Hydroelectric Power Enhancement by Utilizing Available Water Supply Capacity of Nukui Dam

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1. Purpose and research background

Hydroelectric generation is sustainable and conventional domestic energy which hardly discharges CO_2. It is required to promote development and operational improvement powerfully from now on. In this study, we examined the hydroelectric generation supply for peak demand by employing water utilization capacity of the existing dam.

2. For increasing power of 3 power plants in Ohta river

While utilizing Yoshiwago retarding basin and available water use capacity of Nukui dam for power generation capacity, it is assumed to be possible to increase hydroelectric generation by operating peak power generation of the downstream 3 power plants(Yoshigase, Manohira, Ohtagawa). Model diagram of this study is shown in Figure - 1.

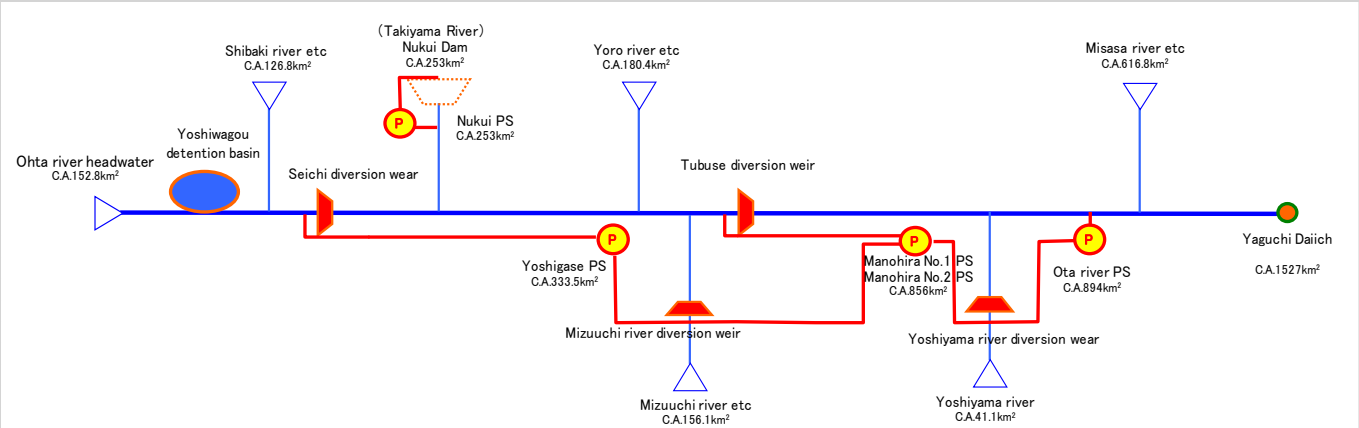

Figure-1 Model figure of Hydroelectric generation reinforcement

Hydroelectric generation is assumed to increase by storing running water into dam at night and discharging water for peak demand during the daytime. Although regarding Nukui Dam, the amount of newly developed water use for Hiroshima City and Hiroshima Prefecture is 300,000 m^3/day, the actual amount of water demand remains only to 80,000 m^3/day. In this case, power companies borrowed temporarily water use capacity up to 16,130,000m^3 equivalent to the unused water volume as generation capacity and utilized for regulating capacity of the peak power generation of downstream power plants.

Regarding Nukui Dam, assuming it to borrow water use capacity from Hiroshima Prefecture and the scale of borrowed water use volume was assumed less than 16,130,000m^3. Then, the peak capacity of generated output by three downstream power plants was estimated under the various water use volumes. 10 hours to the standard as peak power generation time was adopted here. Figure-2 shows the results of calculation; the volume of the peak power generation under the flow condition in 2005, a normal water year.

Keywords: peak power generation, detention basin, capacity, Hydroelectric generation
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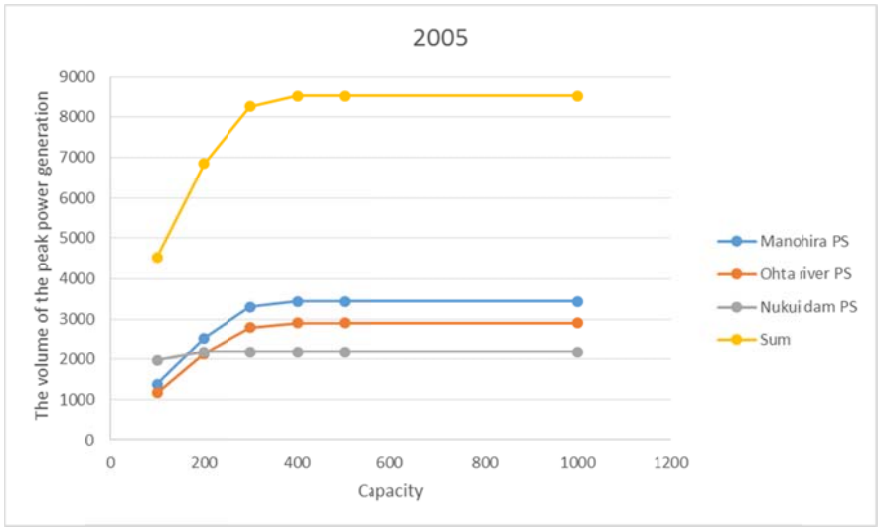

Figure-2 Relationship of peak power generation increased amount of electricity using the unused water use volume in Nukui dam

Annual generated energy is leveling off when the borrowed capacity for hydroelectric generation reaches about 400～500 thousand m^3. The maximum value of the generated energy is about 10,304 MWh, equivalent to approximately 3,030 households electricity. Next, regarding the volume of generated output was calculated with various operating hours of peak power generation from 4 hours to 12 hours. The borrowed water use volume varies from operating hours of peak power generation respectively. Considering this estimation, the volume of water use and the annual volume of general output were calculated. The result of calculations indicates annual volumes of generated output is maximum when the peak generation period is assumed as 8hours.

3. Verification of the economic efficiency

In this chapter we examined the economic efficiency of this method. Annual benefit is determined to calculate by the following equation according to an office notice.

Annual benefit = effective output ×power generation unit price per kW +amount of active power × power generation unit price per kWh = 326 million yen

Here, since afflux style generation was changed into peak power generation, the difference of pumped-storage power generation and national flow power generation was added up only for the clause of an effective output. Since this power generation method utilizes existing dams and plants as a year cost, it is free from construction costs. The power generation company pays only for a running cost, such as electric bills for the maintenance expense concerning the water use volume of Nukui Dam. The annual expense is estimated as follows.

Annual cost = The Nukui Dam administrative and maintenance costs/year×The burden of cost rate of the water for waterworks×Capacity which the power generation company borrows/Water use capacity×0.70＝2,361,000 yen As mentioned above, B/C= about 138

4. Conclusion

This study proves that by implementation of the peak power generation utilizing the unused water use volume of Nukui Dam, the electric power about 10,304 MWh, almost equivalent to 3,030 households electricity can be developed and its economic efficiency is considered to be extremely excellent.