Engineering Geological and Geotechnical Investigations of Dam of the Bunakha Hydroelectric Project (180 MW), Chukha Dzong, Bhutan Himalaya

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Abstract

The proposed Bunakha Hydroelectric Project (BHEP) for generation of 180 MW (3 X 60 MW) hydropower is located near village Bunakha, in Chukha Dzong (District) in the Western Bhutan, covering toposheet no. 78E/11 & 78E/12 India and adjacent country series. BHEP is the upper most major project in the development of the power potential of the Wang Chhu river in Bhutan. BHEP is a storage project utilizing the head between upstream of the existing Chukha HE Project and the confluence of Paro Chhu and Thimphu Chhu. Further, the capacity generation of Chukha HEP (336 MW) and Tala HEP (1020 MW) will also be increased by the development of BHEP because of regulated flow. This proposed storage scheme envisages important structures such as high roller compacted concrete dam, spillway, pressure shafts (penstock), dam toe surface power house and tail race channel. The proposed dam and surface power house facilities at BHEP can utilize a head of 155 m. The estimated gross storage of this project is about 237.52 MCM. In the dam site, river Wang Chhu flows in 170° direction and takes a south-westerly turn after the confluence with Sherjalum Chhu.

The proposed dam is a roller compacted concrete type, with a Orifice type spillway. The maximum height of the dam will be 197m from the foundation. The dam site area is located in the Thimpu Formation of crystalline complex. This litho-units at site is characterized by heterogeneous lithology consisting of generalized of rock viz. banded gneisses, foliated gneiss, with large boudins and bands of quartzite and calc-silicate gneisses with large porphyroblasts of garnet measuring up to 4 mm. These litho units form the foundation of proposed dam. The dam area was investigated through detailed engineering geological mapping, geophysical survey, exploratory drilling & drifting and laboratory testing. The rock mass properties, i.e. joint sets, weathering grade, RQD, RMR, permeability, P-wave velocity etc. of the rock masses to be encountered during the excavation of dam have been analyzed in detail. Core samples from the exploratory drill hole drilled along the dam alignment were tested for physico-mechanical properties of rocks in the laboratory. On the basis of these investigations inferences and recommendations have been made which will be helpful during the construction of the dam.