Case Studies: Overhauls (OHs) and Periodic Inspections for Existing Hydropower Generation Facilities

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Abstract

To use hydropower generation facility stably and continuously, it is necessary to periodically and systematically conduct Overhauls (OHs) and periodic inspections. We provide comprehensive technical support to our customers for these events. When the customers are planning OH and periodic inspections, we provide the necessary equipment parts, construction schedules, and deterioration diagnosis that customers need. The following are examples of OH works conducted by our company in recent years.
(1) Hydro turbine generator OH: Kihoku Dam Hydropower Plant in Soonanbu Land Improvement District in Osaki-cho, So-gun, Kagoshima Prefecture
(2) Periodic inspection of hydropower plant facilities: Oyashiki No. 1 and No. 2 Hydropower Plants of Yamanashi Prefectural Enterprise Bureau

1 Preface

Many of the hydropower generation facilities that have in operation for many years have deteriorated. For effective Overhauls (OHs) and periodic inspections, a full investigation of the current state of the power plant must occur first to examine ways to improve performance, increase output, improve reliability, and simplify maintenance using the latest technology, and then select the most suitable method for each power plant. This paper introduces examples of OH and periodic inspections of existing hydropower generation facilities that have been conducted in recent years.

2 Case Studies

2.1 Hydro Turbine Generator OH : Kihoku Dam Hydropower Plant in Soonanbu Land Improvement District in Osaki-cho, So-gun, Kagoshima Prefecture

2.1.1 Hydropower Plant Overview

In 2007, we supplied a hydro turbine generator and control equipment for Kihoku Dam Hydropower Plant, and conducted OH work in 2017, 10 years after the plant began operation. Fig. 1 shows the external view of Kihoku Dam and Kihoku Dam Hydropower Plant, and Fig. 2 shows the hydro turbine generator.

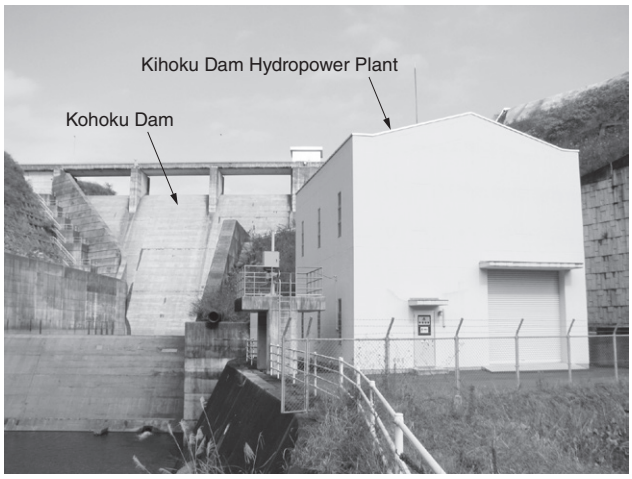

Fig. 1 Kihoku Dam and Kihoku Dam Hydropower Plant
Kihoku Dam and Kihoku Dam Hydropower Plant are shown.

2.1.2 Type of Hydro Turbine Generator

(1) Kihoku Dam Hydropower Plant Facilities
Water intake method: Dam type
Hydro turbine type: Horizontal shaft crossflow hydro turbine
Rating: Flow rate 2.0 m^3/s, effective head 28.90 m
Generator type: Horizontal shaft three-phase induction generator
Rating: 400 kW-6600 V-6 P (1212 min^{-1})-60 Hz

2.1.3 Hydro Turbine OH

More than 10 years has passed since Kihoku

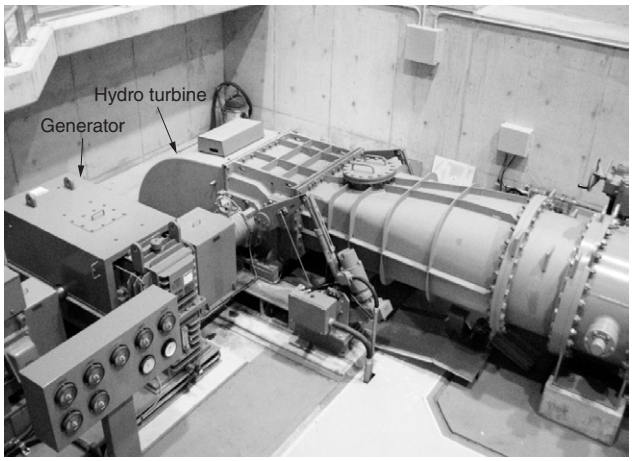

Fig. 2 Hydro Turbine Generator Installed at Kihoku Dam Hydropower Plant

The hydro turbine generator at Kihoku Dam Hydropower Plant is shown.

Fig. 3 Hydro Turbine Generator at Oyashiki No.1 Hydropower Plant

The hydro turbine generator viewed from the turbine side is shown.

Hydropower Plant started operation, but there have been no abnormalities or operational failures, so expensive parts such as runners had not yet already been replaced. Additionally, because there were space constraints on disassembling it on site, we took it back to the factory and disassembled it for inspection. The replaced parts and inspections are as follows.

