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Passage of aquatic species

Daini Numazawa, Japan

An acoustic device installed during the construction of the Daini Numazawa pumped storage power plant in Japan deters migratory fish (particularly Kokonee salmon) from entering the intake structure at the upper reservoir, minimising mortality of migratory species.

Overview

Daini Numazawa is a pumped storage power plant on the Tadamigawa River, Japan. Water is pumped from a lower altitude run-of-river reservoir during periods of excess flow into Lake Numazawa and is subsequently fed through turbines at the Miyashita Power Plant. The scheme has an effective head of 220 m, a maximum discharge of 250 m³ and a maximum output of 460 MW.

The Tadamigawa River is part of the Aganogawa River system. At 210 km in length, with a catchment area of 7,710 km² it is one of the largest rivers in Japan. It boasts a series of dams to maximise hydroelectric generating capacity. Tohoku Electric Power Company manages five dams in this system, generating 60% of their hydroelectric power.

Dam name

Scheme operator

Tohoku Electric Power Company

Size of scheme (MW)

460

Country

Japan

Catchment area

7,710 km²

River

Tadamigawa

Effective reservoir capacity

Upper reservoir 44.7 x 10⁶ m³

Lower reservoir 6.1 x 10⁶ m³

Construction years

1977-1981

Reservoir size

Upper reservoir 3.1 km² Lower reservoir

1.45 km²

Details

Lake Numazawa sustains populations of Kokanee salmon, Crucian carp, carp and pond smelt, with other species also occasionally found in the lake. The Numazawa-numa Fisheries Cooperative Association stocks the lake with 30,000-100,000 Kokanee salmon annually as part of a harvestable fishery program.

Kokanee salmon are an important commercial fish species in Japan, and a large proportion of the Kokanee population undergoes sporadic downstream migration, raising concerns of potential for mass mortalities from fish entering the Miyashita Power Plant intake structures.

During the planning and approvals stage of the Daimi Numazawa scheme, the technology to deter fish from entering power station infrastructure was not available, hence a research and development program was undertaken. The potential to use optical, electrical and/or chemical stimuli to deter fish was investigated, however acoustic deterrents were found to be safe, impact very little on power generation and be effective in repelling migrating salmon.

The acoustic system consists of underwater stereo speakers that work in synchronization with a fish finder. Continuous scanning in the vicinity of the intake is performed with the fish finder, and when fish are detected the underwater speakers emit continuous sounds between 300 and 900 Hz until the fish have moved away from the intake structure.

Fish distributions in the vicinity of the intake have subsequently been surveyed using ship-borne sonar, and have revealed that the acoustic deterrent is effective in deterring fish from the vicinity of the intake structure. Stable Kokanee salmon populations in the lake have further confirmed the effectiveness of this system

Other Aspects

Safety

The acoustic fish deterrent system was selected over systems that utilise optical, electrical or chemical stimuli as the latter had the potential to create employee safety issues during installation, operation or maintenance.

Further information Source: Hydropower Good Practices Workshop, Annex VIII - Examples for Good Practice Report, Villach, Austria, October 2005. International Energy Agency.

<http://www.tohoku-epco.co.jp/index-e.htm>

Yoshiaki TORII and Tetsuo SASAKI, "Overview of the Location of the Daini Numazawa Power Plant and the Development Project", Japan Electric Power Civil Engineering Association, March 1978.