

The 5th
International Forum on the Decommissioning of
the Fukushima Daiichi Nuclear Power Station

Safety and Risk

-from a perspective of technical strategy-

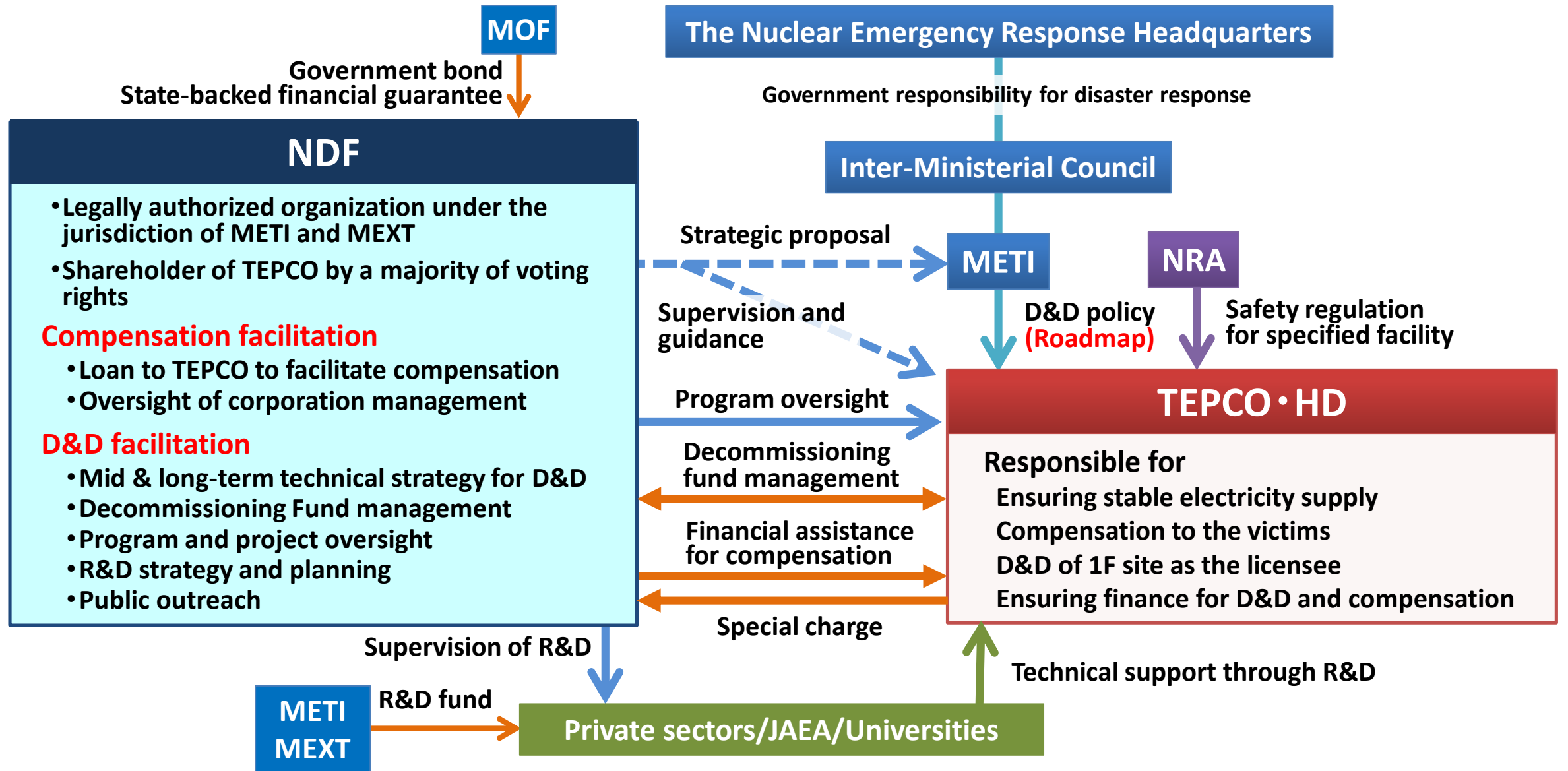
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Kosuke Ono

Program Supervision & Support Office

Nuclear Damage Compensation and Decommissioning Facilitation Corporation (NDF)

The Organizational Structure Addressing 1F Decommissioning



NDF's Activities

Incorporate various proposition focusing on risk reduction into technical strategic plan and carry out activities to promote understandings from international community and local regions through information dissemination and dialogue

➤ **Prepare technical strategic plan**

- ◆ Risk Evaluation
- ◆ Technical Investigation
- ◆ Collecting information and research on overseas cases
- ◆ Research and Development
- ◆ Committees (e.g. Expert Committee on Fuel Debris, Expert Committee on Waste Management)

➤ **Dialogue and information exchange with relevant parties**

(TEPCO, ANRE, NRA, Local Governments, Experts, Overseas organizations etc.)

e.g. prepare report on “The way engineering ought to be from the safety and operator’s perspectives” submitted to TEPCO, ANRE, NRA etc. for their opinions

