Electrical Systems of a Grid Connected 2 MW Mini Hydro Power Project at Siripagama

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ABSTRACT

This paper presents the electrical system design of a 2 MW Mini Hydropower Power Plant (MHPP) project at Siripagama. Catchments area of 19.1 km^2 and annual average rainfall of 3935 mm yield to 3.5 m^3/s designed flow. Net head was found as 68 m. Plant was sized to 2 MW and accordingly structural components and electro-mechanical system were designed. Two numbers of electro-mechanical units in which each unit consists of Francis turbine of 1054 kW, synchronous generator of 1250 kVA, 400 V and two number of 33 kV 1800 kVA step up transformers.

The generator systems were modeled using PSCAD simulation package to check the performance of generator. Also the system together with the transformer was studied during the normal loading and load rejection operations. Grid interconnection lines were modeled using SYNERGEE software. This was used to study the line flows and voltages in the feeder from Ratnapura grid substation to the Siripagama MHPP. The simulation results confirm the proper operation of the MHPP and the grid without violating the limits of voltage and conductor ratings. Finally the total system was commissioned on 19th June 2006. Initially the plant factor was about 36% and in October it rose to 56%. This is one of the projects, which confirmed the better performance of the micro hydro plant in Sri Lanka.

1 INTRODUCTION

One of main sources of power generation in Sri Lanka is hydroelectric. According to the statistical data published by Ceylon Electricity Board (CEB) for the year 2006, 49.4% of total generation is met by hydropower. In 1996, Sri Lanka Government encouraged private sector participation in power generation. As a result at the end of year 2006, 60 numbers of mini hydropower plants were connected to the national grid adding total of 109 MW with an annual generation of 346 GWh (4% of gross production) **[1]**.

In the mini hydro power projects initially site selection is done by analyzing mean stream flow and available head. This helps to take the decision on the plant capacity and to determine the anticipated annual power generation. Then electro-mechanical equipments such as turbine and generator and accessories are selected to suit with design parameters. Generators of directly coupled to turbine shafts are commonly used **[2]**. Generator control unit was used to adjust the power generation according to the availability of water.

Protection system was used to isolate the MHPP when a grid fault occurs. In addition monitoring system was also included. Embedded generators are classified into five and required protection requirements are stipulated in the CEB guide **[3]**. In addition to that a generator protection was made coupled to generator breaker.