

Items required for Measures which should be taken at Tokyo Electric Power Co., Inc.'s Fukushima Daiichi Nuclear Power Station in line with the Designation as the Specified Nuclear Facility

November 7, 2012  
Decision of NRA Commission

Introduction

NRA decides following items as measures which should be taken by the Tokyo Electric Power Co., Inc. (TEPCO) at TEPCO's Fukushima Daiichi Nuclear Power Station designated as the Specified Nuclear Facility pursuant to Article 64-2, Paragraph 2 of the Act on the Regulation of Nuclear Source Material, Nuclear Fuel Material and Reactors (hereinafter referred to as "the Act").

With the objective of reducing and optimizing risks of the overall the Specified Nuclear Facility, for example, completing fuel removal, etc. as early as possible and thus ensuring on-site and off-site safety, NRA decides following items as measures to be taken by the specified licensee, TEPCO, in terms of (1) taking necessary measures promptly and efficiently to achieve the aforementioned objective; (2) for Units 1 to 4, ensuring safety of the reactor decommissioning process and completing decommissioning, including retrieval and storage of melted fuel (fuel debris), as early as possible; and (3) for Units 5 and 6, stably maintaining and continuing cold shutdown.

As for items that need progress in developing technologies in the future, such as retrieval of fuel debris, water sealing of primary containment vessels and reactor decommissioning, flexible measures such as requesting the licensee to appropriately review and revise the Implementation Plan at an appropriate time based on those status including their progress and ordering to revise the Implementation Plan from the Nuclear Regulation Authority, etc. shall be taken.

The Nuclear Regulation Authority will proactively be involved in and make recommendations to matters that need medium- to long-term approaches to ensure safety from the viewpoint of reducing and optimizing risks of the overall Specified Nuclear Facility.

I. Measures to be Taken with regard to the Overall Process and Risk Assessment

Overall process through completion of decommissioning including the process toward decommissioning of reactors as well as retrieval and storage of fuel debris from Units 1 to 4, and overall process for maintaining and continuing cold shutdown for Units 5 and 6 shall be respectively

defined. Overall risks of the Specified Nuclear Facility shall be reduced and optimized through assessment of each process and stage.

In conducting risk assessment for the overall Specified Nuclear Facility and each equipment, reduction and optimization of risks shall be sufficient to ensure on-site and off-site safety through assessment including the impact on wide area of off-site environment.

## II. Items concerning Measures to be taken for Design and Equipment

### 1. Monitoring of reactors, etc.

<Units 1 to 4>

○ Main parameters and operation condition such as cooling temperature and sub-criticality, etc. inside reactor pressure vessel, inside containment vessel and of spent fuel in spent fuel storage facilities, etc. shall be enabled to be monitored.

In particular, the parameters and operation condition necessary to identify abnormal conditions and take actions shall be enabled to be recorded.

○ The procedures for emergency responses shall be prepared.

<Units 5 and 6>

○ Instrumentation and control systems equipment which control to maintain and monitor parameters necessary to secure integrity of reactor core, reactor coolant pressure boundary, primary containment boundary and associated systems shall be maintained in a sound condition.

○ In order to keep reactor core's sub-criticality, in case fuel assemblies are loaded, control rods and control rod drive system shall be maintained in a sound condition, and instrumentation and control system equipment to monitor sub-critical condition shall be maintained in a sound condition.

### 2. Removal of residual heat

<Units 1 to 4>

○ Residual heat from fuel debris, etc. in reactor pressure vessel and primary containment vessel and fuel assemblies in spent fuel storage facilities shall be appropriately removed.

○ The temperature at the bottom of reactor pressure vessel shall be kept under 100°C (except Unit 4).

<Units 5 and 6>

○ Cold shutdown shall be continuously kept by maintaining the equipment in a sound condition, such as reactor cooling system equipment consisting reactor coolant pressure boundary; residual heat removal system and emergency core cooling systems, cooling system equipment for auxiliary

component cooling system, equipment necessary for supplying cooling water such as condensate and make-up water and for water chemistry control, and associated facilities.

### 3. Monitoring of primary containment atmosphere, etc.

<Units 1 to 4>

○ Concentration and volume of radioactive materials released into the environment shall be monitored and reduced as low as reasonably achievable by bleeding and filtering the gas in primary containment vessel, etc.

○ Sub-criticality in reactor pressure vessel and primary containment vessel shall be monitored and kept to prevent criticality.

<Units 5 and 6>

○ Primary containment vessel, equipment constituting primary containment boundary and system equipment controlling containment atmosphere shall be maintained in a sound condition.

### 4. Maintenance of an inert atmosphere

<Units 1 to 4>

○ Concentration of stagnant gas, such as hydrogen, in reactor pressure vessel and primary containment vessel shall be monitored and controlled, and inert atmosphere with nitrogen and other gases shall be maintained to prevent hydrogen explosion. However, these measures do not apply in special cases such as for fuel retrieval, etc.

