

Causes of and Corrective Action against Water Leakage within the Controlled Area at Takahama Unit 4

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The Kansai Electric Power Co., Inc.

At Takahama Unit 4 (pressurized water reactor, rated electric output: 870MW, rated thermal output: 2,660MW, during the 20th refueling outage inspection), an alarm, “caution on the primary system floor drain” was actuated at p.m. 15:42 on February 20, 2016 when the coolant in the chemical and volume control system was passed through the boron thermal regeneration system before increase of the reactor coolant system temperature.

In response to the event, water supply to the boron thermal regeneration system was terminated at p.m. 15:45 on that day and an operator immediately conducted field inspection. As a result, he found a puddle (2m × 4m × 1mm, approx. 8ℓ) on the floor in front of the condensate demineralizer ^{*1} area (EL 10.5m) in Unit 4 reactor auxiliary building

Subsequently the puddle (total amount of radioactivity: approx. $1.4 \times 10^4 \text{Bq}^{*2}$; approx. $1.74 \text{Bq/cm}^3 \times 8\ell$) was wiped off and it was confirmed that there was no remaining contamination.

This event did not cause any radioactive influence on the surrounding environment.

*1 A filtering system to eliminate impurities from the reactor coolant using resin

*2 The estimated amount of radioactivity of the puddle (approx. $1.4 \times 10^4 \text{Bq}$) is below one 200th of Japan’s threshold value ($3.7 \times 10^6 \text{Bq}$).

[As reported in the press release on February 20, 2016]

1. Investigation of causes of the event

(1) Results of field investigation

- Investigation of areas surrounding the puddle in front of the condensate demineralizer area observed water drops attached in the vicinity of 2 valves located above the puddle (inlet and outlet valves of B-mixed bed demineralizer).

- The systems surrounding B-mixed bed demineralizer including the 2 concerned valves were isolated and pressurized to identify the leaking point. When pressure reached 1.1MPa, water leaking between the valve casing and diaphragm sheet of B-mixed bed demineralizer inlet valve (CS-043B) was observed (approx. 0.7ℓ /minute).
- After being pressurized to nearly the design pressure, there was no leakage in the B-mixed bed demineralizer outlet valve. Accordingly, it was determined that the leaking point was in the B-mixed bed demineralizer inlet valve (CS-043B).

(2) Results of overhaul inspection of B-mixed bed demineralizer inlet valve

- We checked the maintenance record and confirmed that overhaul inspection of the concerned valve had been conducted during the 18th refueling outage inspection (August 2008 through January 2009).
- The concerned valve was disassembled and overhaul inspection was conducted again and it was confirmed that there were no foreign objects or defects in the interior of the valve casing and there was no degradation in the diaphragm sheet.
- We checked the status of fastening of 4 valve bonnet bolts and found that the bolts were not uniformly fastened with less fastening torque applied to some bolts.
- As a result of the field investigation, we found that the valve had a horizontal driving shaft and was installed in a narrow place. Therefore, it is estimated fastening torque applied to some bolts was insufficient due to installation of the valve in a narrow place.

(3) Verification of operating records

- We checked the measurements taken by the pressure gage installed upstream of the B-mixed bed demineralizer inlet valve and confirmed that there was a temporary pressure increase (from approx. 2.3MPa to approx. 3.0MPa) during the operation before alarm actuation to pass the coolant through the boron thermal regeneration system.
- Verification of past records revealed that there had been temporary increases in the pressure when feeding water to the boron thermal regeneration system.

2. Estimated causes of the event

It is estimated that fastening torque applied to some bonnet bolts of the B-mixed bed demineralizer inlet valve was insufficient partially due to the status of installing the valve in the field. As a result, water leaked from the concerned valve as the system

pressure temporarily increased during water feeding to the boron thermal regeneration system from the chemical volume and control system.

3. Corrective actions

We will replace the diaphragm sheet of the concerned valve with a new one and will verify if the concerned valve and other valves of the same type (i.e., having the horizontal driving shaft), through which reactor coolant passes, are appropriately fastened or not.

We will also add notes in the valve operation manual about valve bolt fastening operation, including the selection of tools suitable to the place of operation.

In addition, we will include a description in the operating procedure about the operation to feed the reactor coolant to the boron thermal regeneration system from the chemical and volume control system(CVCS) while keeping the pressure of CVCS letdown water at a low level (approx. 1.0MPa) in order to mitigate the influence of pressure fluctuation.

Attachment: Water Leakage within the Controlled Area at Takahama Unit 4

Takahama units 3 and 4 is KEPCO's first unit that has passed the safety screening against the new regulatory requirements which took effect on July 8, 2013 taking into account the lessons learned from the TEPCO's Fukushima Daiichi NPP accident and latest technical findings collected from across the world.

We will continue to make an utmost effort to improve the safety and reliability of our nuclear power plants by collecting and analyzing latest technical information collected at home and abroad. At the same time, we set our goal at achieving the world's highest level of safety while pursuing voluntary safety improvement measures on a continuous basis even beyond the framework of the new regulatory requirements.

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