Research Activities on Radioactive Management at JNES (Intermediate depth disposal)

Radioactive Waste Management and Transport Safety Division
Japan Nuclear Energy Safety Organization

May 24, 2010

Japan Nuclear Energy Safety Organization

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Radioactive Waste Management and Transport Safety Division

Planning Gr. (5)

Coordination and planning of division activities

Waste Form and Decommissioning Safety Evaluation Gr. (9)

Decommissioning, clearance and waste package confirmation

Radioactive Waste and Disposal Safety Evaluation Gr. (14)

Safety of HLW, LLW and VLLW disposal facilities

Storage and Transport Safety Evaluation Gr. (10)

Spent fuel interim storage, waste storage and transport

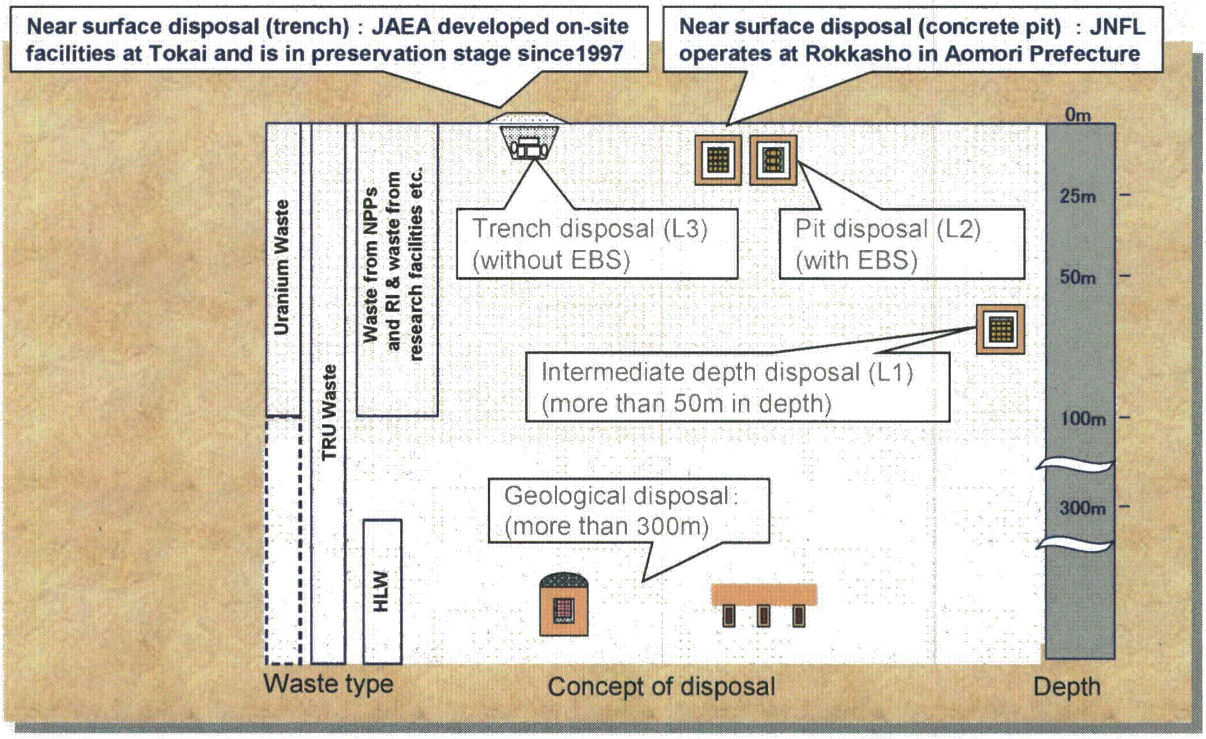
Fuel Cycle Facility Safety Evaluation Group (10)

Fuel fabrication facility and reprocessing facility

Principle of Regulatory Research on Radioactive Waste Management

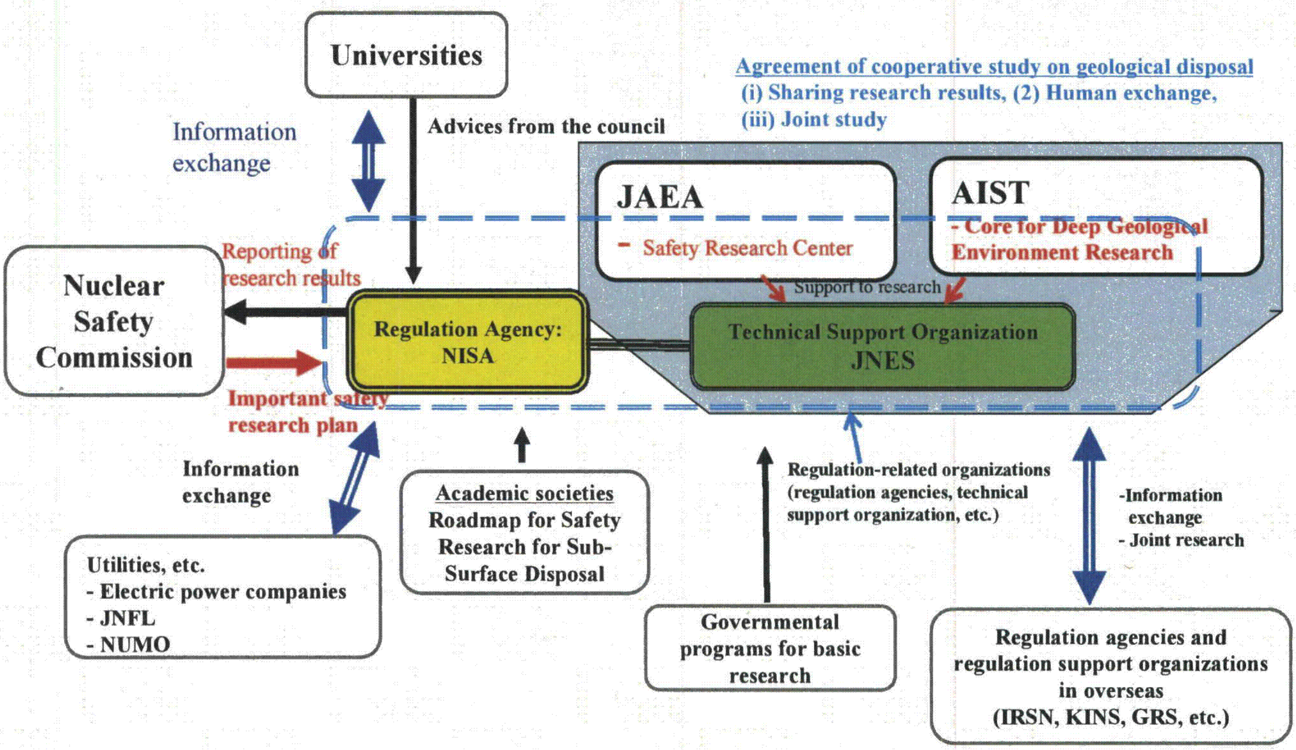
- NISA issued an report of "Regulatory Support Research Plan on Radioactive Waste Management 2010-2014" , September 2009.
- The report identified regulatory needs and supporting research needs.
- Radioactive Waste Management and Transport Safety Division is conducting the regulatory support research in the area of radioactive waste management according to their needs.
- The research is conducted in cooperation with Nuclear Safety Research Center of Japan Atomic Energy Association (JAEA) and Core for Deep Geological Environment Research of Advanced Industrial Science and Technology.

Waste disposal concepts in Japan

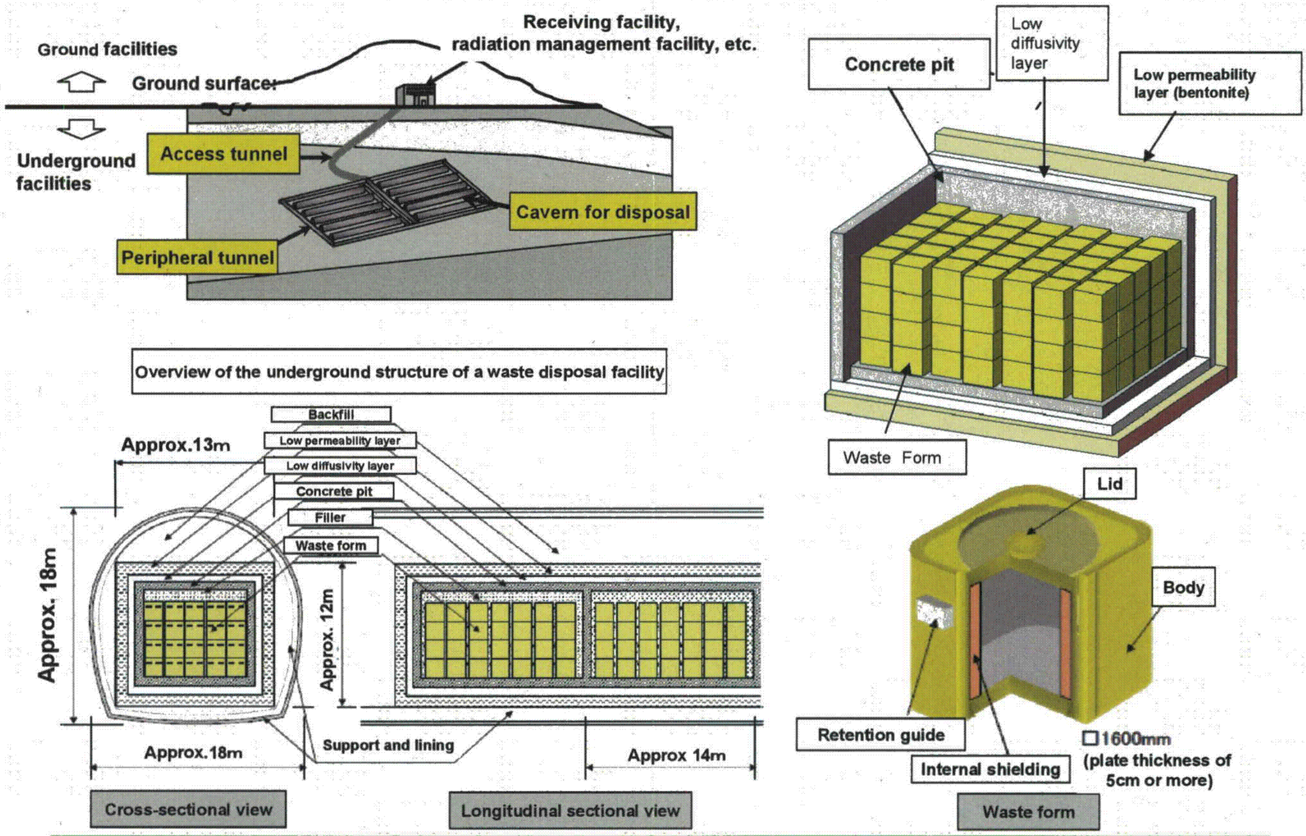


This presentation material focus on intermediate depth disposal

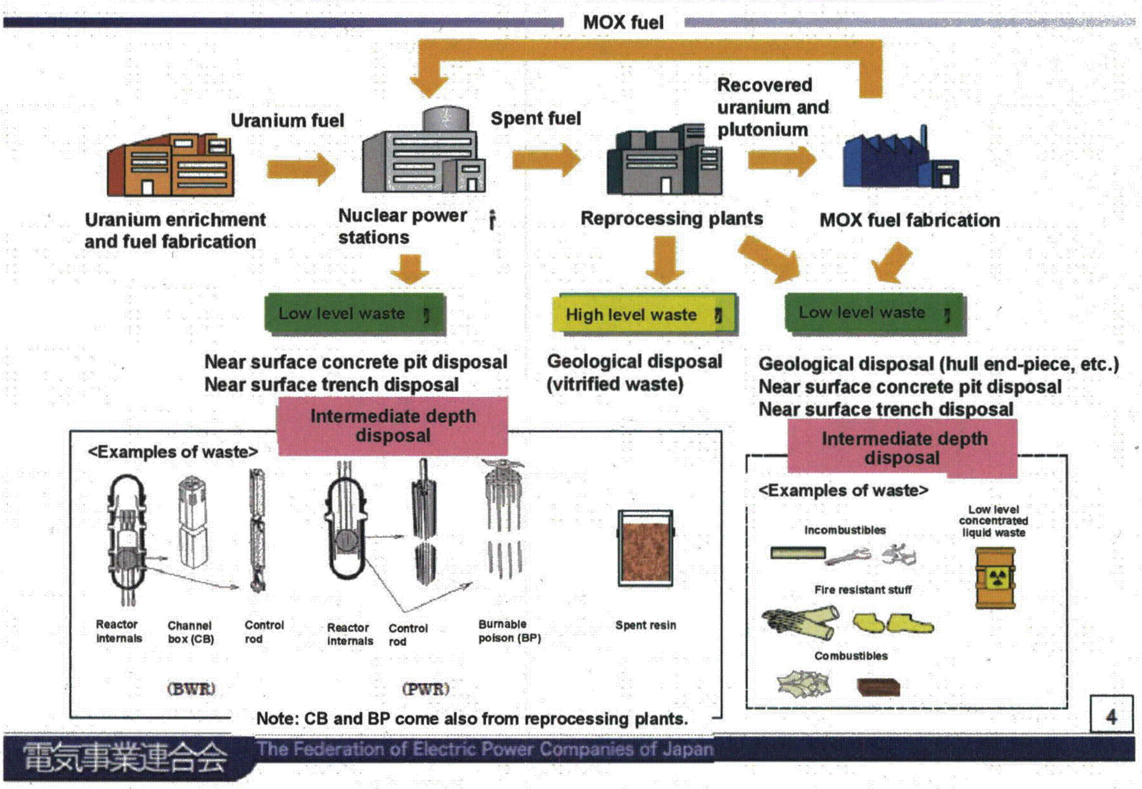
Organizational Framework for research of Intermediate Depth Disposal and Geological Disposal



