NERC Lessons Learned

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- Intermittent Network Connection Causes EMS Disruption
- Unintended Consequences of Altering Protection System Wiring to Accommodate Failing Equipment
- Substation Flooding Events Highlight Potential Design Deficiencies
- Model Data Error Impacts State Estimator and Real-Time Contingency Analysis Results
- Distributed Energy Resource Performance Characteristics during a Disturbance
- Managing UFLS Obligations and Service to Critical Loads during an Energy Emergency

Intermittent Network Connection Causes EMS Disruption

Problem Statement

- Due to the COVID-19 pandemic, TOPs were working dayshift at the main control center (MCC) and nightshift at the BCC. Nightshift operations utilized the MCC’s EMS servers and began to experience intermittent client connection failure with the EMS.
- It was determined that the cause of the intermittent connection was a problematic optical card in the primary network path to the BCC.
- Due to intermittent client connection on the primary path, the EMS continuously swapped from primary to backup sources causing multiple connects and disconnects

Corrective Action

- The problematic component of the primary path was remotely accessed and reset, restoring stability to its operation.
- The problematic optical card of the primary path was replaced.

Lessons Learned

- Ensure that the network path fail-over design for EMS redundant network paths is set to a graceful transition
- Ensure that there are controls in place to keep the primary path unused if it fails until its reliability has been verified.

- **Problem Statement**

Failed CCVT was replaced and voltage sensing for related CCVT equipment was jumpered to a CCVT on a nearby line position but the failing CCVT was left connected to the BES.

The applied jumper provided a false indication of good synch voltage across the open CB causing the causing the sync-check relays in the reclosing system to close the breakers into a permanent fault multiple times in rapid succession

Corrective Action

The practice of using voltages from an adjacent line or bus to replace those of a faulty CCVT will no longer be used

Lesson Learned

- The practice of using jumpers from a good CCVT to temporarily replace the voltages of a failing CCVT has been a standard practice at many entities. However, when CCVTs get to the point that significant voltage error is noticed, the time to failure may be very short.
- It is difficult to predict the implications of altering protection system wiring in an ad hoc fashion. Taking time to review the design and properly engineer the modification could have avoided some of the problems.

Problem Statement

- Heavy rainfall of 5.7 inches of rain and hail over a 2.5 hour period led to the flooding of a basement relay room in the control building at a 230 kV transformer station. Two 230 kV circuits, 6 generators and 500 MWs of load were lost.

Corrective Action

- All critical power system equipment at the transmission station involved in this event will be located above grade by 2023
- A complete overview of the site drainage system will be performed by the TO

- **Lessons Learned**

As the frequency of adverse weather events increases, preventative actions should be taken by the TO to ensure that their transmission facilities are able to withstand the increased stress on equipment as a result of these adverse weather conditions.

Consider the following ideas for prevention or mitigation of substation flooding:

- TOs should consider an extent of condition review of transmission stations that have been identified to be susceptible to flooding to ensure that precautions are taken.
- TOs should consider an extent of condition review of transmission stations that have not previously been susceptible to flooding to ensure that is still the case.
- TOs should ensure that there are no design deficiencies, such as site drainage systems.
- Ensure that all critical power system equipment at the transmission stations are located above grade where possible.
- Past design criteria may no longer be sufficient. TOs and TOPs should review their criteria and ensure it meets what is needed for today and tomorrow.

- **Problem Statement**

State estimator (SE) and real-time contingency analysis (RTCA) systems experienced a software issue post network model deployment that resulted in a questionable solution. The solution quality issue was the result of a software problem that allowed the SE to continue to solve with telemetered MW/MVAR data that had stopped updating.

Corrective Actions

The vendor provided a software workaround that restored application functionality.

The model building and testing teams at the entity also implemented a non-production environment testing setup that mimics the production setup to catch such issues in the future.

The entity implemented monitoring and alerting for analog and digital measurements that do not update after 15 minutes and 1 hour respectively.

Lessons Learned

- Entities should collaborate with vendors to ensure that solutions are put in place to implement modelling changes in test environments prior to introducing them into production.
- Increased awareness indicators for system operators
- The use of off-line/non-production environment testing (sandbox/test environment/QA environment)

Problem Statement

- A three-phase-to-ground fault resulted in two 500 kV circuits being removed from service. This led to a net loss of approximately 1,300 MW

Details

- During the restoration of a circuit terminal to service from a planned outage at a 500 kV transformer station, the line was inadvertently energized while still grounded. This resulted in a permanent three-phase-to-ground fault

Corrective Actions

The TO initiated a protection settings review with the aim of developing corrective actions for pertinent circuits.

Lessons Learned

Switching procedures, particularly at high-risk facilities, should be designed to mitigate the risk of human error.

References

https://www.nerc.com/pa/rrm/ea/Lessons%20Learned%20Document%20Library/LL20220401_DER_Performance_During_a_Disturbance.pdf

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