Outline of the Draft New Regulatory Requirements for Nuclear Fuel Facilities, Research Reactors, and Nuclear Waste Storage/Disposal Facilities

1. Background and Points for the New Regulatory Requirements

○ The Act on the Regulation of Nuclear Source Material, Nuclear Fuel Material and Reactors (Reactor Regulation Act) revised in June 2012 requires to establish new regulatory requirements for nuclear fuel facilities, etc.(*) by December 18, 2013.

*Nuclear fuel facilities, etc.(*) : spent fuel reprocessing facilities, nuclear fuel fabrication facilities (including uranium enrichment facilities), research reactors, spent fuel interim-storage facilitiy, waste disposal facilities, waste management facilities, and nuclear fuel material usage facilities for R&D

[Major revisions]

- Incorporation of the Licensing Standards into legislative ordinances
- New requirements for the countermeasures against severe accidents
  (Applied to spent fuel reprocessing facilities and nuclear fuel fabrication facilities)

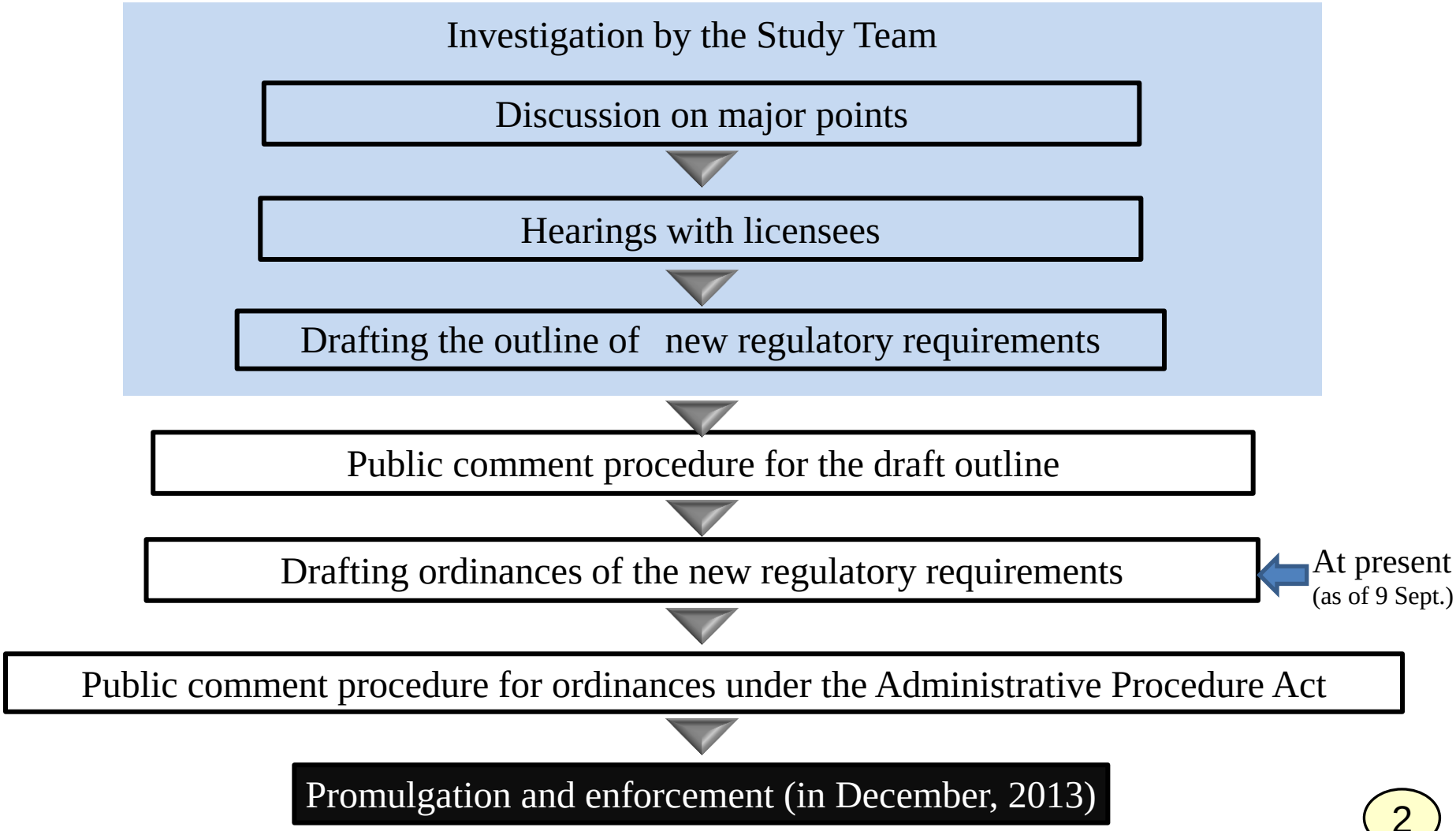
→ Subject to the public comment (from July 25 to August 15, 2013)

- Licensed nuclear facilities are also required to conform the new regulatory requirements (so-called “back-fitting system”).
  (Applied to spent fuel reprocessing facilities, nuclear fuel fabrication facilities, research reactors, spent fuel interim-storage facilities, and waste management facilities)
- Licensees shall conduct the Comprehensive Safety Assessment of their nuclear facilities, report their results to the Nuclear Regulation Authority (NRA) and disclose them to the public.
  (Applied to spent fuel reprocessing facilities, and nuclear fuel fabrication facilities)

○ The new licensing standards are further strengthened by taking into account of the lessons learned from the Fukushima-Daiichi accident as well as international standards, etc. Also countermeasures against severe accidents are newly required as regulatory items.

