GREEN ENERGY FOR UNIVERSITY OF PERADENIYA VIA RENEWABLE POWER GENERATION

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Introduction

World is moving rapidly on green energy concept. Therefore it demands more power from renewable energy sources with several targets set in Government policies. Particularly Sri Lanka was already targeted to acquire 10% of its power from renewable energy sources and moving forward on setting up a separate policy for getting power from renewable energy sources. Even though the Sri Lankan power grid is absorbing about 10% power already from small hydropower plants, with the recent power plants project the total generation will be increased rapidly. Therefore the country is promoting wind, biomass and other renewable power plants with very attractive tariff.

This paper discuss on above aspects focused to University of Peradeniya (UOP) point of view, on how it can help the country to take forward on the green power concept. Therefore an internal project was launched by the Department of Electrical and Electronic Engineering to do a clear study [1] on the university power consumption. This project results the cost and load flow analysis to find out the possibility of integrating a renewable power plant to the University.

Methodology

Initially the arrangement and the condition of the power system of the University were studied. A full day power measurement at the University main feeder (1stApril 2009 10.00hrs to 2ndApril 2009 10.00hrs) from 11kV side was obtained. Data was analyzed to find out the variations on active and reactive power, harmonics, voltage, power factor and frequency.

Then a cost assessment for the last year electricity consumption of the university was carried out from Ceylon Electricity Board (CEB) bills [2]. This helps to find the cost effectiveness of introducing a renewable power plant to the University. Biomass will be one of the ideal energy sources for the UOP, when considering its assets and the environment. In order to detect the line capabilities and the optimum grid connecting points for a Dendro power plant, the University network was modeled and Load flow analysis was done with the aid of IPSA+ computer simulation package.

Measurements and Data Collection

A full day continuous measurement was carried out to find the daily power consumption of the UOP. Yokogawa CW 140 clamp on power meter was used to take continuous harmonic measurements at the UOP main feeder, which is located at CEB Agricultural ring substation as shown in Figure 1.

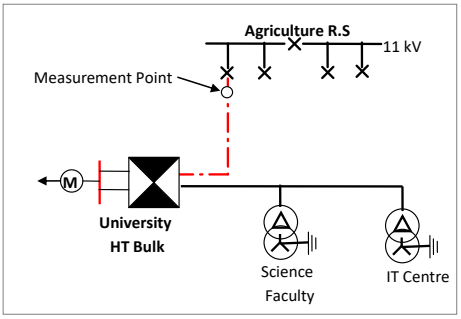

Figure 1. Measuring point of the university feeder

By analyzing the measured data, daily load pattern was obtained. Figures 2 and 3 indicate that a morning peak occur around 6.30 hrs to 7.30 hrs (mainly due to canteen and hostel loads). Maximum peak was occur around 10.00 hrs to 11.30 hrs, which was rather unusual from the country load pattern and it went up to 1 MW. The evening peak was recorded from 15.00 hrs to 16.00 hrs and night peak was around 19.00 hrs to 20.30 hrs (Possibly due to hostel lighting loads).

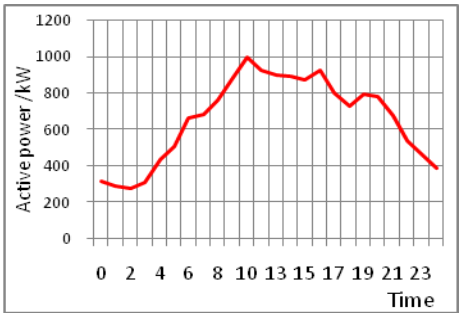

Figure 2. Daily active power curve

Detail bill analysis for the period from March 2008 to February 2009 was carried out. Total expenditures for active power and maximum demand were separately analyzed. UOP consumes nearly 5.1 millions of kWh units per annum and annual total bill

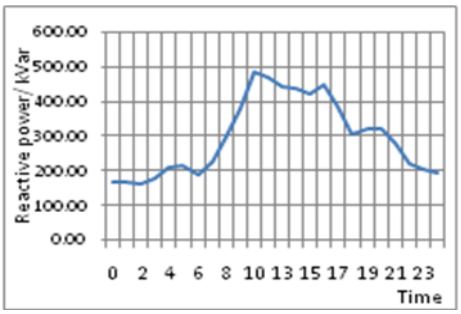

Figure 3. Daily reactive power curve

is approximately 180 million rupees. Annual expenditure for maximum demand is 14% of the total bill. From the observations, the average unit cost is 17.07 rupees per kWh.

