Characteristic approaches of construction at Higashidori Nuclear Power Station

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The Tohoku Electric Power Company is currently building unit No.1 nuclear power station in Higashidori village, Aomori prefecture, with commercial operation scheduled to start July 2005. The Unit 1 is a BWR with the output of 1,100 MWe.

Features of unit No.1 are adoption of Improved Mark I type PCV and discharge the warmed seawater below the water surface system. Some of the characteristic construction approaches are (1) Adoption of hybrid all-weather construction method, (2) Use of a tower crane to carry large blocks, (3) Production of steel frames and beams as a unit, (4) Use of a slope face for steep slope excavation, (5) Adoption of a package type control panel system (PCPS) double floor structure.

We are also conducting “Clean Plant Activities”, keeping the working environment, piping, and equipment very clean. This contributes greatly to reduce the lower radiation exposure for workers after starting the commercial operation.

KEYWORDS: Improved Mark I type PCV, All-weather construction method, Clean Plant Activities

I. Introduction

The Tohoku Electric Power Company now operates three Nuclear Power Plants (Unit1: 524MWe, Unit2/3:825MWe) at the Onagawa Nuclear Power Station in Miyagi prefecture. The company is currently building unit No.1 nuclear power station in Higashidori village, Aomori prefecture, with commercial operation scheduled to start July 2005. The Unit 1 is a BWR with the output of 1,100 MWe, the highest output of all the reactors operated by the Tohoku Electric Power Company.

We are building this plant based on a wide range of experience in the construction and operation of previous nuclear power plants in Japan and overseas. Generation capacity produced by Nuclear Power Plant becomes about 30% after the commercial operation of Unit 1.

II. Outline of site and plant data

The Higashidori Nuclear Power Plant is located in Higashidori village, looking out onto the Pacific Ocean, on the eastern side of the Shimokita Peninsula in Aomori Prefecture.

The site area is about 3,580,000sq. meters, and the greater part of which is forests and fields. Part of this site, at a level of about 13m above the average sea water level of Tokyo Bay, is being prepared for Unit 1, where facilities including the reactor building, turbine building, service building, and seawater heat exchanger building are being constructed.

![Fig.1 Location of Construction site](image1)

![Fig.2 Site layout of Unit 1](image2)

Data summary of Unit is shown in Table 1.

<table>
<thead>
<tr>
<th>Table 1 Data summary of Unit 1</th>
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<tbody>
<tr>
<td>Reactor</td>
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<tr>
<td>Thermal Power</td>
</tr>
<tr>
<td>Pressure, Temperature</td>
</tr>
<tr>
<td>Core</td>
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<tr>
<td>Number of fuel assemblies</td>
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<tr>
<td>Type of assemblies</td>
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<td>PCV</td>
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<td>Pressure</td>
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<td>Generator</td>
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<td>Voltage</td>
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III. Features

1. Introduction of Improved Mark I type PCV
   Improved Mark I type of PCV contributes to the reduction of worker’s radiation level and the improvement of working efficiency because of the large inner space, compared with conventional Park I type PCV.

![Comparison of PCV Type](Image)

Fig3. Comparison of PCV type

![Overview of Improved PCV (May, 2002)](Image)

Fig4. Overview of Improved PCV (May, 2002)

2. Discharge the warmed seawater below the water surface
   Seawater, which has passed through the condenser, is released as warmed seawater within a temperature of 7°C at the outlet. To minimize the effect of water discharges on the ecosystem of the surrounding sea area, warmed seawater is released at a position of about 5.4m below the water surface.

![Schematic diagram of warmed seawater discharge line](Image)

Fig5. Schematic diagram of warmed seawater discharge line

IV. Distinctive Construction approaches

1. Adoption of hybrid all-weather construction method
   The winter condition of the construction site is so severe (snowfall, low outside temperature, strong winds, and so on), then the reactor and turbine building is covered with protective sheeting, using the steel frames of the reactor and turbine buildings, so that construction work can proceed smoothly even in the heavy winter condition.

   We first adopted this method to turbine building in Japan, whereas there are two previous results using this method to reactor building.

![Overview of reactor building covered with sheeting (Jan., 2003)](Image)

Fig6 Overview of reactor building covered with sheeting (Jan., 2003)

   Electric motor-driven slide roof is employed in the center of the reactor building roof. This roof is made of half transparent sheet to let in light inside the building.

