Activities of
Nuclear Damage Compensation &
Decommissioning Facilitation Corporation (NDF)

June 3, 2015

Yasuharu Igarashi
Executive Director

Nuclear Damage Compensation &
Decommissioning Facilitation Corporation
(NDF)
Roles of Bodies for in Fukushima Daiichi Plant Decommissioning

**Government of Japan**
- Inter-Ministerial Council
- Team for Decommissioning and Contaminated water
- Secretary=ANRE
- Decommissioning Policy (Road Map)

**NDF**
- "Strategic Plan"
- R&D Plan
- Technology and Strategic Support
- R&D Plan
- Tech. Development

**TEPCO**
- On-site Decommissioning

**IRID**
- Implementation of R&D

**JAEA**

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As an organization of experts in a variety of technological fields, NDF develops a mid-and-long term technical strategy “The Strategic Plan” through the cooperation with external experts.

- Technology experts in NDF’s decommissioning department (about 30 experts)
  - Plant engineering
  - Robotics
  - Civil engineering and architecture
  - Materials, analysis, monitoring
  - Fuel and nuclear reactor engineering
- Experts from external organizations (universities, JAEA and other research institutions)

<Decommissioning Strategy Board>

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<td>Aug. 21, Thu</td>
<td>Sep. 30, Tue</td>
<td>Oct. 28, Tue*</td>
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<td>6th Jan. 28, Wed</td>
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<td>8th Mar. 26, Thu</td>
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* With the participation of four international special advisors.

<Expert Committee>

- Fuel Debris Retrieval Expert Committee
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- Waste Management Expert Committee
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Intensive Workshop type Meetings have held repeatedly among ANRE, TEPCO and IRID under the Lead of NDF on specific Issues.
(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 overseas organizations.

International Special Advisors

Dr. Rosa Yang  
EPRI Fellow, Nuclear Power, U.S. Electric Power Research Institute (EPRI)

Dr. Mike Weightman  
Former Chief Executive, the Office for Nuclear Regulation (ONR)

Mr. Paul Dickman  
Senior Policy Fellow, U.S. Argonne National Laboratory

Mr. Christophe Behar  
Director of Nuclear Energy Division, Commissariat a l'energie atomique et aux energies alternatives (France) (CEA)

Cooperative Agreement

NDA (UK)  

CEA (France)
Strategic Plan for the Decommissioning of TEPCO’s Fukushima Daiichi Nuclear Power Station
Strategic Plan and Mid-and-Long Term Roadmap

- Goals and policies presented by the Government
- Key elements of strategies, policies and plans determined by the Government

Strategic Plan

- Strategic Plan identifies the issues, ways how to address them and action plans for the most important challenges in terms of the technical judgment for 1) Fuel debris retrieval and 2) Waste management, embracing the organizations involved.

Mid-and-Long Term Roadmap

- Delivery of Decommissioning by TEPCO and research institutions (field work, engineering, R&D)
**Guiding Principles for the Strategic Plan**

- **Principle**
  - The decommissioning of the Fukushima Daiichi Nuclear Power Plant is a **continuous risk reduction** activity to protect people and the environment from the risk of radioactive materials, resulting from severe accident.
  - A risk reduction strategy along a mid- to-long-term timeline will be designed in the Strategic Plan.

- **5 Guiding Principles for Risk Reduction**
  - Principle 1: **Safe**
    - Reduction of risks caused by radioactive materials* and work safety
    - (*Environment impact and exposure to workers)
  - Principle 2: **Proven**
    - Reliable and flexible technology
  - Principle 3: **Efficient**
    - Effective utilization of resource
      - (human, capital, money, and space etc.)
  - Principle 4: **Timely**
    - Awareness of time axis
  - Principle 5: **Field Oriented**
    - Emphasize actual place, actual parts and actual situation
(i) Risk of radioactive materials
- Risk = level of effect x likelihood of loss of containment function

(ii) Level of effect
- Level of effect = level of activity x physical state (solid, liquid or gas)

(iii) Likelihood of loss of containment function
- Likelihood of loss of containment function = possibility of occurrence of the factor x vulnerability of the facility

(iv) How to reduce risk
- Move radioactive materials to a safer and more stable facility.
  - Reduce the degree of effect.
- Decay of radioactivity and change in the physical state.
  - Reduce the likelihood of loss of containment function.
Risks to be addressed
safely, effectively
and carefully with
thorough preparations &
technologies to realize
more stable condition

