Challenges for a Future Australian Electricity Network Dominated by a Geothermal Hub

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ABSTRACT

When a large power plant is located far away from major load centres and also from the high voltage transmission grid, a number of significant issues need to be investigated. In the context of huge potential for geothermal energy in the area of Cooper Basin, electricity transmission issues will provide some key challenges and opportunities for a future secured power network for the Australian national electricity grid. The Cooper Basin does not have electricity consumers next to it, so the power would have to be transmitted quite a long distance over costly transmission facilities. For example, the Innamincka power plant, which plans to produce 50 MW in 2012, will send electricity over 110 kms of transmission lines to the Moomba oil and gas field. It is understood that a 500 MW plant will be built by 2016, which is expected to supply power through a 500 km high-voltage transmission line to the national electricity grid in Port Augusta, and a transmission line to BHP Billiton's Olympic Dam mine, 490 kms away.

By 2030, Australia electricity usage will increase by 66%, with one third of this growth in Queensland. Hence, when large geothermal power plants will be built in the future, power will possibly be transmitted to the Queensland electricity network, which is further away compared to the South Australian grid locations. When the transmission lines are long and the lines carry AC power the reactive power loss at peak load, line charging at off peak load and hence voltage stability issues becomes extremely important to maintain power grid security. In addition, the possibility of inter-area frequency oscillation can't be ignored when power is transmitted through AC transmission lines and the use of flexible AC transmission systems or high voltage (HV) DC transmission systems needs to be examined. There are proven technologies in HVDC converters/inverters, but interaction with HVAC lines and related costs versus technical advantages need to be investigated in an optimum way. The Australian grid in general is weakly meshed and is almost a radial network. Hence any outage of a key transmission facility can create a catastrophic imbalance between generation and demand. This can also create cascaded blackouts. To better understand the consequences of such events, a comprehensive power systems analysis of the national electricity grid is required with possible combinations of geothermal power plants and their connections to the grid. In a deregulated electricity market with a foreseeable carbon trading scheme a number of relevant economic issues also need to be investigated.

This presentation will focus on some key challenges relating to building new transmission facilities for transmitting large amounts of electricity over long distances. Some of them are:

- HVAC versus HVDC, regarding cost and network security;
- HVAC and HVDC interactions;
- Grid stability: thermal, reactive power, harmonics, voltage limits and inter-area frequency oscillation; and
- Overall grid security.