![Overview of slide type roof (December, 2002)](Image)

Fig7. Overview of slide type roof (December, 2002)

2. Use of a large tower crane to carry blocks
   We used an 8,000ton-m tower crane to carry large equipment with piping and supports. This crane can lift things, which weighs 135 tons, within a radius of 60m.

   This tower crane carried the PCV (divided into 35 blocks), radial beam of PCV truss room ceiling (divided into 6 blocks), RPV basis (pedestal, divided into 4 blocks), reactor shield wall, and super cube.

![Overview of slide type roof (December, 2002)](Image)
3. Large blocking of PCV
The height of PCV is about 38m, the diameter is about 24m, and the weight is 3,100 ton. We divided drywell into 19 blocks, suppression chamber into 16 blocks. Then PCV was totally divided into 35 blocks with piping and supports, the largest of which weighed 127 ton, and this has allowed us to increase quality while reducing the amount of welding work done on-site.

4. Production of steel frames and beams as a unit
The total volume of steel frames and beams for the truss room ceiling of the PCV are divided into 6 blocks, and each block is produced as a unit with piping and supports in the factory, and the 8,000 ton-meter tower crane is used to load and install each unit at the site. This construction method could contribute to reduce the amount of work done on-site. The steel frames and beams of the reactor foundation are pre-assembled in the yard at site, and hoisted in by the 8,000 ton-meter tower crane. This shortened the construction schedule.

5. Use of a steep gradient excavation slope
We changed the excavation gradient for the hard rock section from [1:0.5] to [1:0.3] after analyzing the slope face stability, and skipped the cutting of small steps. This reduced the excavation volume.

6. Use of new-type caisson for discharge revetment
We introduced the trapezoidal shape caisson based on the hydraulic model experiment and analysis. This caisson has the superior wave-dissipating ability compared with the conventional rectangular shape caisson, reducing the section area of caisson.
7. Adoption of a package type control panel system (PCPS) double floor structure

We have adopted a PCPS double floor structure that allows the under-floor wiring for the main control room and lower central control room to be separated in both the horizontal and vertical directions by concrete beams, steel H-beams and separators, in order to physically separate the normal service system cables from the cables for the emergency systems, and to increase the efficiency of the cable laying.

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8. Wind shielding wall for protecting insulator bushing

Higashidori site is located very close to the Pacific Ocean, so strong salt wind blow, then this salt adhere to the electric insulator bushing and could cause the dielectric breakdown. To prevent this phenomenon, electric insulator bushing is surrounded by wind shielding wall (65m in length, 17.5m in width, 8m in height).

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V. Environmental protection

1. Sedimentation basin

During construction work, turbid water flows out when it rains because the earth is crop out. In order to stop the direct flow of turbid water into the sea, we have set up the two draining ditches. Turbid water is collected in the sedimentation basins that were set up on the northern and southern side of the construction site respectively, to allow the mud in this turbid water to settle out.

Puddle of rainwater inside the building is gathered in the northern sedimentation basis, only clean water from the top of the sedimentation is allowed to flow into the sea.

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2. Fishway

A small dam has been constructed on the Koippe River, which flows along the north side of the site, to provide an intake of fresh water for use in the power station. Because of our concern for the salmon and other fish that inhibit the Koippe River, we have set up a fishway to allow these fish to travel up and down the river.

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VI. Clean plant activities

For the purpose of building a "safe, low radiation exposure for workers, and highly reliable nuclear power plant", we are implementing “clean plant activities” with the affiliated companies, during each construction stage from production, installation to test operation. This “clean plant activities” includes following:

1) Keeping the working environment clean and tidy.
2) Protection of machines and piping, using the cap and sheets.
3) Clean the inner surface of the pipe.
4) Reduce the waste accompanied by construction work. Any impurities inside a reactor are activated by the reactor, and become radioactive, then increase the reactor’s radiation level. Therefore, it is essential to prevent the ingress of foreign substances into the plant during the construction period.
VII. Conclusion

Prioritizing safety, we will continue to make our efforts to build a high reliable nuclear power plant, ensuring quality control, promoting “Clean Plant Activities”, and making the maximum use of our experience in the construction and operation of Tohoku Electric’s Onagawa Nuclear Power Station, and information we have obtained in Japan and overseas.

We will actively work to make a nuclear power station that can be trusted by local communities and that will become part of their surroundings.

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References