Probable Maximum Precipitation (PMP) Analysis for Bakun Dam Area

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***Abstract*—** Probable Maximum Precipitation is defined as the greatest depth of precipitation which is possible for a given time and duration over a given size storm area under known meteorological conditions. This concept has been used as design criterion of major flood control measures such as spillways of large dams worldwide. It is essential for the generation of Probable Maximum Flood. This paper represents the results of PMP analysis for Bakun Dam Area which has a catchment area of 14,750 km^2. Three sets of results were produced, i.e. by statistical method (with frequency factors from World Meteorological Organization manual and National Hydraulic Research Institute of Malaysia in Technical Research Publication No. 1 (TRP 1)) for duration of 1 hour, 8 hours, 24 hours and daily and by experimental method for production of daily PMP. The results were compared with each other and the one made by Sarawak Electricity Supply Corporation on Bakun Dam construction. The set of PMP values results from substitution of K_m developed by NAHRIM was concluded to be the most reliable results as daily PMP (276mm) was consistent with the one (280mm) produced by SESCO. However, 6 days PMP value (950mm) done by SESCO was recommended as the Bakun Dam Area cover huge catchment area which higher duration of PMP value should be applied.

***Keywords*:** Probable Maximum Precipitation, Bakun Dam, PMP, Statistical Method, Frequency Factor.

I. INTRODUCTION

FOR precipitation, there is a physical upper limit to the amount of precipitation which can fall over a specified area in a given time and known as the Probable Maximum Precipitation (PMP). It is precisely defined as ‘‘theoretically greatest depth of precipitation for a given duration that is physically possible over a given size storm area at a particular geographical location at a certain time of the year’’ [1]. The depth-area-duration relationship plays an important role in the design of hydraulic structures such as dams, weirs, and flood control structures.

Generally, dam failures occur as a result of overtopping due to inadequate spillway design. Over the world, there are about one-third of all dam failures induced by inadequate spillway design [2]. Inadequate spillway capacity is usually caused by underestimating the peak flow or volume of the design flood. Design criteria of spillway are normally based on the PMF transforming from the PMP of critical duration over a given catchment area. Thus the PMP value is useful and essential in forming the PMF hydrograph which has become the design standard for dams throughout the world without risk of overtopping.

Bakun Hydroelectric Dam is located in Sarawak, Malaysia on Balui River which is a tributary of Rajang River, the longest river in Malaysia and around sixty kilometer west of Belaga. In specific, the dam is located at 2° 45′ 23″ north in latitude and 114° 3′ 47″ east in latitude. Rajang River consists of two parts that are Lower Rajang and Upper Rajang. Bakun Dam area is situated within Upper Rajang. The created Bakun Reservoir has a capacity of about 43,800,000,000 m^3 with catchment area of 14,750 km^2, representing 11% of the state of Sarawak [3]. The catchment area is covered mainly by primary jungles on mountainous terrain and steep slopes and the rest by second forest with lower slopes.

Theoretically, estimates of PMP should have zero exceedence probability. However, PMP estimates have been exceeded by the observed rainfall depth in some cases reveals that the PMP approach ‘‘by no means implies zero risk in reality’’ [4]. Thus, methods used for driving PMP should include making judgments based on observed storms and related meteorological process. Besides, to minimize the error come with PMP approach, historic heavy storms over the area of study should be

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