Document Title: GEN-05 – Nuclear Plant Voltage Oscillations

Category: Generator Equipment Failures & Settings Issues

Time Horizon: Operations Assessment

Party Involved: Dominion Virginia Power

Event Date: 2011

Event Description: In 2011, the Dominion System Operator requested a nuclear power plant to reduce its terminal voltage by 3 kV during light load conditions. The voltage reduction caused the generator to go small-signal unstable, leading to severe oscillations with peak-to-peak amplitudes of more than 250 MW and voltage oscillations in the range of approximately 230 kV to 235 kV (5 kV total). The oscillations continued for 12 minutes before the operators spotted the event in SCADA data fluctuations and requested the plant to return to its initial voltage set-point.

Large oscillations of a power generator entail significant dynamic movement in its shaft. This type of oscillation has the potential to cause serious damage to the generator's controllers, governors and generator shaft. Had the oscillation continued for longer, it could have caused poles to slip and other generators to trip. Following the event, Dominion performed further analysis and system validation studies using simulations with PMU data that captured high-resolution dynamic measurements of the generating units. Based on these analyses, Dominion subsequently installed Power System Stabilizers (PSS) on each of the units to help prevent future oscillations.

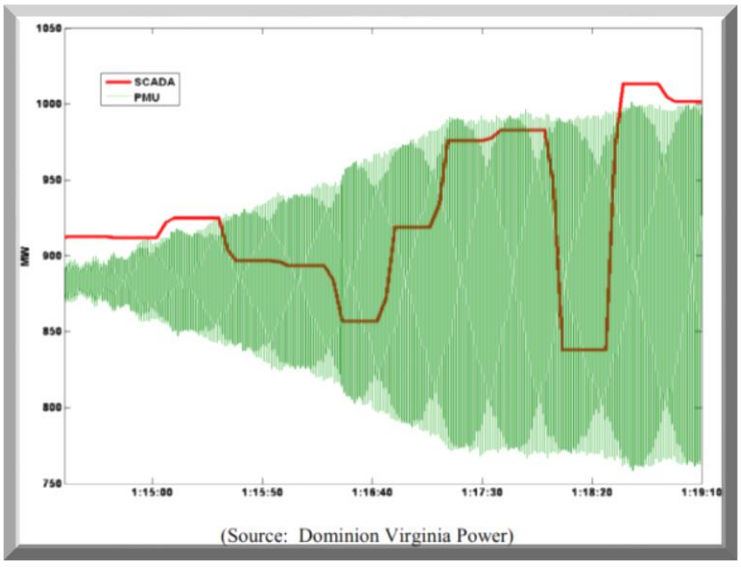

Figure 1 – Dominion Virginia Power Real Power Oscillations

Operational Value

Oscillations are much easier to detect with PMU data than SCADA data due to the higher resolution and time synchronization of PMU data. Operating Engineering staff performed further analysis using PMU data and identified the need to install PSSs on two nuclear generating units.

Excessive oscillations such as those observed during this event can cause significant damage to a generator and could result in other undesirable conditions (e.g., equipment outages, instability, etc.). Identifying and addressing the issue described in this case allowed Dominion to reduce the risk of such oscillations when operating at lower voltage set-points.

Background

The mission of the North American Synchrophasor Initiative (NASPI) Control Room Solutions Task Team (CRSTT) is to work collectively with other NASPI task teams to advance the use of real-time synchrophasor applications for improving control room operations and grid reliability. This team utilizes its experience and regional diversity to provide advice, direction, support and guidance to NASPI stakeholders and other organizations involved in the development and implementation of real-time synchrophasor applications.

This is one of a series of operational use case documents being developed by CRSTT members to describe the various manners in which grid operators and electric utilities are using synchrophasor data to provide value in the Operations Horizon. Existing versions of these papers, along with other CRSTT work products can be found on the CRSTT page of the NASPI website (https://www.naspi.org/crstt).

References

1. NASPI Technical Report titled *Diagnosing Equipment Health and Mis-operations with PMU Data* dated March 20, 2015.
2. NASPI CRSTT work product titled *Using PMU Data to Diagnose Equipment Health and Misops Sheet.*