Planned Concept of Intermediate Disposal Facility to be Assessed

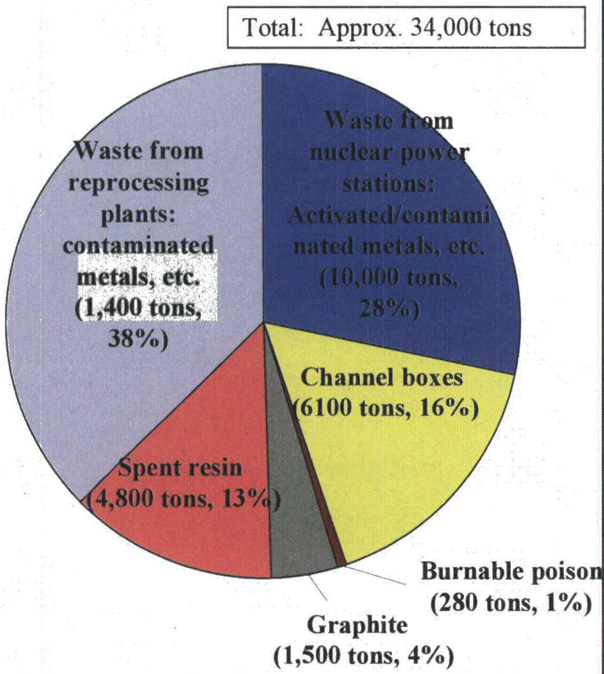


Radioactive Wastes Planned for Disposal



Source: Federation of Electric Power Companies "Report on the Progress of Studies Concerning Intermediate Depth Disposal" (Document No. 17-4 on Radioactive Waste)

Quantities and Characteristics of Radioactive Waste for Intermediate Depth Disposal

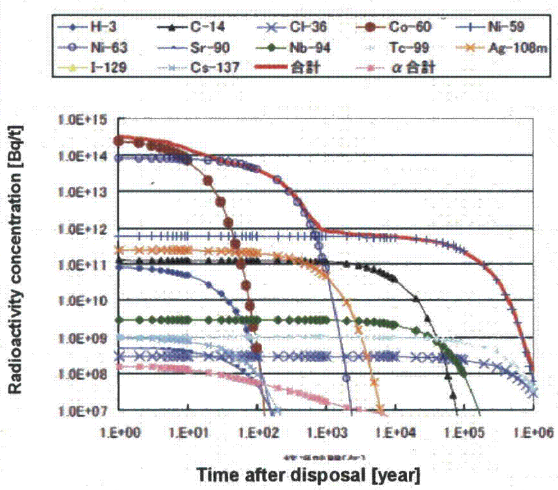


Compiled from: Federation of Electric Power Companies "Quantities and Radioactivity Concentration Levels of Waste for Intermediate Depth Disposal (C2 11-1)

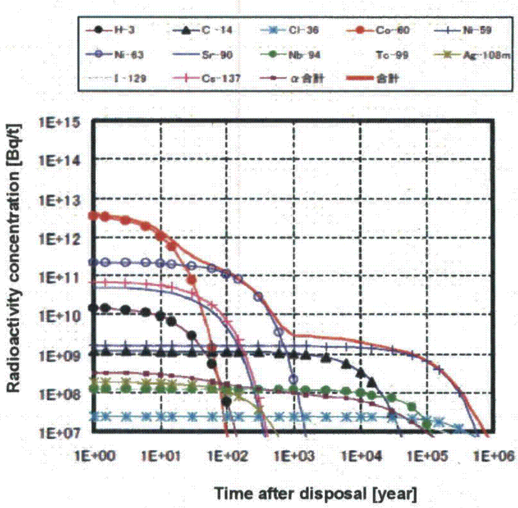
Characteristics of the waste	Typical examples
Large quantity of activated metals	- Channel boxes (BWR) - Control rods (PWR control rods and hafnium control rods) - Reactor internals (BWR/PWR) - Graphite (GCR)
Inclusion of significant quantities of nuclides with a long half life	Typical examples of nuclide with a long half life: C-14: 5.73E+03 years Cl-36: 3.01E+05 years Ni-59: 7.6E+04 years Nb-94: 2.03E+04 years
Generation of large quantities of gas	- Generation of gas from the corrosion of metals - Generation of gas from the radiolysis of water - Generation of gas from the decomposition of organic matter
Inclusion of substances that may have impacts on engineered barriers	Nitrates and sulfates
Inclusion of important nuclides that are difficult to measure	Most nuclides except Co-60

Radioactivity Concentration Decay Curve of Waste in Intermediate Depth Disposal Facility

Operational waste from power stations (activated metal)



Waste from JNFL



Waste for Intermediate depth disposal contains significant quantities of nuclides with a long half life. The verification of the safety of sub-surface disposal facilities, therefore, requires the safety assessment over a long period.

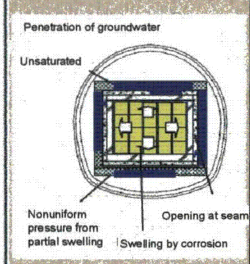
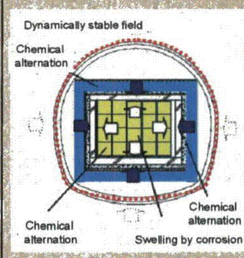
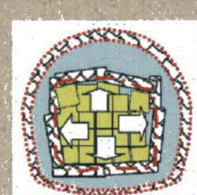
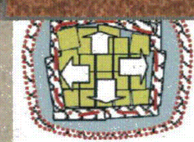
It is important that the safety assessment should address the impacts from geological uplift, erosion and sea level change if such phenomena are likely to take place around the site in a long term.

Current status of discussion in Nuclear Safety Commission

- NSC released a report "Guides for the Safety Assessment of Intermediate Disposal after the Termination of the Institutional Control Period " April 2010.

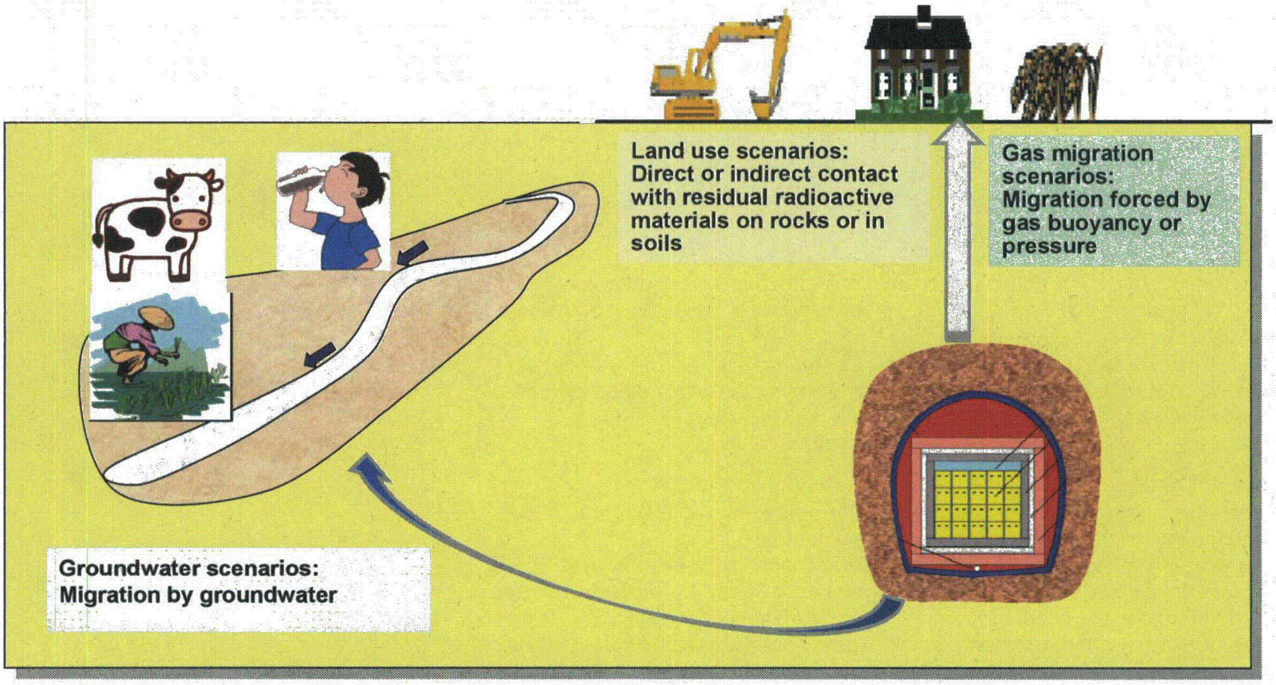
- Safety assessment scenario are classified into the following four categories based on risk informed consideration,
  - a. Likely scenarios — 10 μSv／yr — 1 mrem/yr
  - b. Less-likely scenarios — 300 μSv／yr — probability
  - c. Rare natural event scenarios — 10mSv／yr～100mSv／yr
  - d. Inadvertent human intrusion scenarios — 150 μSv -15 mrem
    - 1mSv／yr～10mSv／yr (Residents)
    - 10mSv～100mSv (Intruders
    - -defined individual intruders (e.g. workers):

Guides for the Setup of Conditions of Disposal Facilities for Different Time Periods

		Post-closure phases			
Time Period	Protective functions / characteristics of engineered barriers and the environmental conditions	Transient period Time up to the stable conditions or the settling of changes in the states of the repository and the peripheral geological environment	Period during which safety depends much on multiple barrier functions In this period, evolutions in the repository conditions are expected be slow, because of the long-term stability of the geological environment	Period during which natural barrier functions are expected to play a major role In this period, the impacts of internal and external factors, which are difficult to exclude or reduce their effects from the setup of repository conditions, become manifest	Period during which the repository is expected to come close to the ground surface In this period, the repository is expected to come close to the ground surface as a result of phenomena such as uplift, erosion and sea level change
Policies concerning the setup of conditions	**Protective functions of engineered barriers:** - Retardation of nuclide migration - Physical resistance against inadvertent human intrusion **Properties of engineered barriers:** - Low permeability - Low diffusivity - Sorption coefficient - Low leaching rate -Other properties (mechanical properties, etc) **Setup of the environmental conditions:** - Temperature (heat) - Hydraulic conditions - Dynamic conditions - Chemical conditions	**- Ensure that engineered barriers are expected to withstand damage and degradation sufficiently well even when subjected to nonuniform progress of transient.**  	**Extrapolation based on scientific and technological bases and findings**  	 **Define conditions based on the evaluation of physical properties specific to barrier materials and functions inherent to natural barriers, assuming a conservative approach to uncertainties.**	 **- Define conditions that accord with the setup of conditions for the near-surface geological environment.**

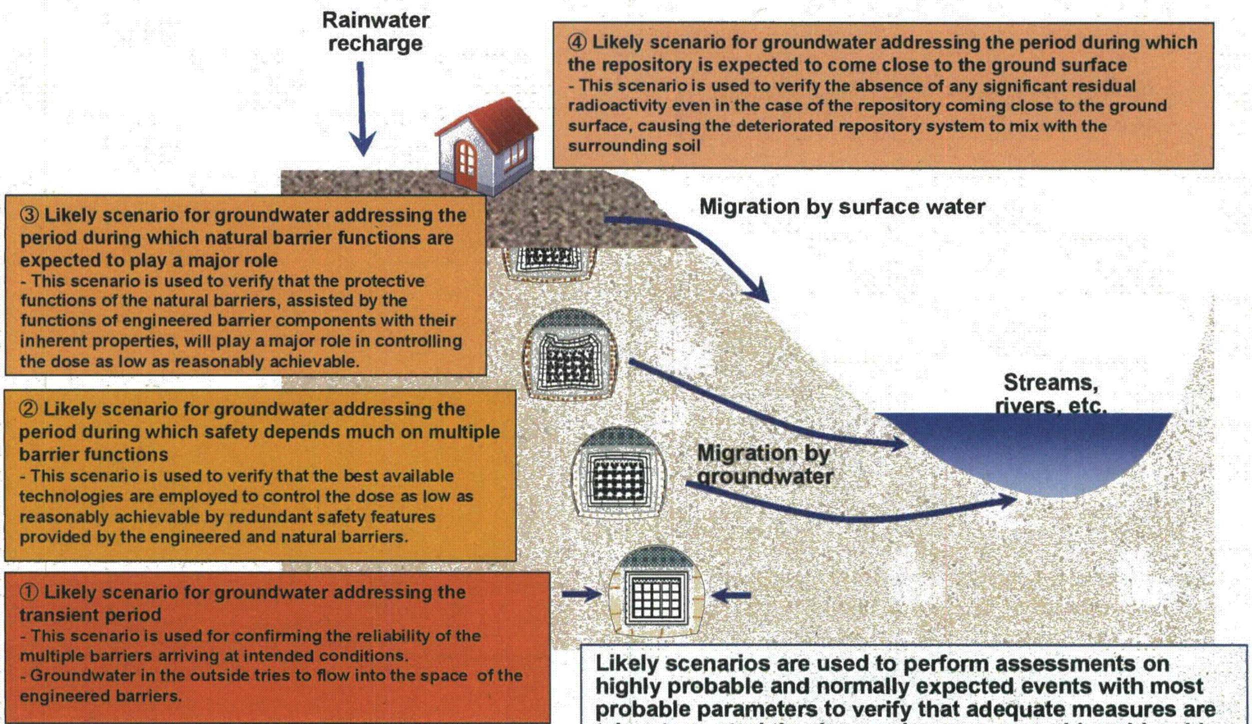
The illustrations of various phases are [illegible] from "Guides Concerning the Setup of Long-Term Conditions for Engineered barriers (draft)" (Document No. 15-2 for the Class-2 Waste Burial Disposal Subcommittee) from the Central Study Institute of Electric Power Industry.

