NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Lesson Learned

Real-Time Contingency Analysis Failure due to a Modeling Error

Primary Interest Groups
Reliability Coordinators (RCs)
Balancing Authorities (BAs)
Transmission Operators (TOPs)
Transmission Owners (TOs)

Problem Statement
A Real-Time Contingency Analysis (RTCA) process failed to converge for 46 minutes.

Details
During the 46-minute period of the event, the state estimator converged intermittently; however, both power flow and contingency analysis were available in study application, and operators had full visibility and control of the system via SCADA.

The system operator did not recognize that the RTCA result had been non-convergent for 29 minutes because the alert status was not in an obvious location on the screen, it was not a prominent color, and it lacked an indication that it was critical. The operator noticed that the RTCA base case diverged after a second alert, so the operator immediately attempted to manually run RTCA two additional times. This action was a procedure used to attempt to correct the problem, but neither run was successful. EMS support personnel were then contacted for assistance. Model updates were made that allowed RTCA to converge approximately 46 minutes after the initial RTCA non-convergence.

An investigation determined that there was an error in a recent model topology .csv change file. Although the topology change was done in accordance with existing processes, it was determined that the error was not present in the development environment used for testing the topology modifications and that the error was introduced during the migration of these changes to the production environment. A .csv file had been prepared with the topology changes and populated on the Development System Network Applications Database. While testing the modifications, corrections were made directly to the Development System Network Applications Database and concurrently to the file that had been used to populate the topology changes on the development system. The concurrent correction made to the file is where the human error occurred and went unnoticed. The incorrectly modified .csv file was then used to populate the topology changes on the Production System Network Applications Database.

It was also determined that the network applications display didn't show the RTCA convergence status in an obvious location, nor did the RTCA status alert clearly indicate that it was critical. In addition, the system operator didn't fully recognize and understand the critical nature of a non-convergent state estimator solution.

Corrective Actions

- A temporary fix was initiated to get a convergent solution. Once the solution was stable, EMS support personnel investigated the non-convergence and identified an error in a recent topology change made to the model, and the error was corrected immediately.
- EMS support personnel modified the process for making Network Applications Database modifications of this nature. The change process now includes an additional step whereby if any changes are made directly to the Development System Network Applications Database during testing, the file will be re-created from the Development System Network Applications Database, the changes will be compared and verified to the original file, and the newly created file will be used to populate the Production System Network Applications database.
- The network applications display was adjusted with the status information moved to a more visible area. The color of the status alert for “non-converged” was changed from brown to red. A unique audible alarm was also added to the “non-converged” status alert.
- The event was communicated to all system operators, detailing the importance of fully understanding what the different solution status terms mean.

Lessons Learned

- An additional change-control procedure needs to be in place to avoid the transfer of bad data to production after it has been successfully tested on the development system.
- For verification of changes, automated review, peer review, or both must be implemented as part of any change process.
- Real-time tools, state estimators, and contingency analysis solutions need to be validated on the production system after a model change.
- Visual tools must prominently display critical alerts to the system operator.
- System operators must be able to recognize when their tools are abnormal and react according to their severity.
- Placement of status indicators, the color of the text based upon the level of the alert, and the type of audible alert must be considered for ease of identification by the system operator.

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NERC – Lessons Learned (via email)	NPCC – Event Analysis
Source of Lesson Learned:	Northeast Power Coordinating Council
Lesson Learned #:	20150601
Date Published:	June 9, 2015
Category:	Communications

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