Technical Strategic Plan 2021

1. Introduction

2. Concept for reducing risks and ensuring safety in the decommissioning of 1F

2.1 Basic policy for the decommissioning of 1F

2.2 Concept of reducing risks caused by radioactive materials

2.3 Approach to ensuring safety during decommissioning

3. Technological strategies toward decommissioning of 1F

(Fuel debris retrieval, Waste management, Contaminated and treated water management, Fuel removal from spent fuel pools)

4. Analysis strategy for promoting decommissioning

5. Efforts to facilitate R&D

6. Activities to support our technical strategy



The screenshot shows the NDF Decommissioning Office website. The header includes the NDF logo and the text "Nuclear Damage Compensation and Decommissioning Facilitation Corporation" and "Decommissioning Office". The navigation menu has four items: "About NDF", "NDF Committees", "Strategic Plan", and "International Activities". The main content area is titled "Strategic Plan 2020" and contains the following text: "NDF published 'Technical Strategic Plan 2020 for Decommissioning of the Fukushima Daiichi Nuclear Power Station of Tokyo Electric Power Company Holdings, Inc.' on October 9, 2020." Below this, it says "Please see below for details." and lists three links: "Technical Strategic Plan 2020 for Decommissioning of the Fukushima Daiichi Nuclear Power Station of Tokyo Electric Power Company Holdings, Inc.", "Technical Strategic Plan 2020 for Decommissioning of the Fukushima Daiichi Nuclear Power Station of Tokyo Electric Power Company Holdings, Inc. (Overview)", and "Technical Strategic Plan 2020 for Decommissioning of the Fukushima Daiichi Nuclear Power Station of Tokyo Electric Power Company Holdings, Inc. (Explanatory material)".

NDF Web page to get Technical Strategic Plan PDF
<https://www.dd.ndf.go.jp/strategic-plan/index2020.html>

Risk Reduction Strategy

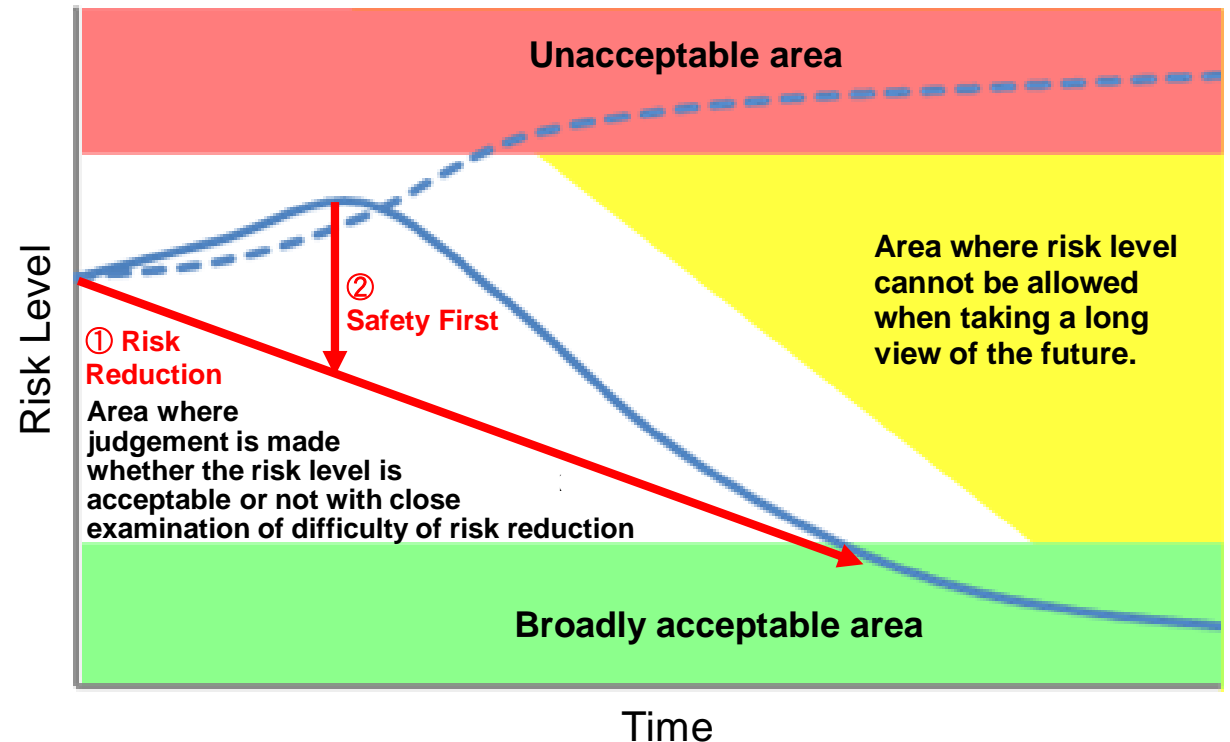
Basic Policy for the Decommissioning of Fukushima Daiichi NPS

Continuously and quickly reduce the risks arising from the radioactive material caused by the accident that do not exist in a normal NPS

➤ Technical Strategic Plan is “**Design of Risk Reduction Strategy**” in the middle-long term

