Activities of Nuclear Damage Compensation & Decommissioning Facilitation Corporation (NDF) and Outline of the " Strategic Plan for Decommissioning of Fukushima Daiichi NPS"

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Akinori NAITO

Nuclear Damage Compensation & Decommissioning Facilitation Corporation

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Nuclear Damage Compensation & Decommissioning Facilitation Corporation (NDF) 1

A duty to support the decommissioning of the stricken reactors has been added to the duties of Nuclear Damage Compensation Facilitation Corporation, which provides financial support to facilitate compensation and supervises the management of TEPCO as a whole.

- Legal Basis

  Act on the Establishment of Nuclear Damage Compensation & Nuclear Decommissioning Facilitation Corporation (NDF)
- Competent Ministers

  Prime Minister, Minister of Education, Culture, Sports, Science and Technology, Minister of Economy, Trade and Industry
- Location

  Headquarters (Tokyo), Fukushima Office (Koriyama), Fukushima Daiichi Nuclear Power Plant Field Office (Naraha)

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Nuclear Damage Compensation & Decommissioning Facilitation Corporation (NDF) 2

- President
  Takehiko Sugiyama : left
(former President of Hitotsubashi University)

- Vice President
  Hajimu Yamana : right
(former President of International Research Institute for Nuclear Decommissioning)

- Capital
  14 billion yen
(Government: nuclear operators = 1:1)

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Challenges toward Fukushima Decommissioning pursued by NDF

- Introducing Management Concept for Decommissioning Work and R&D Projects by Strategic Plan
- Confirming Principle in order to Formulate Strategic Plan including Principle of Risk Reduction for Decommissioning
- Formulating Logic Tree Diagram to solve Key Issues of Decommissioning
- Considering Different Method and Access Way regarding Fuel Debris Retrieval
- Considering the Key Issues for the Structure of Waste management
- Promoting Proactive International Cooperation

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Roles of the Bodies involved in Fukushima Daiichi Plant Decommissioning & Contaminated Water Management

Government of Japan (GOJ)

Develop Policy framework and overall program management

- Adopt the Mid-and-Long-Term Roadmap.
- Project management of emergent issues such as contaminated-water management

Program management →

← Reporting

TEPCO (D&D company)

Deliver decommissioning work

- Fuel removal from the spent fuel pools.
- Contaminated-water management
- Storage of rubble and other solid wastes
- Ensure safety and quality; work environment, etc.

Reporting ↔ Present key issues

Provide a R&D budget ↓

NDF

Formulate strategy and technical support

1. Develop a mid-and-long-term strategy
2. Provide technical support in the program management of key issues
3. R&D Planning, program and project management
4. Promoting international cooperation

Reporting ↔ Advice Guidance

Reporting/ Submission of work plan ↓ | ↑ Safety regulation

Dialogue ↔

Share progress and issues ↕

Nuclear Regulation Authority (NRA)

Safety regulation

R&D organizations such as

-International Research Institute for Nuclear Decommissioning (IRID)

-Japan Atomic Energy Agency (JAEA)

Implementation R&D projects

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Basic Functions of Decommissioning Support Activities

(i) Development of a mid-and- long-term strategy

Develop a mid-and-long-term strategy & support decommissioning activities.

- Retrieve fuel debris.
- Manage waste, etc.

(ii) Technical support in the project management of key issues

- Provide technical support in the current activities of the Government and TEPCO, such as contaminated water management.

(iii) Planning of research & development and progress management

- Plan research and development.
- Manage the project and evaluate the results of research & development.

(iv) Strengthening of international cooperation

- Bring together domestic and overseas wisdom.
- Disclose information in an appropriate manner.

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Strengthening of International Relationship

(i) Appoint overseas experts International Special Advisors and invite them to the Decommissioning Strategy Board meeting.
(ii) Participate in international frameworks such as IAEA and OECD/NEA.
(iii) Develop a cooperative relationship with relevant overseas organizations.

