

NDF Approach to Risk Assessment for Fukushima Daiichi NPS

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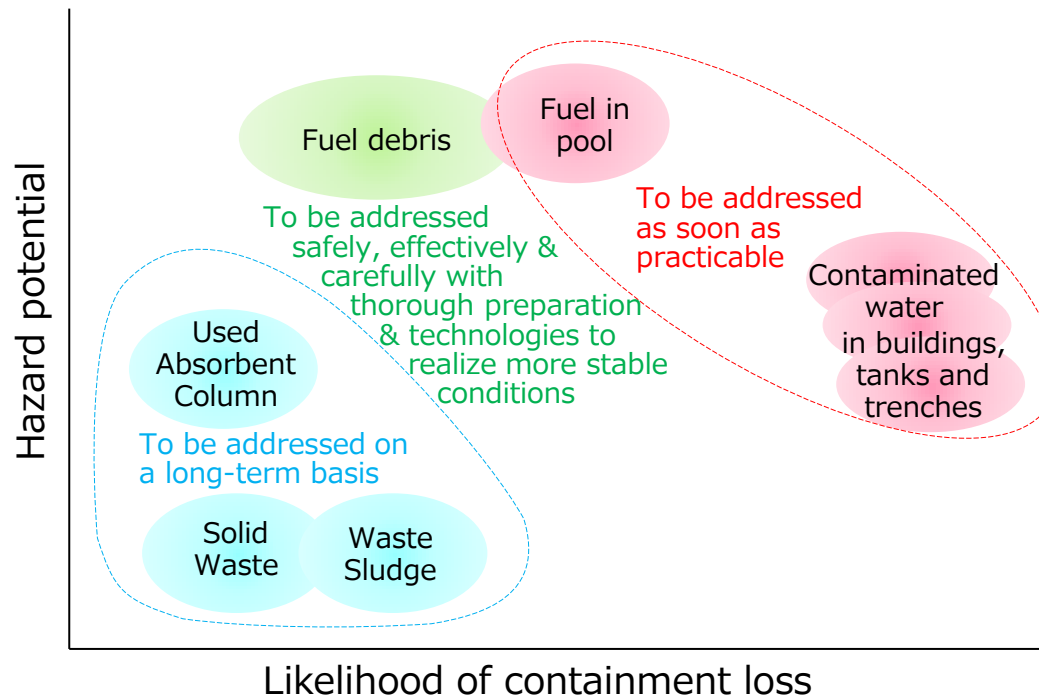
Strategic Plan & Risk Assessment

- NDF's fundamental policy for decommissioning of Fukushima Daiichi NPS (1F)
 - ◆ To reduce continuously and promptly the radiological risks that resulted from the accident
 - ◆ Strategic Plan is to design the mid- to long-term risk reduction strategy

- Risk assessment in 2015 Strategic Plan
 - ◆ Identified primary risk sources
 - Fuel debris, spent fuel, contaminated water, waste
 - ◆ Prioritized through qualitative risk assessment
 - Hazard potential
 - Radioactive inventory and physical form
 - Three-grade assessment
 - Likelihood of containment loss
 - Integrity of containment
 - Three-grade assessment

