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Nuclear Regulation Authority

Regulatory overview for the FDNPS Decommissioning

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International Forum on Decommissioning

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What is the difference between specified nuclear facilities and nuclear power stations?

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What is the difference between specified nuclear facilities and nuclear power stations?

○ Nuclear Power Stations (operation, discontinuation)

Control and manage potential risks, starting from each stage of design and operation.

Even in cases where major trouble has occurred, the risk of impacts on the environment and people can be minimized and avoided in a planned fashion through layered safety measures.

○ FDNPS(decommissioning, risk reduction activities in progress)

Risks that have already become apparent

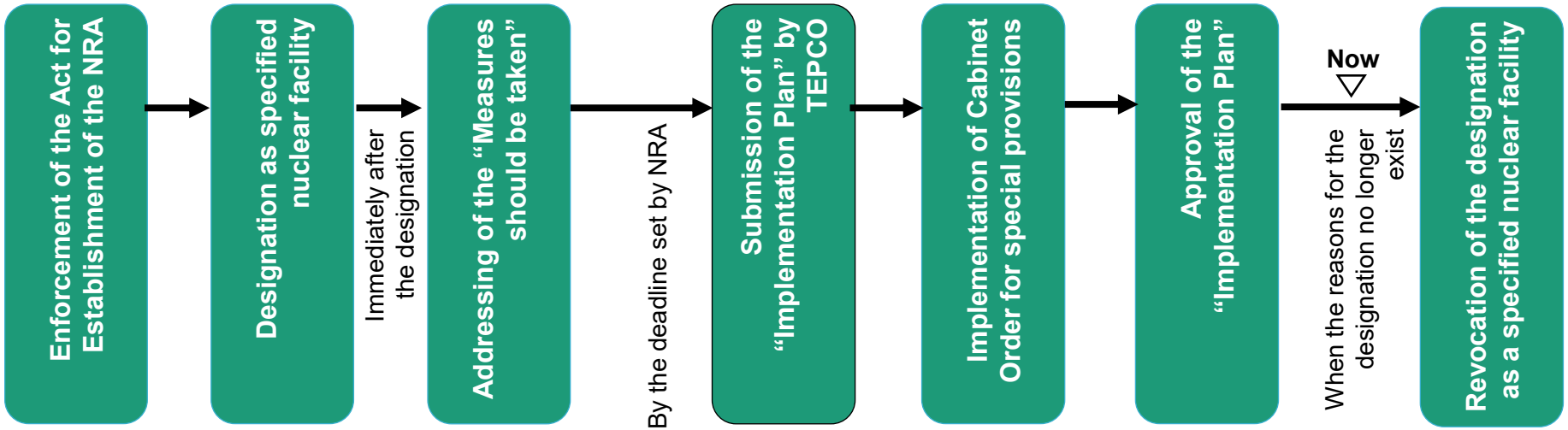
Various risks exist on the site, even outside the reactor main units, and to reduce the risks, it will be essential to stabilize and eliminate the risks, and provide long-term maintenance and storage for the risks.
(Contaminated water, fuel debris, wastes, etc.)

Risks of damaging the environment and people in case of troubles must be avoided in a planned approach.
However, there are no energy sources that would damage the environment and people in comparison with nuclear power stations.

Special regulations for FDNPS (background)

- The Tokyo Electric Power (TEPCO) Fukushima Daiichi Nuclear Power Station (FDNPS) was a nuclear power station where the accident occurred. Special regulations were necessary so it was designated as a specified nuclear facility in November 2012
- “Measures should be taken” are addressed to TEPCO, the operator of FDNPS, the specified nuclear facility. The Nuclear Regulation Authority (NRA) receives an application for the “Implementation Plan” for TEPCO to carry out those measures, and grants approval.

Previous background and future plans



Special regulations for FDNPS / Preamble of the “Measures should be taken”

○ Based on the provisions of Article 64-2, Paragraph (2) of the Act on the Regulation of Nuclear Source Material, Nuclear Fuel Material and Reactors, this document establishes “Measures should be taken” by the specified nuclear operator for the Fukushima Daiichi Nuclear Power Station, designated as a specified nuclear facility.