Radioactive Material Migration Pathways to the Biosphere and Their Assessment by Different Scenarios



All pathways of radioactive nuclides to the biosphere must be addressed (considering migration by liquid, gaseous and solid media).

Evolution of the Likely Scenario for Groundwater through Different Time Periods



Likely scenarios are used to perform assessments on highly probable and normally expected events with most probable parameters to verify that adequate measures are taken to control the dose as low as reasonably achievable in each time period.

Guides for the Safety Assessment for less-likely Scenarios

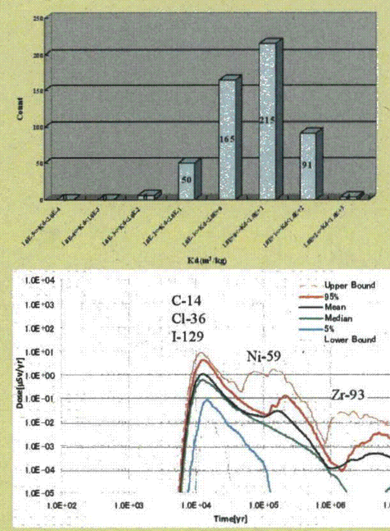
Analysis of factors that cause variations from the likely scenarios
- Preparation of plural less-likely scenarios for each likely scenario

Completeness in the identification of variation factors
- The setup of conditions is preceded by the identification of variation factors by FEP analyses, etc.

Probability and scientific reasonability of variation factors
- If sufficient quantities of statistical data are available, use them to select values in the 97.5% one-sided confidence interval.
- If sufficient quantities of statistical data are not available for addressing uncertainties in long-term safety assessment, make the best use of available scientific and technological findings to set up conditions with sufficient allowances based on a conservative approach.
- If severale parameters largely affect the assessment results, it is useful to evaluate the uncertainties with such parameters by a probabilistic method to verify reasonability in the setup of conditions

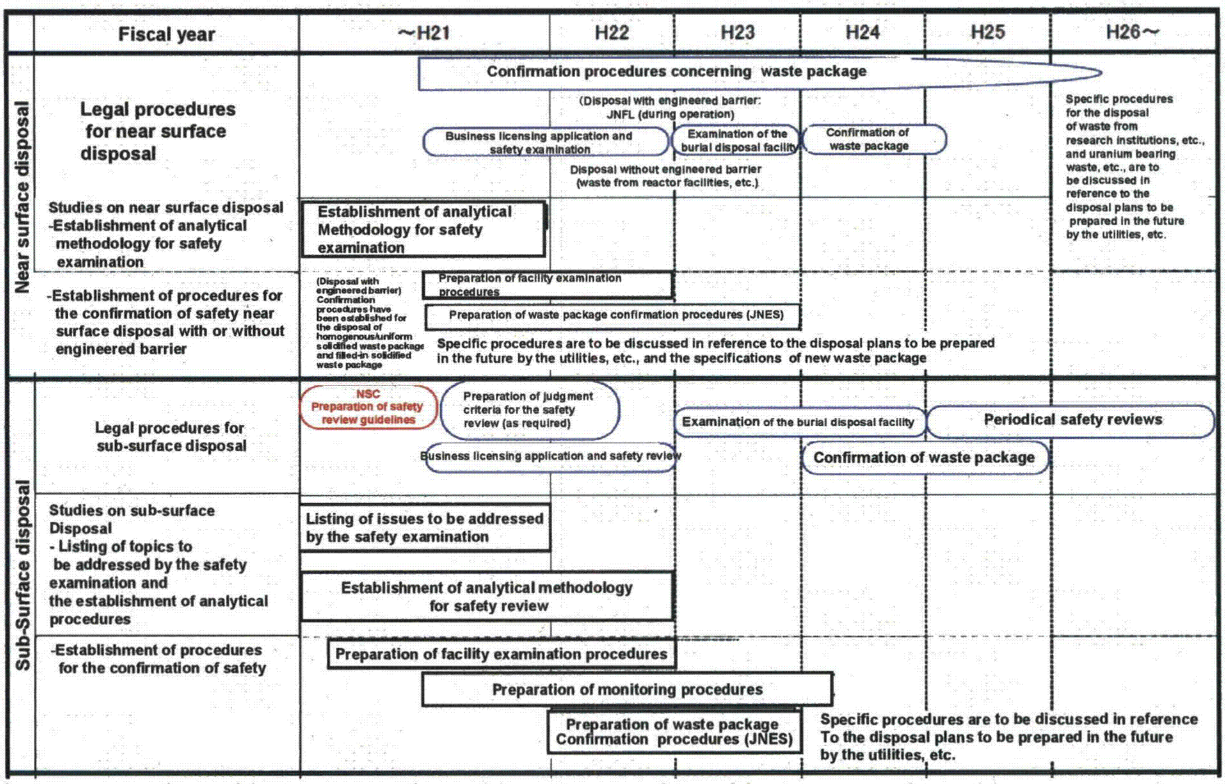
Assessment of the repository system robustness
- A partial loss of safety functions is assumed to verify that the repository system does not depend excessively on any single safety feature.
- However, it is not necessary to assume the absence of contributions from the components that have sufficiently demonstrated their reliability or from inherent properties of materials, etc., provides that such contributions are expected to persist through environmental changes, etc. Rather, scenarios should be designed to address uncertainties in long-term safety assessment.

Example of statistical data on the distribution coefficient



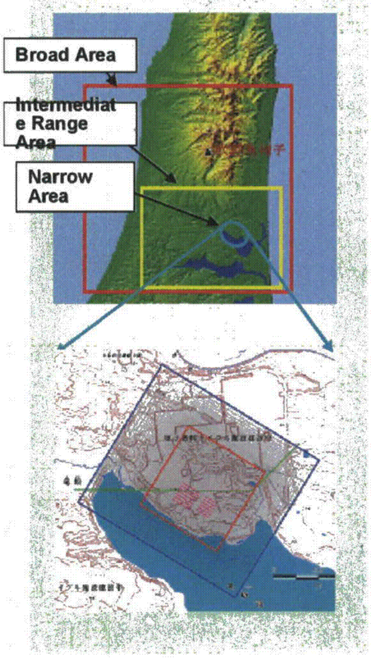
Aoki et al., "Study on uncertainty of safety assessment parameters for intermediate depth disposal (Ⅲ) Example dose calculation" Autumn, 2009, AESJ

Key Safety Studies for Intermediate Disposal and Near Surface Disposal

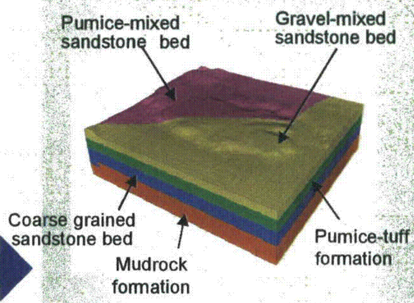


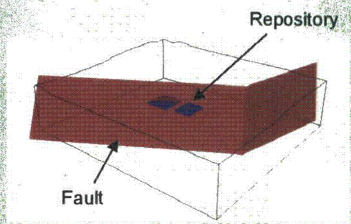
Assessment using General Purpose Multidimensional Flow Analysis Code

Setup of the objective area, faults and repository location

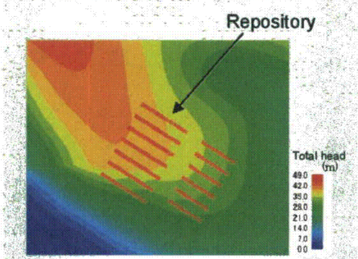


Setup of the hydro-geological models for the objective area, boundary conditions, etc.

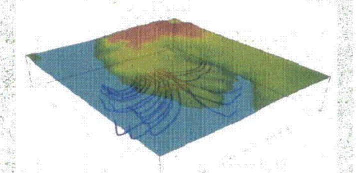




Groundwater flow analysis and the analysis of groundwater travel distance and time



Example of groundwater flow analysis results (profile at the elevation of -89m)

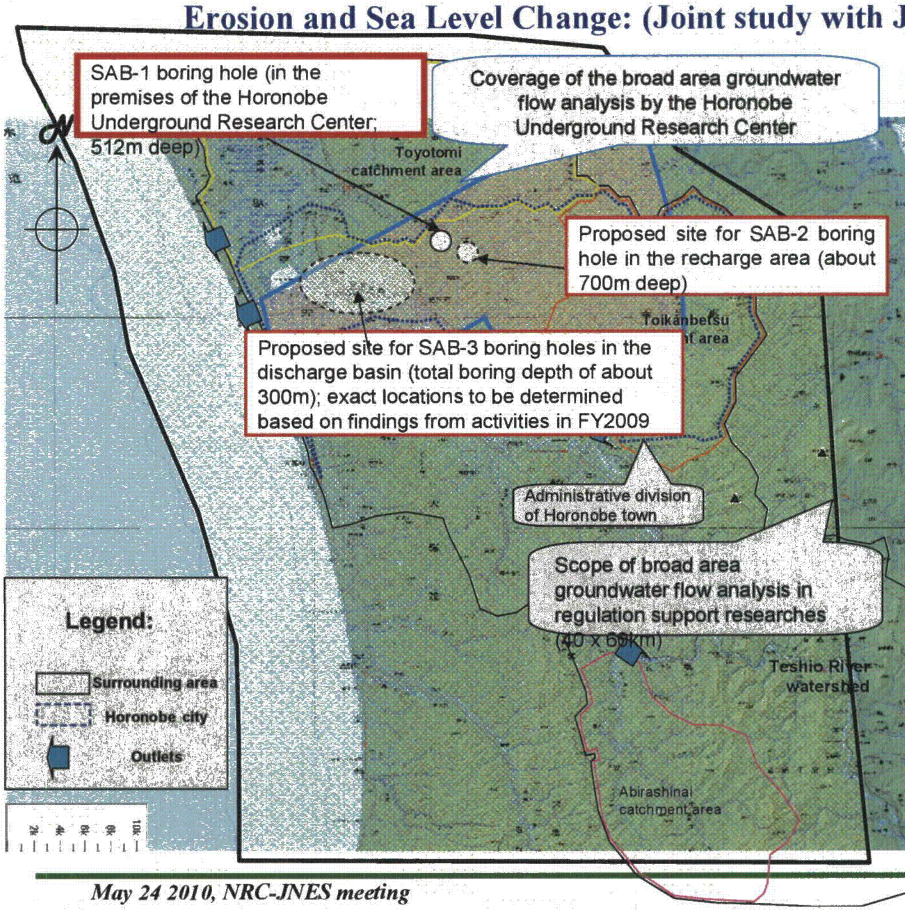


Example of groundwater migration pathway analysis results (determination of travel distance and time)

Safety R&D on Groundwater Flow Assessment

Assessment Objective	Analysis Code	Current Safety R&D
Broad area multi-dimensional groundwater flow assessment	General purpose multidimensional flow analysis codes: TOUGH2, Dtransu, MODFLOW	-JNES has been working toward the establishment of procedures for cross-check analysis. -JNES is preparing the Analysis Support System and Quality Assurance Support System to improve the reliability of cross-check analysis.
Near field multidimensional groundwater flow assessment	Same as the above	
Groundwater flow assessment coupled with uplift, erosion and sea level change	Groundwater flow analysis code that accounts for upheaval, erosion and sea level change: 3D-SEEP	-JAEA Safety Research Center is consigned by NISA to develop the code mainly for the safety assessment of geological disposal. - At present, an experiment for verification of the code is jointly conducted by JAEA, AIST and JNES at the JAEA's Horonobe Underground Research Center.

Verification of Groundwater Flow Analysis Code (3D-SEEP) That Accounts for Uplift, Erosion and Sea Level Change: (Joint study with JAEA and AIST)



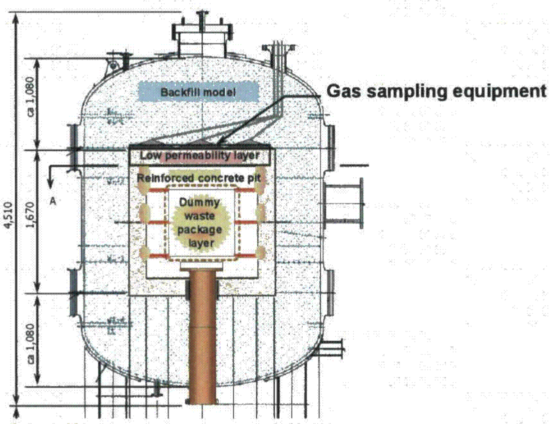
Features of 3D-SEEP Ver. 2:
- ● Three-dimensional analysis of saturated-unsaturated infiltration flows
- Finite element method
- Supports steady and unsteady state analysis.
- Allows consideration of density gradient of seawater, etc. (only in unsteady state analysis mode).
- Supports evolutionary changes of boundary conditions such as the water level, seawater level and rainwater recharge.