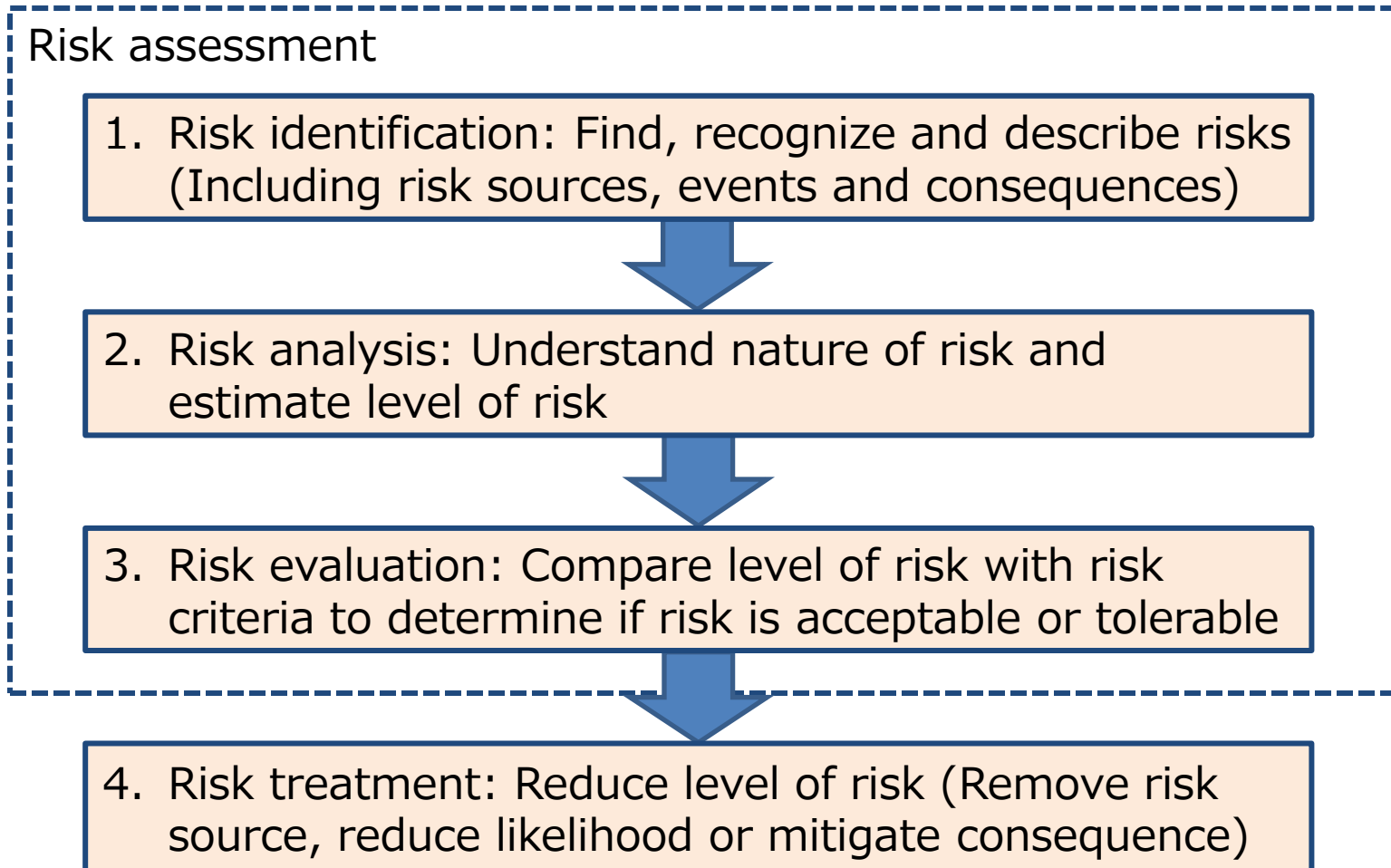
Result of Qualitative Risk Assessment

➤ Prioritized primary risk sources



- Change in “Mid- to Long-Term Roadmap”
 - ◆ Speed oriented → Risk reduction oriented

Risk Management Process



JIS Q 31000:2010 (ISO 31000:2009) Risk management – Principles and guidelines

Terminology

Term*	General definition*	Example in Strategic Plan
Risk	Effect of uncertainty on objectives	Radiological effect on people and environment
Risk source	Intrinsic potential to give rise to risk	Radioactive materials
Event	Series of occurrence and change in circumstances	Occurrence of earthquake etc. and resulting change in risk source and containment
Consequence	Outcome of an event with an effect on objectives	Exposure to public or workers by release of radioactive materials
Likelihood	Chance that something may happen	Chance that exposure to public or workers may happen
Level of risk	Magnitude of risk estimated by combining consequence and likelihood	Product of consequence and likelihood
Risk criteria	Reference used to evaluate the significance of risk	Comparison of risk with various risk sources or after treatment

* JIS Q 31000:2010 (ISO 31000:2009) Risk management – Principles and guidelines

Challenges towards Future Strategic Plan (1/2)

1. Risk identification
 - ◆ Identification of risk sources
 - Characterization of various risk sources
 - ◆ Identification of events and consequences
 - Requirements for degree of detail and achievability
2. Risk analysis
 - ◆ Estimation of level of risks
 - Quantification of consequences and likelihoods under uncertainty
3. Risk evaluation
 - ◆ Purposes of risk evaluation
 - Acceptance or tolerability → Prioritization
 - ◆ Determination of risk criteria
 - Relative comparison of level of risk with various risk sources and after risk treatment

Challenges towards Future Strategic Plan (2/2)