➤ Five (5) Guiding Principles

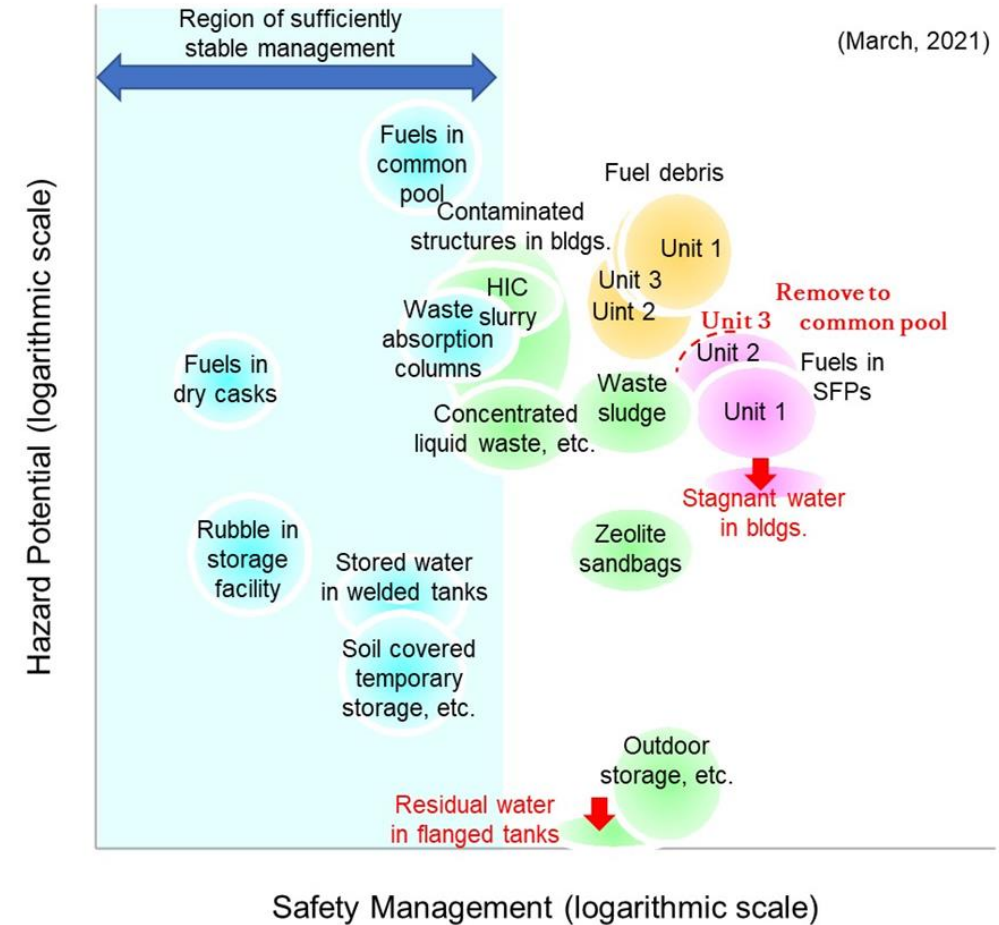
- Safe
- Proven
- Efficient
- Timely
- Field-oriented



① Concept of Risk Reduction caused by radioactive material (1)

SED (Safety and Environmental Detriment)

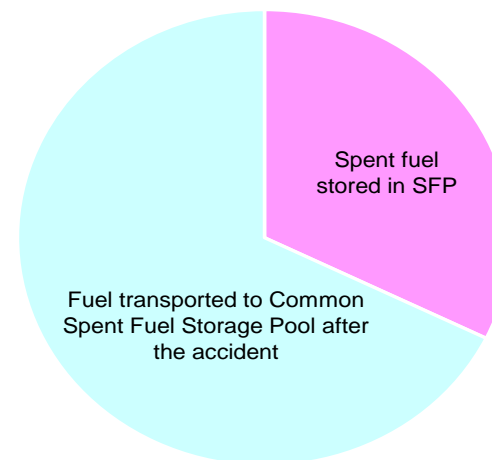
- Method expressing the magnitude of risk level for radioactive materials by “Hazard Potential” x “Safety Management”
- Developed by UK Nuclear Decommissioning Authority (NDA) and customized by NDF for 1F



① Concept of Risk Reduction caused by radioactive material (2)

