

# A Design of a 345-kV Electric Power Transmission Line Interlinking Ramu and Rouna Grids in Papua New Guinea

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**Abstract.** According to PNG Power Limited (PPL), Papua New Guinea's peak power demand is expected to increase from 210 MW in 2012 to 347 MW in 2026. Under the current state of the power sector in Papua New Guinea (PNG), it is critical to implement measures to cope with the increasing power demand to promote investment, economic growth, and ultimately to achieve poverty reduction through economic growth. One of the solutions identified to improve the reliability of PNG power systems and thus to meet the demand is to interconnect the major grids in the country so that the loads could be shared among them. This project embarks in designing a 345-kV electric power transmission line to interlink the Ramu and Rouna power grids of Papua New Guinea. The design is done by analysing all the necessary aspects of the transmission lines with in-depth calculations performed using MATHCAD software. This design is the basis for extra-high voltage (EHV) transmission network in anticipation for the power generation and demand growth in PNG.

## 1 Introduction

Reliable and efficient supply of electricity is a key pillar in stimulating economic development and growth in any country in the world. In PNG however, the growth and sustainability of the economy is often discouraged because of certain key development issues and challenges in the power sector. For instance, due to the rugged geography of PNG the cost of building infrastructures to extend power to off-grid areas is substantial. Meanwhile, aging of the existing infrastructures causes a lot of power losses and reliability issues in the system.

Moreover, due to the isolated power grids in PNG the emergency or standby generating capacities are stretched to the limit in the event of scheduled or emergency shutdowns. Consequently load shedding has become very consistent and frequent hence disrupting daily business operations and leaving consumers dissatisfied with the electricity service provided.

## 2 Ongoing Interconnection Project

The power sector of PNG comprises of two main networks: (i) Port Moresby and (ii) the Ramu system, having peak loads of about 150 MW and 80 MW respectively. These two systems are separated by the Owen Stanley mountain range, which has acted as a formidable constraint against the development of crucial infrastructure within the country.

The PNG map on Figure 1 shows the proposed transmission line route of a possible interconnection, running south from Baiune (Morobe) to Port Moresby. The existing power grid extends further south of Baiune, through Bulolo and on to Wau, about 30 to 40 km to the south. The Hidden Valley mining development, which began operations in 2009, lies a further 20 km to the south. Thus, a 132-kV line to provide 15 MW power to the mine will have covered a substantial distance into the mountains.

The last interconnection analysis was conducted in 1990 by the Électricité de France (EDF) and came up with the following recommendations for the transmission system [1]:

- (a) A 288 km long 220-kV line connecting Wau in the Ramu system to Moitaka in the Port Moresby system;
- (b) 220/132-kV substations at Singsing, Nadzab and Wau in the Ramu system and a 220/66-kV substation at Moitaka;
- (c) Shunt reactors at each end of the tie line – 30 MVAR at Wau and 20 MVAR at Moitaka;
- (d) The upgrading to 220-kV of the double circuit line between Nadzab and Singsing to transmit Ramu 2 hydropower to Nadzab and then to Port Moresby.

EDF found that interconnection was viable once the Port Moresby load reached about 120 MW in 2005, with the transfer capacity of the transmission line being about 80 MW. Currently the Port Moresby load demand has peaked 150 MW a day which will continue to rise into

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