2. Steps to Establish the New Regulatory Requirements

○ The NRA Study Team, consisting of the Commissioner, officials of NRA and experts from academia, investigates new regulatory requirements in meetings open to the public, including live broadcasting through YouTube.



3. Basic Policy to Establish the New Regulatory Requirements

(i) To establish the requirements based on the unique characteristics of each type of facility

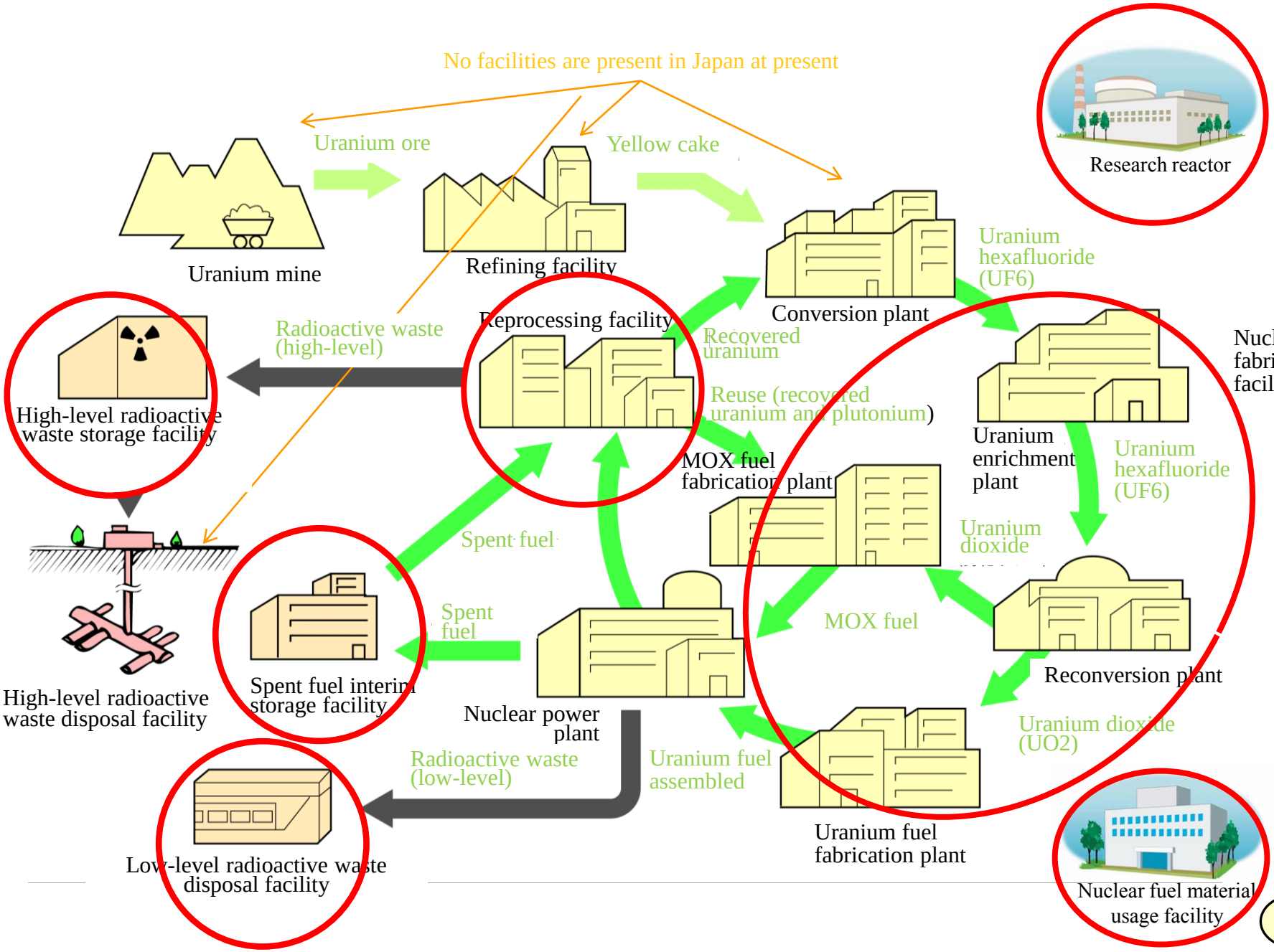
Type of facility	Characteristic	(Ref.) Number of facilities in Japan
Spent fuel reprocessing facility	To process spent fuel chemically and recover uranium and plutonium to recycle as nuclear fuel materials	2
Nuclear fuel fabrication facility	To process nuclear fuel materials physically or chemically into a form and composition usable as fuel in nuclear reactors	7
Research reactor	Nuclear reactors for measurement of nuclear properties, operator training, material tests, and medical irradiation	22 (number of reactor units)
Spent fuel interim storage facility	To store and manage spent fuel, generated at nuclear power plants (NPPs), outside the NPPs temporarily	1
Waste disposal facility	To dispose radioactive waste finally by way of burial	2
Waste management facility	To process and manage up radioactive waste until final disposal	2
Nuclear fuel material usage facility for R&D	To use, store and manage nuclear fuel materials for technological development and analysis, etc.	15 (large-scale facilities*) + 196

*Large-scale facilities refer to facilities that have licensed to use nuclear fuel materials exceeding the quantities specified in Article 41 of the Order for Enforcement of the Reactor Regulation Act.

(ii) To introduce countermeasures against severe accidents

Reprocessing facilities and nuclear fuel fabrication facilities are newly required to prepare countermeasures against severe accidents.