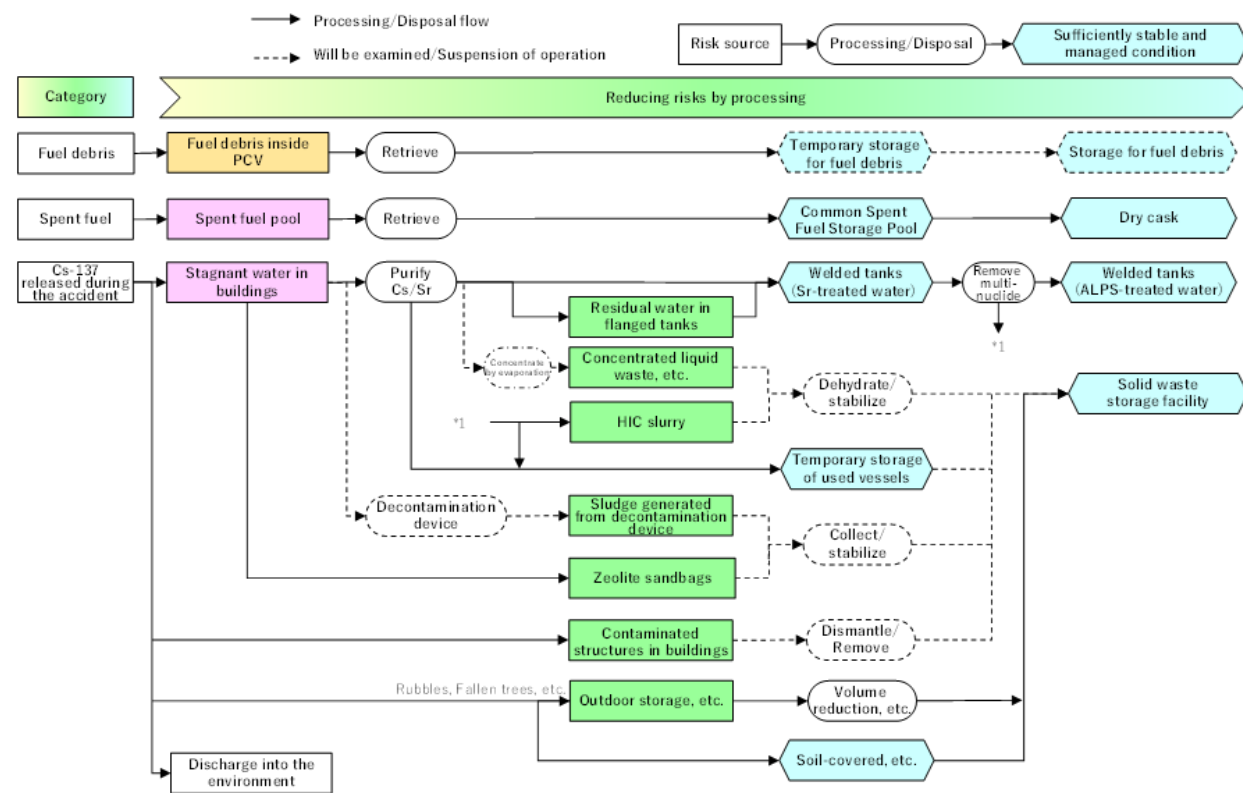
Material Flow

Process to bring major risk sources into the “sufficiently stable management” region as the immediate goal and the decommissioning work progress accordingly

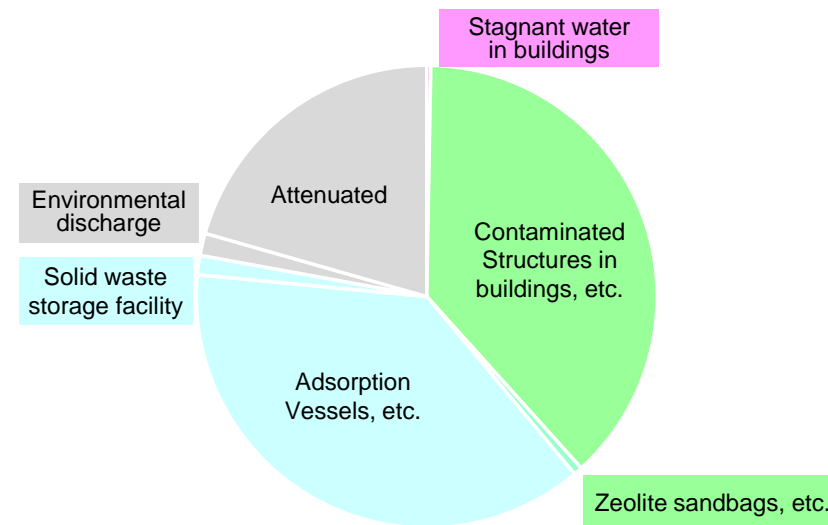


*New fuel not included

(b) Number of spent fuel (units 1 to 4)