○ This also establishes Measures that should be implemented by the specified nuclear operator regarding: taking necessary measures quickly and efficiently to achieve **the goal of ensuring safety of the on-site and the off-site by reducing and optimizing risks of the entire specified nuclear facility**, e.g., by completing fuel retrieval as quickly as possible; ensuring the safety of the process of decommissioning for Units 1 through 4, and achieving the earliest possible completion of decommissioning measures including retrieval and storage of melted fuel (fuel debris); and stably maintaining and continuing cold shutdown of Units 5 and 6.

○ **For issues that will require future advances in technology development—**such as the fuel debris retrieval, containment vessel water sealing, and decommissioning**—the operator is required to appropriately review and amend the Implementation Plan at a suitable time**, and NRA shall respond flexibly, for example by ordering changes to the Implementation Plan.

○ **To reduce and optimize risks for the entire specified nuclear facility, NRA shall be actively involved and make suggestions regarding the best approach to ensuring safety, even for matters requiring medium- to long-term measures.**

Source: Measures should be Taken by the Tokyo Electric Power Co., Inc. Fukushima Daiichi Nuclear Power Station Upon Designation as a Specified Nuclear Facility (NRA decision of November 7, 2012).

Special regulations for FDNPS / Parts of the “Measures should be taken”

I. Measures should be taken for entire process and risk assessment

Each process and stage shall be evaluated, and risk reduction and optimization for the entire specified nuclear facility shall be achieved by clarifying the process leading up to decommissioning, and the entire process up to completion of decommissioning measures including the fuel debris retrieval and storage for Units 1 through 4, and the entire process of maintaining and continuing cold shutdown for Units 5 and 6.

When conducting risk assessment of the entire specified nuclear facility and individual equipment, evaluations shall be carried out including wide-area environmental impacts covering the off-site, and the risk reduction and optimization must be sufficient to ensure the on-sire and off-site safety.

V. Measures should be taken for fuel debris retrieval and decommissioning

○ Nuclear fuel materials including fuel debris must be **reliably maintained in a subcritical state**, and after taking measures such as containment vessel water sealing, the fuel materials shall be safely removed, and then **properly shielded, cooled and stored while preventing dispersion.**

○ While **ensuring the safety of workers and areas both the on-site and off-site**, appropriate measures shall be taken to achieve decommissioning of Units 1 through 4 as quickly and safely as possible.

○ In addition to the above, necessary measures shall be taken in order to prevent disasters, etc.

Source: Measures should be Taken by the Tokyo Electric Power Co., Inc. Fukushima Daiichi Nuclear Power Station Upon Designation as a Specified Nuclear Facility (NRA decision of November 7, 2012).

Special regulations for FDNPS / Relations between the “Measures should be taken” and the “Implementation Plan”

Measures should to be taken

I. Measures should be taken for entire process and risk assessment
II. Measures should be taken regarding design, equipment
III. Measures should be taken for safety of specified nuclear facility
IV. Measures should be taken for protection of specified nuclear fuel material
V. Measures should be taken for fuel debris retrieval and decommissioning
VI. Measures should be taken in formulating an implementation plan
VII. Promoting understanding of implementation of implementation plan
VIII. Undergoing inspection relating to implementation plan

Be addressed to TEPCO by Nuclear Regulation Authority

Implementation plan

I. Entire process and risk assessment for specified nuclear facility
II. Design, equipment of specified nuclear facility
III. Safety of specified nuclear facility
IV. Protection of specified nuclear fuel material
V. Fuel debris retrieval, decommissioning
VI. Promoting understanding of implementation of implementation plan
VII. Undergoing inspection relating to implementation plan

