

Lesson Learned

External Model Data Causing State Estimator to Not Converge

Primary Interest Groups

Transmission Operators (TOPs)

Reliability Coordinators (RCs)

Transmission Owners (TOs) who operate an EMS with study/simulation capabilities

Problem Statement

Several entities in the ReliabilityFirst (RF) Region have experienced state estimator (SE) outages due to Inter-Control Center Communications Protocol (ICCP) data received from neighboring entities. Upon investigation, the topology of the neighboring system had changed but the receiving entities had not updated their representation so the ICCP data no longer matched with the older model. The SE was unable to converge (or solve).

Details

Upon receiving notification that the SE did not converge on its last run, the entities executed their emergency operation procedures to continue monitoring the system. According to these procedures, each entity advised their respective RC and neighboring TOPs so that they could help monitor the system and determine if there were new contingencies or overloads. The entity experiencing the issue then engaged Operations Support personnel (including IT personnel) to troubleshoot why the SE failed to solve. This process involves looking for internal and external data points that are either inaccurate, of bad data quality, or not correctly represented in the external model. Sometimes, vendors are engaged to help troubleshoot the issue and identify the bus or busses that may be the problem. In the examples used for this Lessons Learned document, an external entity was receiving good quality data through an ICCP link; however, because the external model was not accurate, the SE could not converge until either the data points were manually removed or adjusted or the model was fixed.

Corrective Actions

Upon determination that data points or external model were incorrect, there were several actions that allowed the SE to converge (not all methods were used by every entity nor in all cases):

- Removing the data points from the model to allow the SE to converge around the area, hopefully producing a quality solution.
- Phone calls were made to the RC or neighboring entities to assess the situation. It is possible that RTU or other communications-type maintenance may be the reason for the external data point to be invalid (or “bad”) even though its quality shows as good; however, often it is due to some type of external topology change outside of the entity’s footprint. Discuss topology with neighbors so the model can be adjusted as necessary.

- Some entities have the ability to freeze external data (either globally or for a specific area) and revert to the last known good solution. This allows the SE to converge while operations support personnel troubleshoot the external model and incoming data.
- Data bounds and limits were placed where possible on external data so as to throw away any unreasonable data points (e.g., hundreds of MVARs on a subtransmission transformer).
- Applying lower weighting to external measurements was used in some cases (not all EMS allows that method).
- Increase the number of measurements in unsolved areas of the model.

Lesson Learned

RCs and TOPs have expanded their EMS models to monitor the impact of events and outages outside of their footprint. This has increased potential exposure to bad data points, inaccurate topology modeling, and communication issues which may cause SE non-convergence events.

Changes to the BES (including new substations, other new facilities, and removed facilities) need to be communicated to neighboring entities far enough in advance so that they can update their external EMS models and ensure that the data received through ICCP links is accurately matched to the appropriate data points in the model.

- Models can be shared between the RC and its TOPs using standardized formats such as CIM, the Common Information Model.¹ Other than the TOP instituting a change, the RC is the next to know of a change to the topology of the system. This information can be communicated to all entities that include that area in their external model.
- Consider standardizing on model names for facilities. Due to different EMS vendors and platforms, different data points may be called different cryptic names (often truncated due to space limitations). Standardization of these model names could help reduce confusion and lead to fewer SE outages.
- External models should have sufficient detail (topology and SCADA) or should have very little SCADA. Explicitly modeling without sufficient SCADA can lead to solution errors.
- Automatically importing external (topology and SCADA) data while convenient can lead to problems, especially when troubleshooting unsolved areas. Ensure that imports contain all the types of data and default assumptions expected by your system (normally open switches, market model deficiencies).

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¹ EPRI has a [Common Information Model Primer](#) available.

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