(Ref.) Facilities Subject to the New Regulatory Requirements



4. Facility Types covered by the New Regulatory Requirements

(1) Spent fuel reprocessing facilities
(2) Nuclear fuel fabrication facilities
(3) Research reactors
(4) Spent fuel interim storage facilities
(5) Category 2 waste disposal facilities
(6) Waste management facilities

* The new regulatory requirements for nuclear fuel material usage facilities are developed based on those for nuclear fuel fabrication facilities, etc.

4. (1) Summary of Draft Outline for Spent Fuel Reprocessing Facilities

[Strengthening of design basis*]

*Design basis: the standards to ensure the safety of reprocessing facilities so that they do not give a risk of significant radiation exposure to the public.

- ○ To clarify the relationship between the significance of safety functions and classification of importance in the seismic design
- ○ Regarding natural phenomena,
  - ・To enhance strictly the standards for earthquakes and tsunami estimation
  - ・To clarify the natural phenomena to be considered in design, e.g. volcanic eruptions, tornadoes, and forest fires
- ○ To reinforce comprehensive fire protection measures
- ○ To clarify the necessary consideration against external man-induced events, internal-missiles, internal leakage of chemicals, etc.
- ○ To enhance the reliability of electric power sources

[Measures against severe accident]

- ○ To define severe accidents, and require countermeasures and assessment of their effectiveness
- ○ To require countermeasures to suppress a the release of radioactive materials and/or radiation outside the site and those against terrorist attacks such as intentional plane crashes

(Ref.) Severe Accidents of Reprocessing Facilities

○ Severe accidents at reprocessing facilities are defined by the following serious accidents that occur under conditions exceeding design basis.

A. Accidents relating to systems and equipment containing radioactive materials installed in cells

1) Evaporation to dryness due to the loss of cooling functions
In case where cooling functions are lost, waste liquid etc. boils, resulting in its evaporation to dryness.

2) Explosion of hydrogen generated by radiolysis
In case where hydrogen sweeping functions are lost, hydrogen generated by radiolysis accumulates and explodes after its concentration exceeds the lower explosive limit.

3) Fire and/or explosion of organic solvents, etc.
After the temperature of a solvent leaked into the cell reaches the flash point, fire and explosion of the solvent occurs with an ignition source.

4) Criticality accident
A criticality accident occurs due to ~~a~~ deviation from criticality safety measures, e.g. control of concentrations of fissile materials and management of solution transfer.

5) The other accidents (occurred in cells)

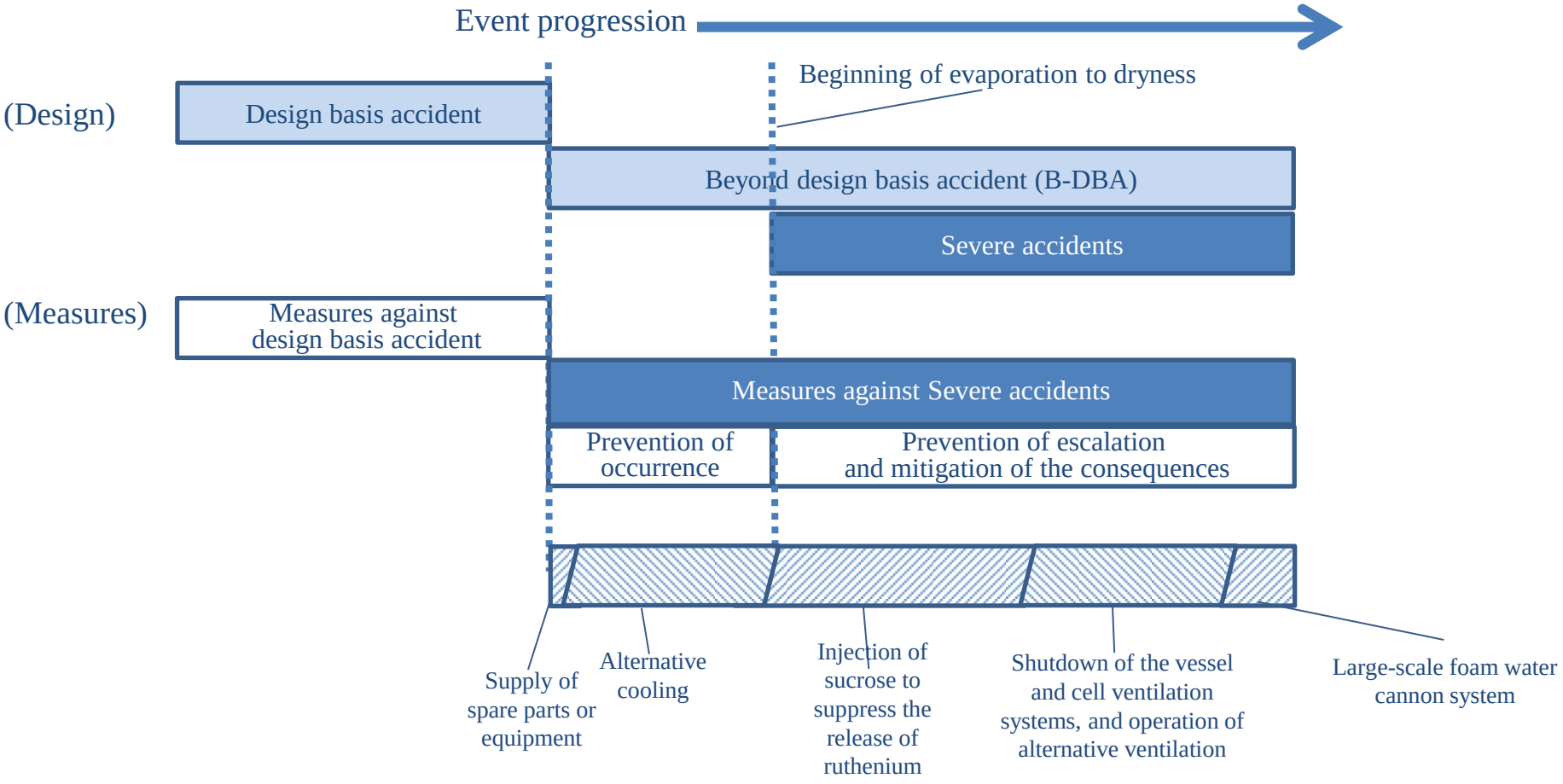
B. Accidents relating to the systems and equipment containing radioactive materials located outside cells

