Attachment

Overview of Evaluation Report regarding seismic safety, etc. for Hamaoka Nuclear Power Station Reactors No. 1 and 2

Regarding Hamaoka Nuclear Power Station reactors no. 1 and 2, that stopped operation on January 30, 2009 and began the process of being decommissioned on November 18 the same year, based on Ministry of Economy, Trade and Industry Nuclear and Industrial Safety Agency (NISA) directive and in consideration of the current status of the facilities, seismic safety assessment, etc. was conducted in light of the New Seismic Durability Guidelines, and it was confirmed that safety is ensured in the facilities. An overview of the results of the assessments is provided below.

1. Content of NISA instructions* (overview)

Hamaoka Nuclear Power Station reactors no. 1 and 2 are currently in the process of being decommissioned. However, in consideration of the fact that spent fuel is being stored in the respective facilities, assessment must be carried out on the seismic safety in consideration of the state of the respective facilities.

However, this requirement shall not apply for each respective facility if it is technologically determined that there is no danger of excessive radiation-exposure levels in surrounding communities, even based upon a premise of radiation escaping to the environment outside the facilities from those radioactive materials that are stored within the facilities. Only in such cases, the respective assessment shall be reported instead.

* Instructions issued by the Ministry of Economy, Trade and Industry Nuclear and Industrial Safety Agency (12.22.2009 NISA No. 3) on December 25, 2009 entitled, "Implementation of the Seismic Safety Assessment, etc. of Hamaoka Nuclear Power Station Reactors no. 1 and 2."

2. Hamaoka No. 1 Reactor

(1) Concept of the assessment

There is only one spent fuel rod stored in reactor no. 1. More than 17 years has passed since it was removed from the core. Hardly any decay heat is produced, and it does not require coolant water. Furthermore, it will not reach a critical state in any predicted environmental conditions. Based on this, assessments were carried out to determine the radiation dosage that would be released to surrounding communities in the event that fission product was released into the environment due to fuel failure (loss of "containment function") or in the event of loss of fuel pool water and the building that have a shielding effect (loss of "shielding function"). It was confirmed that there is no danger of excessive radiation exposure.

(2) Assessment results

a. Loss of containment functions

Based on the premise of loss of the function of the fuel cladding tube of containing fission product and subsequent release of the entire volatile and gas fission products remaining in the fuel, according to the results of assessment of the radiation dose in surrounding communities, the effective dose was confirmed to be about 5.3×10^{-3} mSv, which is far lower than the effective dose of 5 mSv determined to have a significantly low risk of radiation exposure and that is the judgment standard for assessment in the event of an accident as proposed in "Safety Assessment Review Guidelines."

b. Loss of shielding function

The effective dose of radiation from the fuel on surrounding communities, supposing the fuel pool water and concrete structure that makes up the building that have a shielding effect against radiation are lost, is approximately 1.4×10^{-3} mSv/h. It would take more than 140 days to reach 5 mSv, during which response would be possible.

3. Hamaoka No. 2 Reactor

(1) Concept of the assessment

Concerning Reactor No. 2, in considering that there are 1,164 spent and 148 new fuel rods (below termed together as "fuel") being stored in the spent-fuel storage facility of this reactor, seismic safety assessment, etc. of the storage facility* was carried out, and all the "cooling functions," "sub-criticality functions," and "containment functions" necessary for ensuring safety were confirmed to be unimpaired.

* Concerning the "standard ground motion Ss," the standard ground motion Ss (horizontal-motion peak acceleration of 800 cm/s^2) found in the "Seismic Safety Assessment Results Report in Response to Revisions of the 'Seismic Design Evaluation Guidelines for Nuclear Power Reactor Facilities' for Reactor No. 4, Hamaoka Nuclear Power Station" was used.

(2) Assessment results

a. Cooling functions

Seismic safety assessment, etc. was conducted to determine that the fuel pool water is being maintained, and it was confirmed that the fuel cooling function is ensured and that the fuel is being cooled without the fuel pool water boiling.

a) Maintaining fuel pool water

○ According to assessment of the seismic safety of the nuclear reactor building that is attached to the fuel pool by standard ground motion Ss, the shearing strain of the shear wall was confirmed to be below the assessment standard (Table 1). Furthermore, the foundation ground that supports the nuclear reactor building was confirmed to have sufficient bearing power against seismic force by standard ground motion Ss. It was therefore confirmed that the fuel pool water will be maintained even in the event of an earthquake.

