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Introduction

In the first half of 2016, the North American Electric Reliability Corporation (NERC) and Western Electricity Coordinating Council (WECC) engaged in the Reliability Assurance Project of the Western Interconnection. The purpose of the Project was to assess the current status of the Interconnection across key operational practice areas by visiting a sample of Transmission Operators (TOP) across the West. Over the span of five months, the Project Team, consisting of WECC and NERC staff, visited 14 TOPs to discuss situational awareness, operator authority, and data sharing across the Interconnection. This report provides high-level findings on best practices and areas for improvement across the Interconnection based on these visits.

Entities in the Western Interconnection have made improvements over the last five years; however, there is still a broad disparity in the type and quality of practices and approaches in areas critical to assuring reliability. These differences are not correlated to entity size—some small entities take improving their practices very seriously, while some large entities appeared to be deficient and vice versa. The improvements entities have made are commendable; however, WECC and NERC jointly conclude that there is room for improvement in how entities in the Western Interconnection plan for and conduct daily operations. Importantly, there is still a tendency for entities to be reactive in their approach to operations, rather than embracing a proactive approach that identifies risks to real-time operations and creates plans on how to respond.

The Project Team observed the following high-level best practices and areas of concerns, each of which is explained in more detail.

Best Practices:

- System Visualization in the Control Room
- Internal Coordination for Operators
- Aggressive Next Day Study Practices

Concerns:

- Real-Time Contingency Analysis
- Visibility of External Elements
- Next-Day Studies
- Outage Coordination
- Path Operator Authority

During 2017, WECC, in partnership with its stakeholder groups, will undertake a number of assurance initiatives aimed at helping entities continue to improve their performance in these critical areas.
Confidentiality

The Project was a confidential, non-public activity and the identity of the entities involved will not be shared. All responses from entities were and are kept private at both NERC and WECC. In addition, because this Project was not a compliance initiative, the information shared by the entities was not shared with the compliance departments at NERC or WECC. The information contained in this report is being made public with the awareness of the participating entities.

Background

NERC and WECC initiated the Project to gauge the amount of change that has occurred in the Interconnection since the September 8, 2011 Southwest Outage event. The topics covered in the Project are related to the major themes identified in the joint inquiry report (Event Report).

As a result of the Event Report, WECC created the annual Operational Practices Survey. WECC has used the Survey as one of many tools to ascertain, at a high level, the status of various operational practices in the Western Interconnection. The Project used that information—with express permission from the participating entities—and dug deeper into the topics of situational awareness, operator authority, and data sharing.

The Project focused on TOPs in the Western Interconnection due to the nature of the topics and the relevance to TOPs. The Project Team randomly selected 14 of the 50 TOPs in the Western Interconnection and cross-checked that list to ensure it was an accurate representation with regard to load served, geographic distribution and industry segment diversity across the West. The Project Team recognized the burden this engagement would have on entities; therefore, the list was checked to ensure there was no substantial overlap of other Electric Reliability Organization (ERO) activities. This was a voluntary effort and every entity that was invited to participate accepted the invitation.

The Project Team requested to speak in person with front-line personnel in planning and operations, and each entity made staff available. Staff from the entities were welcoming, courteous, forthcoming with information, and frank in their discussion of practices. The Project Team engaged in open discussions with the subject matter experts to understand the processes and tools used in situational awareness, operator authority and data sharing. In addition, entities were very frank in their communications about inter-entity and entity-reliability coordinator relationships.

Following the visits, NERC and WECC conducted individual entity feedback calls and shared project-wide, as well as entity specific, findings. It was during these feedback sessions that entities recommended that the Project Team produce a Project Findings Report to share with the Interconnection.
Overview

Each entity displayed a desire to improve its own operation and a deep pride in operating its part of the bulk power system well. The entities exhibited an eagerness to share their operational practices and to understand what others do. While the Project Team commends all entities in their efforts to improve, and lauds the best practices observed, WECC and NERC jointly conclude that improvement is required on how entities in the Western Interconnection plan for and conduct their daily operations. Entities desired improvement, but some were unaware of their impact on their neighbors’ systems and the Interconnection as a whole. In addition, some entities had not engaged in a systematic review to determine what system changes impact their facilities or impacts they have on neighboring systems.

