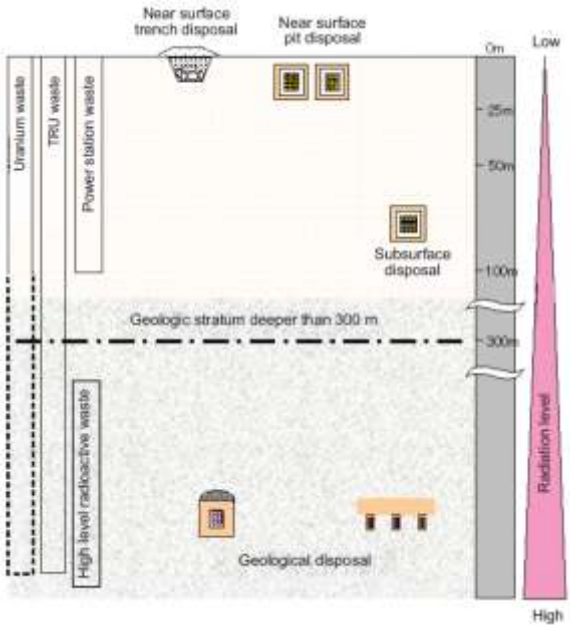
3.3 Waste management issues at the national level

METI and MEXT have established, and continued to improve, the legal framework consisting of the Reactor Regulation Act and the Radiation Disease Prevention Act for safe processing, storage and disposal of radioactive waste, on the basis of studies and decisions made by JAEC and the NSC. Among these regulations, criteria for gaseous and liquid radioactive waste discharges have been established in accordance with relevant international recommendations. Solid radioactive waste is classified into two categories, namely HLW (liquid waste generated from spent fuel reprocessing and its vitrification) and LLW. LLW is sub-classified according to origin (differing radionuclide composition) and level of radioactivity. The Reactor Regulation Act was amended in May 2005 to provide clearance levels and

procedures for verification and the relevant regulations are under amendment.

JAEC makes decisions on the basic policy for radioactive waste disposal. Based on this, the NSC decides on the basic concepts for safety regulations for land disposal, upper limits of radioactivity concentrations for disposal of radioactive materials and methods for safety assessment of disposal facilities. METI and MEXT establish relevant regulations.

A summary of the basic concepts for radioactive waste disposal is provided in the following diagram:



Quoted from "Government of Japan, Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, National Report of Japan for the Fourth Review Meeting, Oct. 2011, p.184."

There are two basic concepts for land disposal, namely "geological disposal" and "near-surface and subsurface disposal with institutional control". Near-surface and subsurface disposal consists of near-surface disposal with engineered barriers (concrete pits), near-surface disposal without engineered barriers (trench) and subsurface disposal (disposal at a sufficient depth to ensure a safety margin from conventional underground construction). HLW is disposed of solely by geological disposal and LLW can be disposed of either by geological disposal or near-surface and subsurface disposal with institutional control, depending on the properties of the waste. Vitrified HLW is emplaced in a stable geological formation at a depth of more than 300 meters, following 30 to 50 years of interim storage to allow cooling. For LLW from power reactors, relatively higher-level waste is disposed of in subsurface disposal facilities, relatively lower-level waste is disposed of in near-surface disposal facilities with engineered barriers and very low-level waste is disposed of in near-surface facilities without engineered barriers. Radioactive waste containing transuranic nuclides from reprocessing, uranium waste from enrichment and/or fuel manufacturing and waste from research facilities, etc. are disposed of either by geological disposal or near-surface and intermediate depth disposal with institutional control, depending on types of radionuclides and levels of radioactivity. In the future, discussions will continue on measures that can be taken to accommodate different disposal methods within a single disposal facility or to co-dispose of wastes of different origin in a single disposal facility.

Concerning the regulations for disposal of LLW from reactor facilities, the upper limits of radioactivity concentration for separating higher concentration "Category 1" waste (geological disposal) from lower concentration "Category 2" waste (near-surface and subsurface disposal) to be applied for licensing of radioactive waste disposal have already been established on the basis of the Reactor Regulation Act. Radioactive waste returned from overseas reprocessing is to be disposed of together with waste from domestic reprocessing.

The Final Disposal Act, enacted in the year 2000, provides for the establishment of the implementing organization for disposal of HLW, the financial reserves for disposal and the procedure for selecting a disposal site. The nuclear industry established NUMO, the implementing organization for HLW disposal approved by the government, on the basis of the Act.