The project (up to FY2010) aims at verifying the analysis code in reference to boring data from a broad area (including both recharge and catchment areas) in the Horonobe region, which is characterized by noticeable geological activities that result in uplift, erosion and sea level change.

Assessment of Engineered Barrier Performance in the Transient Period
Experiments for the Verification of Safety Margins for Engineered Barriers

- Engineering-scale (about 1/5) model (more than 100years →about 2years)
- Understanding of resaturation and gas migration behaviors in the low permeability layer

Test set overview (before coating)



Concept of the three-dimensional test set (1/5 scale model)

The following should be verified by this experiment for the verification of safety margins for engineered barriers using an engineering-scale model:
1. Stable preservation of the low permeability property
→ Using the engineering-scale model, it should be verified that the whole layer swells uniformly and the intended low permeability property is achieved without much dependence on local-scale properties.
2. Formation of gas breakthrough pathways by the growing gas pressure
→ The stress from gas pressure may concentrate at corners of the low permeability layer, producing breakthrough pathways even at a relatively low gas pressure. It should be verified that such will not spoil the integrity of engineered barriers.
3. Restoration of low permeability after the release of gas
→ It should be verified that breakthrough pathways are closed again and the low permeability property is restored due to the self-sealing property of bentonite.

Annex

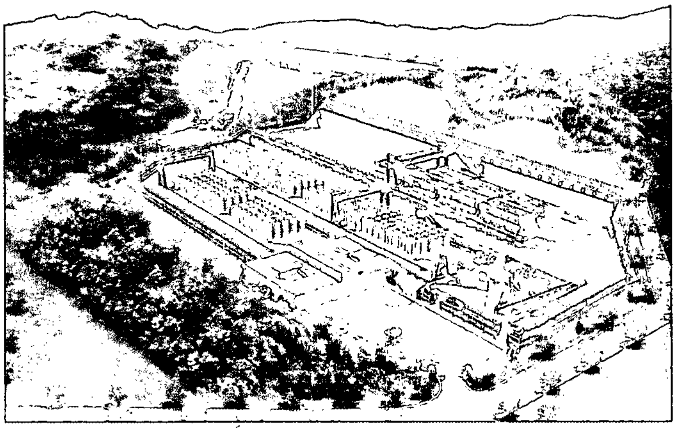
Regulatory Research Needs for Geological Deposal

1. Developing "safety indicators" to judge the adequacy of site investigation results presented by the implementer

2. Compiling basic requirements of safety design and safety assessment needed to make a technical evaluation of the license application, as well as developing safety indicators for objective evaluation

3. Developing an independent safety assessment methodology

Regulatory Framework and Issues for Safe Management of Spent Fuel in the Republic of Korea



June 3, 2010

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V. Regulations on disposal

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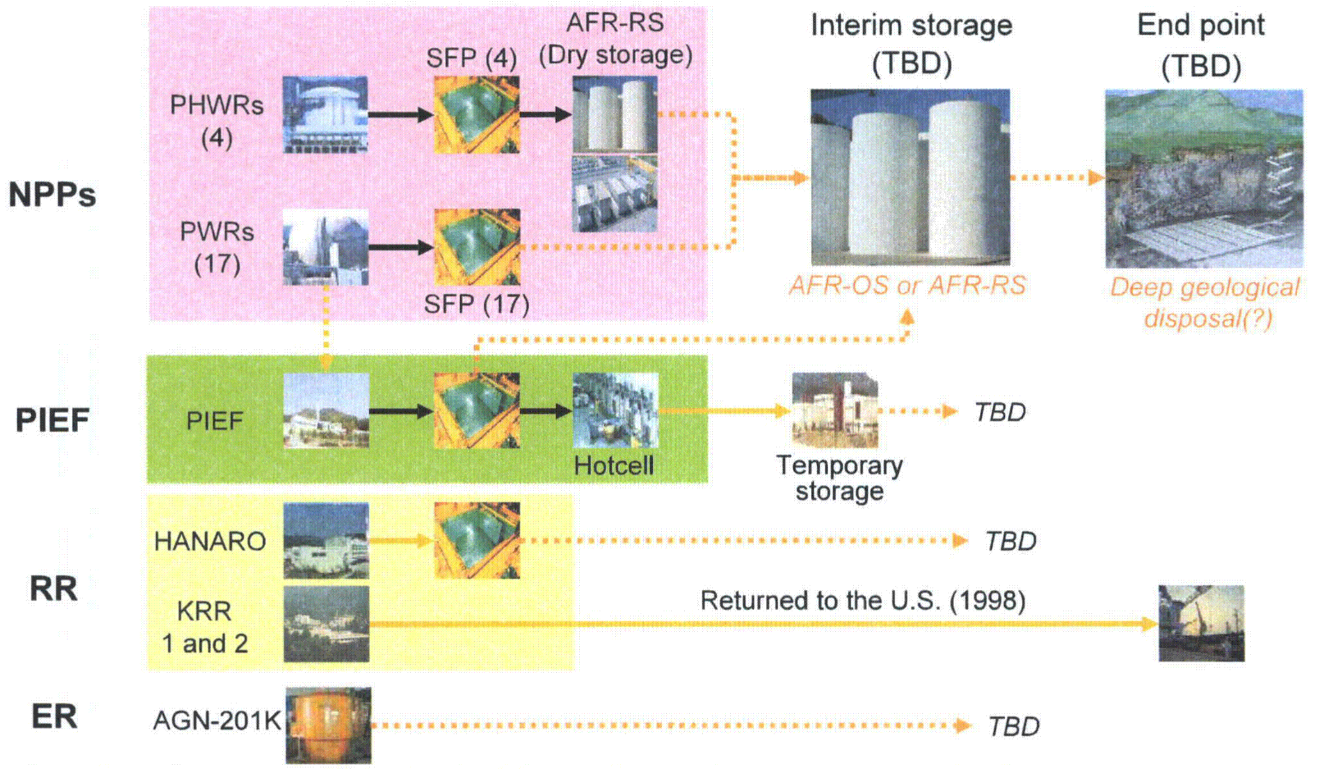
Background information

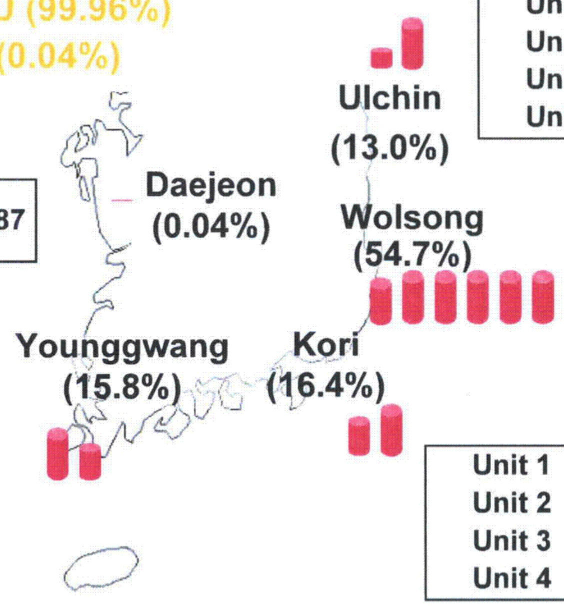
Framework of spent fuel management



Inventory of spent fuel

Total inventory: 10,765 MTU

- KHNP ☞ 10,761 MTU (99.96%)
- KAERI ☞ 3.87 MTU (0.04%)



Unit 1 Unit 2 Unit 3 Unit 4 Unit 5 Unit 6	1,401

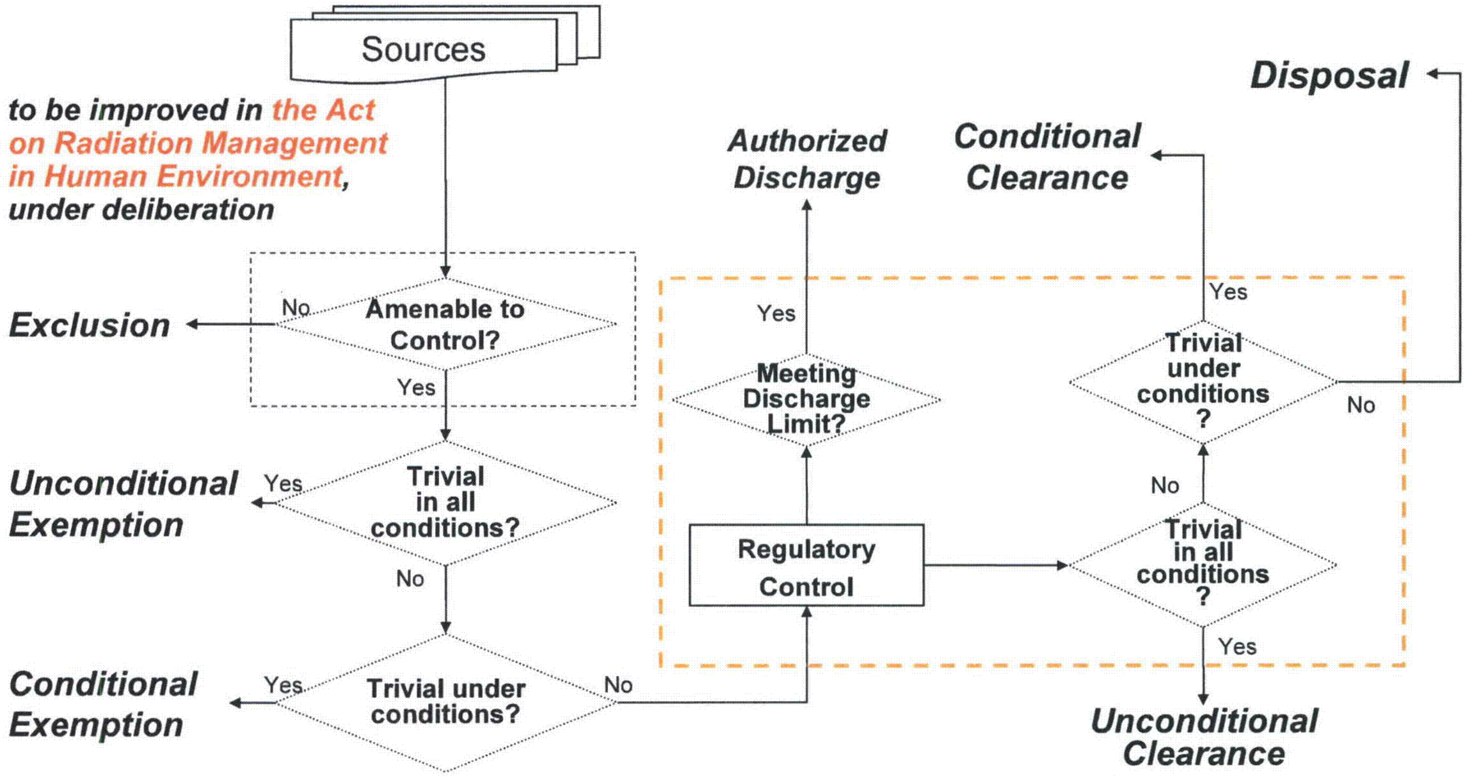
HANARO PIEF	3.87

Unit 1 Unit 2 Unit 3 Unit 4 AFR-RS	5,894

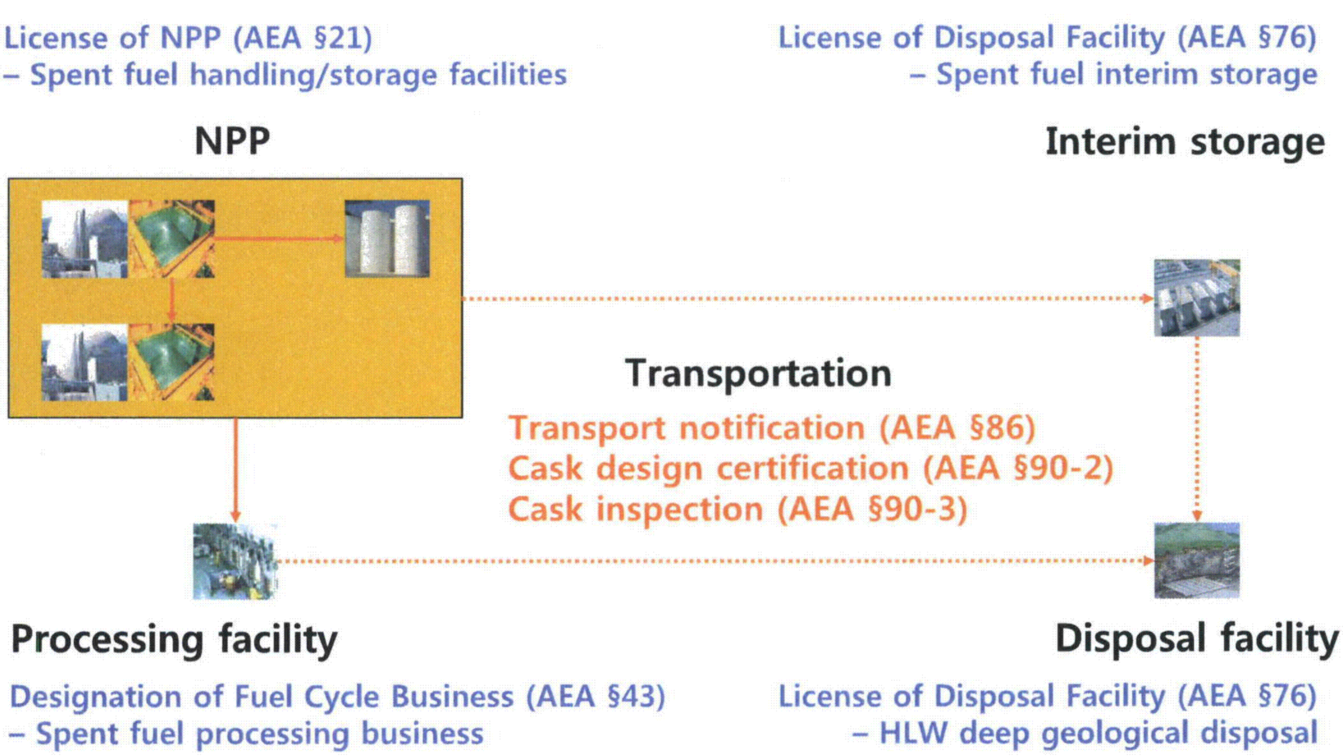
Unit 1 Unit 2 Unit 3 Unit 4 Unit 5 Unit 6	1,704