Be prepared by TEPCO, approved by Nuclear Regulation Authority

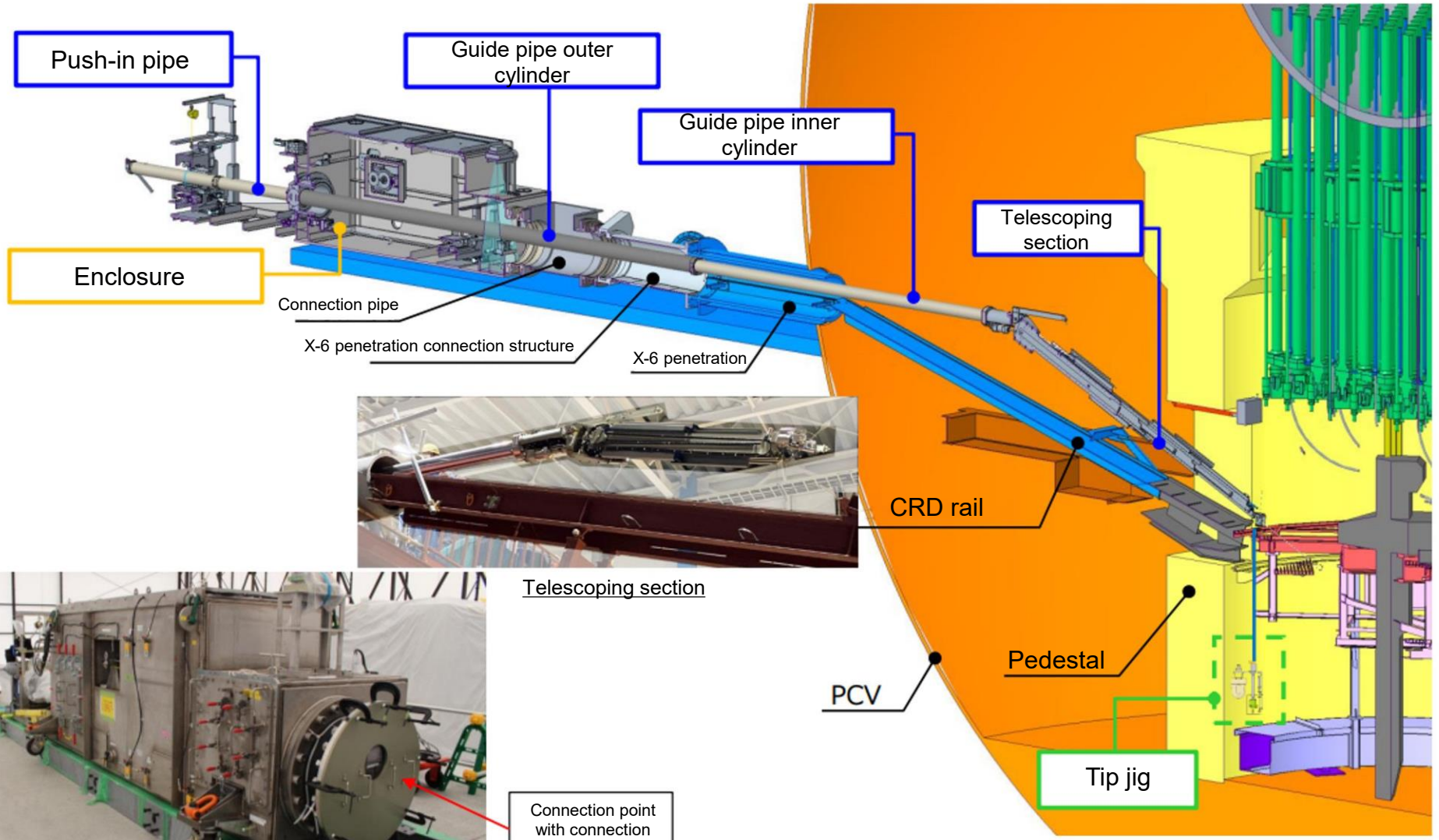
Examples of licensing and inspection for FDNPS, Experimental retrieval of debris

Point of licensing and inspection

◎Sealing Function Boundary

◎Restrictions on retrieval debris considering worker exposure

◎Usage Period



Telescoping section

Telescoping unit

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From documentation for the 115th Review Meeting for Monitoring and Evaluation of Specified Nuclear Facilities
https://www.da.nra.go.jp/view/NRA100007024?contents=NRA100007024-002-011#pdf=NRA100007024-002-011

