Tsunami Protection Countermeasures Implementation at Kashiwazaki-Kariwa Nuclear Power Station

June 22, 2012
Tokyo Electric Power Station
Kashiwazaki-Kariwa Nuclear Power Station
Outline of Tsunami Protection Countermeasures Implemented at Kashiwazaki-Kariwa Nuclear Power Station

1. Seawall Construction
Seawalls are being built against the coast line to prevent impact from Tsunami and protect the facilities (such as the gas oil tank) and buildings in the power station.

2. Preventing the Buildings from Being Flooded
(1) Seawall construction
Seawalls are built along the Reactor Buildings to protect facilities and equipments crucial for ensuring safety (power facilities, emergency diesel generators, etc.).

After countermeasure implementation

(2) Watertight doors at the Reactor Building, etc.
Adopting watertight doors at the Reactor Building, Turbine Building and Heat Exchanger Building prevents the equipments and facilities in the building from being flooded.

(3) Installation of emergency high-voltage switchboards and the permanent cables in the Reactor Building
By installing emergency high-voltage switchboards and permanent cables in the Reactor Building, stable power supply to facilities such as the residual heat removal system pumps can be secured at station blackouts.

(4) Installation of alternative underwater pumps and alternative seawater heat exchanger facility
Alternative underwater pumps are installed to allow the operation of residual heat removal system in the case that the seawater system cooling function is disabled.

(5) Top vent system installation at the Reactor Building
A top vent system is installed to prevent hydrogen retention in the Reactor Building.

(6) Strengthening the environment monitoring equipments
In order to be well prepared for information gathering in case of emergencies, additional monitoring cars are deployed to allow continuous radiation dose measurements in the surrounding area of the power station.

(7) Equipments/Materials storage built on high ground for emergency
The equipments/materials storage is built on high ground to allow access to necessary equipments and materials in case of Tsunami emergencies.

3. Strengthening the Heat Removal/Cooling Functions
(1) Water source installation
Freshwater storage is installed as a water source to secure stable cooling water supply to the reactor and the spent fuel pool in case of emergency.

(2) Additional deployment of air-cooled gas turbine power supply cars
Large capacity gas turbine power supply cars are additionally deployed to secure power supply allowing the stable operation of residual heat removal pumps in the case of station blackouts.

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The construction of the seawalls started in November 2011. Seawalls (15m above sea level) are being built along Unit 1-4 (Arahama side) and Unit 5-7 (Ominato side). Along with an observation deck, these constructions that surround the entire power station will prevent Tsunami from flowing into the power station site. In consideration of the ground heights, the seawalls built along Unit 1-4 are made of reinforced concrete and those built along Unit 5-7 are made of improved soil.
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Seawall Construction

Unit 1-4 (Arahama side)

- **Tsunami Protection Countermeasures Implemented at Kashiwazaki-Kariwa Nuclear Power Station**
- **Seawall Construction**

Unit 5-7 (Ominato side)

- **Embankment made of cement improved soil**
- **Foundation improvement**

**Approx. 1m**

**Approx. 3m**

**Approx. 2.5m**

**Foundation improvement**

**Width: Approx. 15m**

**Height: Approx. 10m**

(15m above sea level)

**Foundation pile**

**Foundation improvement**

**Width: Approx. 15m**

**Height: Approx. 3m**

(15m above sea level)

**Embankment made of cement improved soil**

**Replaced with cement improved soil**

**Width: Approx. 10m**
Seawalls along Unit 1-4 (Arahama side)
Foundation pile construction: Approx. 460 piles installed as of the end of May 2012
The entire seawalls construction: Approx. 30% completed as of the end of May 2012
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Progress Status of Seawall Construction

Seawalls along Unit 5-7 (Ominato side)
Embarkment construction using cement improved soil: Approx. 80% completed as of the end of May 2012
Freshwater transfer from the reservoir to the tank is done based on gravity flow requiring no power, in order to allow water transfer even in the case of station blackouts.

The freshwater reservoir must be built on the flat ground at approx. 45m above sea level to prevent impact from Tsunami.

In order to secure necessary amount of freshwater even after an earthquake, a drilling operation is done on the ground and an embankment using cement improved soil is built. An impermeable liner is installed on the inner surface of the freshwater reservoir to prevent water leak in the case of an earthquake. The reservoir height is set high enough to secure necessary amount of freshwater, taking into account the overflow due to the sloshing phenomenon at the time of an earthquake.

The capacity of the freshwater reservoir is approx. 20,000m³ which is equivalent to the freshwater storage amount in the existing tank. With the new reservoir, the stored freshwater amount is increased twice as much.