Unit 1 Unit 2 Unit 3 Unit 4	1,762

Regulatory control scheme on RM



Regulatory scheme on each step of SFM



Basic radiological dose criteria

Dose limits

Item	Radiation Worker	Frequent Access Personnel and Transport Worker	Public
Effective Dose	100 mSv for 5 consecutive years; and not exceeding 50 mSv/y	12 mSv/y	1 mSv/y
Equivalent Dose • lens of the eye • skin, feet, and hands	 150 mSv/y 500 mSv/y	 15 mSv/y 50 mSv/y	 15 mSv/y 50 mSv/y

Dose constraints for nuclear facilities in operation

Facility	Liquid Effluent	Effective Dose (0.03 mSv/y) Equivalent Dose (0.1 mSv/y)
	Gaseous Effluent	Gamma/Beta Air Dose (0.1, 0.2 mGy/y) Effective Dose, External (0.05 mSv/y) Skin Equivalent Dose, External (0.15 mSv/y) Equivalent Dose from Particulates (0.15 mSv/y)
Site		Effective Dose (0.25 mSv/y) Thyroid Equivalent Dose (0.75 mSv/y)
Effluent Control Limit (ECL) for Discharge		

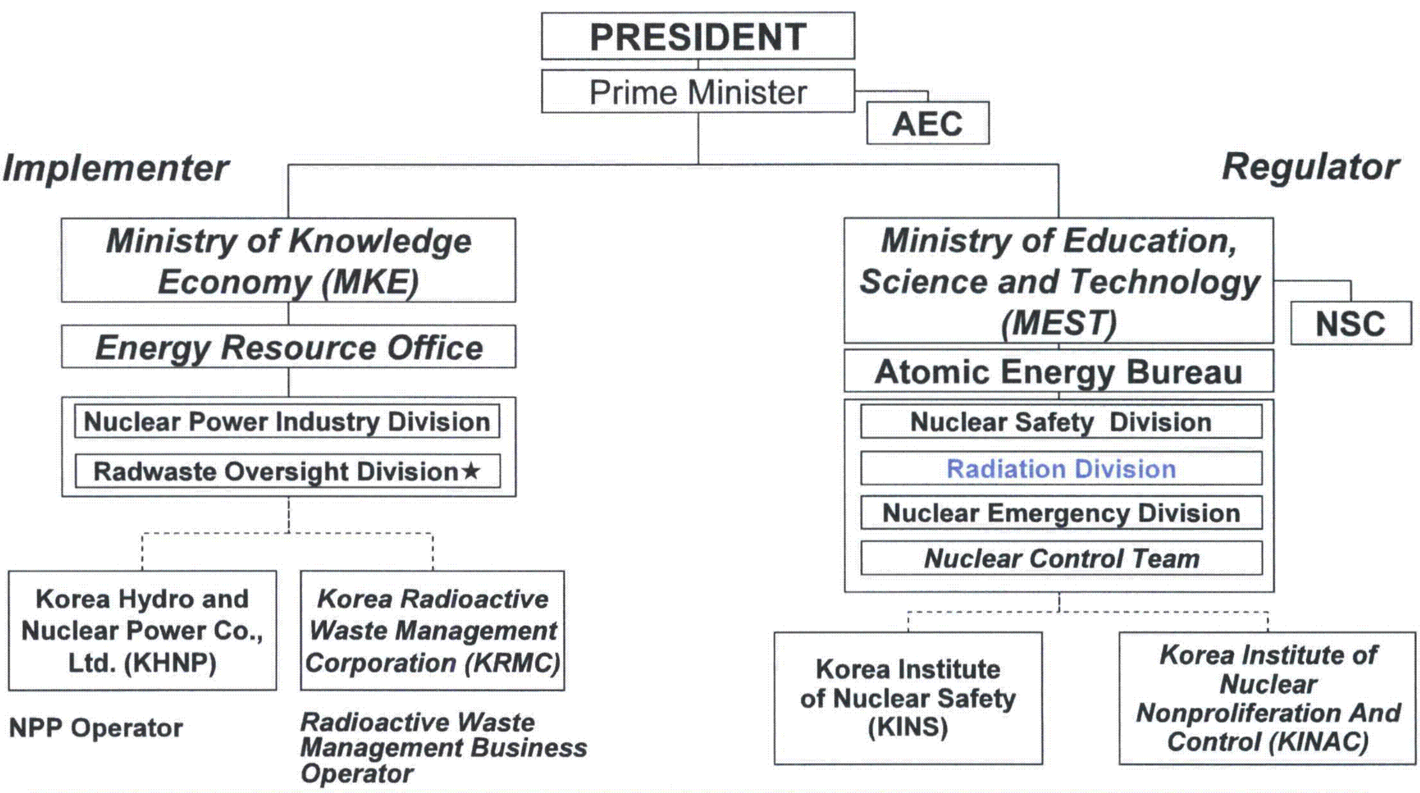
Shielding design standards

Inside facilities continually accessed by persons	• neither exceed the annual occupational dose limit; nor • exceed 1mSv per week
Areas boundary of facilities occupied by people	• neither exceed the annual public dose limit; nor • exceed 0.1 mSv per week

Clearance standards

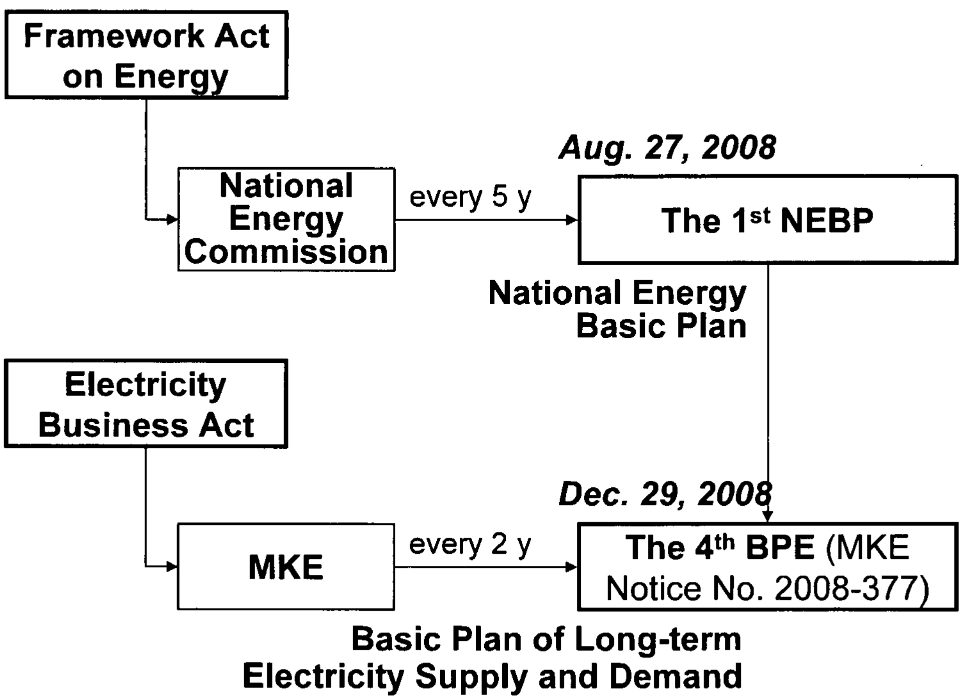
Dose Criteria	• 0.01 mSv/y and 1 person-Sv/y
Clearance Levels	• 100 Bq/g for specified short-lived RNs (Type A waste) • Case-specific Calculations (Type B waste)

Related major organizations



National policy on SF management

Nuclear power development plan



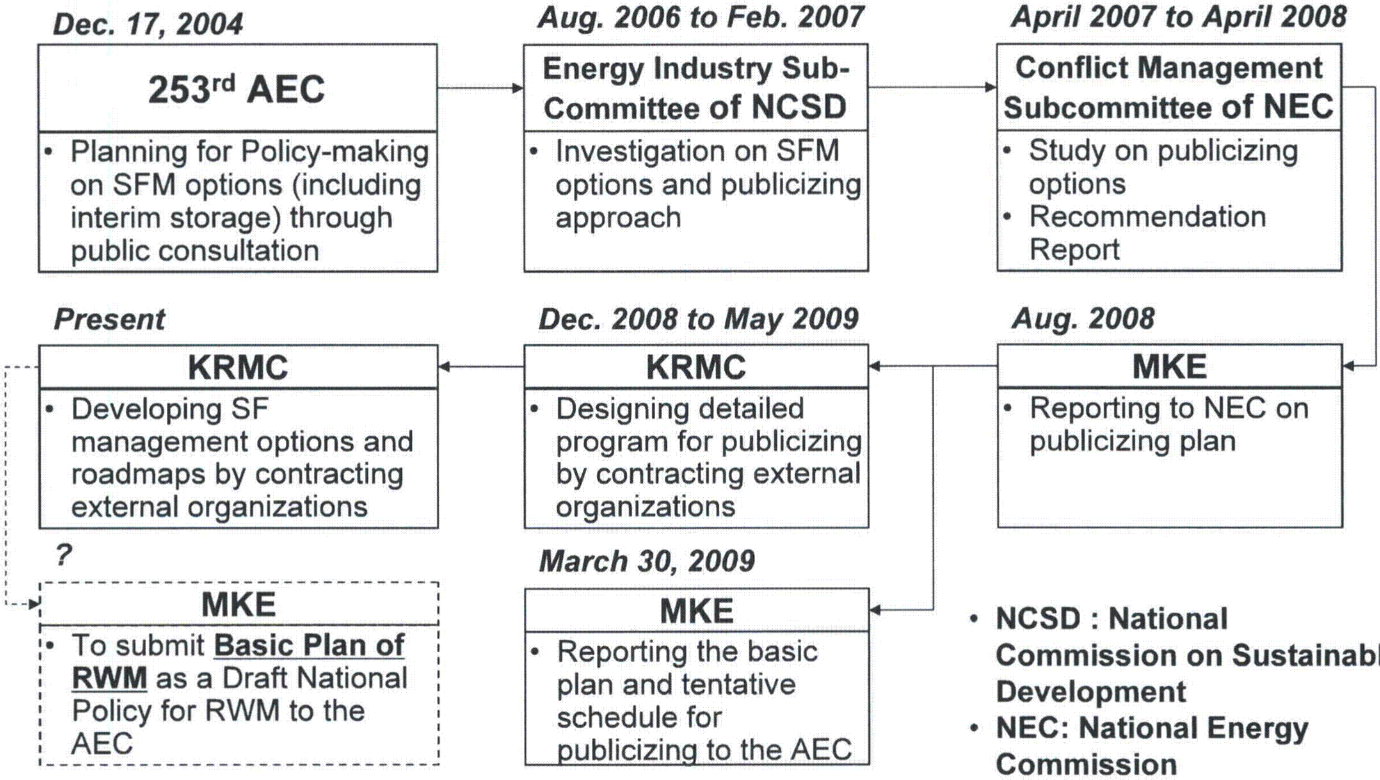
Nuclear Share

	Installation Capacity	*Electricity Generation*
The 1st NEBP	*26% (2006) to 41% (2030)*	*36% (2006) to 59%(2030)*
The 4th BPE	*24.8% (2008) to 32.6% (2022)*	*35.5% (2007) to 47.9%(2022)*

By 2030, 20(O) + 6(C) + 2(R) + 10 additional units NPPs

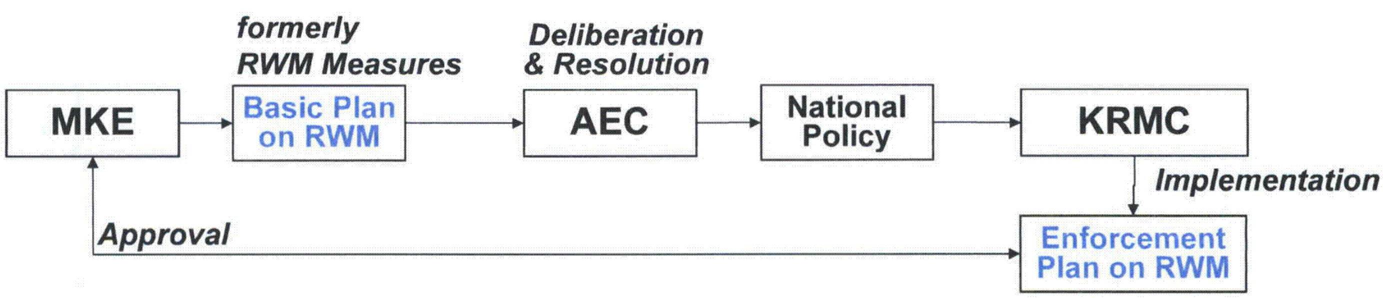
By 2022, 20(O) + 6(C) + 2(R) + 4 additional units