1) Fuel damage in spent fuel storage pools

2) The other accidents (occurred at outside of cells)

(Ref.) Basic Concepts of Severe Accidents of Reprocessing Facilities

Events and countermeasures in the illustration below are for the case of "evaporation to dryness due to loss of cooling functions" as an example.



(Ref.) Overview of the Requirements for Measures against Severe Accidents of Reprocessing Facilities (1)

(In the case of evaporation to dryness due to loss of cooling functions)

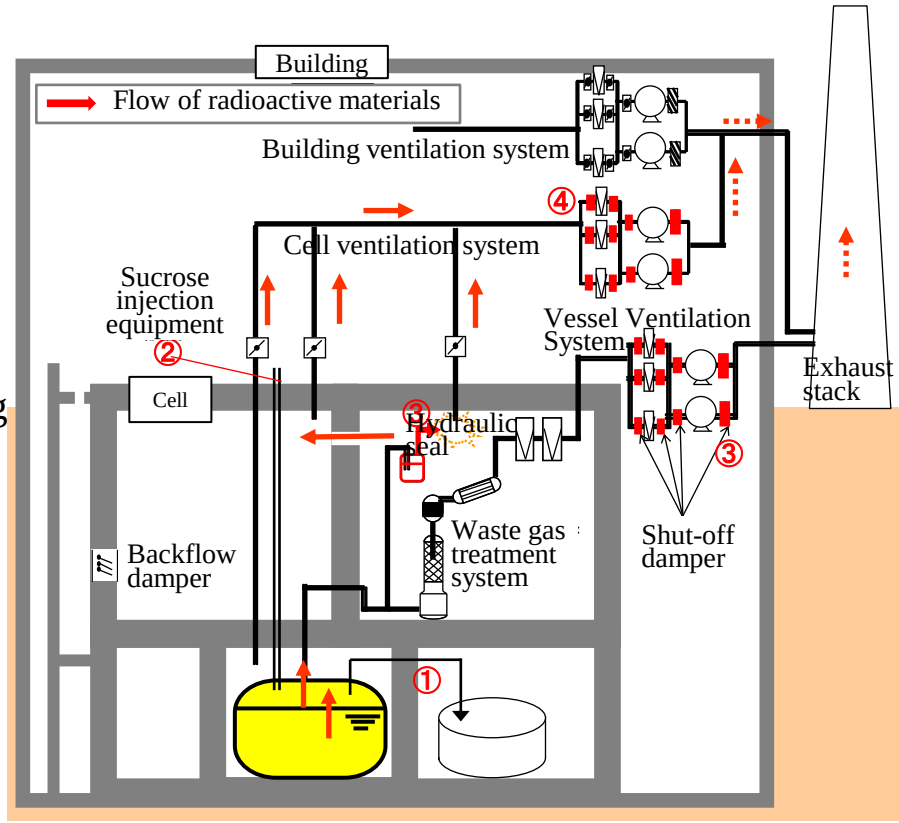
- The followings means ~~should~~ shall be provided as the countermeasures against evaporation to dryness due to loss of cooling function.

(i) Preventing evaporation to dryness
(e.g.) Alternative cooling equipment, solution recovery/ transfer equipment, equipment to directly inject water through cooling pipes, etc.

(ii) Curbing and delaying evaporation of volitile ruthenium
(e.g.) Injection of sucrose, etc.