### 5. Fuel removal and, appropriate storage and management of removed fuel

<Units 1 to 4>

○ In removing fuel from spent fuel storage facilities, sub-criticality shall be reliably maintained, measures to prevent fuel fall and mitigate its effects shall be taken, and shielding shall be provided as appropriate. Removed fuel shall be appropriately cooled and stored.

<Units 5 and 6>

○ In removing fuel from reactor and spent fuel storage facilities, sub-criticality shall be reliably maintained, fall prevention measures shall be taken and shielding shall be provided. Equipment necessary to appropriately cool and store the removed fuel shall be maintained in a sound condition.

### 6. Ensuring power source

○ Structures, Systems and Components (hereinafter referred to as “SSCs”) with safety function of especially high importance shall be able to be supplied with electricity by both of off-site power source (transmission grid) and emergency on-site power source and be able to ensure and maintain sufficiently high reliability, when they need electricity to fulfill their functions.

○ To prevent loss of necessary power supply due to the failure of external power supply system, emergency on-site power supply system and other relating power supply equipment, abnormal event shall be detected and prevented from its expansion and propagation.

#### 7. Design considerations for loss of power

○ In the case of station blackout, cooling of inside reactor pressure vessel, inside primary containment vessel and spent fuel storage facilities shall be secured and recovered. To achieve this, alternative power source and alternative water supply equipment including power supply vehicles and pump trucks shall be equipped.

#### 8. Treatment, storage, and management of radioactive solid waste

○ In treating and storing radioactive solid waste such as rubble generated in the Facility, taking into account its characteristics, radiation dose in the area surrounding the site shall be reduced as low as reasonably achievable by treating them appropriately, securing sufficient capacity for storage and providing appropriate management such as shielding.

#### 9. Treatment, storage, and management of radioactive liquid waste

○ In treating radioactive liquid waste such as contaminated water generated in the Facility, taking into account its characteristics, radiation dose in the area surrounding the site shall be reduced as low as reasonably achievable by controlling the waste generation, treating them appropriately to reduce concentration of radioactive materials, securing sufficient capacity for storage and providing shield, preventing leakage and expansion of contamination, etc. In addition, treatment and storage facilities shall be equipped with adequate shielding capability and structures that hamper leak of liquid waste and expansion of contamination so that radioactive materials may not be released into environment through groundwater, water leak, etc.

#### 10. Treatment and management of radioactive gaseous waste

○ In treating radioactive gaseous waste generated in the Facility shall be, taking into account its characteristics, radiation dose in the area surrounding the site shall be reduced as low as reasonably achievable, by controlling this waste generation and providing appropriate treatment and management.

#### 11. Radiation protection, etc. in the area surrounding the site by restricting release of radioactive materials, etc.

○ Radiation dose in the area surrounding the site shall be reduced as low as reasonably achievable, taking appropriate measures to restrict release of radioactive materials from the Specified Nuclear Facility into environment (atmosphere, ocean, etc.).

○ Specifically, effective dose (estimated value taking into account additional releases of radioactive materials from the overall Facility due to rubble and contaminated water, etc. generated after the accident, which are stored in the Facility) along the site boundaries shall be reduced less than 1 mSv/year by March 2013.

#### 12. Management, etc. of workers' exposure dose

○ Considering workability of radiation workers under the current exposure condition, dose rate of the workers' entry area and exposure dose associated with their work shall be reduced as low as reasonably achievable, by taking necessary radiation protection measures, such as providing shield, deployment of equipment, remote control, prevention of radioactive material leaks, ventilation and decontamination, etc.

#### 13. Emergency measures

○ Facilities needed in case of accident, such as emergency response center and escape routes, and equipment for emergency shall be prepared.

○ Appropriate alarm system and equipment for communication shall be provided so that proper directions may be conveyed to everyone in the Specified Nuclear Facility in case of accident. Equipment for communication between the Specified Nuclear Facility and off-site necessary places shall be provided with redundancy and diversity.

#### 14. Design considerations

○ For design of the facilities, following items shall be taken into consideration appropriately taking into account importance of safety.

##### (1) Applied codes and standards

Design, selection of materials, fabrication and inspection of SSCs with safety function shall conform to those codes and standards which are considered to be appropriate taking into account importance of their safety function, respectively.

##### (2) Design considerations for natural phenomena

- SSCs with safety function shall be provided with appropriate seismic categories considering the importance of their safety function and possible safety impact caused by loss of function due to earthquake, and be designed to sufficiently withstand design seismic load considered to be appropriate.

- SSCs with safety function shall be designed so that the safety of the facilities may not be impaired by postulated natural phenomena other than earthquake (such as tsunami, heavy rain, typhoon and tornado, etc.). SSCs with safety function of especially high importance shall be designed taking into account appropriate combination of conditions considered to be severest among predictable natural phenomena or natural load together with accident load.

(3) Design considerations for external human-induced events

- SSCs with safety function shall be designed so that the safety of the facilities may not be impaired by postulated external human-induced events.

- SSCs with safety functions shall be designed to be provided with appropriate means to protect them against any illegal access by outsiders, etc.

(4) Design considerations for fire

The facilities shall be designed so that safety may not be impaired by fire, by combining appropriately protective measures such as fire prevention, fire detection, fire extinguishing and mitigation of fire effect.