Policy making on SF management



- **NCSD : National Commission on Sustainable Development**
- **NEC: National Energy Commission**

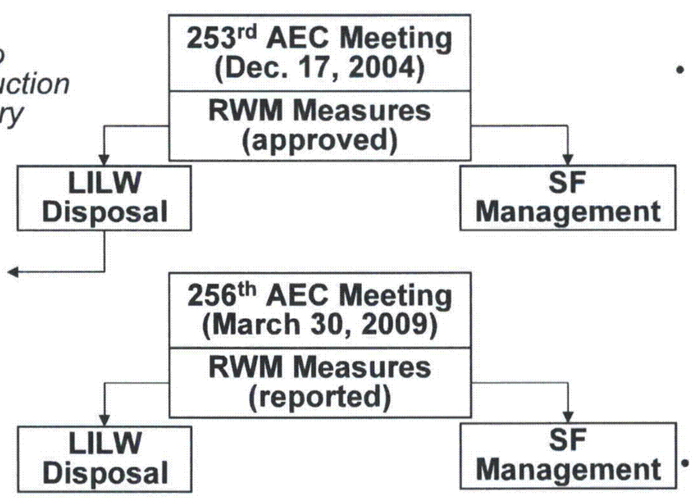
National policy on RWM and SFM



- *The AEC resolved to proceed with construction of the LILW repository firstly by 2008*

The repository is now under construction

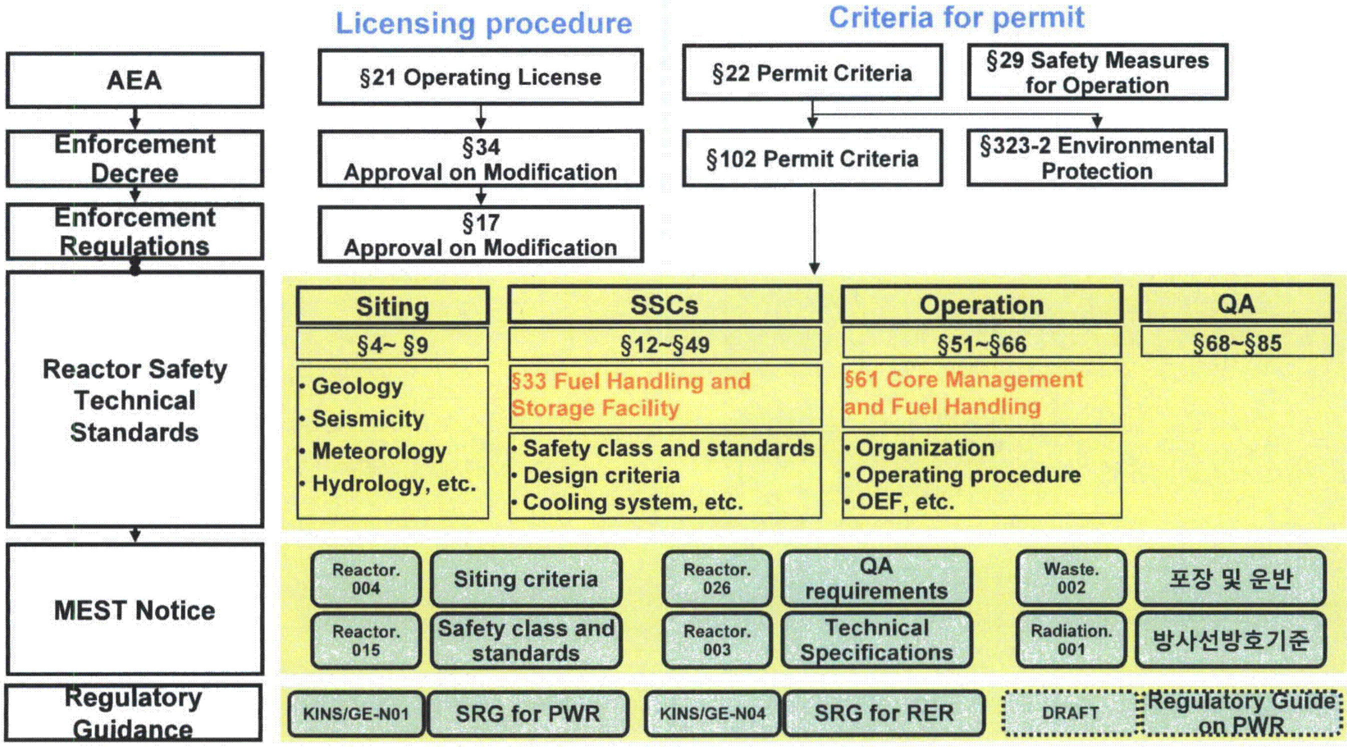
- *The MKE reported the status of construction of the WLDC.*



- ***Measures for SFM including interim storage**: to be determined in a timely manner through national consensus by public consultation among stakeholders, with consideration given to the development of domestic and international technology*
- ***Reported Publicizing Plan***

Regulations on temporary storage

Licensing procedures and regulatory requirements on temporary storage



Standards on temporary storage of SF

(Safety standards of reactor facilities §33)

Handling		Storage
Preventing criticality	← Criticality →	Subcriticality even at optimal conditions
Preventing fuel damage	← Fuel damage →	Damage-proofing (impact, stress, corrosion)
Preventing fuel melting	← Decay heat →	Hear-removal; Monitoring and safety measures
• 2mSv/h (surface) • 0.1mSv/h (1 m-distance)	← Radiation level →	Monitoring and safety measures 0.025mSv/h (at water surface)
Retaining fuel	← Loss of power	
Heat, impact, and heat-proofing	← Cask	
	Other safety features →	Containment, confinement, shielding, and purification

Regulatory guidance on temporary storage

Safety Review Guide (PWR) KINS/GE-N01

- Design of SSCs → Seismic class I structures → SF storage racks
- Aux. systems → SF storage → Criticality safety of SF storage facility
- Aux. systems → SFP cooling and cleanup
- Aux. systems → Heavy-load handling system
- Accident analysis → Accidents in SF handling
- Accident analysis → Dropping SF transport cask

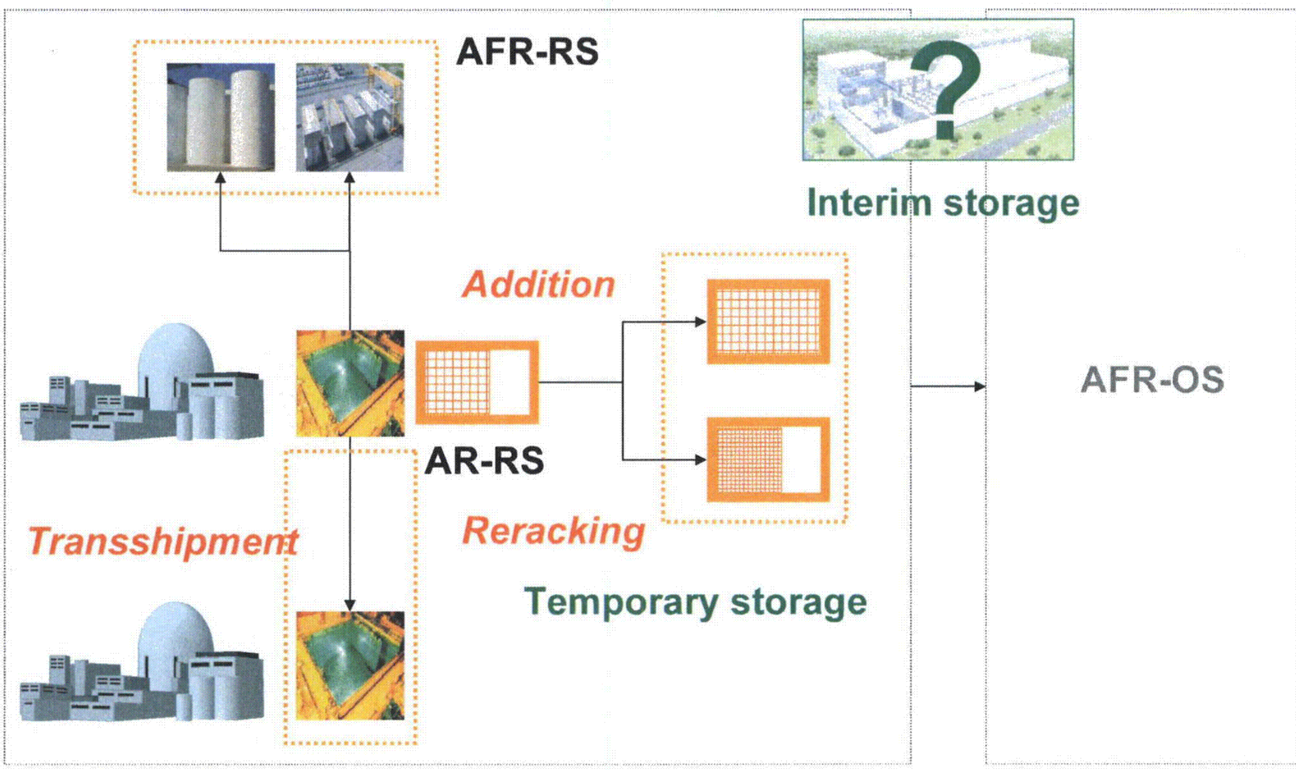
Safety Regulatory Guide (DRAFT)

- Structure design → Design criteria of SF storage facility; Structural design of SF storage racks
- Aux. systems → Criticality safety of on-site SF storage and handling facility

Technical specifications

- Safety limits and LCOs
  - Water level above fuel rack (e.g. > 7 m)
  - Boron concentration in pool water (e.g. > 2,400 ppm)
  - Initial enrichment, burn-up, cooling time, etc.
  - Emergency ventilation system of the fuel building
- Radiological criteria
  - Criticality, cooling, water-level, dose rate, cleanup system
  - Handling system, equipment, personnel qualification, etc.

Securing storage capacity for SF



Securing storage capacity for SF

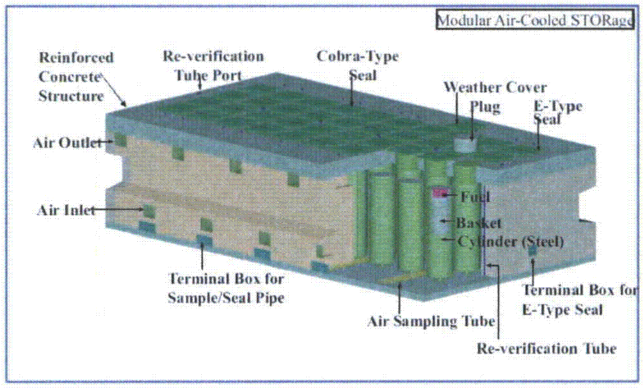
NPP Site	Measures	Remark
Kori	Units 1 and 2: Transshipment Units 3 and 4: Addition and Reracking	
Yonggwang	Unit 1: Addition and Reracking Unit 2: Addition Units 3 and 4: Reracking	Units 5 and 6: Reracking is planned in 2012
Ulchin	Units 1 and 2: Trasshipment Units 1 to 4: Reracking	Units 5 and 6: Reracking is planned in 2013
Wolsong	AFR-RS Dry Storage: Silos and Vaults	PHWRs

Dry storage for PHWR fuel - Silo

- Capacity
  - 300 units of silos
  - 9 fuel baskets per silo
  - 60 bundles per basket
- Dimension
  - 6.5 m (H), 3.1 m (D)
- Construction period:
  - 60 units (1992)
  - 80 units (1998)
  - 60 units (2002)
  - 100 units (2005)

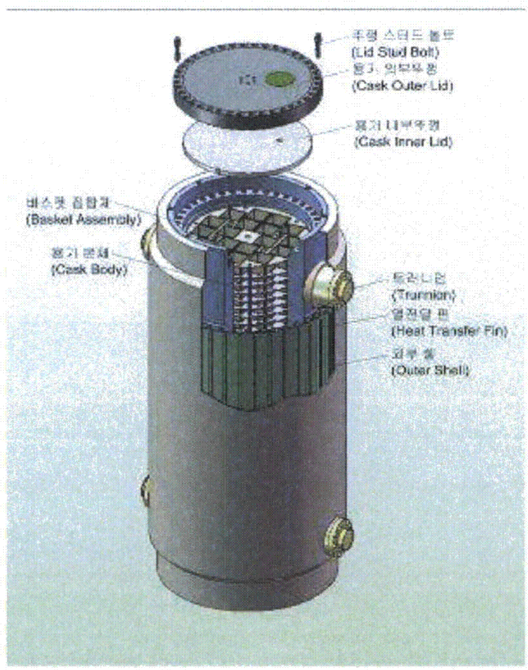
Dry storage for PHWR fuel – MACSTOR/KN-400

- Capacity
  - 7 modules
  - 40 cylinders per module
  - 10 fuel baskets per cylinder
  - 60 bundles per basket
- Commissioning: 2010



Transport cask for SF from PWR

- Capacity: KSNP-type SF 18 assemblies
- Dimension:
  - 2,351 mm (D)
  - 5,159 mm (H)
- Weight: 126,814kg
- Design/Manufacturing: KONES Corporation
- Design certification: 2010