(1) Replacing the governor motor
(2) Replacing the maintenance hatch seal
(3) Replacing the V-packing on the hydro turbine shaft
(4) Leakage inspection from the valve body packing of the inlet valve

2.1.4 Generator OH

As with the OH of the hydro turbine, the generator's OH had space constraints, so the following parts were brought back to the factory and replaced and inspected.

(1) Replacement of direct coupling side/non-direct coupling side bearings
(2) Disassembly and inspection of stator and rotor

By making the past records of this OH, we will use the data to make suitable proposals for the next OH of the Kihoku Hydropower Plant.

2.2 Periodic Inspection of Hydropower Generation Facilities: Oyashiki No. 1 and No. 2 Hydropower Plants of Yamanashi Prefectural Enterprise Bureau

2.2.1 Hydropower Plant Overview

Oyashiki No. 1 and No. 2 Hydropower Plant of Yamanashi Prefectural Enterprise Bureau have been in operation since the Taisho Era (1912-1926).

Oyashiki No. 1 Hydropower Plant takes water used at another power plant upstream and water through the conduit from the water intake exclusively for the No. 1 Hydropower Plant. The No. 2 Hydropower Plant takes water used at the No. 1 through the conduit. It then generates the power. Both hydropower plants are conduit type power plants.

According to a plan by Yamanashi Prefectural Enterprise Bureau, the current hydro turbine, generator, and other equipment were updated in 2000; thereafter, regular inspections were conducted every three years, followed by an overhaul in 2014 to ensure a continued stable power supply. **Fig. 3** shows the hydro turbine generator at Oyashiki No. 1 Hydropower Plant. **Fig. 4** shows the hydro turbine generator at Oyashiki No. 2 Hydropower Plant.

2.2.2 Type of Hydro Turbine Generator

(1) Oyashiki No. 1 Hydropower Plant facilities
Water intake method: Conduit type
Hydro turbine type: Horizontal shaft Francis hydro turbine
Rating: Maximum water usage 6.40 m^3/s, maximum effective head 23.99 m
Generator type: horizontal shaft three-phase synchronous generator
Rating: 1370 kVA-6600 V-18 P (333 min^{-1})-50 Hz
(2) Oyashiki No. 2 Hydropower Plant facilities
Water intake method: Channel type
Water turbine type: horizontal axis Francis water turbine

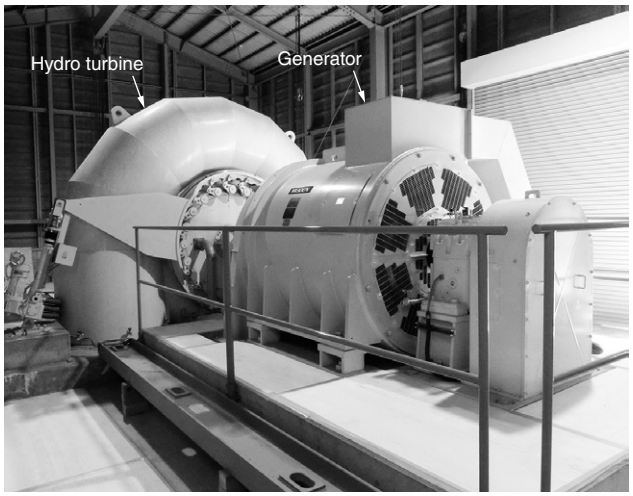

Fig. 4 **Hydro Turbine Generator at Oyashiki No.2 Hydropower Plant**

The hydro turbine generator viewed from the generator side is shown.

Rating: Maximum water usage 6.07 m^3/s, maximum effective head 18.10 m
Generator type: horizontal shaft three-phase synchronous generator
Rating: 970 kVA-6600 V-20 P (300 min^{-1})-50 Hz

2.2.3 Regular Inspection of Equipment

In November 2021, we were contracted by Yamanashi Prefectural Enterprise Bureau to carry out regular inspections every three years, and the details of the inspections and works carried out are as follows.

(1) Check the appearance and dimensions of each piece of equipment.
(2) Internal checks from the inspection port (confirmation of internal contamination status, hydro turbine/generator gap, etc.)
(3) Replacement of parts that were confirmed to have deteriorated over time during the periodic inspection three years ago (replacement of governor grease, packing of various parts, circuit breaker coils, power supply for control unit sequencer, etc.)

Afterwards, we compared the test results before and after the inspection with two tests, a no-water test and a water test. The hydro turbine generator was stopped during the no water test and for the water test, we conducted tests while it was in operation. We confirmed that the power was being generated normally.

In January 2022, Oyashiki No. 2 Hydropower Plant updated its integrated control device to the MYGENEQUE series and is now operating as an even more reliable power generation facility, including the control panel. We will continue to contribute to periodic inspections, overhaul inspections, and OH work.

3 Postscript

We introduced the OH works and periodic inspections of existing hydropower facilities that were conducted in recent years.

We will continue to respond to customer requests and contribute to the maintenance, performance, and reliability of the hydropower generation facilities we have supplied.

Finally, we would like to express my gratitude to our customers and the related people for the substantial support we received during the OH works and inspections of these projects.