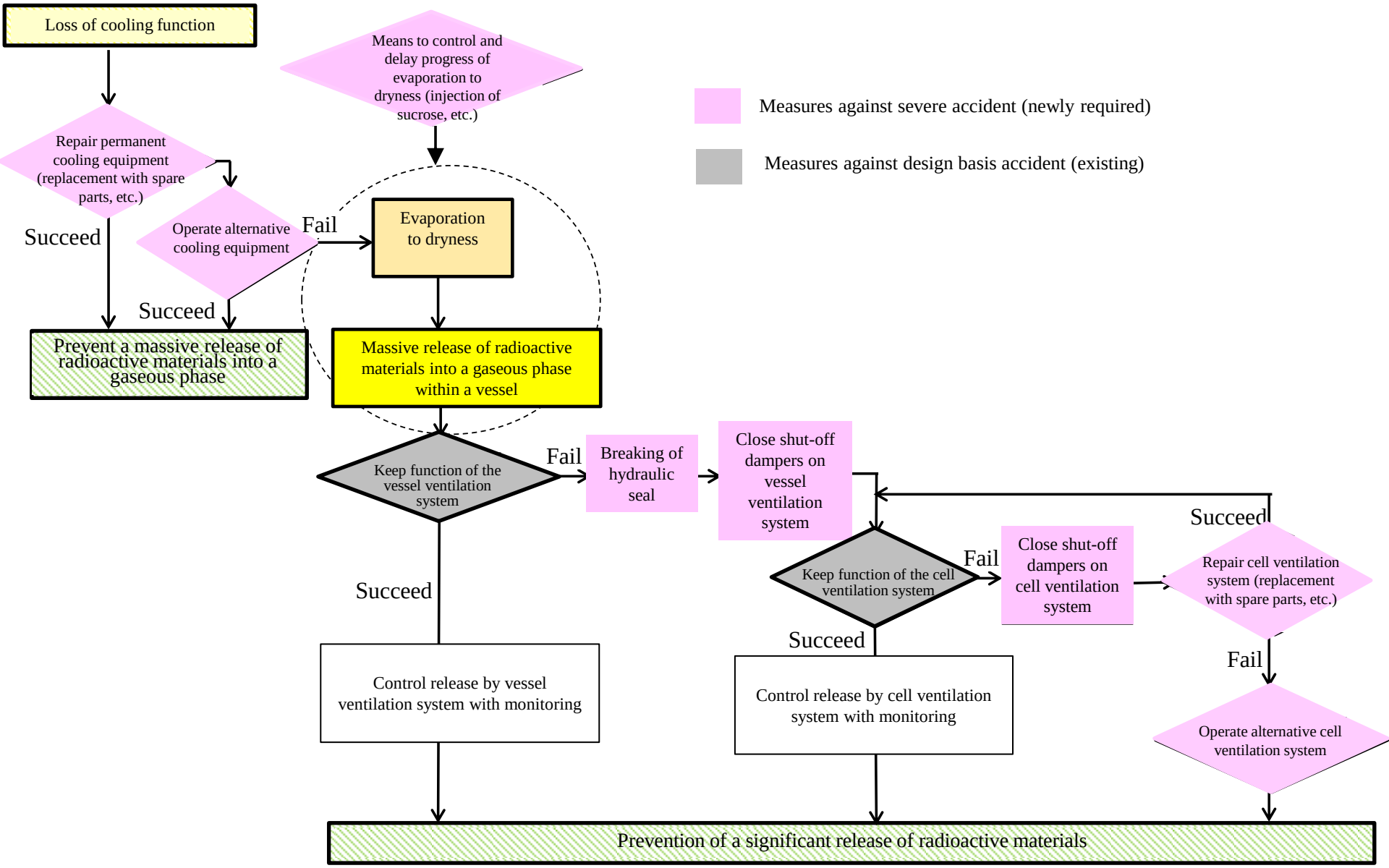
(iii) Closing off the vessel ventilation system and drawing radioactive materials into the cell
(e.g.) Isolation valves, dampers, hydraulic seal , etc.

(iv) Mitigating the consequences
(e.g.) Installation of alternative cell ventilation equipment, etc.



Prevention of a significant release of radioactive materials

(Ref.) Example of Event Progression and Corresponding Countermeasure Required in the Case of a Loss of Cooling Function



(Ref.) Overview of the Requirements for Measures against Severe Accidents of Reprocessing Facilities (2)

- Measures to suppress a release/dispersion of radioactive materials and/or radiation outside the site

  (e.g.)

  - Large scale foam water cannon system

- Measures against extreme natural disasters and intentional aircraft crashes

  - To prepare equipment to obtain necessary information on facility status
  - To prevent simultaneous losing functions of the emergency response center and the control room due to common cause
  - To disperse the location of repositories for the materials and equipment for severe accident management

  etc.

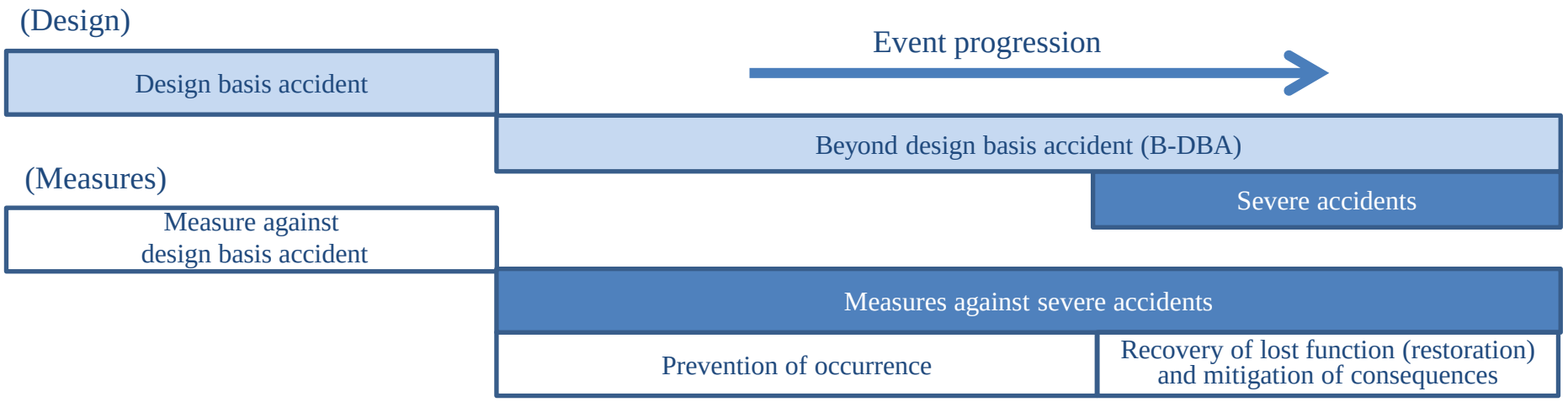
4. (2) Summary of Draft Outline for Nuclear Fuel Fabrication Facilities

[Strengthening of design basis*]

*Design basis: The standards to ensure the safety of fuel manufacture facilities so that they do not give a risk of significant radiation exposure to the public.

