Document Title: EA006 - Post-Event Analysis of a Compound Event Using Synchrophasor Data
Category: Event Analysis
Time Horizon: Operations Assessment
Party Involved: ERCOT
Event Date: ??/??/????

Event Description: A post-event analysis was conducted by ERCOT engineers for a compound event on the grid. In the process of analyzing a loss-of-generation event using PMU data, ERCOT engineers discovered other disturbances immediately before the loss of generation. This triggered a more in-depth analysis of these disturbances.

The event began with a phase-to-ground fault (determined by PMU frequency and voltage), which was followed by three separate frequency ramps. Since SCADA telemetry indicated that only the third frequency ramp was caused by a generator going offline, ERCOT requested information from the operator of the power plant about a possible load rejection/imbalance event. The operator confirmed that the load imbalance had indeed happened while the TSP in the area confirmed the occurrence of the fault as well as a relay mis-operation in response to the fault at the Point of Interconnection (POI) of the generating station.

Figure1 shows a one-line of the region. A phase-to-ground fault on a 138 kV bus section at the sub-station marked as S2, one bus away from the POI of generating unit G1, was followed by mis-operation of relays at the POI (sub-station S1 in the one-line). The clearing of the fault caused the 345kV circuit connecting the sub-stations S1 and S2 to be tripped, causing a transient imbalance between the loading and mechanical power of unit G1. This finally led to the tripping of the generator and a total frequency swing of 0.217 Hz.

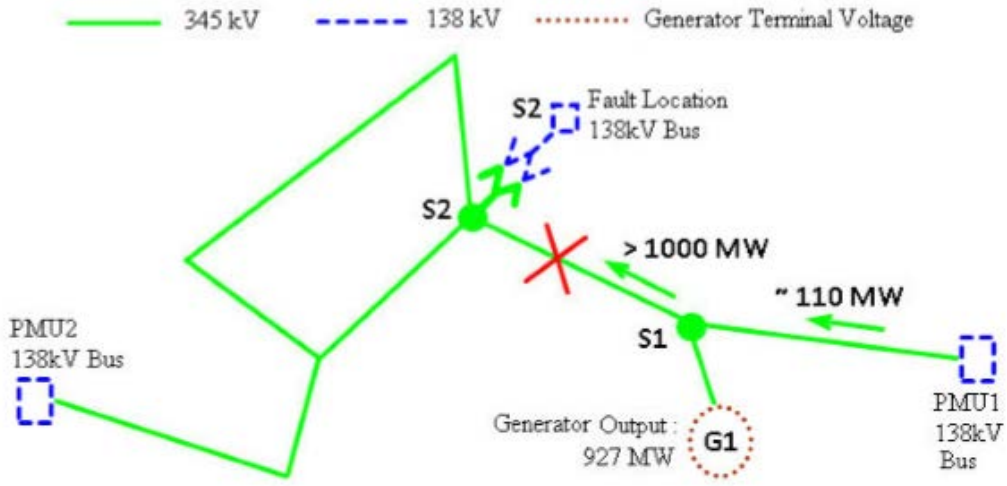

Figure 1 – One-line of the 345kV system near the event and the relative location of the PMUs

The frequency characteristic (Figure 2) recorded by the PMUs on the system showed Impulse and Ramp frequency characteristics that helped identify when different events occurred.