Results and discussion

Rough estimates show that, at the UOP dendro power plant can be generated at 8.5 rupees/kWh and capital cost is 1200 USD/kWh. Hence investment for a 1MW dendro plant will be about 132 million rupees. For the safety margin with an additional cost multiplication factor of 2, it is estimated as 264 million rupees. Total saving per annum with introducing a dendro plant is 5100000 kWh units X (17.07-8.5) = 43.71 million rupees per year. Therefore the payback period is = 264/43.71 (= 6.03). It confirms that the payback period will be about six years.

Load flow analysis for University power system with dendro power plant connected, was carried out with the aid of IPSA+ package. Input data set was taken into account with the aging factor of the system. Objective was to verify line capabilities and to find out the optimum grid connecting points for the dendro power plant. University grid was modeled as shown in figure 4.

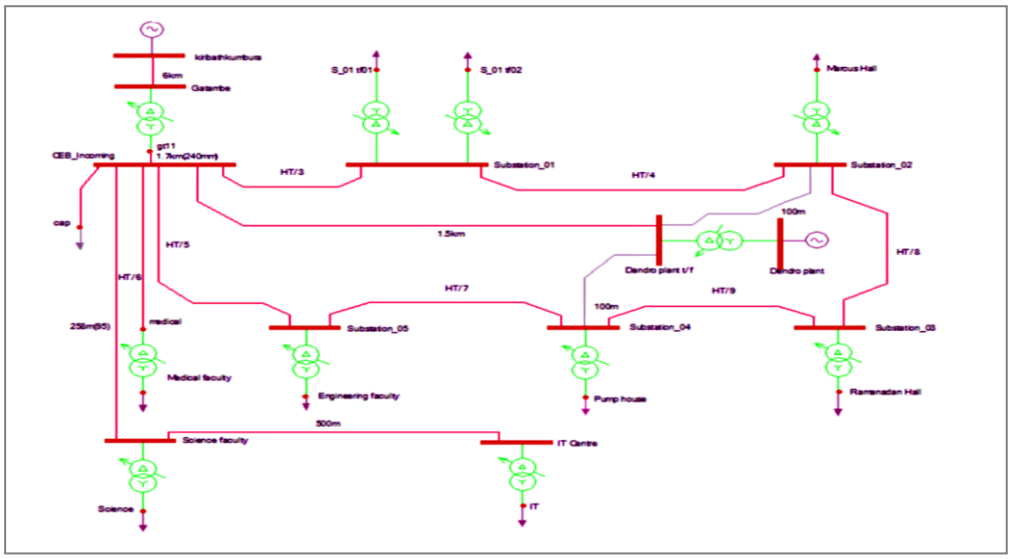

Figure 4. Load Flow Analysis of the university grid

Voltage rise effect and fault levels were also evaluated for different connecting points for each sub stations under maximum and minimum loading conditions.

Conclusions

Load consumption at the University grid intake was studied with continuous measurement. According to the load curve, it was found that 1MW plant is sufficient to meet the university load consumption. Further excess power can be sold to CEB through net metering.

Load flow in the University network was studied in IPSA package. This result reflected that the existing lines are capable of handling the loads introduced by the proposed plant. Further the simulation results showed that plant can be placed near the Marcus Fernando hall and connected to the University ring at 11 kV level.

The electricity bill analysis was done by checking the last year bills to find out the cost of electricity with electrical energy consumption. Results obtained were very interesting and it showed that the payback period for the proposed 1MW plant is approximately 6 years.

Effort to generate energy requirement for the UoP with green technologies will be a superb example for other Universities and Organizations in the world. This will not only demonstrate the capabilities of the environmentally friendly plant operations but it will also make a positive impact on research arena thus leads to global green environment in long term.

References

[1] The renewable energy obligation 2004-2005: Facts and Figures, Ofgem, UK. http://www.ofgem.gov.uk/Media/ FactSheets/Documents1/13052-56.pdf, accessed May 2007.

[2] Ceylon Electricity Board, “Statistical Digest 2006”, Statistical Unit, Commercial & Corporate Branch.