Rosa Yang	EPRI Fellow, Nuclear Power, U.S. Electric Power Research Institute (EPRI)
Mike Weightman	Former Chief Executive, the Office for Nuclear Regulation (ONR)
Paul Dickman	Senior Policy Fellow, U.S. Argonne National Laboratory
Christophe Behar	Director of Nuclear Energy Division, Commissariat a l'energie atomique et aux energies alternatives (France) (CEA)

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Skeleton of Strategic Plan

- **5 Guiding Principles** for Risk Reduction
  - ✓ Principle 1: **Safe** — Reduction in the risk of radioactive materials (Impact on the off-site environment, exposure of workers)
  - ✓ Principle 2: **Reliable** — Reliable and flexible technology
  - ✓ Principle 3: **Reasonable** — Effective utilization of resource (human,capital, money, and space etc.)
  - ✓ Principle 4: **Speedy** — Awareness of time axis
  - ✓ Principle 5: **Site-reality Oriented** — Emphasize actual place, actual parts and actual situation

- Areas specifically addressed from Risk reduction purpose
  - ➢ **Fuel Debris Retrieval**
    - Develop a workable scenario for fuel debris retrieval assuming several methods (submersion, dry) and a combination of the methods, taking into account the status of each Unit.
  - ➢ **Waste Management**
    - Develop a policy for storage management, treatment and disposal from a mid-to- long-term perspective, based on the principles for safe waste disposal and appropriate waste treatment.

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Principle for Risk Reduction in Strategic Plan

3. Definition of risk

(i) Risk of radioactive materials

- Risk = level of effect x probability of occurrence

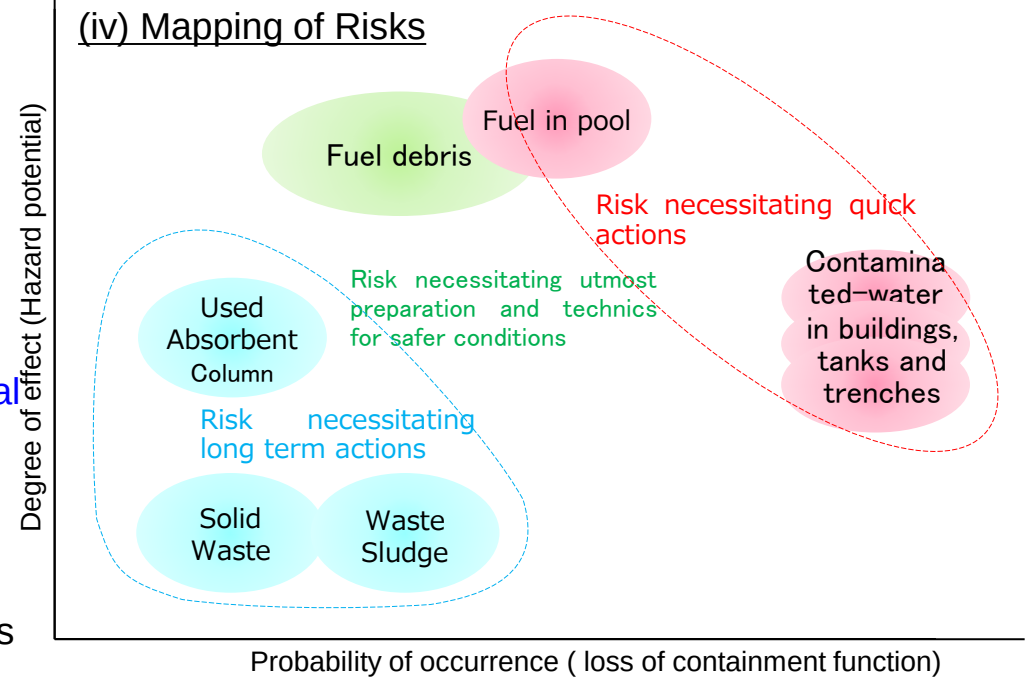
(ii) Degree of effect

- If the containment function is lost, radiation effects (exposure, environmental contamination) occur.
- Degree of effect = level of activity x physical state (solid, liquid or gas)

(iii) Probability of occurrence

- Factors for the loss of the containment function include natural phenomena, failures and improper operations.
- The vulnerability of the facility to the above factors needs to be considered.
- Probability of occurrence = possibility of occurrence of the factor x vulnerability of the facility

(iv) Mapping of Risks



(v) How to reduce risk

- Move radioactive materials to a safer and more stable facility.
  → Reduce the probability of occurrence.
- Decay of radioactivity and change in the physical state
  → Reduce the degree of effect.