3.3.1 Issues and priorities

The most pressing current issue is the establishment of national safety standards, legislation and provisions for disposal of radioactive waste as shown below:

HLW

Development of the safety regulation system for final disposal of radioactive waste under the Reactor Regulation Act as amended in June 2007. The Subcommittee for Radioactive Waste Safety under the Nuclear and Industrial Safety Subcommittee of the Advisory Committee for Natural Resources and Energy issued a report titled "On the Safety Regulation of Geological Disposal of High-Level Radioactive Waste (January 2008)." This report prescribes the technical standards for high-level waste disposal facilities and waste packages, measures for maintaining facility safety, periodic safety review and the steps for closing the facility.

NSC's Advisory Board on High-level Waste Repository Safety issued the report on "Safety Communication on Geological Disposal" in January 2011. This report is based on the Committee's recognition that it is important, in confidence building of the safety of geological disposal, to establish a safety communication system, which enables stakeholders or their representatives to participate in the process to establish the confidence in long-term safety, as well as a regulatory framework that fully takes account of ensuring the robustness of long-term safety functions of waste disposal facilities.

LLW containing relatively high radioactivity concentrations (e.g. reactor core internals) and other LLW

The Subcommittee for Radioactive Waste Safety also discussed the safety regulation system for subsurface disposal and issued a report titled "On the Safety Regulation of Subsurface Disposal of Low-Level Radioactive Wastes" in January 2008. Concerning waste from core structures, the report prescribes the disposal depth, requirements for design and construction of facilities, technical standards for waste packages, periodic safety review, monitoring and record-keeping. In addition, in March 2008, the Subcommittee issued a report titled "On the Safety Regulation of the Near-Surface Disposal of Low-Level Radioactive Wastes". The report contains the results of a study on the technical standards for near-surface disposal of low- and very low-level radioactive waste.

NSC issued the "Policy of the Safety Assessment of Sub-surface Disposal after the Period

for Active Control" in April 2010, which incorporated risk-based safety assessment in order to appropriately address uncertainties in the long-term prediction after the period for active control. NSC also issued the "Basic Guide for Safety Review of Category 2 Radioactive Waste Disposal" in August 2010, by adding the safety assessment of sub-surface disposal to the safety assessment of near surface disposal of low level radioactive waste which was already in practice in Japan.

In response to the above discussions and studies, NISA developed the safety regulation system for the disposal of HLW, streamlined the existing safety regulations for radioactive waste disposal and established the following: "Rules for Category 1 Wastes consisting of Nuclear Fuel Materials or Materials Contaminated with Nuclear Fuel Materials" as the basis for safety regulation for geological disposal of HLW and "Rules for Category 2 Wastes consisting of Nuclear Fuel Materials or Materials Contaminated with Nuclear Fuel Materials" as the basis for safety regulation for subsurface disposal and near-surface disposal of LLW.

3.3.2 Developments in policy and regulations

See Table 1.

3.4 Research and development

3.4.1 Research infrastructure

Concerning R&D in the implementing phase, JAEC specified the framework in the national policy document "Framework for Nuclear Energy Policy" issued in October 2005 (provisional translation can be found at http://www.aec.go.jp/jicst/NC/tyoki/taikou/kettei/eng_ver.pdf). Following this R&D framework, METI states in its basic policy that:

- NUMO is responsible for conducting R&D on safe implementation of geological disposal with improved technology from economic and practical perspectives.
- The government and relevant research organizations including JAEA should proceed with R&D for establishing the safety regulation framework, other fundamental R&D related to increasing confidence in repository technology and improving the methodology for safety assessment and geoscientific studies.

To establish a sound basis on which to build a sufficient level of public confidence, it is essential for the technical community to be confident in the engineering feasibility as well as in the long-term safety of the geological disposal system. This can be achieved by conducting well designed and quality controlled R&D activities and integration of the results into the collective confidence of the technical community as a whole.

With a substantial amount of experience and expertise in this field, GIRDD/JAEA continues to be responsible for R&D activities aimed at enhancing the reliability of repository technology and establishing safety assessment methodologies and relevant databases. In this connection, the demonstration of site characterization methodology from the ground surface in two ongoing underground research laboratory (URL) projects (at Mizunami and Horonobe) is essential for supporting NUMO's program, as well as for establishing relevant regulatory infrastructure at an early stage. Basic studies and experiments to be conducted in the experimental facilities ENTRY, QUALITY and NUCEF will contribute to better understanding of the observed phenomena in the two URLs.