- ○ To clarify the relationship between the significance of safety functions and classification of importance in the seismic design
- ○ To enhance strictly the standards for earthquakes and tsunamis estimation for MOX fuel fabrication facilities
- ○ For uranium fuel fabrication facilities,
  - To increase the overdesign factor for static seismic force
  - To apply the same requirements to the important safety-related facilities on earthquakes and tsunamis as those of MOX fuel fabrication facilities [Measures against severe accidents]
- ○ To define severe accidents, and require countermeasures and assessment of their effectiveness
- ○ To require countermeasures for prevention of all types of nuclear fuel fabrication facilities (for MOX as well as uranium fuel fabrication). In addition, to require such measures for MOX fuel fabrication facilities for,
  - Recovering lost functions and restoring from severe accident condition
  - Suppressing a release of radioactive materials/radiation outside the site (mitigating consequence)
- ○ To require countermeasures against the chemical influence of uranium hexafluoride

(Ref.) Basic Concepts of Severe Accidents of Nuclear Fuel Fabrication Facilities



Followings are defined as design basis accident,

- Accident due to loss of confinement
- Criticality accident

As either hydrogen generation due to radiolysis or accidental heat generation due to chemical reactions doesn't occur at nuclear fuel fabrication facilities, it is difficult to identify initiating events and postulate scenarios of events under conditions which would exceed the design basis conditions.
In the new regulatory requirements, therefore, the losses of confinement functions of buildings and ventilation systems are defined as severe accidents at the nuclear fuel fabrication facilities, then countermeasures are required to prevent their occurrences, to recover lost functions and to mitigate their consequences .

(Ref.) Overview of Measures against Severe Accidents of MOX Fuel Fabrication Facilities

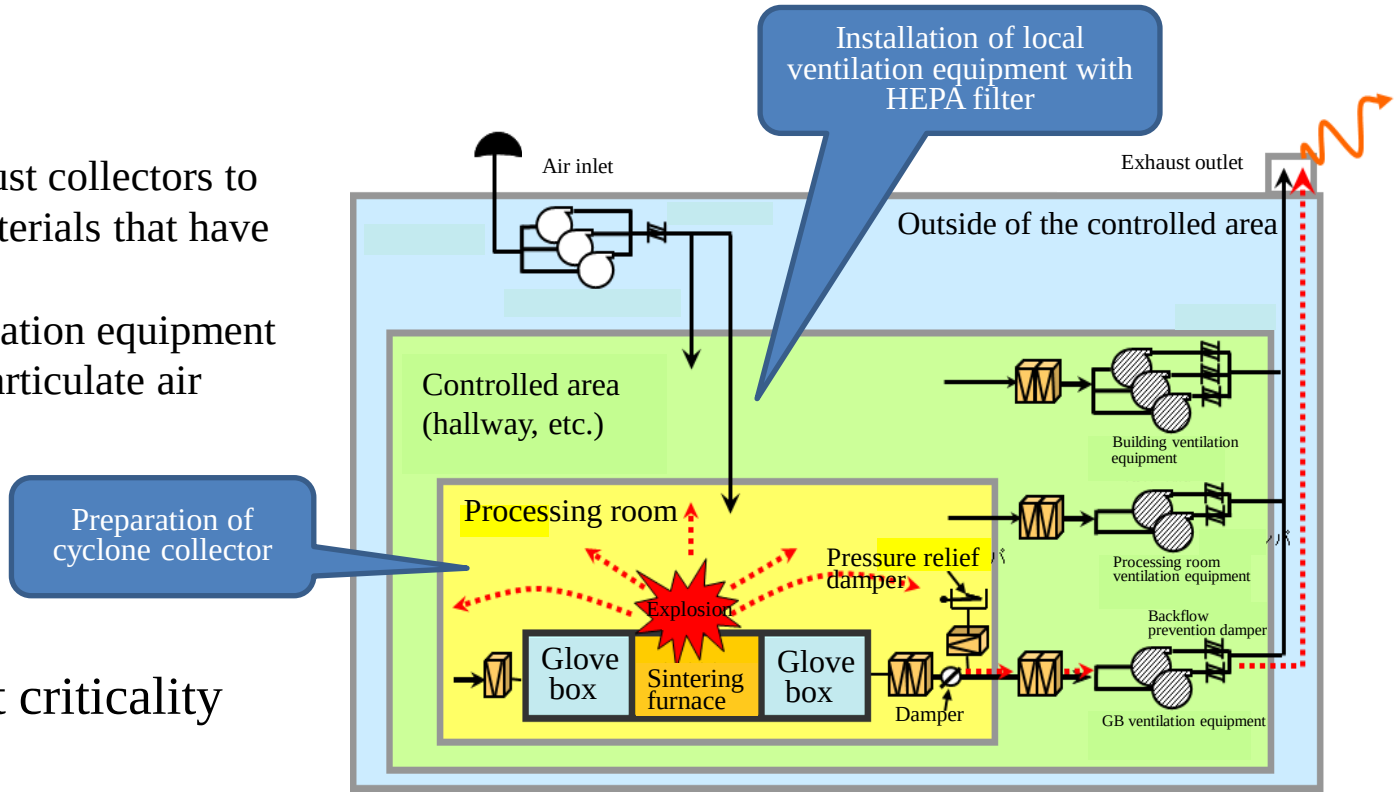
Measures against accidents due to loss of confinement

- To prepare measures to restore from severe accidents and recover lost confinement functions

(example)

・To prepare cyclone dust collectors to collect nuclear fuel materials that have dispersed or leaked

・To install local ventilation equipment with high-efficiency particulate air (HEPA) filters, etc.