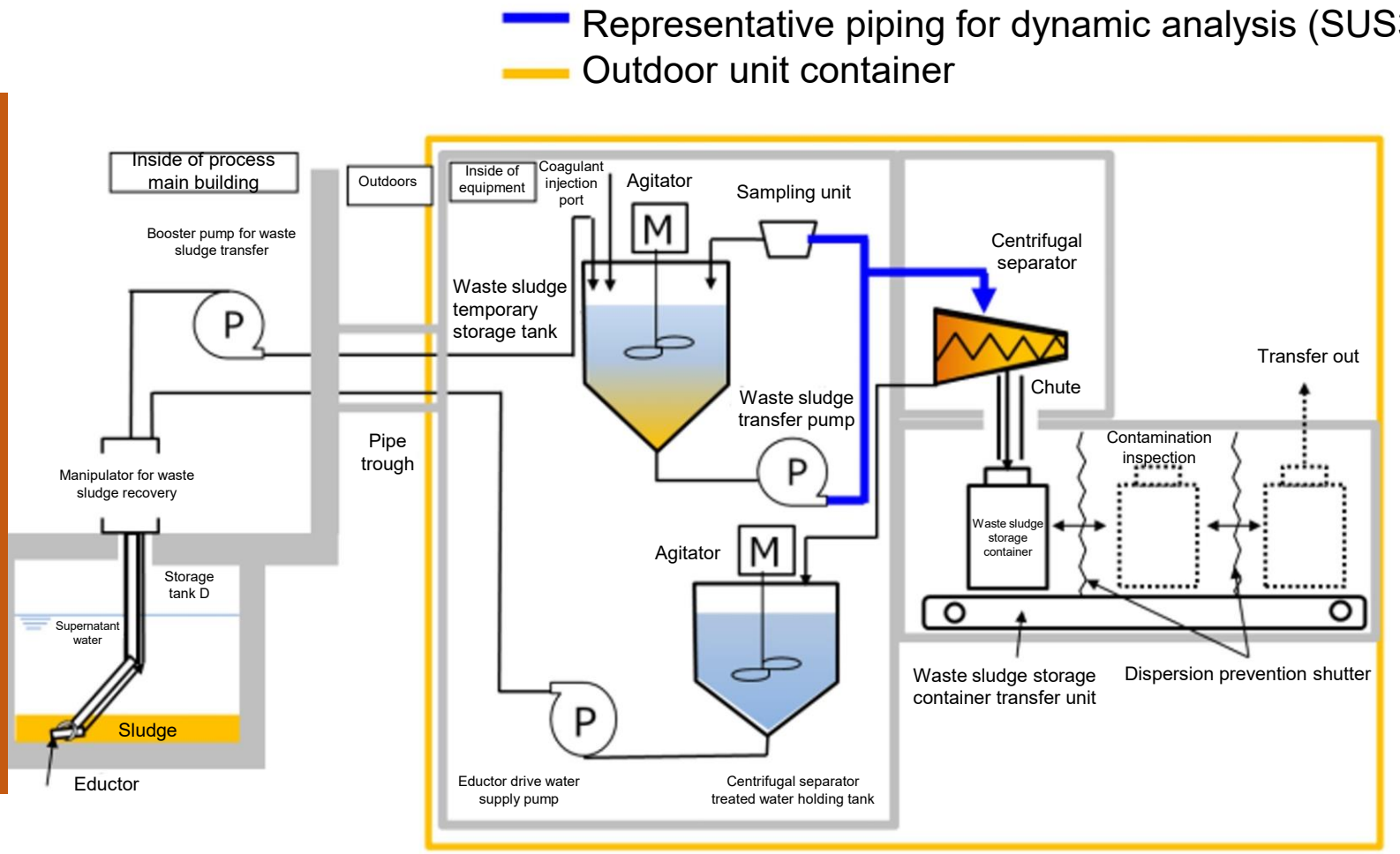
Examples of licensing and inspection for FDNPS, Waste sludge recovery facility