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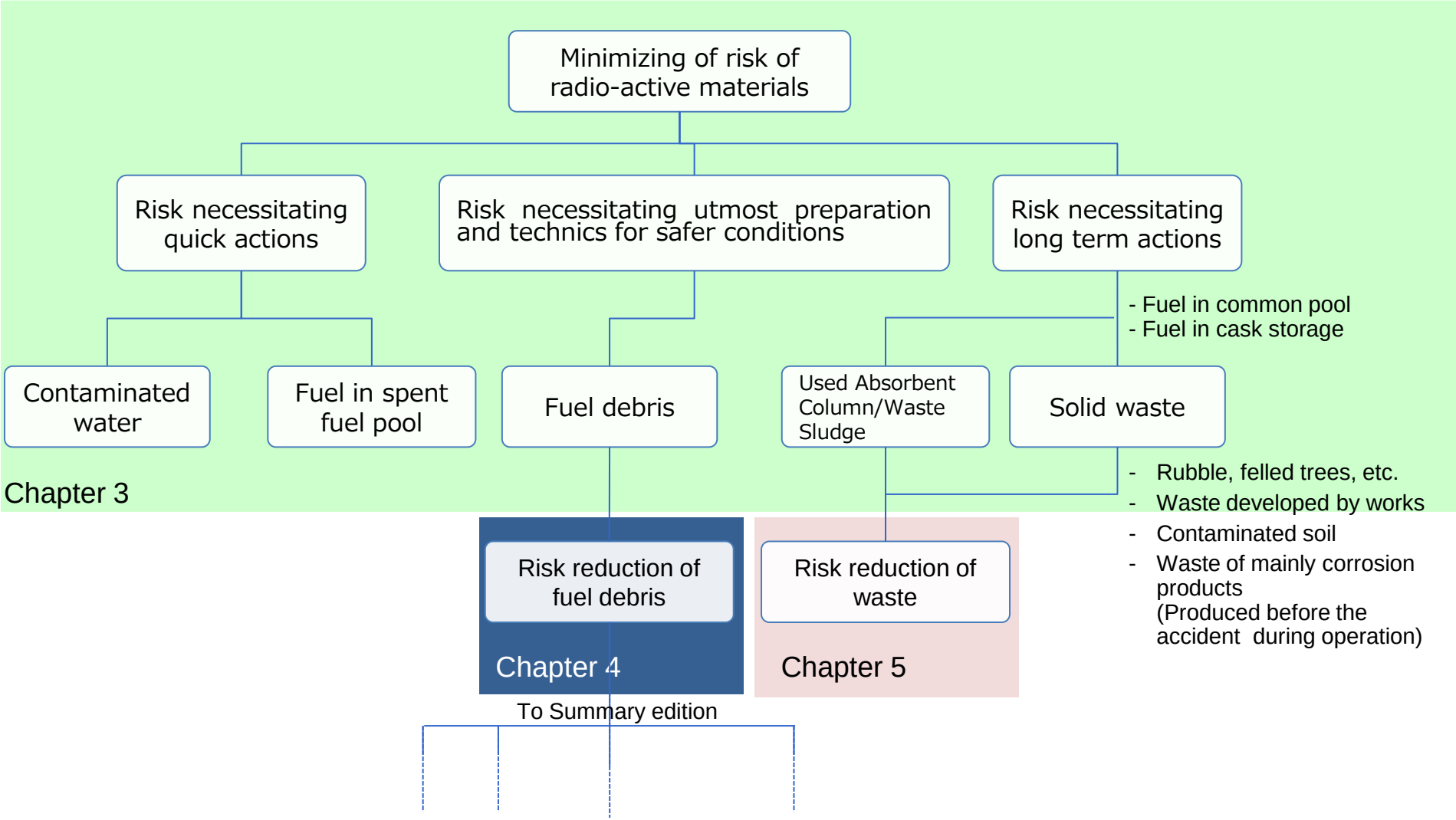
Logic Tree Diagram Regarding Risk Reduction (Summary)



