Fukushima Daiichi nuclear accident
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Damaged facilities at the site

Situation in March 2016

This document is based on publicly available information on the situation of the Fukushima Daiichi plant.

I. Summary of the facts[1] and general condition of the facilities following the accident

The magnitude 9 earthquake, which occurred on 11 March 2011, 80 km east of the island of Honshu in Japan and the tsunami that ensued severely affected Japanese territory in the Tohoku region, with major consequences for people and infrastructure.

By devastating the site of the Fukushima Daiichi plant, these natural events caused the meltdown of the cores of three nuclear reactors [2] and the loss of cooling of several spent fuel pools.

Explosions also occurred in the reactor buildings 1 to 4 due to the hydrogen produced by the core fuel degradation.

Significant releases into the environment took place as from 12 March 2011, and then more moderately but persistently for several weeks. The accident was rated as Level 7 on the INES scale.

II. Facility control actions

In late 2011, TEPCO reported the achievement of a "cold shutdown" condition, a non-fully suitable expression, mainly reflecting that water in the reactors was being maintained at a temperature lower than 100°C. This prevents water evaporation to limit releases to the environment from the containment leakages.

Reactors 1, 2 and 3 are now maintained at a temperature between 20 and 50°C by continuous injection of fresh water (at a flow rate of the order of 5 m^3/h per reactor). Due to the leaks in the primary and containment vessels, the injected water flows into the basements of the buildings where it mixes with groundwater seepages and is then recovered to be treated and partly reused to cool the reactors[3].

In addition, nitrogen is injected as required into the containment and the tanks of Reactors 1-3 to maintain their inerting and thus avoid any risk of hydrogen combustion.

The fuel pools are cooled in a closed circuit; the temperatures in the pools are lower than 30°C.

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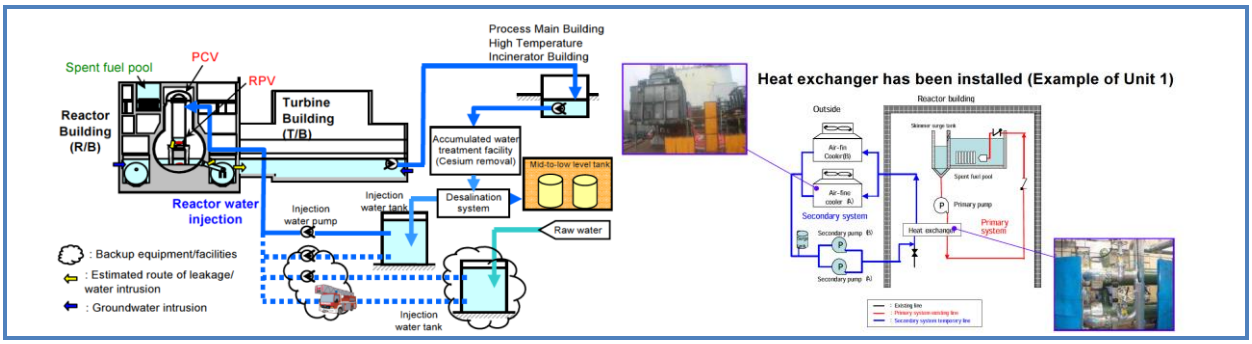
[1] For more information, visit the IRSN website: In French www.irsn.fr/fukushima, In English www.irsn.fr/fuku-lessons

[2] Reactor 4 has been unloaded and Reactors 5 and 6 are in safe shutdown - Visit the IRSN website for more information on the course of the accident: http://www.irsn.fr/EN/publications/thematic-safety/fukushima/Pages/video-fukushima-2-years-later.aspx

[3] See the background notes on the management of radioactive water and groundwater.



Source TEPCO - Schematic diagrams of the cooling of the reactors and pools

In order to stabilise the situation of the facilities, TEPCO implemented redundant provisions and emergency electrical generators to maintain the cooling of the facilities and ensure the inerting of the containment and primary vessels with nitrogen. In addition, some equipment was installed in the elevated areas and anti-tsunami protection was set up at the edge of the site. Finally, essential parameters (water temperature, hydrogen content in the containments, water levels, etc.) were monitored.

Furthermore, the residual heat[4] still present in the cores and storage pools has significantly decreased since the accident. TEPCO now has significant time to intervene if it encounters difficulties with the cooling provisions implemented.

TEPCO is also conducting investigations and specific inspections in the facilities. It hopes to thus better define its action plan for the recovery of fuel and dismantling. These visits also enable the gathering of facility monitoring information, stricter monitoring of important parameters and the detection of possible defects requiring additional actions.