Point of licensing and inspection

◎Sealing Function Boundary

◎Amounts of Handling limits and shielding considering worker exposure

◎Usage Period



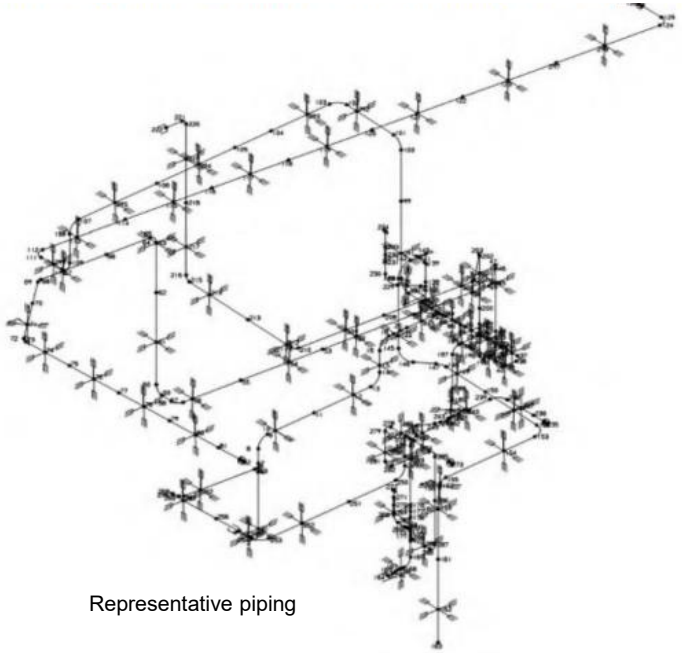
Schematic diagram of waste sludge recovery facility system

From documentation for the 24th Technical Meeting on licensing of Implementation Plans for Specified Nuclear Facilities, etc.
https://www.da.nra.go.jp/view/NRA100007837?contents=NRA100007837-002-005#pdf=NRA100007837-002-005

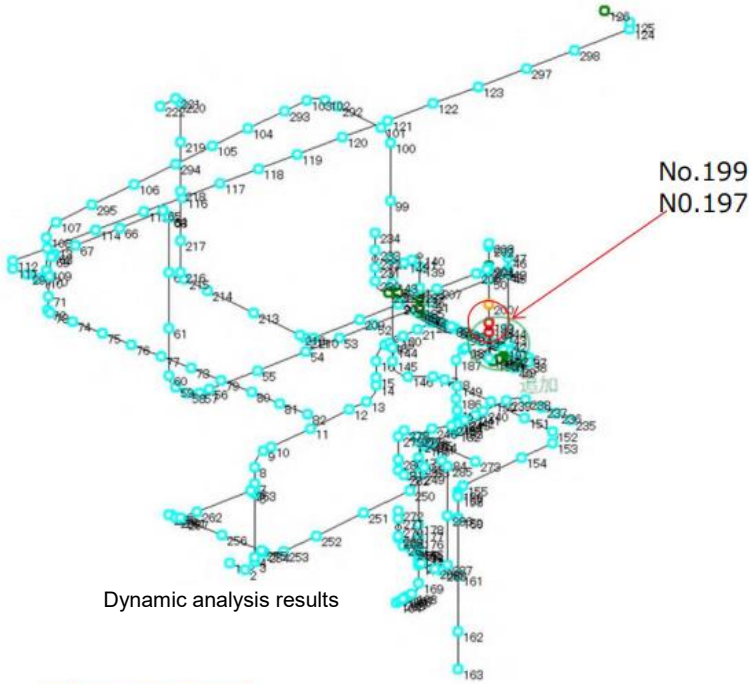
Examples of licensing and inspection for FDNPS, Waste sludge recovery facility

Results of dynamic analysis

- The waste sludge recovery facility is a B-class facility, and based on JEAG 4601 “Technical Guide for Seismic Design of Nuclear Power Stations”, allowable stress for piping is the design yield point (Sy) for primary stress (including bending stress) in the Class-3 allowable stress condition B_AS.
- The results of dynamic analysis of piping showed points not satisfying the design yield point (Sy)



Representative piping



Dynamic analysis results

Representative piping dynamic analysis results

Evaluation point	Generated stress (MPa)	Design yield point (Sy) (MPa)	Stress ratio
No.199	214	175	1.22
No.197	192	175	1.10

: Points where stress ratio exceeds 1.0 (No. 199, 197)
: Points where stress ratio exceeds 0.8 and falls below 1.0
: Points where stress ratio exceeds 0.4 and falls below 0.8
: Points where stress ratio falls below 0.4

From documentation for the 24th Technical Meeting on licensing of Implementation Plans for Specified Nuclear Facilities, etc.
https://www.da.nra.go.jp/view/NRA100007837?contents=NRA100007837-002-005#pdf=NRA100007837-002-005

Examples of licensing and inspection for FDNPS, Waste sludge recovery facility

- NRA has proposed that, considering the unique circumstances of 1F, it could also be approvable that a combination includes flexible response and reasonable facility design in this licensing process.