Apart from GIRDD/JAEA, other organizations such as the Radioactive Waste

Management Funding and Research Center (RWMC), the Central Research Institute of the Electric Power Industry (CRIEPI), the National Institute of Advanced Industrial Science and Technology (AIST) and the National Institute of Radiological Science (NIRS) are also promoting R&D to support government policy-making, formulation of regulations and implementation of the HLW disposal program. In July 2005, a "Coordination Executive" was established to maximize the output from these R&D organizations, including GIRDD/JAEA. The Executive is comprised of senior members of the R&D organizations and is managed by ANRE of METI. The regulator, its associated R&D organizations and NUMO participate as observers. From April 2009, NUMO has become a member of the Executive to allow it to take a more active lead in the national R&D program.

NUMO has prepared the so-called 2010 Report documenting its progress in technical developments since 2000. The report also presents the safety policy that describes how NUMO aims to achieve safe geological disposal through the long-term project. The draft of the report was published for review by both national and international experts. The final version reflecting the review comments was posted on the NUMO website (http://www.numo.or.jp), with the title "Safety of the Geological Disposal Project FY2010", in September 2011. As the 2010 Technical Report does not include the lessons learnt from the Tohoku Earthquake. NUMO decided to carry out additional evaluations for ensuring operational and post-closure safety of the geological disposal facility with respect to natural events.

Infrastructure for regulatory research exists independently under NISA, which promotes regulatory research in cooperation with the Japan Nuclear Energy Safety Organization (JNES), the Nuclear Safety Research Center (NSRC) of JAEA and the Research Core for Deep Geological Environments (RCDGE) of AIST.

Contracts from NISA of METI and/or JNES have been awarded to JAEA and AIST for operation of NSRC/JAEA and RCDGE/AIST. These two bodies prepare plans on the approach and need for work to be performed. Their work is reviewed two to three times a year by assessment boards consisting of specialists in different areas of science and technology. NISA's standing subcommittee (Radioactive Waste Safety Subcommittee) also checks these activities.

3.4.2 Contents of R&D plans

The Coordination Executive issued a comprehensive R&D program in 2006 to provide a solid technical basis for supporting both NUMO and the safety regulatory organizations throughout the geological disposal project. This program integrates all relevant R&D activities carried out by member organizations in terms of development and demonstration of the methods and techniques for site investigation and evaluation, repository engineering and the technology and tools for safety assessment. Taking into account the progress of the geological disposal project, this R&D program is periodically reviewed by independent experts, e.g. from universities, to provide timely input to NUMO and the regulatory organizations.

The regulatory bodies NSC and NISA have introduced research programs on nuclear safety, independent of the Coordination Executive's comprehensive R&D program. The regulatory bodies' research programs cover low- and high-level radioactive waste and decommissioning of nuclear facilities.

The NSC published its report "Prioritized Nuclear Safety Research Plan (Second Term)" in August 2009. The NSC developed the safety research strategy and identified important research to be conducted intensively over five years starting in 2010. The topics of the research on waste disposal include developing site characterization methodologies, establishing the fundamental concept for safety assessment and developing safety assessment methodologies and

the underlying scientific basis. The topics of the research on decommissioning include inventory estimation, developing methods for assessing the safety of workers and the public during dismantling and establishing fundamental concepts for site closure.

NISA has promoted regulatory research since 2001 in cooperation with JNES, RCDGE/AIST and NSRC/JAEA. Based on its needs, NISA funds regulatory research aimed at establishing safety criteria and maintaining and developing the safety regulatory infrastructure. NISA has discussed regulatory research and its implementation in the Radioactive Waste Safety Subcommittee since October 2008, and issued the "Regulatory Support Research Plan on Radioactive Waste Management (FY2010-2014)" in October 2009.

The main contents of the Plan are research supporting the technical review of the results of stepwise site investigations (preliminary and detailed investigations), research to establish fundamental requirements including safety design and the basic concept of safety assessment, and to support technical assessments for licensing applications, the draft of the "Regulatory Research Report on Geological Disposal" and transmission of its contents to international communities such as the IAEA and OECD/NEA, establishment of a quality assurance system for data for safety regulation and so on.

"The Regulatory Research Report on Geological Disposal" represents the regulatory status for geological disposal and will be published in accordance with the progress of implementation of the disposal project. The report is also expected to make communication between the regulatory body and the implementer transparent and to promote public understanding of the safety regulation of geological disposal.

