Towards the utilization of hydraulic energy in river basins

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1. Introduction

The nationwide shortage of electric power caused by the Great East Japan Earthquake may continue for a long time, and hydroelectric power, which is a reusable energy, is expected to be utilized and promoted more than ever. Among dams managed by the Ministry of Land, Infrastructure, Transport and Tourism and by the Japan Water Agency, management use electric power generation equipment which uses maintenance discharge and water supply discharge from dams had already been installed at 28 dams nationwide (January 2011), and while they supply electric power to be used for dam management, they have further reduced the cost of dam management through the sale of surplus electrical power. More than 30 years have passed since the start of operation of the first management use electric power generating equipment, which was installed around 1980, and the cost of renewal and maintenance of the equipment is predicted to increase in the future. And because the quantity of electric power will continue to increase, it is essential to increase the efficiency of maintenance to boost the cost-benefits of installing new electric power generating equipment.

This research studied measures to increase of the efficiency of maintenance of management use electric power generating equipment in order to make greater use of unused hydraulic energy of river basins.

2. Present state of maintenance of dam management use electric power generating equipment

When management use electric power generation is shut down, purchasing management use electric power increases maintenance cost while income from the sale of electric power falls, so it is necessary to absolutely minimize system shut down time. A questionnaire survey of inspections, renewals, and other maintenance of electric power generating equipment was carried out at the 28 dams equipped with management use electric power generating equipment. The results show that the systems are shut down for inspections or by malfunctions an average of 14.7 days/year, and of these, electric power generators are shut down for periodical inspections of the electric generators or gate equipment an average of 4.1 days. But, if equipment is inspected by dismantling maintenance, power generation is shut off an average of 41.8 days. Electric generating equipment was only shut down by a malfunction 16 times, but the impact was severe, because the average length of time it was shut down for restoration was an average of 41.3 days. Electric power generating equipment was shut down by malfunctions an average of 14.2 years after it started operation. Renewal of equipment now almost entirely involves electric parts and occurs an average of about 19 years after the start of operation.

Photo 1. Management Use Electric Power Generating Equipment (Sagae Dam)

3. Efficient electric power generating equipment maintenance methods

Through an analysis of maintenance costs revealed by the questionnaire, it was discovered that approximately 3/4 of inspection and maintenance costs is the cost of dismantling maintenance. Looking at the reason for performing dismantling maintenance shows that about 3/4 is carried out according to an ordinary inspection cycle for each part (time plan). For this reason, it is possible to further reduce maintenance costs by performing dismantling maintenance at a low frequency but often enough to prevent malfunctions caused by insufficient maintenance. This research classified ways of renewing each type of part (preventive maintenance, post-maintenance) based on degree of importance and restoration period. At this time, data concerning past malfunctions and renewals are limited, so in order to decide the appropriate frequency of inspections and renewals, continuous data must be accumulated in the future.

4. Future study guidelines

In the future, to explore further potential uses of hydraulic energy, we will study measures to increase electricity by selecting new installation locations for management use electric power generating equipment and renewing the reservoir water level operation of multi-purpose dams, and study challenges such as the impact of implantation on river environments and systemic restrictions, etc.