(a) Risk reduction process



(c) Cs-137 released at the time of the accident (units 1 to 3) 6

② Approach to ensuing safety during decommissioning

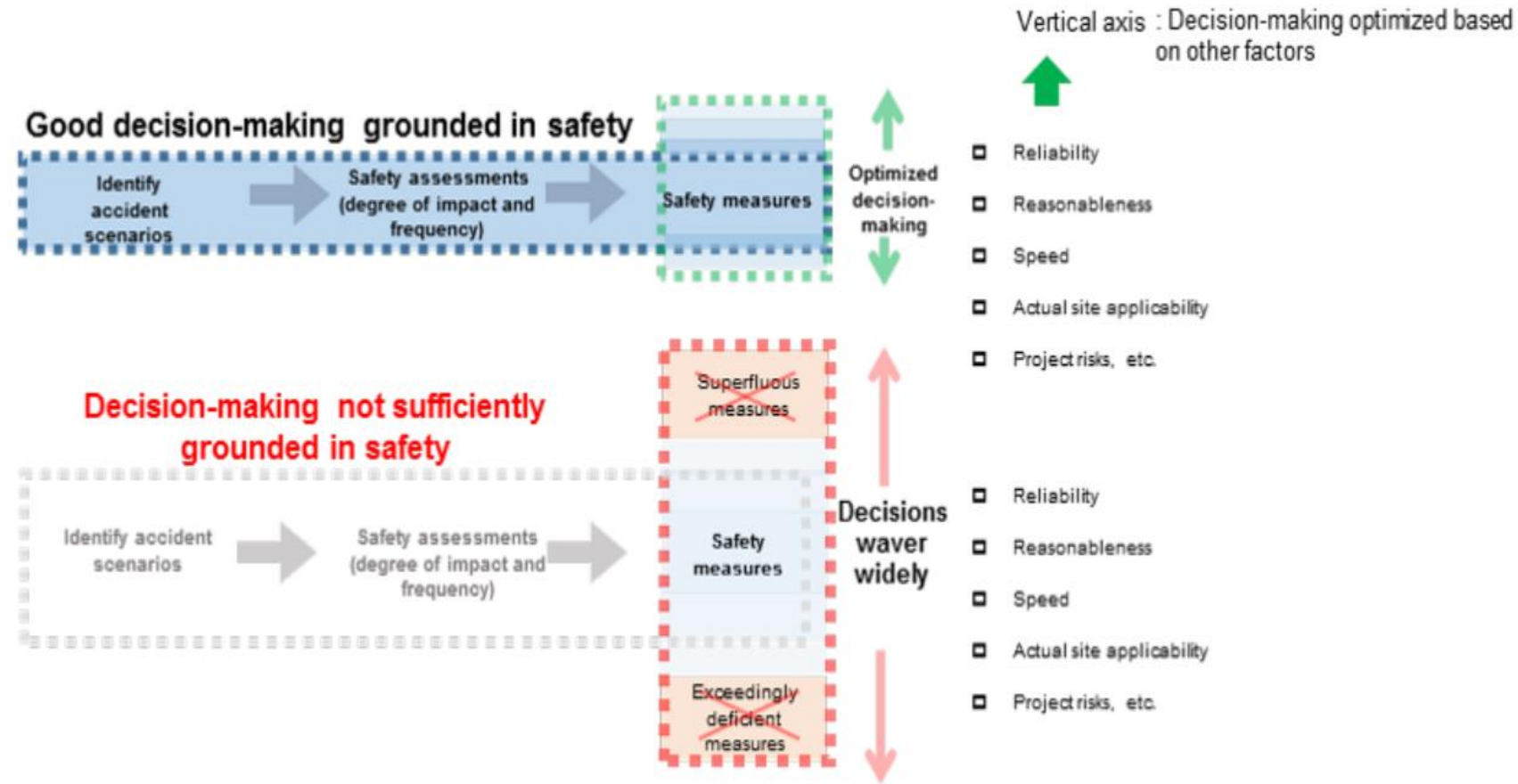
- For the unprecedented and technically difficult tasks such as fuel debris retrieval, in addition to designing/manufacturing method or equipment,
 - “**safety perspective**” as the operator handling potentially hazardous material, and
 - “field-oriented (operation, maintenance, radiation control, instrumentation, analysis etc.) perspective” (“**operator’s perspective**”) needs to be sufficiently reflected into such method or equipment.
- To achieve the above purpose, **these perspectives have to be fully reflected in the process (project)** leading up to the use of method or equipment in the field. Without these perspectives being adequately reflected in the project, consequently results (method, equipment etc.) may be brought which is not suitable for use in the fields, obstructing safe and stable decommissioning.

② Approach to ensuing safety during decommissioning – Peculiarity of 1F

- A large amount of radioactive material (including α -nuclides that have a significant impact in internal exposure) is in an unsealed state, as well as in unusual (atypical) and various forms
- Barriers for containing radioactive materials, such as reactor buildings and PCVs, are incomplete
- Significant uncertainties exist regarding the state of these radioactive materials and containment barriers, etc.
- Difficulty in accessing the site and installing instrumentation devices to obtain on-site information due to constraints such as high radiation levels on site
- Since the current level of radiation is high and further degradation of containment barriers is a concern, it is necessary to take measures in consideration of the time axis without prolonging the decommissioning activities

② Approach to ensuing safety during decommissioning – Safety perspective

For unprecedented 1F decommissioning with significant uncertainties, **deliberated safety evaluation** has to be the basis for making decisions regarding safety measures (concept of “**Safety first**”). As a result, the decisions will not be significantly unstable (without excessive or too little measures) due to various elements other than safety.