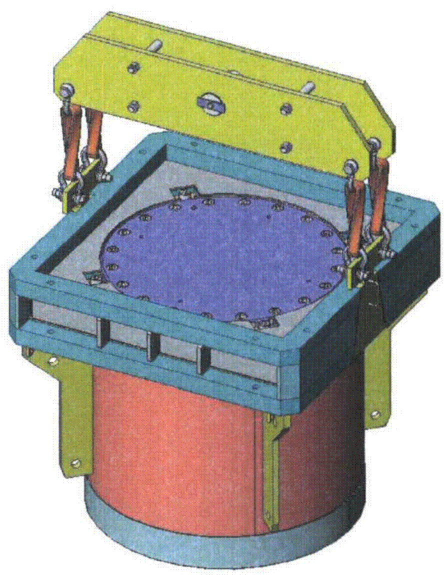
Transport cask, KN-18

Transport cask for SF from PWR

Transport cask, KN-12
- certified in 2002

Transport cask for SF from PHWR

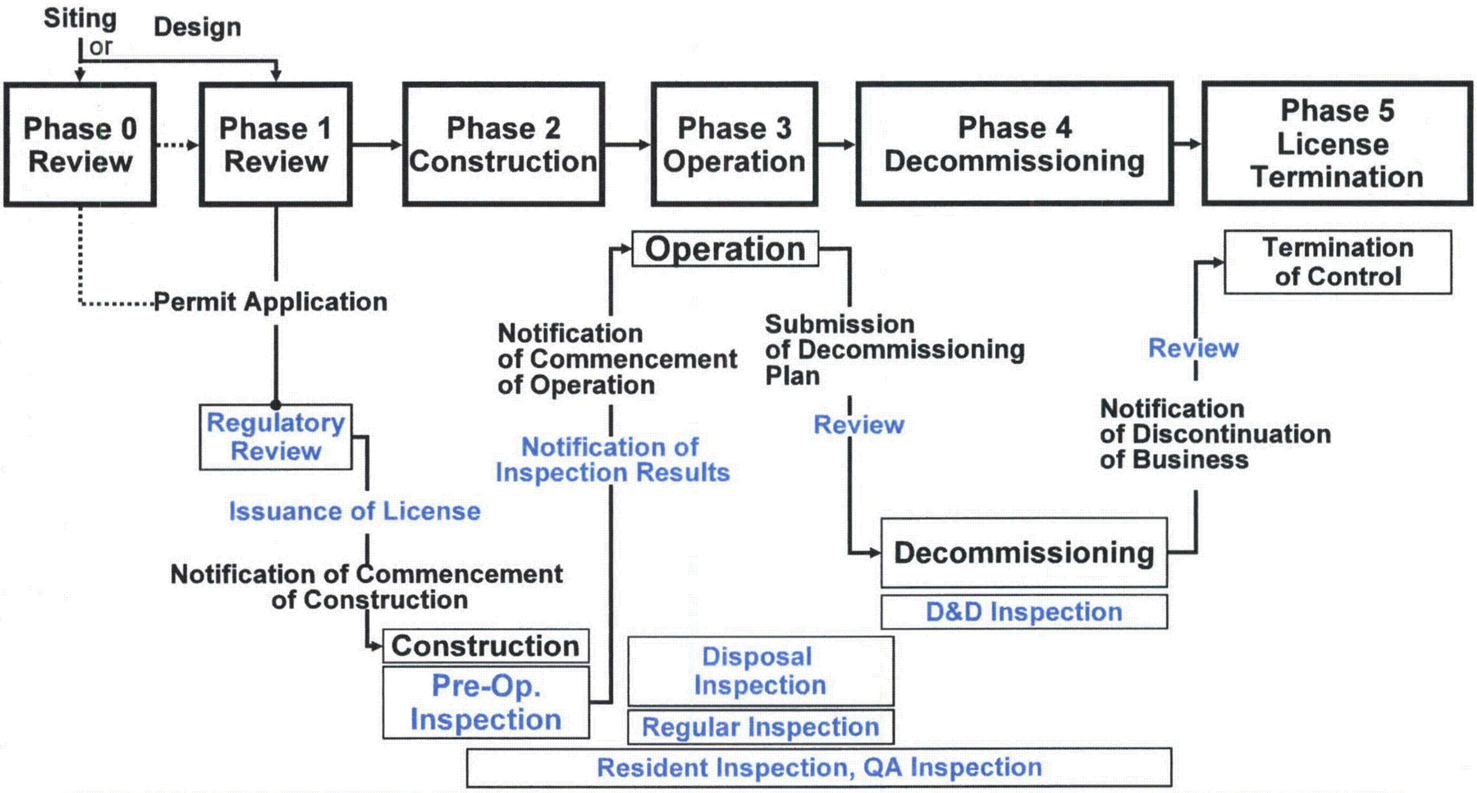
- Capacity: PHWR-type SF 120 bundles (2 baskets, 60 bundles per basket)
- Dimension:
  - 2,750 mm (D)
  - 2,516 mm (H)
- Weight: 126,814kg
- Design/Manufacturing: Holtec International
- Design certification: 2009



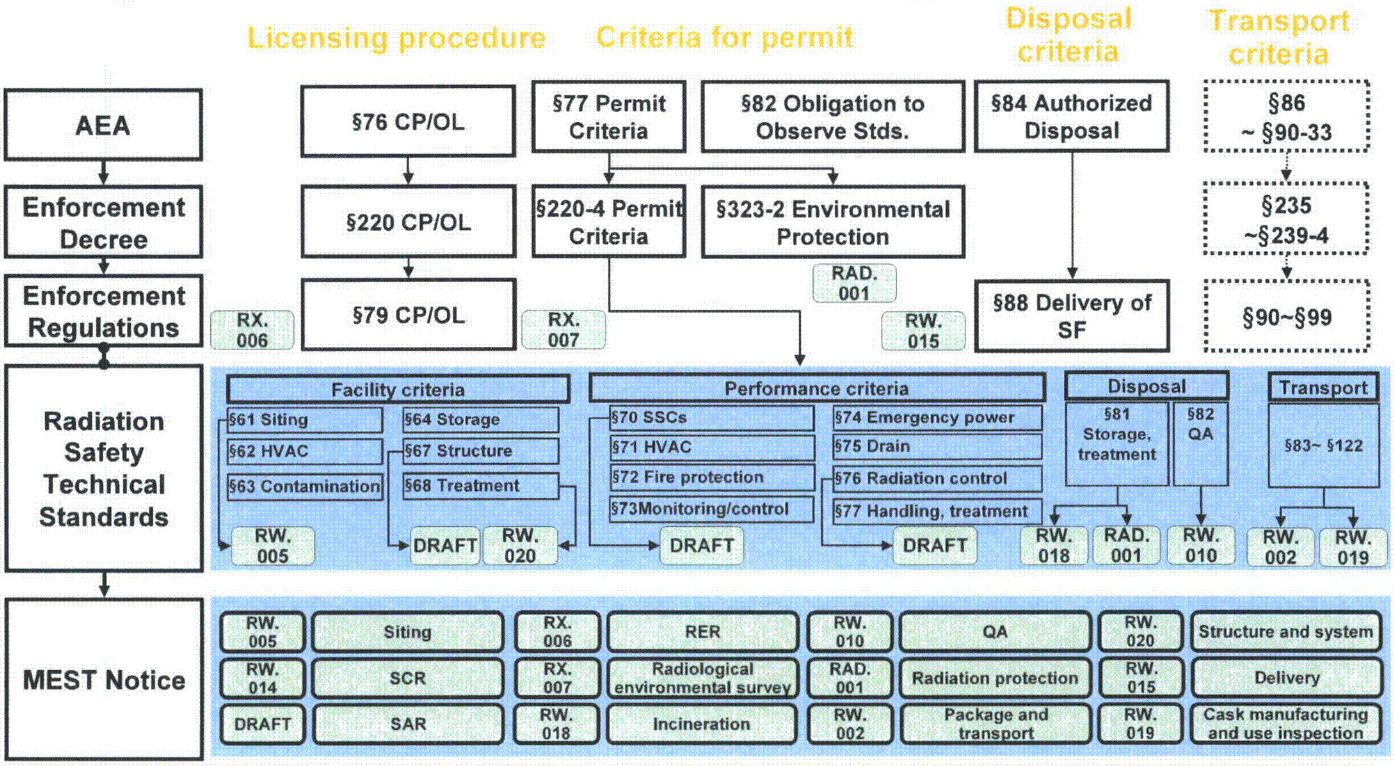
Transport cask
(HISTAR-63)

Regulations on interim storage

Stepwise regulatory system - interim storage



Licensing procedures and regulatory requirements on interim storage



Documents for permit application - interim storage

AEA §76 - related

① **Radiological Environmental Report**

② **Safety Analysis Report**

③ Safety Administration Rules

④ Design and Construction Methods

⑤ Quality Assurance Program

Enforcement Decree of the AEA §79 - related

① Construction and Operation Plan

② Storage, Processing and Disposal Methods

③ Types and Volume of SF

④ Technical Capabilities regarding Construction and Operation

⑤ Equipment and Manpower

Standards on interim storage of SF

- Siting Criteria
  - Meteorological conditions, Hydro-geological features, Earthquakes
  - Ecological characteristics
  - Availability of existing water resources, etc.
- Standards for Structure and Equipments
  - Shielding
  - Prevention of criticality and sufficient cooling capacity
  - Prevention of radiological hazards due to natural phenomena
    - Tsunami, Tornado, Typhoon, Flooding, Heavy Snow/Rainfall, Earthquake, etc.
  - Retaining safety functions in fire and/or explosion accidents
  - Prevention of undue radiation exposure due to accidental release of RM

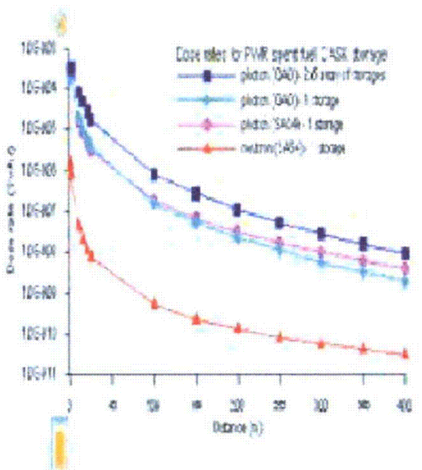
Standards on structures and facilities of interim storage of SF

Articles in the draft Notice	U.S. (10 CFR Part 72)	IAEA (Safety Series No. 116)
§ 4 (Basic requirements) § 23 (specs. and stds.)	Subpart A, F	§ 201-206, § 207-212
§ 4 (Basic requirements), § 5 (Base foundation)	§ 72.122(b)(2)(ii)	§ 217, § 322-332
§ 13 (Materials)	§ 72.120(d)	§ 230-237, § 342-245
§ 11 (Removal of heat)	**§ 72.128(a)(4)**	**§ 225-229, § 338-341**
§ 8 (Criticality)	**§ 72.124(a)~(c)**	**§ 213-216, § 320-321**
§ 10 (Confinement)	**§ 72.122(h)**	**§ 223-224**
§ 9 (Shielding)	**§ 72.126(a)(6)**	**§ 221**
§ 14 (Radiation protection)	§ 72.126(a)~(c)	§ 218-220; § 333-337
§ 15 (Fire protection)	§ 72.122(c)	§ 409-411

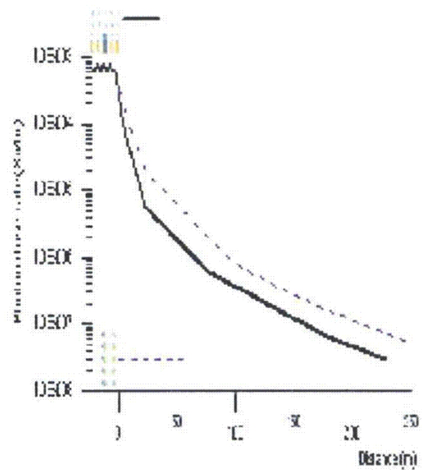
Standards on structures and facilities of interim storage of SF

Articles in the draft Notice	U.S. (10 CFR Part 72)	IAEA (Safety Series No. 116)
§ 12 (Handling equipments)	§ 72.128(a)	§ 238-232 § 346-347
§ 22 (Test, monitoring, inspection, and maintenance)	§ 72.122(a),(f)	§ 601-603
§ 6 (Natural disasters) § 7 (Man-made accidents)	§ 72.122(b)	(SS No. 118)
§ 16 (Alarming equipment) § 17 (Lighting) § 19 (Maintenance of facilities)	§ 72.122(j),(k)	§ 401-418
§ 24 (Prevention of sharing systems)	§ 72.122(d),(k)(4)	
§ 20 (Emergency power)	§ 72.122(k)(3)	§ 402~403
§ 26 (Decommissioning)	§ 72.130	§ 701-703
§ 4 (Basic requirement)	§ 72.122(l), § 236(h),(m)	

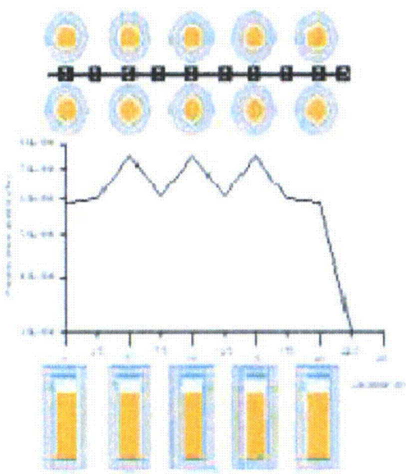
R&D for regulating interim storage of SF