Regulatory research on decommissioning has also been planned by the Decommissioning Safety Subcommittee since February 2009 and the "Regulatory Support Research Plan on Decommissioning (FY2010-2014)" was issued in October 2009.

The main contents of this Plan are research on the decommissioning program for using facilities for nuclear materials, research on termination of decommissioning, research on appropriate control of decommissioning waste and so on.

3.5 Financing of radioactive waste management

When granting the operating license for a nuclear facility, except for facilities for the use nuclear fuel materials, the regulatory body confirms, in accordance with the Reactor Regulation Act, that the applicant possesses the necessary financial basis.

The applicant has to submit an activity plan that explains the financial basis of the activities.

In addition, the electricity utilities have been placing monies to be used for spent fuel reprocessing from electricity sales in a fund administered by an agency designated by METI in accordance with the "Act on the Deposit and Administration of Funds for Reprocessing of Spent Fuel from Nuclear Power Generation" of May 2005. The total funds deposited by 10 electricity utilities amounted to around 2,400 billion yen at the end of March 2011.

In accordance with the Final Disposal Act enacted in May 2000, the operators of power reactor facilities provide funds for geological disposal of radioactive waste to NUMO, who entrusts management of the funds to RWMC. Every year, METI notifies the utilities of the

amount of money to be deposited in the fund. The cost of construction of a repository and disposal of 40,000 packages of vitrified HLW is estimated to be around 3 trillion yen. The amount of money deposited with RWMC at the end of March 2011 was about 800 billion yen.

For the disposal of waste from research facilities, etc., the waste producers must finance disposal under the polluter pays principle, as set forth in the Framework for Nuclear Energy Policy. The largest generator of the above waste, JAEA, initiated funding for disposal based on the amendment of the Act on the Japan Atomic Energy Agency, Independent Administrative Agency in June 2008. The amount of the budget for fiscal year 2010 is about 4.3 billion yen.

4. DECOMMISSIONING STRATEGY AND CURRENT PRACTICE

4.1 Decommissioning strategy

JAEC states that nuclear facilities should be decommissioned safely at the responsibility of the license-holder with the understanding and support of local communities and also that generation of radioactive waste should be minimized. JAEC promotes research and development efforts aimed at recycling and/or reusing waste and, after decommissioning of commercial power reactors, the land is expected to serve as sites for new nuclear power plants, again with the understanding of the affected communities.

4.2 Status of decommissioning projects

The list of commercial nuclear power reactors in the process of being decommissioned and planned to be decommissioned is as follows:

Name of facility	Location	Reactor type	Electrical output (MW)	Commercial operation	Status of decommissioning
Japan Atomic Power Co., Tokai Power Plant	Ibaraki	GCR	166	July 1966 - March 1998	Decommissioning started in 2001 and the decommissioning plan was approved in June 2006. All the fuel was shipped to the UK in June 2001. Dismantling in the non-reactor area is ongoing. Decommissioning will be completed by FY 2017.
Japan Atomic Energy Agency, Fugen Decommissioning Engineering Center	Fukui	ATR	165	March 1979 - March 2003	The spent fuel was removed from the core and placed in the storage pool. It is currently being transferred to the Tokai reprocessing center. The decommissioning plan was approved in February 2008 and dismantling in the non-reactor area is ongoing. Decommissioning will be completed by FY 2028.
Chubu Electric Power Co., Hamaoka NPS Unit-1	Shizuoka	BWR	540	March 1976 - Jan. 2009	In preparation for decommissioning. The decommissioning plan was submitted in June 2009 and approved in November. Decommissioning will be completed by around FY2036.
Chubu Electric Power Co., Hamaoka NPS Unit-2	Shizuoka.	BWR	840	Nov. 1978 - Jan. 2009	

(As of the end of March 2011)

The list of research reactor facilities in the process of being decommissioned or planned to be decommissioned is as follows;