“Pressure-resistant/abrasion-resistant hose” with flexible structure design is used, to be able to withstand earthquakes and minimize the impact of earthquakes.

The water transfer line has a double structure allowing the pressure-resistant/abrasion-resistant hose inside to be protected even when the outer layer is damaged.
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Freshwater Reservoir

Freshwater reservoir
Size: 64m (Length) x 120m (Width) x 6.5m (Depth)
The maximum water depth: 4.8m
Capacity: Approx. 20,000 m³ (Effective capacity: 18,000 m³)

Water transfer pipe
Material: Abrasion-resistant rubber (Approx. 8.5mm thick)
Inside diameter: Approx. 150mm

Pressure-resistant/abrasion-resistant hose

Water transfer pipe trench

Freshwater reservoir and the wells

Water transfer line
Water supply line

Aoyama North St.
Sado St.
Daijingu Pond

Well No.1
Well No.2

Embankment
Impermeable liner
Sand pocket

Water transfer pipe trench

Freshwater reservoir (A-A Cross section)
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Progress Status of Freshwater Reservoir Construction

Drilling operation

Freshwater reservoir (Full view)
Underground Gas Oil Tank

- For backup power supply line for emergency, the permanent cable is installed between the emergency high voltage switchboard at the transformer building and the emergency high voltage switchboard of each unit.
- Permanent cable is installed between the air-cooled gas turbine power supply car and the emergency high voltage switchboard at the transformer building.
- Underground gas oil tank is installed to allow stable fuel supply to the air-cooled gas turbine power supply car.

- Tank type: Double-wall tank
- Tank capacity: 50,000L
- Number of tanks: 3

Temporary storage space for the emergency vehicles
Underground gas oil tank installation location
Transformer Building (For construction)
Tsunami Protection Countermeasures Implemented at Kashiwazaki-Kariwa Nuclear Power Station

Installation of the Underground Gas Oil Tank and Air-cooled Gas Turbine Power Supply Cars

Photo taken on May 25, 2012

Underground gas oil tank installation completed

2 air-cooled gas turbine power supply cars have been deployed
### Progress Status of Tsunami Protection Countermeasure Implementation at Kashiwazaki-Kariwa Nuclear Power Station

As of June 21, 2012

<table>
<thead>
<tr>
<th>Countermeasure</th>
<th>Overall Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FY 2011</td>
</tr>
<tr>
<td><strong>1. Seawall Construction</strong></td>
<td>Design</td>
</tr>
<tr>
<td><strong>2. Preventing the Buildings from Being Flooded</strong></td>
<td></td>
</tr>
<tr>
<td>(1) Seawall/Flood barrier panels installation</td>
<td></td>
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<tr>
<td>(2) Watertight doors at the Reactor Building, etc.</td>
<td>Design</td>
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<tr>
<td><strong>3. Strengthening the Heat Removal/Cooling Functions</strong></td>
<td></td>
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<tr>
<td>(1) Water source installation</td>
<td></td>
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<tr>
<td>(2) Additional deployment of air-cooled gas turbine power supply cars</td>
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<td>(3) Installation of emergency high-voltage switchboards and the permanent cables in the Reactor Building</td>
<td>Design/Manufacture</td>
</tr>
<tr>
<td>(4) Installation of alternative underwater pumps and alternative seawater heat exchanger facility</td>
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<td>(5) Top vent system installation at the Reactor Building</td>
<td></td>
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<td>(6) Strengthening the environment monitoring equipments, additional deployment of monitoring cars</td>
<td>Design/Preparation</td>
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<td>(7) Equipments/materials storage built on high ground for emergency</td>
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</tbody>
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\[\text{June 21, 2012}\]
## Progress Status of Tsunami Protection Countermeasure Implementation at Kashiwazaki-Kariwa Nuclear Power Station

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<table>
<thead>
<tr>
<th>Countermeasure</th>
<th>Unit 1</th>
<th>Unit 2</th>
<th>Unit 3</th>
<th>Unit 4</th>
<th>Unit 5</th>
<th>Unit 6</th>
<th>Unit 7</th>
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</thead>
<tbody>
<tr>
<td>1. Seawall Construction</td>
<td></td>
<td></td>
<td></td>
<td>Under construction</td>
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<td>(1) Seawall/Flood barrier panels installation</td>
<td>Completed</td>
<td>Under construction</td>
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<td>No opening under 16m above sea level</td>
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<td>(2) Watertight doors at the Reactor Building, etc.</td>
<td>Completed</td>
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<td>(3)-1 Installation of emergency high-voltage switchboards</td>
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<tr>
<td>(3)-2 Installation of permanent cables in the Reactor Building</td>
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*We will continue implementing necessary Tsunami protection countermeasures to further enhance the reliability of nuclear power station.