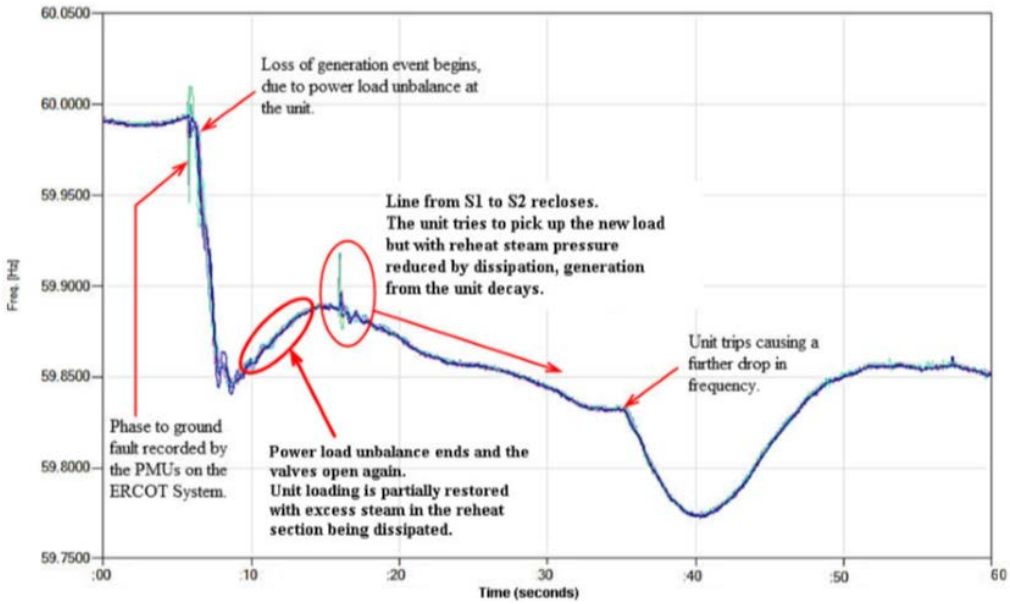

Figure 2 – System Frequency recorded by the PMUs on the ERCOT Grid during this event

The initiating event which occurred was confirmed to be a fault by examining the voltage magnitudes at the two PMUs (PMU1 and PMU2) identified in the oneline of the region. As shown on Figure 3, there was a sharp (near instantaneous) drop in the voltage recorded by the PMUs, which is the characteristic of voltage near a fault.

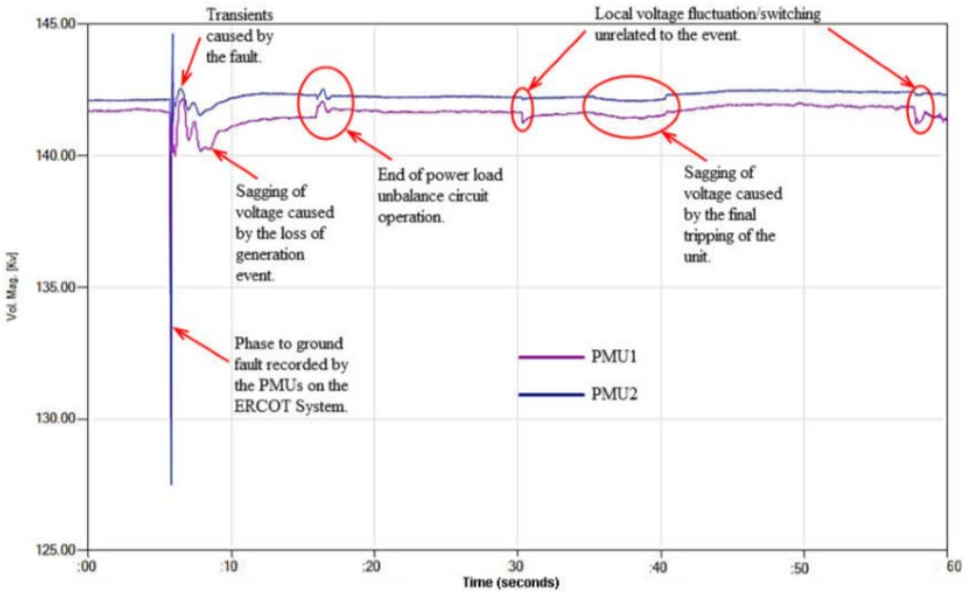

Figure 3 – Phase Voltages measured by PMUs near the event

Operational Value

This example illustrates how synchrophasor data can provide enhanced situational awareness to Operations on the dynamic nature of the electric transmission system. By being able to identify different system events occurring in a relatively short time window further analysis can be performed of the individual events to determine issues with device operation and potential corrective actions.

The above is only a portion of the full report developed by ERCOT personnel. A link to the full post-event paper follows:
https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=2ahUKEwi3rIqjz_XfAhWOHzQIHTvzBt4QFjAAegQIAhAC&url=http%3A%2F%2Fcigre-usnc.tamu.edu%2Fwp-content%2Fuploads%2F2015%2F06%2FPost-Event-Analysis-of-a-Compound-Event-in-the-ERCOT-System-Using-Synchrophasor-Data.pdf&usg=AOvVaw2M715dPG0-lJnwyjvwvt-s

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).