Concept of “Safety first” (conceptual diagram)

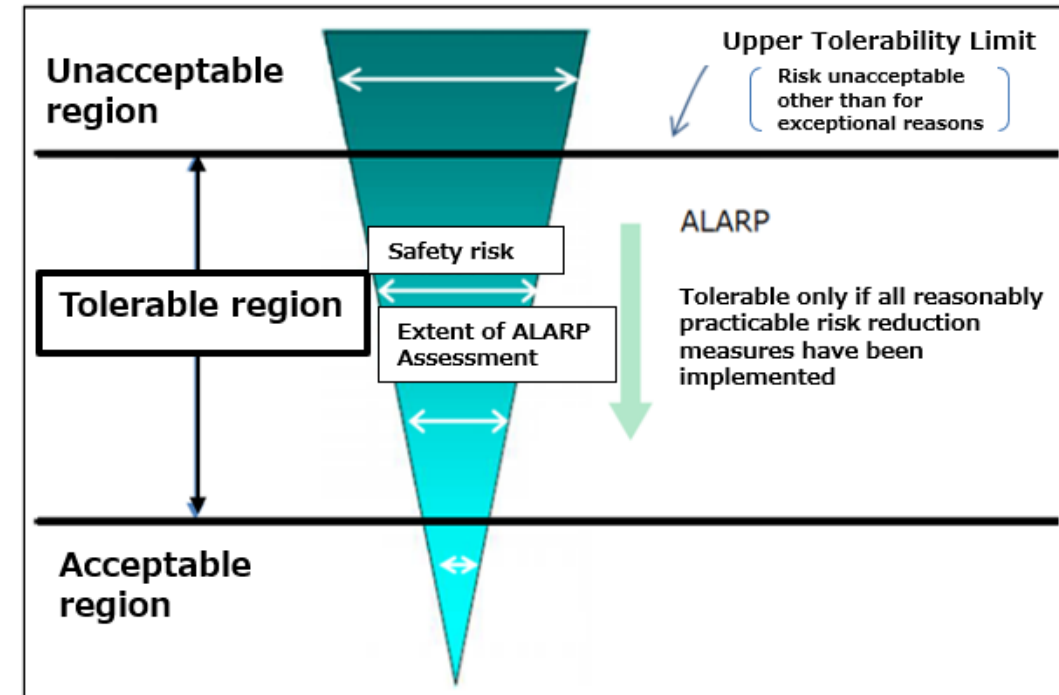
② Approach to ensuing safety during decommissioning – Operator perspective

As 1F decommissioning is unprecedented works, views and feelings of individuals engaged in the field works (operation, maintenance, radiation control, instrumentation, analysis etc.) are important (“operator perspective”).

- ▶ **Complementation of design by operations, including operating controls**
Since it is difficult to ensure safety only by design, **ensuring safety by both design and operations together such as “lead & learn”** should be effective measures.
- ▶ **Utilization of information in design obtained through monitoring, analysis**
To cope with significant uncertainties, it is important to **“make a comprehensive use of monitoring (instrumentation monitoring, visual observation, simulation etc.) and analysis.**
- ▶ **Handling an abnormality**
Assuming also the case of failing procurement of design function (product quality) such as 1F-3FHM malfunction, **measures for abnormality (including unexpected events at the time of designing) shall be prepared with backup of operation in the field.**

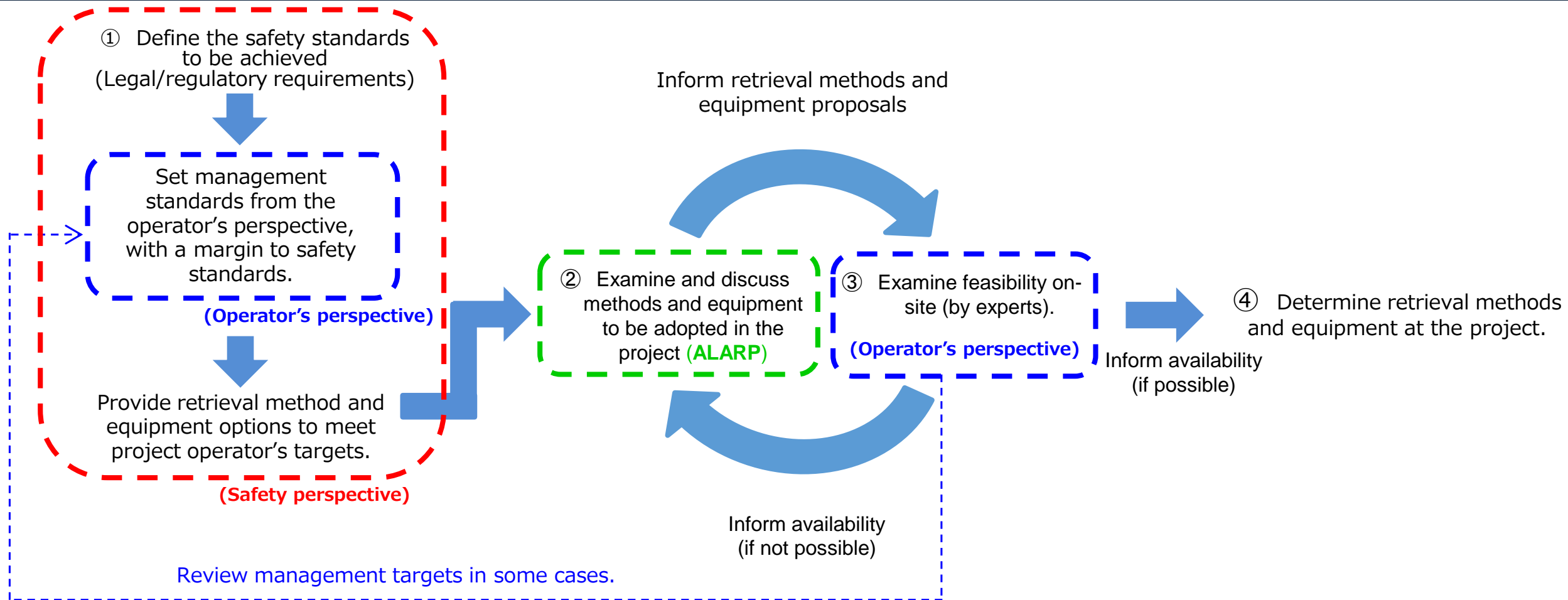
② Approach to ensuing safety during decommissioning – ALARP