(5) Design considerations for environmental conditions

SSCs with safety function shall be designed to withstand any environmental conditions, including aging effect. In particular, countermeasures shall be taken with adequate consideration of integrity assessment for the structures affected by the accident and the earthquake, etc.

(6) Design considerations for common use

In case SSCs are shared between multiple units, they shall be designed to be provided with sufficient redundancy and backup system so that safety of the facilities may not be impaired.

(7) Design considerations for operators' actions

The facilities shall be designed to be provided with appropriate preventive measures against operators' erroneous operation.

(8) Design considerations for reliability

- SSCs with safety function and monitoring function shall be designed so that their adequately high reliability may be ensured and maintained.

- Systems with safety function of especially high importance shall be designed to achieve their safety function, and shall be designed to be provided with redundancy, diversity and independency, taking into consideration their configuration, operating principle and safety function to be fulfilled.

(9) Design considerations for testability

SSCs with safety function shall be designed so that their function may be tested to verify their integrity and capability by means of appropriate method.

15. Other Item concerning Measures to be Taken

○ In addition to the aforementioned items, appropriate measures shall be taken when deemed necessary to prevent disaster.

III. Items concerning Measures Taken for Security of the Specified Nuclear Facility

By taking appropriate measures such as operation management, maintenance management, radiation control, radioactive waste management, emergency measure and on-site and off-site environmental radiation monitoring, etc., “II. Items concerning Measures to be taken for Design and Facilities” shall be ensured to be appropriately and reliably implemented, and workers’ and on-site and off-site safety shall be ensured.

Particularly, with regard to emergency measures during accident or disaster, systems for communication with organizations concerned and medical care in emergency shall be developed in addition to responses to emergency situation.

In addition, education and training shall be appropriately conducted for employees and workers including those of contracted and subcontracted companies to maintain and improve their skill and capability.

#### IV. Items concerning Measures to be Taken for Physical Protection of Specified Nuclear Fuel Materials

Appropriate measures shall be taken to prevent unlawful transfer by means of theft, etc. of nuclear fuel materials in the Specified Nuclear Facility (Specified Nuclear Fuel Materials).

#### V. Items concerning Measures to be Taken for Retrieval of Fuel Debris and Reactor Decommissioning

- For nuclear fuel materials including fuel debris, etc. , sub-criticality shall be reliably maintained, and after taking measures including water sealing of primary containment vessel, they shall be safely retrieved, prevented from dispersing, appropriately shielded, cooled and stored.
- Appropriate measures shall be taken to realize the decommissioning of Units 1 to 4 as early and as safely as possible while ensuring workers’ and on-site and off-site safety.
- In addition to the aforementioned, appropriate measures shall be taken when deemed necessary to prevent disaster, etc.

#### VI. Items to be Taken into Consideration in Developing the Implementation Plan

In developing the Implementation Plan, which is submitted to the Nuclear Regulation Authority pursuant to the provisions of Article 64-2, Paragraph 2 of the Act, plans, regulations, etc. listed below shall be appropriately reflected.

1. Plans, etc. reported response to the reporting orders pursuant to the provisions of Article 67, Paragraph 1 of the Act

- Reports on the Facility Management Plan (including Reports No. 1 to 3 and their amendments, etc.) in accordance with the “Policy on Mid-Term Safety” for Units 1 to 4 of the TEPCO’s Fukushima Daiichi Nuclear Power Station
- Report on the plan, etc. toward radiation dose reduction at the site boundaries of the TEPCO’s Fukushima Daiichi Nuclear Power Station

2. Plans, etc. reported in accordance with instructions from the Nuclear and Industrial Safety Agency

- Implementation Plan for Reliability Improvement Measures at the TEPCO’s Fukushima Daiichi Nuclear Power Station
- Report on Further Measures to be Taken Concerning the Implementation Plan for Reliability Improvement Measures at the TEPCO’s Fukushima Daiichi Nuclear Power Station

3. Safety Program, etc. approved pursuant to the provisions of the Act

- Operational Safety Program for the Fukushima Daiichi Nuclear Power Station
- Physical Protection Program of Nuclear Facilities and Nuclear Material for the Fukushima Daiichi Nuclear Power Station

Particularly for Units 1 to 4, when construction work is carried out to install or modify equipment important for safety, the method of design and the construction work shall be described in the Implementation Plan; and when the facilities, etc. that may be contaminated by the nuclear fuel materials or other radioactive materials are dismantled or removed, the method thereby shall be described in the Implementation Plan.

#### VII. Promotion of Understanding of the Implementation Plan

In carrying out the Implementation Plan, measures in the Plan, contents of risk assessments, progress on measures, etc. shall be continually explained to the public at large, including local residents and municipalities, and the relevant information shall be disclosed in an effort to promote understanding.

#### VIII. Inspections to be Undergone Pertaining to the Implementation Plan

The facilities, and the measures for operational safety and for physical protection of Specified Nuclear Fuel Materials, which are described in the Implementation Plan shall be inspected pursuant the provisions of Article 64-3, Paragraph 7 of the Act.