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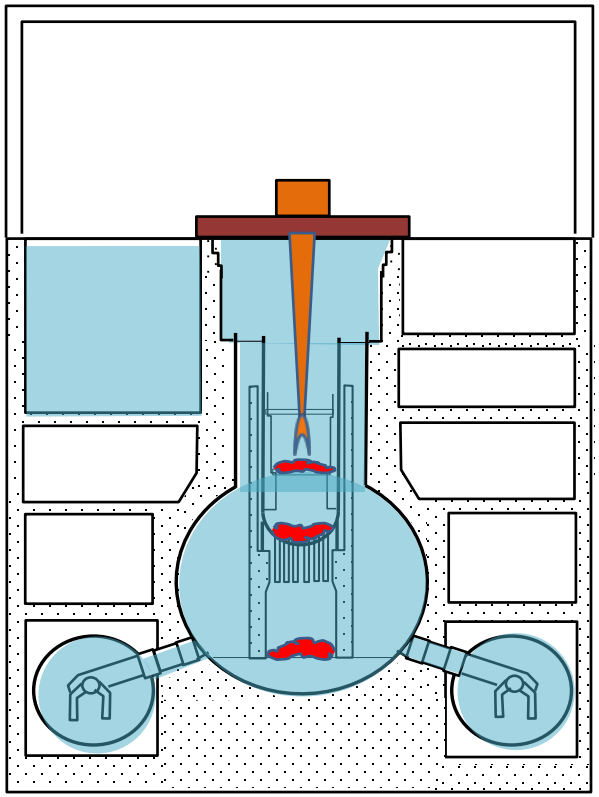
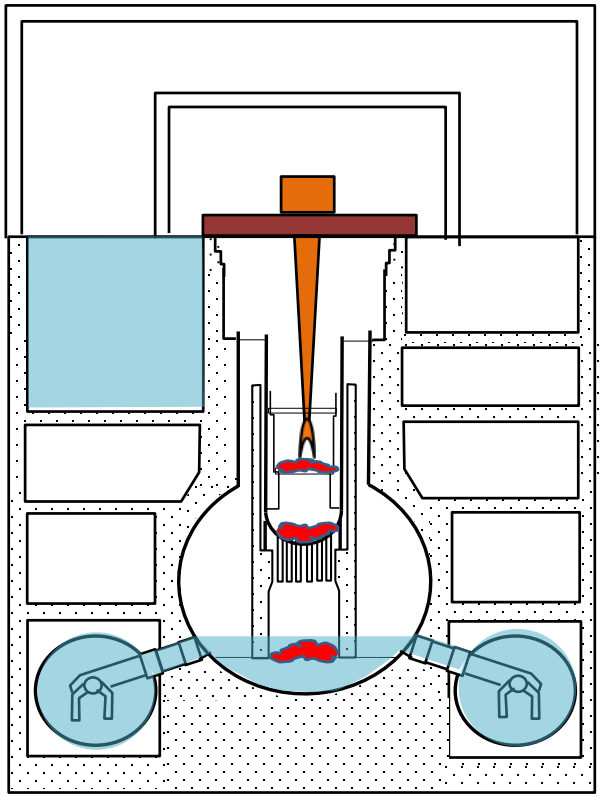
Three Methods of Fuel Debris Retrieval



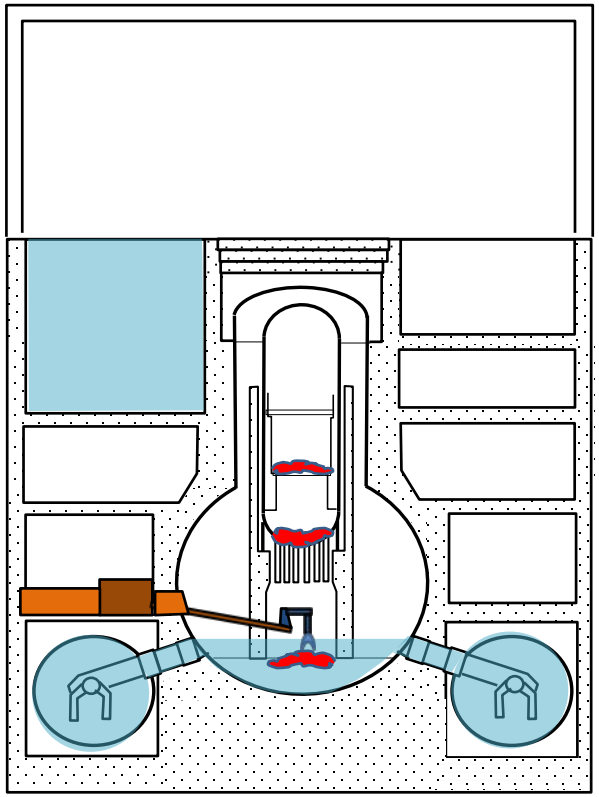
submersion method

Image on condition that the removal of core internals above fuel debris has finished.



dry top access method

Image on condition that the removal of core internals above fuel debris has finished.



dry side access method

Image on condition that RPV pedestal exterior component inside PCV and the interference have been removed.