Name of facility	Location	Reactor type	Thermal output (kW)	Service period	Status of decommissioning
Japan Atomic Energy Agency Tokai Research and Development Center Nuclear Science Research Institute, JRR-2	Ibaraki	Heavy-water moderated cooling tank reactor	10,000	Oct. 1960 - Dec. 1996	The following decommissioning activities 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 and Development Center Nuclear Science Research Institute, VHTRC	Ibaraki	Graphite moderated reactor	0.01	May 1985 - June 1999	Dismantling and removal of the reactor body and leveling of reactor (including resin coating) have been completed.
Japan Atomic Energy Agency Mutsu Office Reactor Facilities of the First Nuclear Ship (Mutsu)	Aomori	Pressurized light-water moderated and cooled reactor, PWR	36,000	Aug. 1974 - Jan. 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 O-arai Research and Development Center Deuterium Critical Assembly (DCA)	Ibaraki	Heavy-water moderated reactor	1	Dec. 1969 - Sep. 2001	Deactivation has been completed. Removal of heavy-water and cooling system.
Hitachi Ltd. Power & Industrial Systems, Nuclear System Division Ozenji Hitachi Training Reactor Center Hitachi Training Reactor (HTR)	Kanagawa	Light-water moderated and cooled reactor	100	Dec. 1961 - Feb. 1975	Dismantling has been completed. Currently ongoing are maintenance of the spent fuel storage pool and storage of radioactive waste.
Toshiba Corporation Research Reactor Center Toshiba Training Reactor-1 (TTR-1)	Kanagawa	Light-water moderated inhomogeneous reactor	100	March 1962 - March 2001	Permanent suspension of operational functions and removal of reactor cooling system facilities. Removal of spent fuel.
Tokyo City University (former Musashi Institute of Technology) Atomic Energy Research Laboratory	Kanagawa	Zirconium hydride moderated light-water cooled reactor	100	Jan. 1963 - March 2004	Extended shutdown, removal of spent fuel.
Rikkyo University Institute for Atomic Energy	Kanagawa	Zirconium hydride moderated light-water cooled reactor	100	Dec. 1961 - Dec. 2001	Extended shutdown, removal of spent fuel.
YAYOI Reactor of the University of Tokyo	Ibaraki	Uranium fuel air-cooled fast reactor	2	April 1971 - March 2011	Termination of operation at the end of 2011.

(As of the end of March 2011)

4.3 Decommissioning issues at a national level

The Framework for Nuclear Energy Policy issued by JAEC states that it is important to carry out decommissioning of nuclear facilities such as commercial power reactors, experimental research reactors and nuclear fuel cycle facilities, ensuring safety and at the operator's own responsibility, in accordance with the revised Reactor Regulation Act and observing government regulations. The understanding and cooperation of local communities has to be obtained.

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

"Basic Guides for Safety Review on Dismantling of Nuclear Reactor Installations" (December 1985, NSC, revised in August 2001)

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

"Philosophy for Safety Assurance and Safety Regulation of 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, and in order to ensure safety during the decommissioning of commercial nuclear power reactors, regulations were implemented by applying the existing provisions in the Reactor Regulation Act, such as “notification of dismantling” or “modification of the operational safety program by operators”.

So far, the decommissioning of reactor facilities has been implemented at the Power Demonstration Reactor (JPDR) of JAEA and the Tokai Nuclear Power Plant of Japan Atomic Power Co. Inc. Development and application of dismantling technologies has progressed and the know-how for decommissioning has been accumulated through this work.

Under such circumstances, NSC pointed out on October 2004, that it is required to investigate the development of a graded approach in safety regulation system in accordance with the progress of dismantling processes, considering that the main activities during the period after the termination of operation are safety management of spent fuels, dismantling works and the associated radiation control and handling of radioactive wastes, and that the regulatory experience 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 termination of operation of reactor facilities.

The Decommissioning Safety Subcommittee has investigated appropriate regulatory systems for decommissioning, based on regulatory experience with decommissioning of reactor facilities under the current system. The investigation was conducted on using a graded regulatory approach to deal with the progress of the decommissioning activities, the diversity of the facilities and development of technology in the near future. The results are reported in "The Development of Decommissioning Regulations for Nuclear Facilities" (December 9, 2004).

The Subcommittee recognized that the decommissioning of nuclear reactors was becoming a routine activity and the amendment of legislation had to address a graded regulatory approach and clarification of the responsibilities of license-holders. It was considered important (i) to clarify the requirements for decommissioning regulations, (ii) to maintain transparency in

procedures for the operators and (iii) to obtain the understanding and confidence of the national public and local residents on decommissioning regulations.

The Subcommittee proposed the way forward for decommissioning regulations as:

- replacing "dismantling notification by license-holder" with "approval by the regulatory body of the license-holder's decommissioning plan and dismantling processes and methods"
- implementing decommissioning as approved in the plan
- demonstrating that completion of decommissioning has been confirmed by the regulatory body; after confirmation of the completion of decommissioning the operating license becomes invalid
- demonstrating that the regulatory activities during decommissioning (e.g. periodical inspections, nuclear safety inspections) have been modified in accordance with the change in the function of the facilities and of the activities for safe operation as decommissioning proceeds (graded regulatory approach).

