The Options And Design Improvements Of The Electric Grid Of Sarawak As An Example For Developing Countries

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Abstract - ***This research is a reference for decision makers of electric grids especially in developing countries. This is done by describing the 90 year old Sarawak electric grid, including design improvements to further enhance it. The grid includes the power plants, the substations and the transmission and distribution lines. Grid equipment (notably power stations) is so expensive that only politicians of the highest level can make decisions regarding them. The problem is only a few engineers are in politics. Therefore there is a need for an easily accessible scholarly paper on the power system options for developing countries.***

Key Words: *Sarawak, electric grid, options, developing countries, design.*

1. INTRODUCTION

Electric grids are already one of the most expensive installations in the world; currently tagged at six trillion dollars. The grid will grow by 44% from 2008 to 2030 and much of this will be in developing countries [1]. On the other hand engineers have tended to stay away from politics all over the world. Warnings about this problem have been made by many top thinkers because this situation cannot carry on as high technology increasingly becomes an inherent part of economic activities of any country [2]. Engineers with extensive field experience must be among the top decision making bodies of any country [2]. In some countries like China, top engineers are just picked to be politicians but in a democracy, engineers have to be cajoled to leave their comfort zones and become politicians for the good of society [2]. An example of how disasters can occur if engineers are not decision makers is the construction of the Banqiao hydroelectric dam in China. The main engineer (hydrologist), Chen Xing was pushed out of the project by politicians because he was vocal about the design. But when the dam finally burst in 1975 killing 171,000 people, politicians called him back to rebuild the dam and now China is the world leader in dam construction with the largest hydroelectricity generation in the world [3].

The power system of Sarawak, Malaysia was studied and designs were formulated to optimize it further as a reference model for other developing countries.

Sarawak is the largest state of Malaysia (at 124,450 km^2) but with a population of only 2.5 million. The state is located on the equator and therefore has a rainfall of about 4000mm (157 inches) per year compared to a USA average of just 715mm (28 inches) [4]. The topography is of high mountain ranges at the border with Indonesia, with ridges up to 1,200 meters high [5]. The rare combination of all these four factors of large land area, low population density, high rainfall and mountains ranges makes development of hydroelectricity ideal for Sarawak. Added to this, other clean sources of energy are not optimal for equatorial Sarawak. It is for this reason that Sarawak has already built three dams and ten more are in the planning stages. The exploitable potential of hydroelectricity in Malaysia is 123 TWh per year and 70% of this or 86 TWh lies in Sarawak [6]. Sarawak's hydroelectricity resource was studied by the SAMA Consortium. This Consortium came as a technical aid to Malaysia, granted by the German government, via the German Agency for Technical Co-operation (GTZ). A total 51 dam sites were identified, each with a potential to generate more than 50 MW. Their combined hydroelectric generation potential is 20,000 MW [6].

Sarawak faces the same geopolitical situation of many developing countries where decision makers are influenced by big trends in developed countries. Among these trends are the developments of solar and wind power sources. The problem is wind and solar are good options for the Northern and Southern hemisphere but bad for equatorial countries.

Solar is not suitable for a country where cloud cover and blue sky comes and goes many times within the day. Power companies need to be able to predict the availability of power. The problems of solar in cloudy countries is explained by solar development in Hawaii where dependence on solar power damaged grid equipment because a cloud cover can take out 70 to 80 percent of power output in less than a minute. Other than hydroelectricity, no other power stations can load the grid or backup this loss that fast. Thus the other power stations in Hawaii and switchgears were damaged as the load drew all their demand from the remaining diesel engines and gas turbines [7].