Research and Development Plan for Decommissioning of TEPCO Fukushima Daiichi Nuclear Power Station Units 1 to 4 (Digest Version)

1. Positioning of Research and Development Plan

- This plan was established on December 21, 2011 at the Government and TEPCO's Mid-and-Long Term Countermeasure Meeting based on instruction from the Mr. Edano, Minister of Economy, Trade and Industry, and Mr. Hosono, Minister for the Restoration from and Prevention of Nuclear Accident, with TEPCO and ANRE bringing together the cooperation of MEXT, JAEA, Toshiba, and Hitachi/ Hitachi-GE Nuclear Energy (partially revised July 30, 2012).

2. Basic Approach to Implement Research & Development

- Understand needs in the field and incorporate it into R&D. Aim to apply such results quickly and properly to the field.
- Give consideration so that the applicable technologies and expert knowledge in Japan and overseas is proactively used and incorporated in R&D for each phase from planning to implementation so that the required R&D is conducted efficiently.
- Upon defining priority areas for mid-to-long term human resource development, reinforce coordination with universities and research institutions to proactively promote activities that contribute to securing human resources and development.

3. Research and Development Plan

（1） R&D related to removal of fuel in SFP

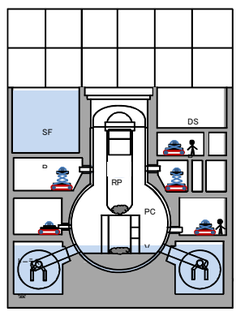
- Conduct R&D for storage ensuring long-term integrity and possibility of fuel reprocessing after removing spent fuel that may be deformed or damaged due to exposure to seawater.

（2） R&D related to preparing to remove fuel debris

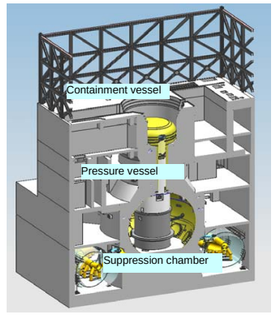
- For Units 1 to 3, it is assumed that nuclear fuel and core internals have melted and resolidified (fuel debris) and are in the reactor pressure vessel (RPV) and primary containment vessel (PCV).
- Basic policy is defined as removing fuel debris while it is completely underwater from the viewpoint of dose reduction.

① Removal of fuel debris using remotely operated equipment/ devices

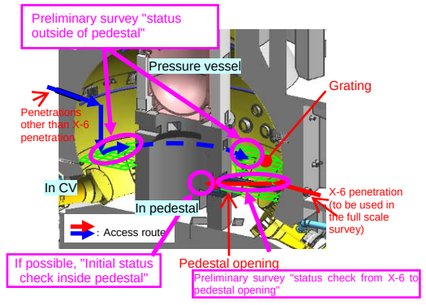
- Need decontamination work using remote technology and plan for dose reduction.
- Because fuel debris will be removed underwater, develop and validate methods and equipment for identifying and repairing PCV damage locations, investigating location/ conditions of fuel debris, and debris removal in high radiation and narrow spaces.



Schematic diagram of PCV leakage point survey



Schematic diagram of locations of PCV leakage point identification / fixing / internal surveys



Schematic diagram of parts for PCV internal survey

② Understanding/ analyzing core conditions

- Advance severe accident analysis code based on analysis of the Fukushima Daiichi accident and severe accident based on mock-up tests, comprehensively assess information such as findings from other analyses, field investigations and others to estimate in-core conditions.

③ Understand fuel debris properties and prepare for treatment

- The melting time and seawater injection is different for this accident compared to TMI-2 accident and is assumed that the fuel debris generated is different. Understand the characteristics when removed, and prepare to manage it while ensuring safety.
- Understand solubility, chemical stability and other chemical characteristics, conduct tests on mock debris and actual debris related to its treatment and disposal to gain prospects for long-term storage, treatment, and disposal after defueling.

（3） R&D related to radioactive material processing/ disposal

- Radwaste such as high radiation rubble due to hydrogen explosion and due to treatment of contaminated accumulated water. Analyze and understand the characteristics of such waste and use those results to study safe and rational ways to process/ dispose of it.
- Waste generated from fuel debris removal work and reactor facility dismantling waste is to be processed and disposed of by predicting the properties and volume of generated waste based on contamination level of facilities and dismantling method.

（4） Considerations related to application of remote operation technologies

- Consider and propose new technologies or back-up plans for remote operation technologies which are or may be difficult to achieve.
- Proactively coordinate with fundamental R&D being conducted at other technical R&D institutions.

4. R&D Promotion Organization

- Established the "Research and Development Headquarters" under the Government and TEPCO's Mid-to-Long Term Countermeasure Meeting and is held once a month.
- Actions toward decommissioning after this accident encompass many difficult issues that have never been experienced before in the world. Therefore, engage in R&D by consolidating wisdom from around the world through cooperation within Japan and internationally.
- Establish an organization for overall management so that individual R&D projects are steadily and effectively implemented and so that overall R&D is appropriate assessed including review and partial revision or deletion of the plan and organization based on overall progress.
- Further improve R&D organization including developing research center facilities to be able to respond to identified issues.

5. Research Center Concept: Fukushima as the Center of International Research

- Based on the Basic Policy for Recovery and Reconstruction of Fukushima, conduct R&D gathering wisdom from within Japan and internationally to become an international research center in the future. In doing so, effectively utilize expert knowledge and existing facilities such as JAEA and engage in developing and securing human resources. Also give consideration to contribute to local employment and economy. To specify this concept, start considering

conceptual design and basic design.

① Facility necessary to develop and demonstrate remote operation equipment/devices

- To avoid field applicability checks of equipment/ devices as much as possible, develop a real-scale mockup facility for PCV leak location investigations and repair technology, and further specify actual robot equipment applicability verifications.

② Facility for radioactive material analysis

- To respond to needs for radioactive material analysis for decommissioning, along with utilization of existing facilities, a new multi-function analysis facility will be developed in phases in conjunction with human resource development.

6. Approach for International Cooperation

- Widely communicate the overall mid-and-long term measures and task status in a timely manner so as to be able to utilize global wisdom.
- Assess possibilities of information/advice and cooperation from foreign government institutions, international organizations, and private companies to effectively and efficiently conduct R&D. Adopt useful equipment and systems with flexibility and agility.

7. HR Development from Mid-to-Long Term Perspective

- Decommissioning activities are foreseen to take about 30 to 40 years until completion. Therefore, it is necessary to ensure and develop human resources in the mid-to-long term in implementing field work and R&D.
- While designating mid-to-long term HR development as a focus area, select a core center (university/ research institution) that can be expected to take leadership in promoting fundamental research and HR development.

End