Dose Rate vs. Distance (Single Cask)



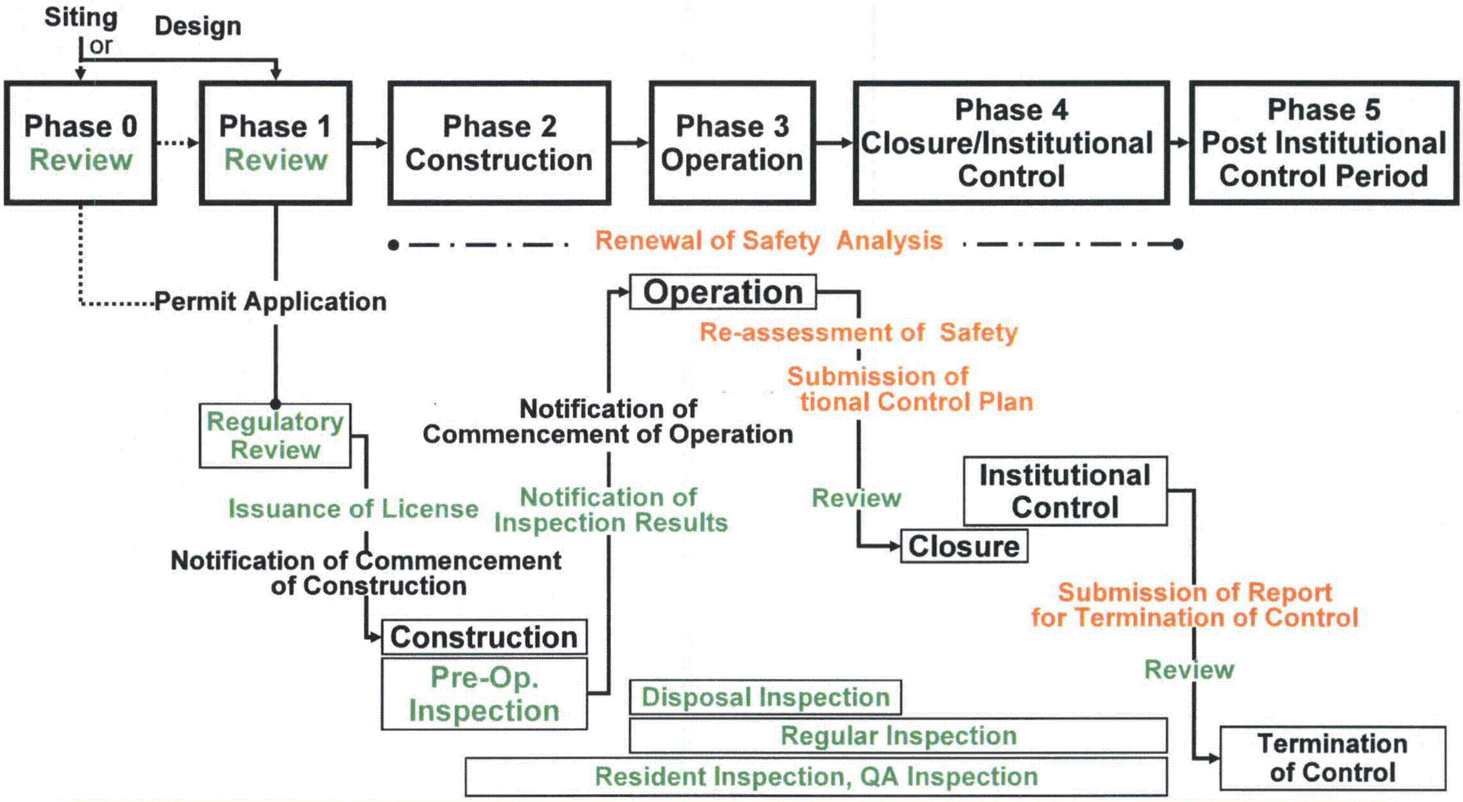
Dose Rate vs. Distance (Arrays of multiple casks) - along with longitudinal and transverse directions



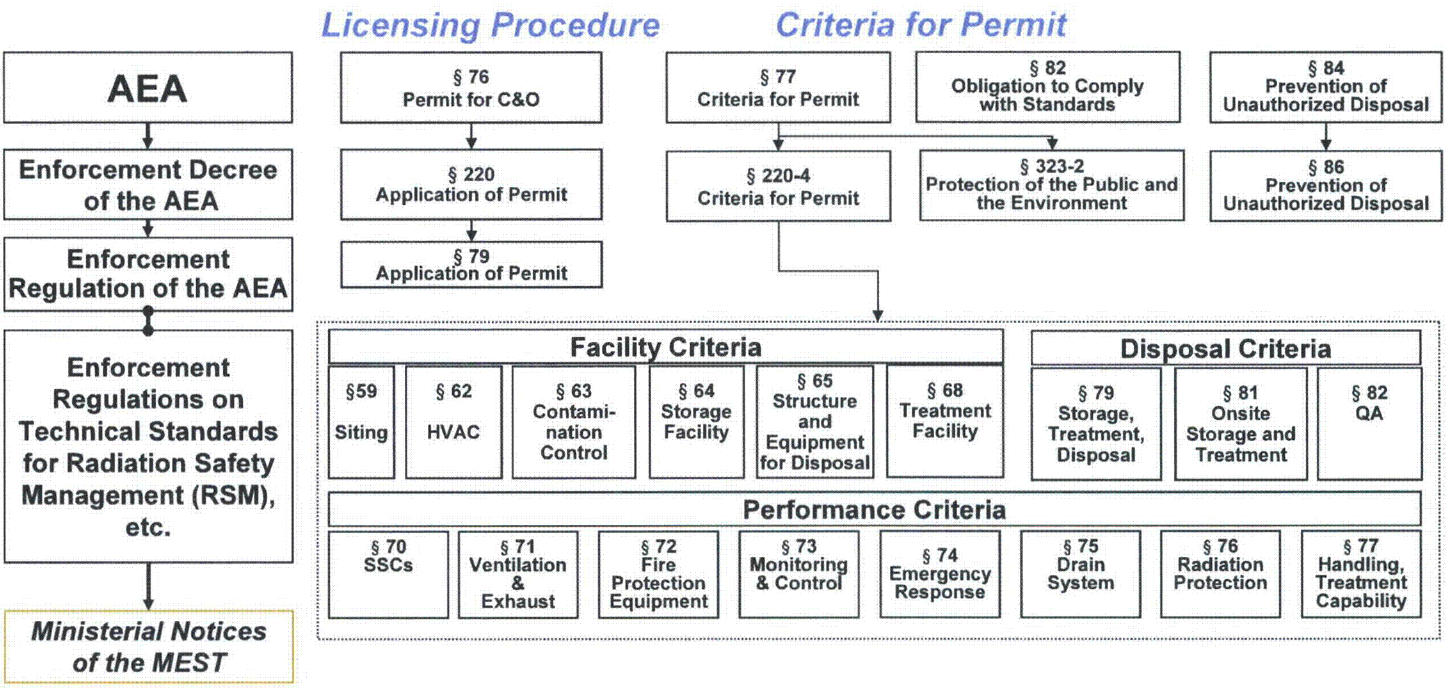
Dose Rate vs. Distance (Arrays of multiple casks) - along with longitudinal center line of arrays

Regulations on disposal

Stepwise regulatory system – disposal



Licensing procedures and regulatory requirements on disposal facility



Standards on deep geological disposal - siting criteria

- Distant from
  - densely populated areas, surface/subsurface water, and deposits of flammable natural resources
- Located in an area/location not seriously affected by
  - sea water, weather change, etc.
- Geologically stable
- Founded on the rocks of low permeability, porosity, and diffusivity
- Founded on the underground media not seriously affected by decay heat

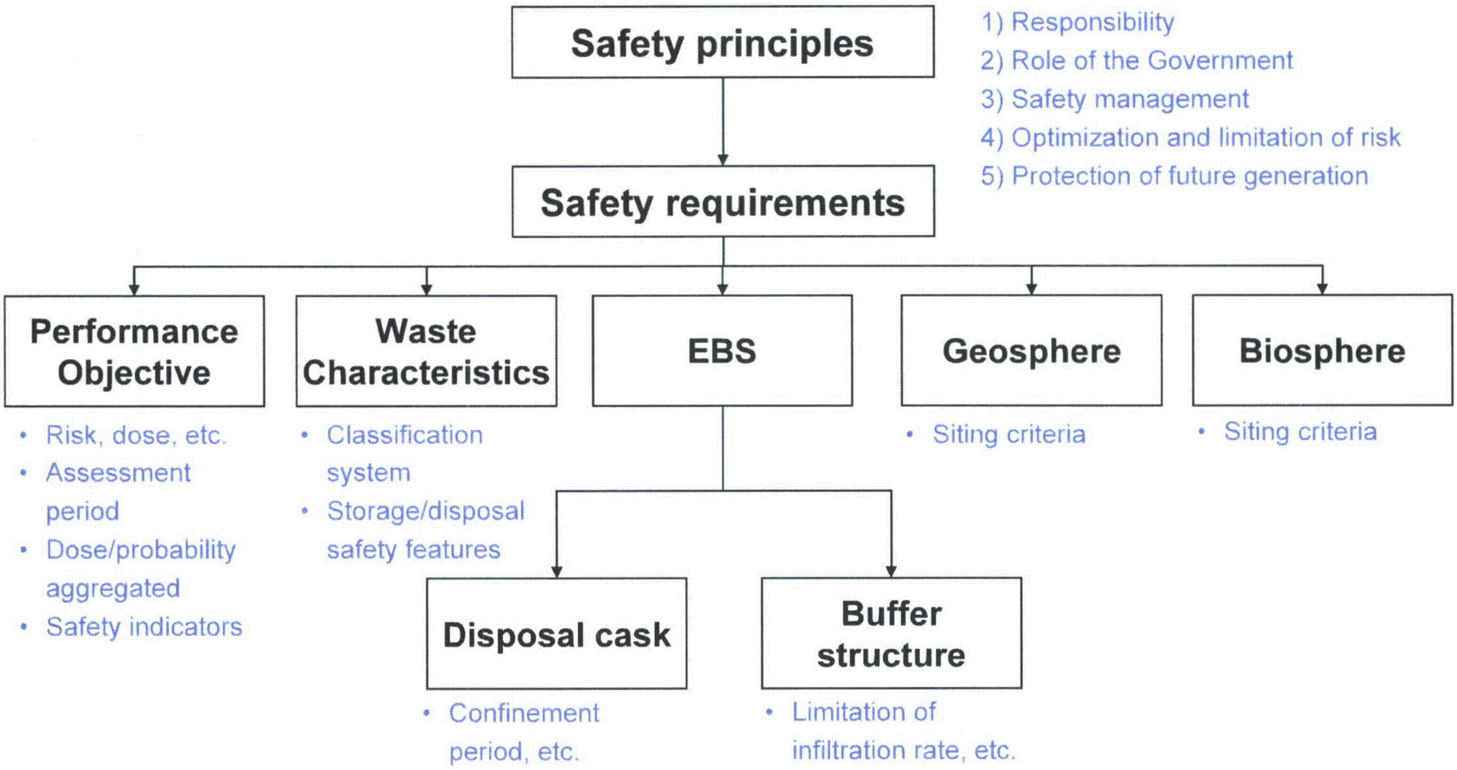
Standards on deep geological disposal

- Structure and equipment criteria
  - Controlling decay heat and pressure generated from waste
  - Preventing potential criticality
- Storage, treatment and disposal criteria
  - Setting up preservation area and/or exclusion area
  - Attaching radiation sign on the waste package
  - Limiting radiation dose to worker, etc.

Post-closure radiological criteria for disposal facility

- LILW disposal facility (MEST Notice RW.011)
  - Natural phenomena: 0.1 mSv/y
  - Unexpected disruptive events: 10^{-6}/y
  - Human intrusion: 1 mSv/y
- HLW disposal facility (under development)
  - Total risk to the public: 10^{-6}/y
  - Dose from a single scenario: 10 mSv/y
  - Development of safety case by using safety indicators

Regulatory R&D framework on HLW disposal



Concluding remarks

Summary

- National policy on SFM
  - to be decided through publicizing process in a few years
- Temporary storage of SF
  - fully experienced
  - few more capacity expansions being expected
- Interim storage of SF
  - being anticipated in the near future
  - to be ready for licensing in 2 to 3 years
- Disposal of SF
  - continuing regulatory R&D on basic concepts

Challenges, areas of interests, etc.

- Policy issues
  - Uncertainty in the end point of SF and time schedule thereof
- Interim storage safety issues
  - Graded approach to AFR-RS and AFR-OS
  - Regulations on AFR-RS after decommissioning of reactor(s)
  - Interfaces between storage and transport regulations
  - Consideration of transportation risk
  - Aircraft crash vs. storage buildings
  - Storage of damaged or high burn-up fuel
  - Pilot PRA of a dry cask storage system

Challenges, areas of interests, etc.

- Disposal safety issues
  - Revision of present regulatory framework on disposal
  - Pre-licensing activities and their legal/practical aspects
  - Role of regulator in site selection process and approval
  - Interfaces among storage, transportation, and disposal of SF
  - Lessons-learned from YMP
  - Anything else...

Thanks for your attention...