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Issues of Waste Management

- Characterization and inventory estimation have been proactively studied by IRID and JAEA. A rough picture of the entire situation of the various wastes generated by the accident and post-accident response has been drawn.
- However, for the wastes caused by severe accident, there is no particular regulatory standard for their segmentation and disposal. In addition, the national system for their final disposal, has not been decided yet.
- In this context, NDF launched a study by setting an expert committee for waste management issues, and its preliminary result is incorporated into the first version of the Strategic Plan.
- As a part of this study, NDF has started reviewing relevant world's standards for waste management. GSR-part5 and SSR-5 of IAEA are important references for this study.

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Planning of Research and Development and Progress Management (1)

Get information on developments in a series of research and development projects on decommissioning in an integrated manner; review the developments; and conduct activities to develop and implement a plan for the following year.

(i) Contaminated Water Treatment Demonstration Project (Agency of Natural Resources and Energy)

- High-Performance Multi-Nuclide Removal System (High-Performance ALPS) Development & Demonstration Project
- Large-Scale Frozen-Soil Shielding Wall Development & Demonstration Project

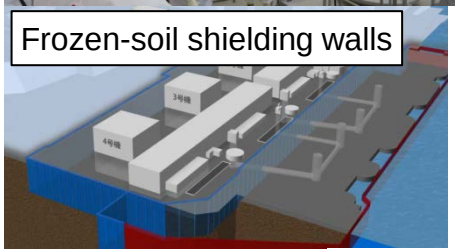
(ii) Decommissioning & Contaminated Water Management Fund Project (Agency of Natural Resources and Energy)

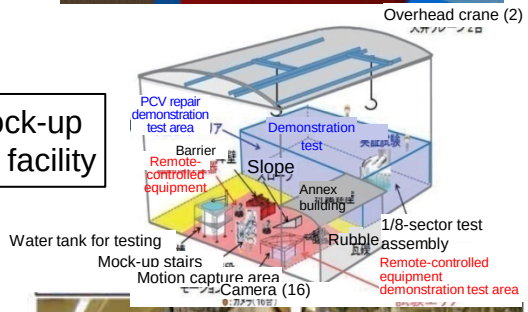
- Contaminated-Water Management Technology Demonstration Project (the international request for proposal)
- Project for the Evaluation of the Concept of Alternative Fuel Debris Retrieval Method and the Feasibility of Component Technologies (the international request for proposal)
- Technology Development Project

(iii) Research Center Facility Development Project (Agency of Natural Resources and Energy)

- Mock-up test facility
- Analysis and research and development facility

(iv) JAEA-Funded Basic Research & Research Center Development Project (Ministry of Education, Culture, Sports, Science and Technology)





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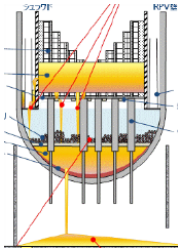
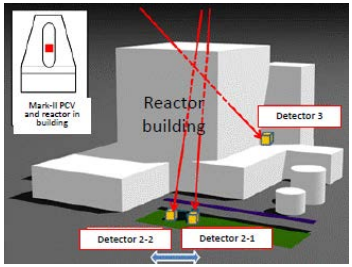
Planning of Research and Development and Progress Management (2)

Get information on developments in a series of research and development projects on decommissioning in an integrated manner; review the developments; and conduct activities to develop a plan for the following year.

Preparation for fuel debris retrieval	Containment examination & repair technology	Development of remote-controlled Reactor Building decontamination technology
		Development of a comprehensive dose reduction program
		Development of technology to identify containment leak locations
		Development of technology to repair containment leak locations/stop leakage
		Full-scale testing of technology to repair containment leak locations /stop leakage
	Fuel debris retrieval technology	Development of technology to examine the inside of the containment vessel
		Development of technology to examine the inside of the reactor pressure vessel
		Development of techniques and systems to retrieve fuel debris and core internals
		Development of technology to contain, retrieve and store fuel debris in the reactor
		Development of fuel debris criticality control technology
	Core/fuel debris evaluation technology	Getting information on reactor by improving accident development analysis technology
		Development of reactor fuel debris detection technology (MUON)
		Development of technology to determine the physical state of fuel debris and to treat fuel debris
		(Spent fuel pool management)
	Integrity evaluation technology	(Spent fuel pool management)
		Development of technology to evaluate the integrity of the reactor pressure vessel & the containment vessel
Spent fuel pool management		Development of a method for treating damaged fuel removed from the spent fuel pool
		Evaluation of the long-term integrity of fuel assemblies, etc. removed from the spent fuel pool
Radioactive waste treatment/ disposal		Research and development on solid waste treatment and disposal