On the basis of this recognition, the Reactor Regulation Act was amended in May 2005 and the safety regulations for decommissioning of reactors and other facilities were updated. In response to the amendment of the Act, the Enforcement Ordinance for the Reactor Regulation Act and related ministerial ordinances (rules for refineries, commercial power reactors, reactors in the development stage, research reactors, fuel fabrication facilities, spent fuel storage facilities, reprocessing plants, waste disposal, waste storage and use of nuclear materials) were amended in November 2005 and came into force in December of the same year.

The above amendment of the legislation and regulations clarified the legal process for decommissioning. A license-holder applying for approval of decommissioning has to submit a decommissioning plan that describes the facility to be dismantled and the dismantling method, the transfer of nuclear fuel materials, removal of contamination from nuclear fuel materials, management of nuclear fuel materials or materials contaminated with nuclear fuel materials, the process of decommissioning activities, radiation exposure control, safety assessment, systems with functions to be maintained, their performance, financial plans and the organization of implementation. The regulatory body approves the decommissioning plan after examining its conformity with the technical standards. In the final stage of decommissioning, the license-holder submits a document that describes the status of dismantling, transfer of nuclear fuel materials, removal of contamination with nuclear fuel materials, management of nuclear fuel materials or materials contaminated with nuclear fuel materials and final distribution of contamination with nuclear fuel materials and requests the regulatory body's confirmation. Decommissioning is completed after the regulatory body confirms that measures for prevention of radiation hazard are no longer necessary and management of nuclear fuel materials or materials contaminated with nuclear fuel materials is complete.

In addition, a staged regulatory system was introduced. For example, the annual periodical facility inspection by the government is no longer conducted when nuclear fuel materials have been removed from the facility.

4.4 Research and development

4.4.1 Research infrastructure

NISA is promoting regulatory research on decommissioning in cooperation with JNES; the latter implements safety research on decommissioning of nuclear fuel cycle facilities and

reactor facilities in area regulated by NISA.

JAEA is also responsible for research activities on decommissioning of nuclear fuel cycle facilities and reactor facilities.

4.4.2 Contents of R&D plans

JNES has been carrying out a safety research program titled “Study on Standardization of Decommissioning”. This program consists of (1) a study of decommissioning of nuclear fuel cycle facilities, (2) a study of decommissioning of reactor facilities, (3) a study of termination of decommissioning including site release and (4) a study of appropriate control of decommissioning waste.

JAEA has been implementing decommissioning research such as safety evaluation methods for nuclear fuel cycle facilities, reactor facilities and site release measurement methods; this work is partly financed by JNES.

4.5 Financing

Regarding the financial basis for decommissioning of nuclear installations, METI issued a Ministerial Order under the Electricity Utilities Industry Act on the reserves to be set aside for decommissioning of nuclear power generation facilities. Based on the Ministerial Order, electricity utilities set aside internal reserves for decommissioning to meet the costs of dismantling and removal of commercial power reactor facilities and the costs of processing and disposal of the waste from decommissioning. The amount of reserves at the end of March 2011 was around 1,700 billion yen from 10 electricity utilities.

The financial basis of the license-holder for use of nuclear fuel materials has to be confirmed through procedures applied to approve the Operational Safety Program and the steps to be taken at the time of decommissioning.

Table-1 Classification of basic concepts for disposal and status of activities for preparing relevant regulations

