Power Stability Expert

| Case Study |

Stability Control for Ecuadorian Power Grid

Guarantee continuous power supply for modern society

Overview

The electricity demand of Ecuadorian Power System in recent years has an annual growth rate of beween 5% and 7%. However, the expansion of the National Transmission System is insufficient comparing to the increase in generation and demand. In the Ecuadorian power system, the most important load centers are powered by Santa Rosa (Pichincha) and Paschal (Guayas) substations, while the largest generation center is located at Molino substation (Paute and Mazar hydro power plant - South of the country). Consequently, some of 230 kV main ring lines were operating with heavy loads, especially when there are very low transfers from Colombia to Ecuador.

Because of these system characteristics, if the double contingencies happen in some of the 230 kV lines of main transmission system, the Ecuadorian Power System will expose to loss of stability, especially during high hydro generation dispatch on channels Mazar – Paute and Agoyán - San Francisco, with potential risk of total or partial collapses in the system.

Customer Needs

To meet the power stability requirement and ensure the stable power supply of Ecuadorian modern society, it needs to expand the transmission system so as to strengthen primary system structure, optimize the utilization of resources and safeguard the integrity of the National Interconnected System. In detail, the following issues shall be solved,

- To improve power grid safety and reliability in a short time with limit budgets
- To reduce excess kinetic energy of the system, especially from hydro power plant Agoyán, San Francisco, Paute and Mazar
- To correctly switch off some machines during low frequencies
- To install a protection system with fast response time (less than 200 milliseconds) so as to maintain stable operation for N-2 contingencies in the 230 kV ring

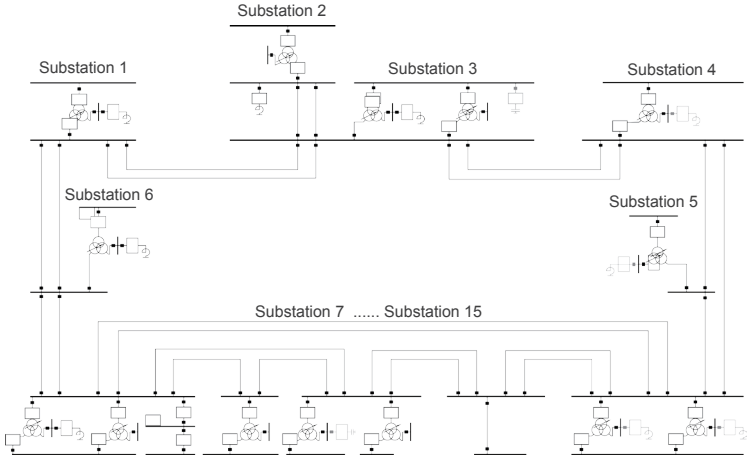

Figure 1. Schematic Diagram of Ecuadorian Power Grid

NR Solution

As a power stability expert, NR worked together with Ecuadorian utilities and successfully completed the implementation of Power Stability Control System (PSCS). This system is comprehensively designed to coordinate and operate in sequence to prevent power system instability. NR's work scope includes design, supply, installation, commissioning, warranty, and training of the PSCS for Ecuadorian national power network.

According to the stability calculation results and inter-station communication conditions of Ecuador Grid, central and bay stability control devices were installed in the following stations: CENCACE Control Center (CC), Transelectric Control Center(CC) and 25 stations (transmission substations and generation stations). Among them, Molino station is both a monitoring execution station and a generator tripping station. Santo Domingo station and Pascuales station are both monitoring execution stations and load shedding stations.

NR's power stability control system is mainly applicable to wide-area interconnected power system consisted of multiple substations and power plants. The system adopts hierarchical architecture with superior reliability control methods. The hardware and software designs ensure the selectivity and rapidity with a high degree of reliability. Based on the advanced hardware platform, NR's PSCS has a strong anti-jamming and anti-electromagnetic radiation performance.

The power stability control system composed of master station, various sub-stations and execution stations. Each bay unit collects multi-channel analog sampling and contact information of switches and identifies the operation mode. The central unit is responsible for the information collection from bay units in each station. Power stability control strategies are integrated in the host. Each PCS-992M could be a host to perform local stability control strategies, with the hardware and software modularity and standardization. The expansion of PCSC is flexible and the modification is ease to achieve.

The power stability controllers at each station adopts redundant configuration, and thus the PSCS can operate normally if one sub-system (A or B) is out of service. The collected information will be used exclusively for stability control functionality and is not shared with other protection systems.

Power stability controllers in each substation and power plant are inter-connected via PDH system. The messages are transmitted under IEC61850 8-1 frame format.

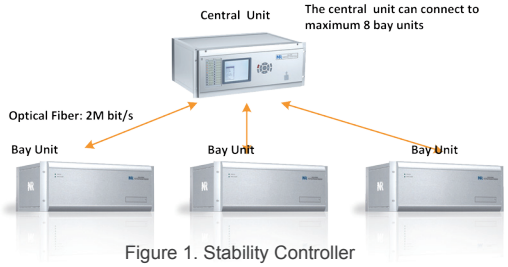

Figure 1. Stability Controller

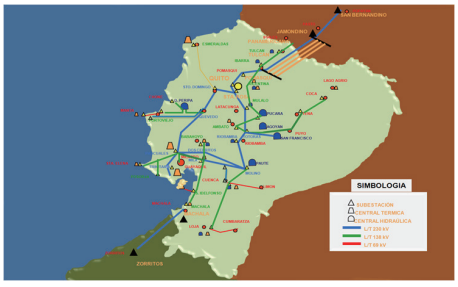

Figure 2. Topological structure of Ecuador PSCS

Customer Benefits

With NR's innovative power stability control system, the stability of Ecuadorian power grid has been enhanced significantly after the commissioning of the PSCS system. Compared with expanding the primary system, PSCS can save enormous investment and construction time. Additional, with improved stability margin of the transmission system, the Ecuadorian power grid can transfer more power through the network, which brings huge amount of economic benefits to the utility.

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