IRSN emphasises the importance of the provisions implemented by TEPCO for the control of the facilities in a persistently difficult environment linked to a still limited knowledge of the condition of the facilities, reduced accessibility to the damaged buildings, restrictive intervention conditions and the current level of reliability of some of the resources implemented. These facility control actions should be maintained over time and require great vigilance by TEPCO.

III. Release control actions

Diffuse releases into the environment continue due to the very serious deterioration of the confinement barriers.

TEPCO is continuing its actions to control these emissions, notably with the establishment of structures covering the buildings of the damaged reactors and underground barriers to manage groundwater.

IV. Plant control recovery plan

TEPCO considers that the early stages of regaining control of the plant have been carried out, in so far as, on the one hand the reactors and pools are being cooled, maintaining the water in the facilities at a low temperature and, on the other hand, the residual releases are at very low levels. Site clean-up actions continue, in particular to enable future work.

The action plan adopted by TEPCO comprises three main stages:

[4] Residual heat is heat that the nuclear fuel continues to emit despite the stopping of the chain reaction. It comes from the decay of radioactive elements.

- The first step is to begin the removal of the fuel from the pools. The retrieval of the fuel from the pool of Reactor 4, which contains the greatest amount of fuel[5], began in November 2013 and was completed in December, at the end of 2014[6] in accordance with the original planning.
- In mid-2015, TEPCO postponed the start of the fuel retrieval from the pool of Reactor 3, from late 2015 to late 2017. It initiated the construction of a structure covering the building of this reactor. The removal of the larger debris from the top floor of the building (5th level[7]) was completed on 11 October 2013.

Source TEPCO - Cover of the Reactor 3 building
(project plan and view of the structures before assembly)

On the 2nd of August 2015, TEPCO extracted from the pool of Reactor 3 a fuel handling crane that had fallen in there during the accident. Given the size of this crane, this operation was an important step to enable the future removal of the fuel. Furthermore, TEPCO has taken many precautions with regard to the risks associated with the handling of such a piece - more than 20 tonnes.

Source TEPCO - Removal of a fuel handling crane from the pool of Reactor No. 3

In Mid-2015, TEPCO also postponed the fuel retrieval from the pools of Reactors 1 and 2 to 2020.

Significant work still needs to be done on Reactor 1: the current protection building set up in October 2011 should be dismantled in order to allow the removal of debris; a new building will be built for the fuel retrieval. After a first test removing two panels in

[5] More than 1500 fuel assemblies were present in the pool of Reactor No.4, compared to 492, 615 and 566 respectively in the pools of Reactors No. 1, 2 and 3.
[6] For a description of relevant activities: In French
http://www.irsn.fr/FR/Actualites_presse/Actualites/Pages/20131119_Fukushima-retrait-combustible-piscine-reacteur.aspx
[7] The 5th level of the Fukushima Daiichi reactor buildings is the operating level during shutdown phases. The primary and containment vessels opening operations and then the fuel unloading operations were conducted from this level.

December 2014 to make sure that the environment was not affected, TEPCO actually started the dismantling work on the building at the end of July 2015.

Source TEPCO – Removal of a panel of the building covering Reactor 1 (July 2015) and current condition of the building

- For the second stage, initiating the removal of the degraded fuel from Reactors No. 1 to 3 is planned. An extensive research programme has been initiated for this purpose. It is aimed at developing investigative resources additional to those already implemented, in order to know the condition of the facilities more precisely, and to identify and develop the necessary resources. The removal of the degraded fuel should start between 2020 and 2025 depending on the reactor concerned. The schedule remains very dependent on that of the research programme and the knowledge obtained about the condition of the facilities;
- The final stage will lead to the full dismantling of the facilities, with a goal of 30 to 40 years.

In December 2013, TEPCO also decided to dismantle Reactors No. 5 and 6 of the site, the return to operation of which was planned after the implementation of an improvement programme that was yet to be established. It will use these dismantling operations to prepare for those of the damaged reactors.

IRSN emphasises that the deadlines announced should be considered as orders of magnitude and that significant operations to further characterise the state of the facilities, as well as research work, still need to be done. IRSN notes, however, the importance of the means implemented by TEPCO to keep to the overall schedule announced. TEPCO regularly adjusts its schedule based on what it learns from its investigations in the facilities and the progress of the work but, to date, the progress appears to be in line with this schedule.