Classification			JAEC: Disposal method	JAEC: System and Responsibility	NSC: Fundamental concept of safety regulation		NSC: Upper bound of radioactive waste disposal		NSC: Safety review guidelines	Legislation etc. on safety regulations: Law	Legislation etc. on safety regulations: Government order	Legislation etc. on safety regulations: Rules
High level radioactive waste			**Completed** "Policy on processing and disposal of radioactive wastes" (Interim Report) (August 1984) "Basic policy toward disposal of high level radioactive wastes" (May 1998)		**Completed** asic policy of safety regulation on high level radioactive waste disposal " (November 2000) "Environmental requirements to be considered at the selection of the preliminary investigation areas for high level radioactive waste disposal" (September 2002) "Licensing procedure relating to the safety regulation of specified radioactive waste disposal and involvement of Nuclear Safety Commission in these activities" (Interim Report) (May 2007) "Safety communication on the Geological Disposal" (January 2011)	**Completed** Commonly Important Issues for the Safety Regulations of Radioactive Waste Disposal,(June, 2004).		**Future discussion**	The Reactor Regulation Act* Radiation Disease Prevention Act	**Published** "Enforcement Ordinance for the Reactor Regulation Act" (April 2008)	**Published** "Rules for category 1 waste disposal for nuclear fuel material or material contaminated with nuclear fuel material" (April 2008)
Low- level radioactive waste	Long Half Lives Low Heat Radioactive Waste (TRU waste)		**Completed** "Basic policy of processing and disposal of radioactive wastes containing transuranic nuclides" (March 2000) "Geological disposal of long half lives low heat radioactive waste, Technical feasibility of co-disposal with high level radioactive waste" (April 2006)		**Completed** "Basic policy of safety regulation on low level radioactive waste disposal" (Interim Report) (July 2007) "Policy of the safety assessment of subsurface disposal after the period for active control" (April 2010)		**Completed** "Upper Bounds of Radioactive Concentration for Burial of Low-Level Radioactive Solid Waste" (May 2007)		**Partially Completed** Basic guide for safety review of Category 2 radioactive waste disposal, (August 2010) **Future discussion** Guide for geological disposal			**Partially Published** "Rules for category 1 waste disposal for nuclear fuel material or Material contaminated with nuclear fuel material" (April 2008) "Rule for category 2 Waste disposal of nuclear fuel material or material contaminated with nuclear fuel material" (April 2008)
	Waste from power reactor facility	Waste of Core Structures etc. (Relatively higher radioactive waste)	**Completed** "Basic policy of disposal of low level radioactive waste that exceeds the concentration limit value in the ordinance" (October 1998)		**Completed** "Basic policy of safety regulation on low-level radioactive waste disposal that exceeds the concentration limit value in the ordinance" (July 2007) "Policy of the safety assessment of subsurface disposal after the period for active control" (April 2010)	**Completed** Basic Policy for Safety Regulations on Low-Level Radioactive Waste disposal (Interim Report), (July 2007)	**Completed** "Reference radionuclide concentration values for safety regulations of land disposal of low-level radioactive solid waste" (Third Report) (September 2000)	**Completed** "Upper Bounds of Radioactive Concentration for Burial of Low-Level Radioactive Solid Waste" (May, 2007)	**Completed** Basic guide for safety review of Category 2 radioactive waste disposal, (August 2010)		**Published** "Enforcement Ordinance for the Reactor Regulation Act" (December 2000)	**Published** "Rules for category 2 waste disposal for nuclear fuel material or material contaminated with nuclear fuel material" (April 2008)
		Low level radioactive waste (Relatively lower radioactive waste)	**Completed** "Policy on processing and disposal of radioactive wastes" (Interim Report) (August 1984)	**Completed** "Policy on processing and disposal of radioactive wastes" (Final Report) (October 1985)	**Completed** "Basic policy of safety regulation for land disposal of low-level solid radioactive waste" (October 1985)		**Completed** "Reference radionuclide concentration values for safety regulations of land disposal of low level radioactive solid waste" (Interim Report) (February 1987), ib. (Second Interim Report) (June 1992)		**Completed** Basic guide for safety review of Category 2 radioactive waste disposal, (August 2010)		**Published** "Enforcement Ordinance for the Reactor Regulation Act" (March, 1987), (September 1992)	
		Very low level Radioactive waste: Concrete, etc.					**Completed** "Reference radionuclide concentration values for safety regulations of land disposal of low level radioactive solid waste" (Second Interim Report) (June 1992)		**Completed** Basic guide for safety review of Category 2 radioactive waste disposal, (August 2010)		**Published** "Enforcement Ordinance for the Reactor Regulation Act" (September 1992)	
		Very low level Radioactive waste: Metal, etc.					**Completed** "Reference radionuclide concentration values for safety regulations of land disposal of low level radioactive solid waste" (Third Interim Report) (September 2000)	**Concluded** "Upper Bounds of Radioactive Concentration for Burial of Low-Level Radioactive Solid Waste" (May, 2007)			**Published** "Enforcement Ordinance for the Reactor Regulation Act" (December 2000)	
	Uranium waste		**Completed** "Basic policy of processing and disposal of Uranium wastes" (December 2000)		**Partially Completed** "Basic concept of safety regulation for near surface disposal of solid radioactive waste generated from research laboratories, etc." (April 2006)		**Future discussion**				**Published** "Enforcement Ordinance for the Reactor Regulation Act" (April 2008)	**Future discussion**
	Waste from research facilities, etc.		**Completed** "Fundamental concept of processing and disposal of wastes generated at research laboratories, etc."(May 1998) The report on "The approach to realize the disposal of radioisotopes and waste from research facility etc. (to be disposed of near surface)"(October, 2006) "The promotion of the approach to realize the disposal of waste from research facility etc." (February 2008)		**Completed** "Basic policy of safety regulation of near surface disposal of solid radioisotope wastes generated from radioactive isotope use facility" (January, 2004) "Basic policy of safety regulation for near surface disposal of solid radioactive waste generated from research laboratories, etc." (April, 2006)	*2	**Completed, except for radioisotope waste disposal facility** "Upper Bounds of Radioactive Concentration for Burial of Low-Level Radioactive Solid Waste" (May 2007)	**Completed, except for radioisotope waste disposal facility** Basic guide for safety review of category 2 radioactive waste disposal, (August 2010)			**Published** "Enforcement Ordinance for the Reactor Regulation Act" (May 2005) "Enforcement Ordinance for the Reactor Regulation Act" (April 2008)	**Partially Published** "Rules for the enforcement of Radiation Disease Prevention Act" (June 2005) "Rules for category 2 waste disposal for nuclear fuel material contaminated with nuclear fuel material" (April 2008)
Materials that need not be treated as radioactive wastes (Waste equivalent to clearance)			**Completed** "Policy on processing and disposal of radioactive wastes" (Interim Report) (August 1984) "Basic policy of processing and disposal of uranium wastes" (December 2000)		**Under discussion since May 1997** a: Completed: Major nuclear reactor facilities (March 1999), Heavy water reactors, fast neutron reactors, etc. (July 2001), Nuclear fuel material use facilities (facilities dealing with irradiated fuels and materials) (April 2003), Radionuclide concentrations for materials not requiring treatment as radioactive wastes, generated from dismantling etc. of reactor facilities and nuclear fuel use facilities" (December 2004), (Partial amendment, March, 2005), Uranium processing facilities (October 2009) b. Under discussion: TRU facilities c. Future discussion: Radioisotope facilities						**Published** "Enforcement Ordinance for the Reactor Regulation Act" (December 2005)	**Partially Published** Rules for the confirmation of radioactivity concentration within the materials used in the factory of licensee defined in clause 4 of Article 64-2 of Reactor Regulation Act(December 2005), (June 2011) "Rules for confirmation, etc. on radioactivity of reactors, etc. for use of research and development" (November, 2005),(February 2011)