- For safety, there is a **minimum level of safety standards** that must be met before the relevant method or equipment can be used.
- At levels above the level that meets this minimum level, there is a range of choices and, within this range, methods and equipment to be adopted will be determined based on trade-off between the safety level to be achieved and project cost and duration, a kind of **“ALARP” (As Low As Reasonably Practicable)**. There is also an issue as to whether such methods and equipment are **feasible in the field**.
- Based on the above, deciding methods and equipment to be deployed needs judgment **in three areas, which are “defining the safety standards”, “indicating the feasibility on-site”, and “examining and discussing at projects”**.



3 regions concerning safety risk acceptance

② Approach to ensuing safety during decommissioning – ALARP

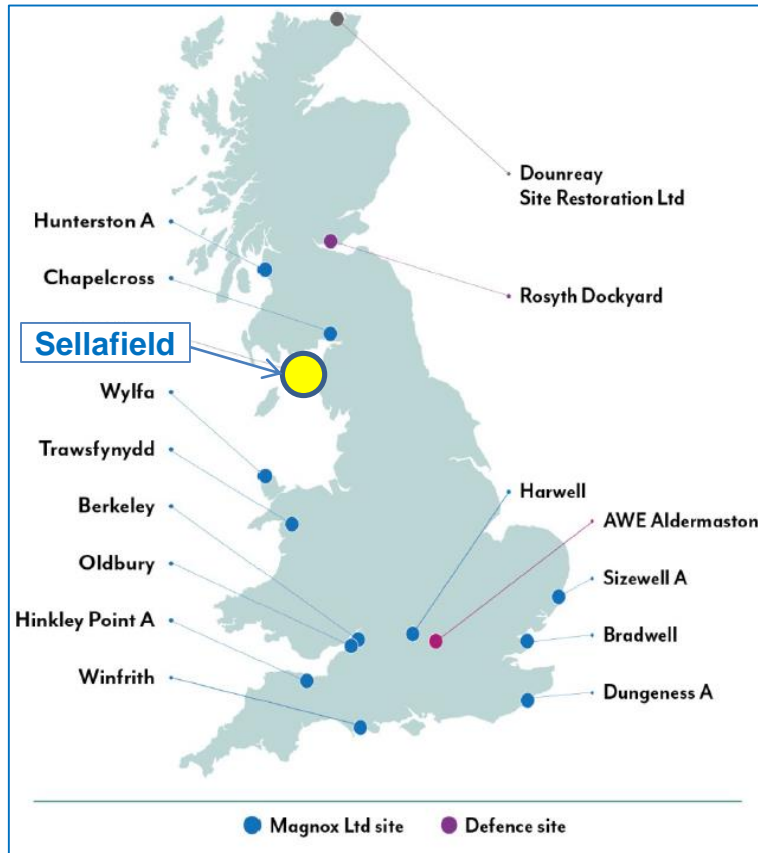


ALARP centered on safety (conceptual diagram)

ALARP judgment requires social consensus !

Dialogue and information exchange with relevant parties

Investigation on cases in UK



Overview of Sellafeld Site

(Source: "A Revised Strategy for the Regulation of Sellafeld Site" Mina Golshan at RIC 2018)

● History • Background

- Despite significant amount was invested by Government during 2000~2013, hazard/risk reduction did not show progress at Sellafield.
- ONR put the highest priority on hazard reduction at Sellafield as 2014 regulatory issue. To achieve this objective:
 - Regulatory approach on Sellafield shall be fundamentally reviewed and new regulatory strategy shall be formulated and implemented.
 - Organization and regulatory method of ONR Sellafield Div. shall be reviewed toward consistent, effective and efficient regulation.

● G6 (Collaboration with relevant organizations)

G6 | ONR, SL, NDA, Department of Energy and Climate Change, Shareholder Executive and Environment Agency
... starting at 2014 led by ONR

- **Decide strategy and direction** toward acceleration of hazard and risk reduction
- **While sharing strategy and direction, each organization plays its individual** role (role of ONR as an independent regulator remains unchanged)
 - ✓ ONR and operators needs to be understood **in the context of liabilities** under the regulations
 - ✓ **Independence of ONR as decision** maker is indispensable
 - ✓ ONR continues **execution procedures** properly
 - ✓ **Constructive approach** shall be adopted, together with operators and relevant parties.
 - ✓ **Innovation shall be promoted** to achieve the best safety improvement based on **good regulatory practice**.