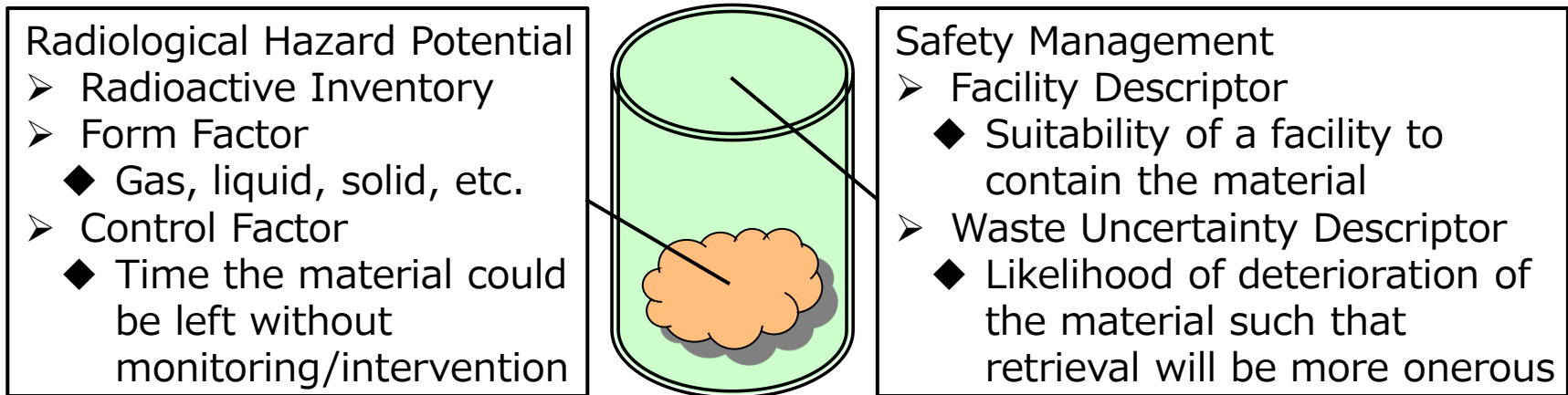
- Risk treatment
 - ◆ Creation of options
 - A wide spectrum of potential options
 - Time dependence of risk for no action option
 - ◆ Determination of metrics
 - Strategic Plan's 5 guiding principles
 - Safe, proven, efficient, timely and field-oriented
 - Consideration of change in facility conditions and events resulting from operation during treatment
 - ◆ Selection of best option
 - Comparison of metrics between the options

- Requirements for risk assessment methodologies



Comprehensive Risk Assessment Methodology

- SED score: Safety and Environmental Detriment score
 - ◆ Developed by U.K. Nuclear Decommissioning Authority (NDA)
 - ◆ Used to inform prioritization of its nuclear facilities



- NDF is customizing SED score to 1F with consultation from NDA
 - ◆ Different risk sources and containment conditions than NDA's facilities
 - ◆ Change in interpretation, addition or deletion of the factors

Quantitative Risk Assessment Methodology

- Probabilistic Risk Assessment (PRA) methodology
 - ◆ Risk analysis by event, likelihood and consequence
 - ◆ Used to assess risks for operating and new power reactors

Initiating event	Event 1	Event 2	...	Final state
Occurrence	Success	Success	Success	(No effect)
		Failure		(No effect)
	Failure	Failure	Failure	Likelihood & consequence
			Failure	Likelihood & consequence

- NDF is developing the methodology adapted from PRA jointly with U.S. DOE's Pacific Northwest National Laboratory (PNNL)
 - ◆ Uncertainty in condition of risk sources, event and likelihood
 - ◆ Developing with generic information and expert judgement

Concluding Remarks

- NDF's mission is to design the risk reduction strategy for continuous and prompt reduction of the radiological risks in 1F
 - ◆ Qualitative risk assessment was carried out for prioritization in 2015 Strategic Plan

- Towards designing the future risk reduction strategy, new risk assessment methodologies become necessary
 - ◆ Comprehensive methodology for prioritization
 - Under modification of SED score with consultation from U.K. NDA
 - ◆ Quantitative methodology for risk treatment
 - Under development of the methodology adapted from PRA in cooperation with U.S. PNNL

- Using these methodologies, the risk reduction strategy will be designed and implemented into the future strategic plan
 - ◆ Note that any decisions should be made not only with risk information but with various considerations