*1): Waste from research facilities, etc. includes not only the waste regulated under the Reactor Regulation Act but also the waste regulated under the Radiation Disease Prevention Act, the Medical Care Act or the Pharmaceutical Affairs Act.
*2): "Basic concept of safety regulation on low-level radioactive waste burial" (Interim Report) (July 12, 2007)
Quoted from "Government of Japan, Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, National Report of Japan for the Fourth Review Meeting, Oct. 2011, p.5."

ACRONYMS AND ABBREVIATIONS

AIST	National Institute of Advanced Industrial Science and Technology
ANRE	Agency for Natural Resources and Energy, METI
ATR	Advanced Thermal Reactor
DCA	Deuterium Critical Assembly
ENTRY	ENgineering scale Test and Research facilitY
GCR	Gas Cooled Reactor
GIRDD	Geological Isolation Research & Development Directorate, JAEA
HLW	High-Level Waste
JAEA	Japan Atomic Energy Agency
JAEC	Japan Atomic Energy Commission
JNES	Japan Nuclear Energy Safety Organization
JNFL	Japan Nuclear Fuel Ltd.
JPDR	Japan Power Demonstration Reactor
JRR-1,2	Japan Research Reactor - 1, 2
LLW	Low-Level Waste
METI	Ministry of Economy, Trade and Industry
MEXT	Ministry of Education Culture, Sports, Science and Technology
MLIT	Ministry of Land, Infrastructure and Transport and Tourism
NISA	Nuclear and Industrial Safety Agency, METI
NUCEF	NUclear Cycle safety Engineering research Facility
NUMO	Nuclear Waste Management Organization of Japan
NSC	Nuclear Safety Commission of Japan
NSRC	Nuclear Safety Research Center, JAEA
QUALITY	QUantitative Assessment radionuclide migration experimental faciLITY
RCDGE	Research Core for Deep Geological Environments, AIST
TRU	Transuranic waste
TTR-1	Toshiba Test Reactor - 1
VHTRC	Very High Temperature Reactor Critical Assembly