Minimizing risk of radio-active materials

Risks to be addressed as expeditiously as possible

Contaminated water

Fuel in pool

Fuel debris

Risks to be addressed on a long-term basis

Secondary waste

Radioactive Solid waste

Risk reduction of fuel debris

Risk reduction of waste

➢ **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, processing and disposal from a mid-to-long-term perspective, based on the principles for safe waste disposal and appropriate waste processing.
Three Priority Methods of Fuel Debris Retrieval

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

**Partial submersion top access**
Image on condition that the removal of core internals above fuel debris has finished.

**Partial submersion side access**
Image on condition that RPV pedestal exterior component inside PCV and the interference have been removed.
Road towards Fuel Debris Retrieval (Reference)

Technical Maturity*1 (TRL)

- Concept study
  - Screening
  - Prioritization
    - Safety
    - Resource
    - Site

- FS/Concept design
  - Important performance requirements

- Element test

Selection of retrieval method

- Equipment System performance guarantee
  - Practical application/verification test
  - Basic/detail design

Preparation work

Mock up and training

Start fuel debris retrieval

Prerequisite

- Understanding the plant and reactor conditions
- Safety requirement (regulatory requirement)
- Securing accessibility (Decontamination, etc.)

Time

*1 The vertical axis does not represent the individual technology but an image of the technical maturity of the overall retrieval system.
Structure of Strategic Plan for Waste Management

Objective:
Risk reduction of the waste

Storage management
- Reduction of generating waste
  - Control of materials and equipment bringing into the site
  - Reuse of Materials and equipment
  - Recycle
  - Volume reduction treatment
  - Stabilization treatment
  - Segregation storage according to the doses and property for exposure reduction

Ensuring safety
- Analysis
- Data evaluation (Modeling)
- Applicability of existed disposal concept
- Investigation of new disposal concept

Treatment and disposal *
- Disposal concept according to waste characteristics
- Pretreatment
- Treatment
- Conditioning

Development of necessary regulations **
- Treatment consistent with disposal

*: HP SW-1 (2017) Fundamental policies of treatment and disposal
HP SW-2 (2021) Prospect of the safety of treatment and disposal
**: To be performed after the HP SW-2.
NDF has reviewed relevant world’s standards for waste management. GSR-part5 and SSR-5 of IAEA are important references.

- To contain the waste
- To isolate the waste from the accessible biosphere and to reduce substantially the likelihood of, and all possible consequences of, inadvertent human intrusion into the waste
- To inhibit, reduce and delay the migration of radionuclides at any time from the waste to the accessible biosphere
- To ensure that the amounts of radionuclides reaching the accessible biosphere due to any migration from the disposal facility are such that possible radiological consequences are acceptably low at all times
- To control the release of radioactive materials to ensure that their concentrations without having do not have significant health effects

Approaches to the radioactive waste treatment are also developed.
Policy of Waste Management

Storage management
- Reduction of volume generated
  - Reduction of carry-in materials
  - Considerations on the secondary waste
- Storage management
  - Plan for storage management
  - Storage management plan for the waste generated from fuel debris retrieval

Waste Treatment & Disposal
- Understanding of waste properties
  - Waste sampling plan
  - Analysis ability for understanding of waste properties
- Treatment and disposal methods according to the characteristics of the waste at the Fukushima Daiichi NPS
  - Study on treatment and disposal methods
  - Classification management and history information management
  - Regulatory system
It is important to facilitate interaction and communication among researchers and engineers involved in a series of R&D initiatives.
R & D Activities

- **R&D facilities (JAEE)**
  - Mock-up test facility
  - Radioactive materials analysis and research facility
  - International joint research center for decommissioning

- **Fundamental Research Activities**
  - JAEA & other research organizations
  - Universities

- **Development and securing of human resource**
## Future Development of the Strategic Plan

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<th>2016 FY</th>
<th>2017 FY &amp; onward</th>
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<td><strong>Strategic Plan is living document!</strong></td>
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- **Strategic Plan development/follow-up/revision**

  - Initial plan
  - Revision
  - Revision
  - Revision as appropriate

### Requirements for scenario
- Technical feasibility
- Ease of field work
- Assurance of safety
- Risk assessment

### Field work/survey conducted

### Products of research & development (data acquisition, assessment method, etc.)

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