Measures against criticality accidents

- To prepare measures to terminate criticality accidents, to prevent the reoccurrence and to mitigate the consequences

(example) To prepare neutron absorbers, and neutron shield, etc.

4. (3) Summary of Draft Outline for Research Reactors

- To specify requirements to address "accidents beyond design basis" for reactors with high potential risks(*)

  * Research reactors with nuclear power exceeding 500kW, such as water-cooled reactors, sodium-cooled reactors, and gas-cooled reactors

- To enhance strictly the standards for earthquakes and tsunamis , in particular countermeasures against tsunamis
- To require considerations against external man-induced events (e.g. illegal access by a third party)
- To require the preparation of procedures to inform visitors on the premises of the occurrence of accidental events and to give them evacuation instructions

- Requirements to address "accidents beyond design basis"
  - Measures to prevent fuel damage and mitigate the consequences
  - Measures to prevent fuel damage and mitigate the consequences at spent fuel storage equipment

- Requirements for sodium-cooled research reactors and gas-cooled research reactors ~~in~~ according to their characteristic features

  (example)
  - To ensure the integrity of the reactor coolant pressure boundary (reactor coolant boundary)
  - To require functions to remove residual heat in addition to decay heat

4. (4) Summary of Draft Outline for Spent Fuel Interim Storage Facilities

- Only apply to the storage method using metal dry casks for transport and storage which are adopted in Mutsu storage facility under construction
- Maintain the existing regulatory requirements (ie: NSC guideline) with regard to the confinement functions and other basic safety functions
- Require natural convection decay heat removal functions

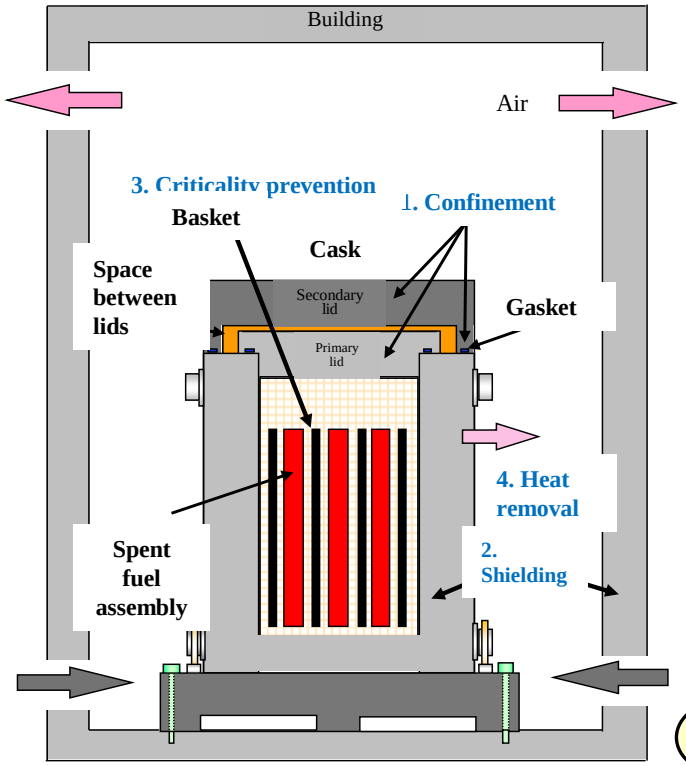
Major requirements

Design of spent fuel interim storage facilities
:Basic safety functions (confinement, shielding, criticality prevention, decay heat removal), etc.

Radiation management, etc. : Radiation monitoring, consideration of materials aging for metal casks, etc.

Other safety measures : Consideration of natural phenomena and convey of metal casks, etc.

[Basic safety functions of spent fuel interim storage facilities]



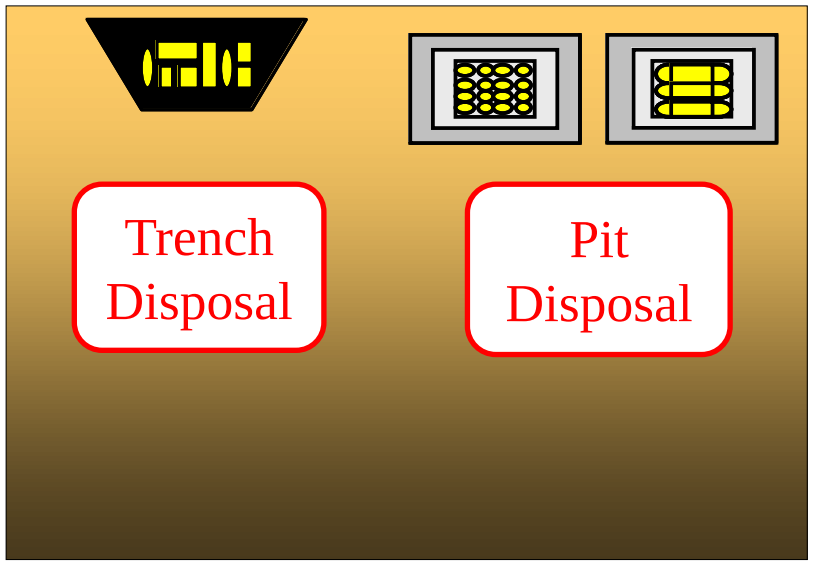
4. (5) Summary of Draft Outline for Near-Surface Disposal Facilities

- Apply to pit disposal and trench disposal facilities
- Require appropriate management to maintain the safety functions required by the design (preservation of waste repository) until approval of a decommissioning plan
- Introduce new system to update assessments periodically based on the latest knowledge until approval of a decommissioning plan

Major design requirements

- Waste Repository : Containment, Retardation of Migration, Shielding, etc.
- Radiation Control, etc.: Monitoring, Surveillance, Radiation Protection, etc.
- Other safety measures : Consideration of Natural Phenomena, etc.