○It was confirmed that, in the event of a loss of function in the fuel pool water injection equipment, it would take more than 100 days for the regular water level to reduce to a level that exposes the fuel due to vaporization, which would be enough time to respond accordingly, for example by taking emergency safety measures such as water injection via a deployed portable power pump and by restoring the functioning of the equipment.

b) Maintaining fuel pool water temperature

○Measurements were taken of the changes in water temperature of the reactor no. 2 fuel pool from September to October 2011 with the fuel pool cooling system equipment turned off. It was confirmed that no boiling occurred, and that a roughly equilibrium state at approximately 57°C was achieved (Figure 1). In addition, according to calculations to assess the fuel pool water temperature throughout the year, it was confirmed that a temperature of approximately 62°C was maintained during the hottest month (August).

b. Sub-criticality function

Sub-criticality is ensured by storing the fuel in fuel racks and maintaining an appropriate distance between fuel rods. According to the seismic safety assessment of the fuel racks by standard ground motion Ss, the generated stress was confirmed to be below the assessment standard (Table 1).

c. Containment function

As stated in a. and b. above, cooling of the fuel is ensured by maintaining the fuel pool water level and seismic safety of the fuel rack is ensured. The fuel will therefore not reach criticality. The containment function (including shielding function) is thus confirmed to be ensured.

d. Other (events accompanying an earthquake)

a) Safety of surrounding slopes

Regarding the safety of surrounding slopes, it was confirmed that sufficient space is procured between said slopes and the reactor building and that there are no slopes that affect the safety.

b) Safety against tsunami

In the event of loss of function of the fuel pool water injection equipment or cooling system equipment, the water temperature will be maintained, and there would be a sufficient amount of time before the fuel was exposed due to vaporization. Therefore, measures such as water injection by portable power pumps and restoration of the equipment would be possible. It is thus confirmed that tsunami will have no effect on the safety.

Table 1. Results of seismic safety assessments

Facility	Assessed part	Evaluation content (units)	Generated value	Assessment standard
Nuclear reactor building	Shear wall	Shearing strain (-)	0.27×10^{-3}	2.0×10^{-3}
Fuel rack	Square tube	Stress (MPa)	195	246
	Anchor bolts	Stress (MPa)	50	529
	Support beam	Stress (MPa)	165	200

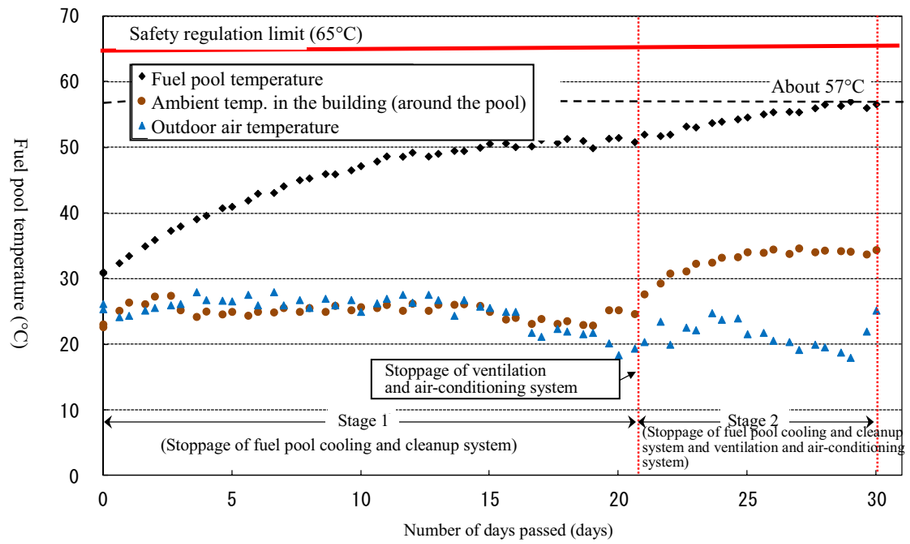

Figure 1. Results of fuel pool water temperature measurement (September 6 – October 6, 2011)