Stability Study and Modernization Roadmap for Expanding Vietnamese Power System

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Owed to an economic boom and changes in energy market structure, the Vietnamese power system is one of the world’s fastest expanding power systems today. With a growth rate of 12% per annum in the generation and transmission systems, the installed capacity has increased from 22.6 MW in 2011 to 32.2 MW in 2014. According to recent prognoses, until 2030, both the system’s annual energy production and the installed capacity are expected to quintuple. Siemens PTI’s consulting team has been entrusted with a comprehensive system study to derive sustainable solutions to increase and maintain the system’s stability.

The Vietnamese power system has grown along a 1500 km 500 kV backbone double-circuit transmission line ranging from the cities of Hanoi in the North to Hochiminh City in the South. This line interconnects three regional power systems into a unified national power system. An estimated 47.5 percent of the power generation is based on hydro power; the remaining share is mainly supplied by gas and coal-fired power stations.

With a very high share of hydro power generation, power production fluctuates with changing conditions during the rainy season in winter and the dry season in summer. In addition, the rapid interconnection of new generating units and increasing power demand has led to very high capacity utilization and left the system with a very reduced primary and secondary reserve. Stability problems are causing a high fault rate and have even resulted in critical power oscillations and blackouts.

Grid and distribution codes were issued to regulate system operation and planning to ensure the reliability and security of power supply, but could not compensate for the stability issues resulting from the rapid system expansion. At the same time, the Vietnamese power system entered the energy market. The newly issued legal framework for electricity market operation has made it even more difficult to derive suitable operation schemes.

Figure 1 - Hanoi Challenges

1 Hanoi Challenges; source: Bloomberg [http://www.bloomberg.com/image/iOKR1rF5EgR8.jpg]
The state-owned power company Electricity of Vietnam (EVN) operates more than 90 power generation companies with its total installed capacity of above 31,000 MW, accounting for up to 55% of the power system’s entire installed capacity. The Vietnamese government has entrusted EVN with ensuring the grid’s power security.

From 2001-2004 EVN assigned National Load Dispatch Centre (NLDC) with a project to enhance the stability of the Vietnamese power system until 2010. However, due to insufficient facilities, incomplete system data and a lack of suitable system planning tools, many of the faults could not be analyzed in detail to study the root causes, in particular; the faults on the 500 kV transmission line or tripping of major generation units.

![Image of power lines](http://en.vdb.gov.vn/news2341/500kv-electric-line-starts-supplying-power-to-the-south)

Figure 2 - 500 kV Pleiku-My Phuoc- Cau Bong line (440 km) in Operation May 2014

In the framework of a new project launched by the Vietnamese government to enhance the reliability of the power system and prevent wide area outage and blackout, National Load Dispatch Centre has now commissioned Siemens PTI with a comprehensive consulting project. The aim of this project is to derive suitable mitigation measures for the stability issues in the Vietnamese power system and to develop a modernization roadmap to support the expected developments in the next 15 years.

The network consulting group at PTI HQ will work in close cooperation with the NLDC project team and a local consultant from Siemens Vietnam, who will assist in gathering and reviewing all required data and communicating with the local generation and transmission companies.

The project team started work with data collection through measurements on site and investigating the existing equipment. Based on this data the consultants have performed detailed studies on generator stability, eigenvalue analysis, voltage stability and frequency stability in order to define suitable mitigation measures.

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As a short-term measure to mitigate the inter-area oscillations between the large generator groups in the Northern and Southern parts of the system, Siemens PTI will determine the suitable power system stabilizer (PSS) settings and activate the PSS which are already available in the system but not activated. This will improve the system security, enlarge the availability of generation and transmission and make the system reliable for the electrical market. As a long-term solution for generator and voltage stability issues, Siemens PTI is suggesting the installation of SVCplus which will significantly increase the system's power quality and minimize the risk of voltage collapse and blackout.

Figure 3A - Vietnam 500kV/220kV/110kV System (2010/2011)³

In addition, to address the frequency stability issues and enhance the system control, more reserve is needed. Siemens PTI is suggesting the integration of a modern load shedding system by installing phasor measurement units (PMUs) on the double-circuit transmission line. With these PMUs, it is possible to determine the exact position of a fault, which gives a clear indication of how load shedding has to be done to stabilize the system. With PMUs the system will be prepared for a wide area protection and control system, which could further improve the power system performance in the future.

The project includes training and technology transfer as well as software for specific tasks.

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