(Reference) Measures when there is a point that does not satisfy the allowable stress

TEPCO

- The piping for which dynamic analysis was conducted this time is long piping for which evaluation is expected to be the most demanding, and there is a low probability that piping evaluated from now will exceed the design yield point (Sy) that is the allowable stress. In the unlikely event that a location of piping do not satisfy the design yield point (Sy), the following measures will be taken after considering the short in-service period of the waste sludge recovery facility and the early risk reduction.
  - The generated stress is verified to be less than the primary stress (including bending stress) of 0.9 Su (Su: design tensile strength) for the allowable stress state IV_A of the S-class facility (which is stipulated by JEAG 4601) so that piping boundaries do not fail during Class B earthquakes.
  - However, since the design yield point (Sy) is not satisfied, if an earthquake occurs during the in-service period of the waste sludge recovery facility, operation will be resumed after confirming soundness of the facilities if needed.
- When allowable stress is exceeded in future seismic load evaluations of 1F decommissioning facilities, we want to include this types of measure as one option, and strive for rational response from the standpoint of the in-service period and risk reduction.

From documentation for the 24th Technical Meeting on licensing of Implementation Plans for Specified Nuclear Facilities, etc.
https://www.da.nra.go.jp/view/NRA100007837?contents=NRA100007837-002-005#pdf=NRA100007837-002-005

Summary

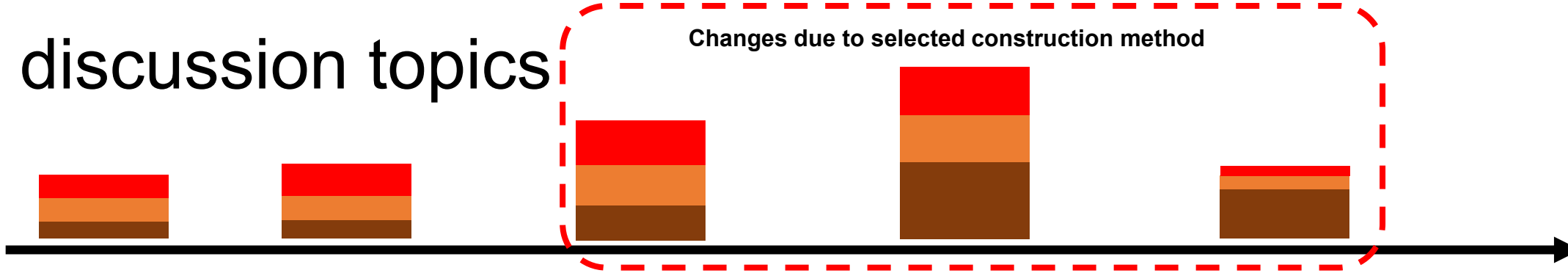
- As for the regulations for FDNPS, in order to respond to risks that have become apparent due to the accident, unlike an ordinary nuclear facility, NRA established the “Measures should be taken” and also concudts licensing and inspection based on the Implementation Plan.

- In the “Measures should be taken”, its goal is to reduce and optimize risks of FDNPS as a whole, and ensure the both on-site and off-site safety.

- In the practices of the licensing thus far, flexible responses have been implemented, such as NRA presented alternative options including sets with flexible measures and reasonable facility design, to avoid unnecessary licensing processes.

- NRA believe this regulatory policy and flexible response can naturally be applied to future debris retrieval as well.

Expected discussion topics



Stage of investigation	Small quantity retrieval	Staged expansion of scale	Large-scale retrieval	Cleanup, dismantling, etc.

Safety assurance review items

◎ **Risk level**
- Containment
- Shielding (people, workers)

◎ **Measures in case of an emergency**
- Operations (including flexible response)
- Design (improvements for accident scenarios, earthquake resistance flowchart)

→What is the scenario with the greatest impact in case of an emergency?

◎ **Impact on decommissioning risk reduction activities due to the retrieval**
- Work interruption and suspension due to external hazards (earthquakes, tsunamis, etc.)
- Major delays due to retrieval equipment failures, trouble, etc.
- Quality control errors, supply chain withdrawals, etc.

→ What are the important elements for ensuring business continuity?

Thank you for your attention!