“How to **enable the projects to be moved forward ?” is most difficult for regulator.
– Stop or delay progress is easy !**

8 themes/Regulators' Code

- Sellafield regulatory strategy: prioritization, eliminating obstacles, finding fit-for-purpose solution (not 100% perfect solution), risk balance (long term, short term) etc.
- How regulation should be

Early Engagements

- Regulatory involvement prior to official application
- Promote ONR's understandings and close a recognition gap between operator and ONR

Internal Regulator

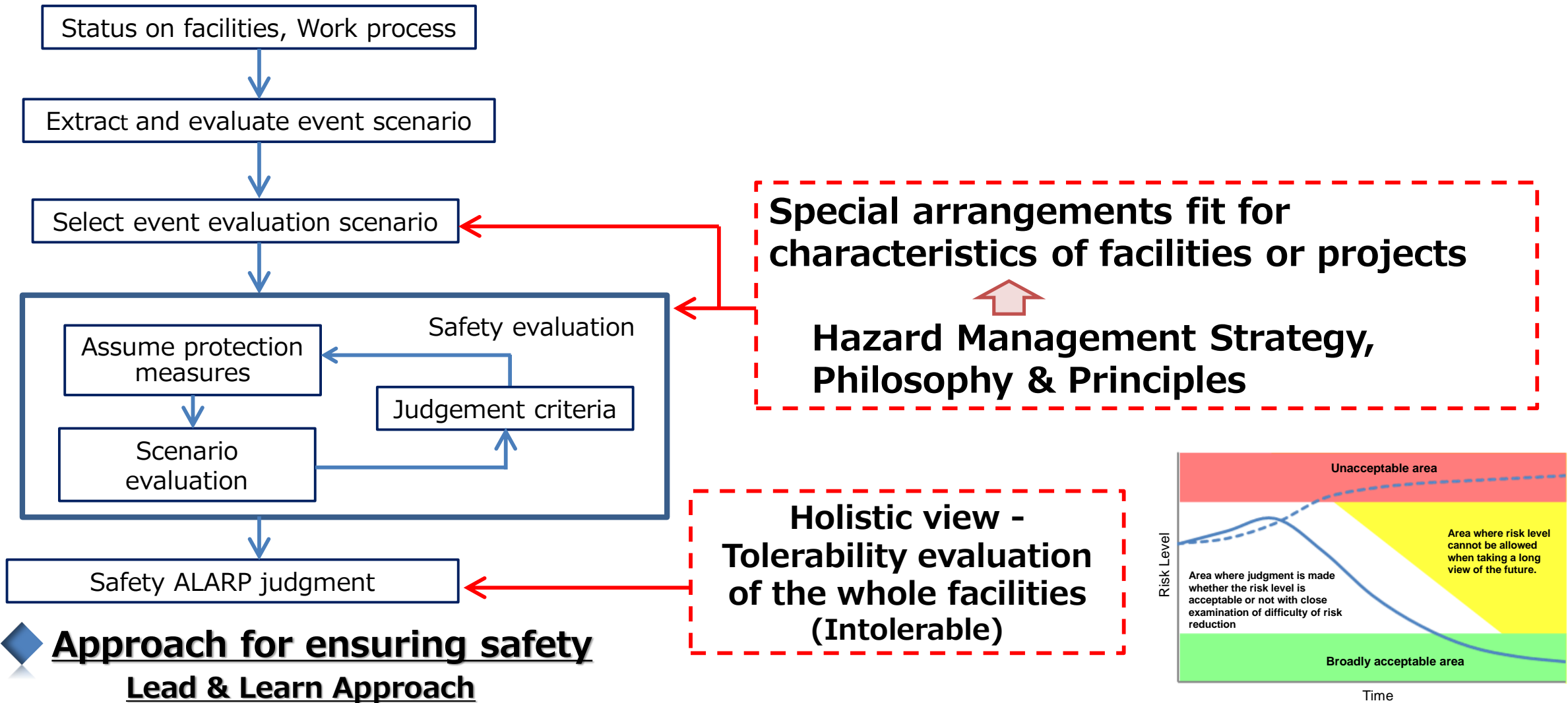
- Support or enforce operator's self regulation process
- Operator's ownership of its own liabilities
- Merit brought both operator and ONR

Flexible Permissioning

- Arrangements including regulatory involvement is agreed by both ONR and operator (regulation fit for characteristics of facilities or projects)

Enhanced Decision Making Process

- ONR internal process supporting critical or complicated regulatory judgement such as long or short term risk balance (third parties' opinion on sufficiency of judgement)



◆ Approach for ensuring safety Lead & Learn Approach

Reflect knowledge obtained by preceding projects into later projects: reducing significant uncertainties systematically and step by step

Dialogue and information exchange with relevant parties

- How to evaluate and make a judgment on safety for the decommissioning of reactor damaged by the accident accompanied by significant uncertainties is both important and difficult issue to the operator (TEPCO) as well as all parties involved in the decommissioning.
- NDF plays a leading role to implement the decommissioning of 1F safely, steadily and quickly with sharing various safety related issues with parties involved in the decommissioning including Nuclear Regulation Authority (NRA) and exchanging views of each party in a straightforward and sincere manner.