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Cost-benefits of VSC-HVDC Transmission Technology Application in the Northwest Province of Zambia

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Abstract

The Zambia Power System is characterized by the concentration of generation in the south of the country while the main load centres, the mines, are concentrated in the north in what is called the Copperbelt province, renown the world over for its Copper and Colbalt mines. Between these mines and the power stations is a large transmission distance in the order of 400km.

The need to supply large power to the mines on the Copperbelt province is historically what has driven the development of the Zambia Power System. There are signs that this history is about to repeat itself in the life of the Northwestern province.

The Northwestern province of Zambia lies further north and west of the Copperbelt. It is of the same geology as the world renown copperbelt but three times as big. It is being touted as the future of Mining in Zambia! This though, will require a huge investment in new mines and the necessary support infrastructure; among others electrical power of the order of 500MW.

Due to the absence of local generation this bulk power must be moved from the power stations in the south over a distance of +600km to the Northwestern province (NWP). This paper attempts to answer the question "What is the best way to do this? How should the transmission infrastructure be optimally developed?"

Meanwhile, fueled by advances in high power semiconductors, a silent revolution has taken place in the application of Power Electronics to transmission systems. Power electronics based solutions are now replacing traditional electromagnetic installations in many transmission applications at an increasing rate. The benefits in improved efficiency and functionality have been so spectacular that one could say that "finally the marriage between power electronics and the transmission system has been consummated".

The latest technological break through is the emergence of state-of-the-art high power voltage source converters (VSCs) built of Insulated Gate Bipolar Transistors (IGBT) or Gate Turn Off Thyristors (GTO) instead of the traditional thyristors. The voltage source converter is revolutionising the transmission system by opening up new possibilities in the field of HVDC power transmission.

This paper takes the first step at how the power transmission infrastructure to the NWP should be **optimally developed** in the face of a new VSC based HVDC transmission technology. The paper compares the application of this new VSC-HVDC transmission technology with the traditional HVAC and HVDC technologies in a case study for Power Supply to Zambia's Northwestern Province.