Estimated current status of Fukushima-Daiichi Nuclear Power Plant Units 1-3*

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Committee for Investigation of Nuclear Safety

Technical Analysis Subcomimittee

Atomic Energy Society of Japan

Executive Summary

- The nuclear reactors and the spent fuel pools in Fukushima-Daiichi Nuclear Power Station are in stable situation. Continuous cooling by water injection is necessary to keep the situation.
- When appropriate cooling measures are being taken, situation of the nuclear reactors and the spent fuel pools will be stabilized. As a result, the possibility of excessive release of radioactive material will be suppressed. However, implementation of stable and robust cooling systems and confinement of radioactive material should be carried out considering the potential risks such as of aftershock.
- The first priority is put to the effort to keep the stable condition of the nuclear reactors and the spent fuel pools such as continuous cooling and securement of redundancy for the cooling methods. Furthermore, confinement of contaminated water by radioactive material has equally prioritized in order to prevent additional release of radioactive material.

1. Unit 1

(1) Core status

- The core is considered to be severely degraded due to insufficient cooling in the initial phase of the accident. There was considerable time delay between the uncovering of fuel from cooling water and the injection of seawater. The core pressure was still high when the seawater injection was started, which prevented efficient injection of water into the core. Core damage fraction is estimated as 70% based on the measurement result of CAMS (Containment Atmospheric Monitoring System). Anther estimation on the core damage fraction would be difficult based on the currently available information.
- Part of fuel debris is deposited on the core support plate and/or the bottom of the reactor pressure vessel.
- If the measured temperature at the feed-water nozzle is correct, generated vapor in the core is superheated by the uncovered fuel, i.e., part of the fuel would have emerged from the water.
- If the measured temperatures at the bottom of the reactor pressure vessel and the measured

* The present document tries to provide an estimation of current status of Fukushima-Daiichi Nuclear Power Plant Units 1-3, based on the reported information. Part of the present estimation might be revised when new information is obtained.

Contact E-mail: QandAhobkan@aesj.or.jp

internal pressure of the reactor vessel are correct, the fuel debris deposited on the bottom of the reactor vessel would be cooled enough and be in the form of a solid.

(2)Reactor pressure vessel

- Injection rate of water (currently borated fresh water) is 6 t/h and generation rate of vapor by decay heat in the core is estimated as approximately 2 t/h. Thus fresh water would be added in the core at the rate of approximately 4 t/h.
- The internal pressure of the reactor vessel shows saturation trend. This trend suggests possibility of water vapor leakage from the safety relief valve and/or vapor/liquid leakage from the reactor vessel.
- Since the reactor vessel holds higher internal pressure than atmospheric pressure, the leakage of the vapor and/or liquid does not seem to be very large. However, the variations of pressure in the reactor vessel and the containment vessel showed similar trends when the inert gas (N_2) was injected into the containment vessel in order to prevent hydrogen explosion. These variations of the pressure may suggest the internal pressure of the reactor vessel may be similar that in the containment vessel, i.e., there would be possibility of anomaly on the measurement value of the internal pressure of the reactor pressure vessel. In the latter scenario, the leakage from the reactor pressure vessel may not be small.

(3)Containment vessel

- The internal pressure of the containment vessel is considered to continuously rise when the vent line from the suppression chamber has not been activated. However, the measurement value of the internal pressure is almost constant.
- The internal pressure of the containment vessel was increased when the inert gas (nitrogen) was injected in it. However, the internal pressure showed saturation trend at a later time.
- The above observations suggest that there is small leakage of the vapor.
- There are no measurement data that suggest degradation of the suppression chamber.

2. Unit 2

(1)Core

- The core is considered to be degraded due to insufficient cooling during the initial phase of the accident. The core pressure was still high when the seawater injection was started, which made considerable time delay between the uncovering of fuel from cooling water and the injection of seawater into the core. Core damage fraction is estimated as 30% based on the measurement result of CAMS (Containment Atmospheric Monitoring System). Another estimation on the core damage fraction seems to be difficult based on the currently available information.

•Similar to Unit 1, part of fuel debris is deposited on the core support plate and/or the bottom of the reactor pressure vessel.

•If the measured temperature at the feed-water nozzle is correct, generated vapor in the core is superheated by the uncovered fuel, i.e., part of the fuel would have emerged from the water.

•If the measured temperatures at the bottom of the reactor pressure vessel and the measured internal pressure of the reactor vessel are correct, the fuel debris deposited on the bottom of the reactor vessel would be cooled enough and be in the form of a solid.

(2)Reactor pressure vessel

•Injection rate of water (currently borated fresh water) is 7 t/h and generation rate of steam is estimated as approximately 4 t/h. Thus fresh water would be added in the core at the rate of approximately 3 t/h.

•The internal pressure of the reactor vessel is similar to that of the containment vessel. This observation suggests possibility of vapor and/or liquid leakage from the reactor vessel.

(3)Containment vessel

•The suppression chamber is considered to be broken due to the abnormal noise event at approximately 6 AM, March 15th. Liquid would be leaked from the suppression chamber.

•Considerable amount of radioactive material would have be released when the suppression chamber was broken.

•Potential reason for the break is (1) hydrogen explosion, which was occurred by the leaked hydrogen from the suppression chamber and the oxygen outside the suppression chamber, (2) excessive pressure due to the vapor inflow from the safety relief valve of the reactor vessel.

3. Unit 3

(1)Core

•The core is considered to be degraded due to insufficient cooling during the initial phase of the accident. Seawater was injected after uncovering of the core from cooling water, but the water level would not be recovered to the level for sufficient cooling. Core damage fraction is estimated as 25% based on the measurement result of CAMS (Containment Atmospheric Monitoring System). Another estimation on the core damage fraction seems to be difficult based on the currently available information.

•Similar to Unit 1, part of fuel debris is deposited on the core support plate and/or the bottom of the reactor pressure vessel.

•If the measured temperatures at the bottom of the reactor pressure vessel and the measured internal pressure of the reactor vessel are correct, the fuel debris deposited on the bottom of the reactor vessel would be cooled enough and be in the form of a solid.

- If the measured temperature at the feed-water nozzle is correct, the fuel in the core would have emerged from the water.

(2)Reactor pressure vessel

- Injection rate of water (currently borated fresh water) is 7 t/h and generation rate of vapor is estimated as approximately 4 t/h. Thus fresh water would be added in the core at the rate of approximately 3 t/h.
- The internal pressure of the reactor vessel is similar to that of the containment vessel. This observation suggests possibility of vapor and/or liquid leakage from the reactor vessel.

(3)Containment vessel

- The internal pressure of the containment vessel is considered to continuously rise when the vent line from the suppression chamber is not activated. However, the measurement value of the internal pressure is almost constant.
- If the vent line is not activated, the above observation suggests that there is small leakage of vapor.

4. Spent fuel storage pool

Continuous cooling is essential for the spent fuel storage pools. Heat generation rate of the spent fuel pool of Unit 4 is large thus needs special attention.

(For reference) Current heat generation rate

	Core	Spent fuel storage pool
Unit 1	approx. 1.4MW	approx. 0.07MW
Unit 2	approx. 2.4MW	approx. 0.5MW
Unit 3	approx. 2.4MW	approx. 0.2MW
Unit 4	No fuel in core.	approx. 2MW