Development of technology to identify containment leak locations





Development of reactor fuel debris detection technology (MUON)

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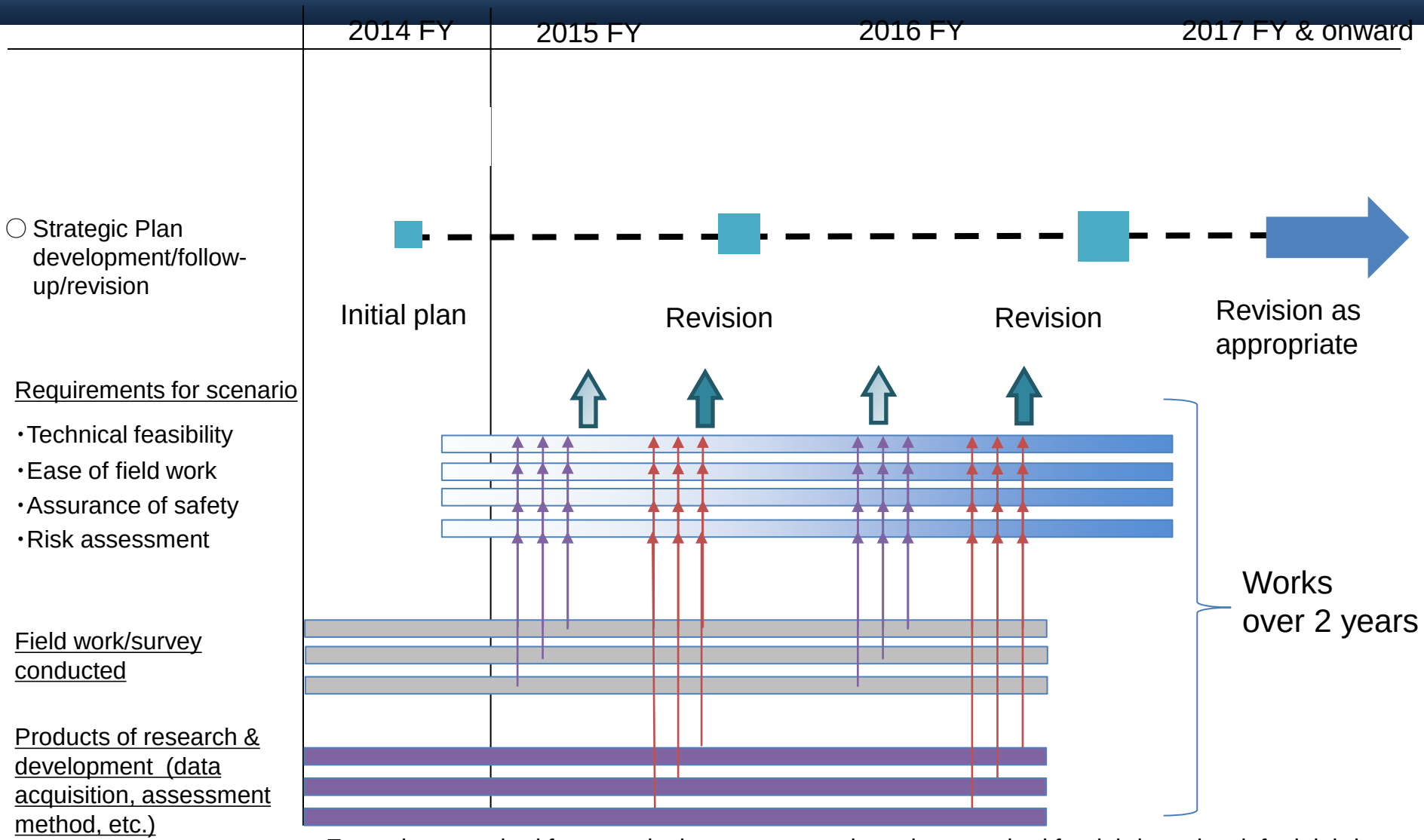
Activities for Strategic Plan Development



Example: a method for water leakage stoppage, integrity, a method for debris retrieval, fuel debris detection, waste-related activities

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