[Concept of pit disposal and trench disposal]

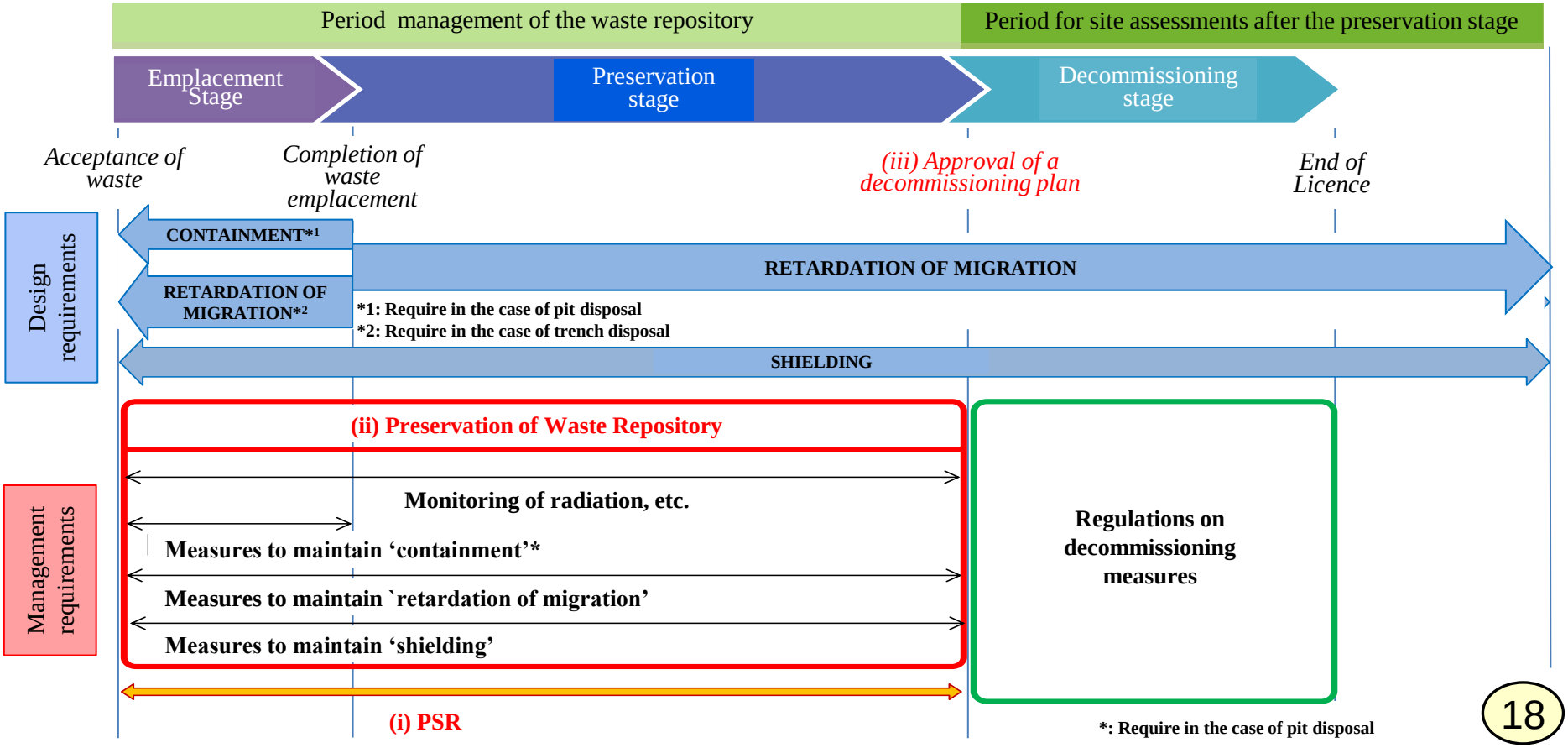


(Ref.) Design and Management Requirements for Near-Surface Waste Disposal Facilities

(i) **Periodic Safety Reviews(PSR)** : Introduce new system to update assessments periodically based on the latest knowledge

(ii) **Preservation of Waste Repository**: Require preservation of waste repository through such means as radiation monitoring and remediation in the case of abnormalities, until approval for a decommissioning plan

(iii) **Criteria for Approval of a Decommissioning Plan** : Add the judgment, safety is insured after the termination in the preservation of the waste repository, based on PSR



4. (6) Summary of Draft Outline for Waste Management Facilities

- Clarify requirements concerning the treatment and management of waste, which are the features of waste management facilities
- Reflect the latest knowledge in the evaluation of seismic force and tsunamis
- Impose new management requirements regarding periodic safety review, including those on aging effects

Design of waste management facilities

- Radioactive waste treatment facilities with consideration given to prevention of the leakage, etc. of radioactive materials
- Radioactive waste storage facilities with sufficient capacity where cooling and other measures are taken appropriately as needed, etc.

Radiation management, etc.

- Radiation monitoring
- Radiation protection, etc.

Other safety measures

- Consideration of natural phenomena, etc.