The Project Team observed across all entities visited a historical reliance on communication and cooperation. This reliance is rooted in years of cooperation that these entities implemented prior to the initiation of the mandatory Reliability Standards. Regular and open communication is common among entities and their neighbors to ensure entities are anticipating the same operating conditions. However, the organic growth of communication across the Western Interconnection has left few formal, centralized processes.

Across the Interconnection, there is evidence that a cultural shift has begun with entities moving away from a reactive operational approach to a more proactive approach. However, further improvement is necessary. When their primary tools were alarms, operators could only take a reactive approach to system operations. New tools like advanced modeling, real-time views, real-time contingency analysis, and centralized communication hubs enable operators to look forward in time and anticipate what might be coming. Operators are able to be, and should be, more proactive in how they operate the system to mitigate potential risks to reliability. The Project Team encountered a number of entities that had adopted advanced tools, but not all had made the shift to a more proactive mindset. Some entities were in the midst of making the transition, either having the tools but not fully using them or not having the tools but realizing they need them. It is not enough to just have new tools; this must be coupled with a new approach to operating the system. A shift to a more proactive mindset is critical to operating a system of ever-increasing complexity.

Best Practices and Areas for Improvement

Discussions with the entities revealed several best practices and approaches, as well as some areas where additional improvement should be made.
Best Practices:

System Visualization in the Control Room

The Project Team toured the control rooms of each entity it visited and observed a range of control room designs and philosophies. For some, it was obvious that a great deal of intention and thought had gone into the control room’s design. For example, some companies have invested in capital improvements to bring engineers into the control room space to enhance coordination with operators.

Across the control rooms, the Project Team observed a number of different display types and map boards. Operators are inundated with ever-increasing amounts of information, sometimes to the point of information overload. Two entities consider this concern in the design of their map boards and utilize a dark board concept, where colors or lights are used only to highlight issues on the grid. All system elements operating normally remain dark or neutrally colored so as not to draw attention. Another technique the Project Team observed was the use of pie charts or bar symbols indicating percent line loading on the map board. This simple addition gives even the casual observer the ability to immediately identify the loading of any system element on the map board display. This improvement was made possible because this entity allowed one of its operators to develop expertise in map board design and then apply that expertise to its control room.

Internal Coordination

The Project Team observed a range of practices around the handoff of study work from the engineers to the operators. In all cases, the hand off works and operators feel they can get study support if they need it. At a few entities, the handoff of studies to operations is exceptional. In particular, some entities have enhanced communication between the engineers and operators, including daily written reports, shift updates, and in a few cases, daily face-to-face meetings between the operators and engineers to go over the studies and discuss mitigation plans.

Next-Day Studies

As with other topics, there are a range of next-day study practices across the entities visited. Some of those practices rise to the level of best practices. Although the NERC Reliability Standards require that entities conduct or evaluate a study each day, some entities take it a step further to conduct a new, unique next-day study each day. One entity conducts a rolling study for each of the next three days. This allows the entity to see potential issues on the system with a longer time horizon, increasing the time it has to address potential issues.
Areas for Improvement

Situational Awareness/RTCA

While there were entities with outstanding practices around real-time contingency analysis (RTCA), overall, this remains a concern across the Interconnection. The issue here is two-fold. Not only is it important that entities have the tools in place to conduct real-time contingency analysis of the system, it is essential that entities also adopt a proactive attitude in the use of those tools.

RTCA is a critical tool to maintain predictive situational awareness. Several of the entities the Project Team visited have in-house RTCA while others rely on Peak Reliability’s (Peak) Hosted Advanced Applications (HAA) tool. There are a few entities that have neither, while others monitor both. Without the ability to study and address potential issues in real-time, entities lack critical system awareness. On April 1, 2017, the new TOP-001-3 R13 requirement will go into effect, which requires TOPs to conduct a real-time assessment every 30 minutes. Adhering to this requirement should bring all entities into alignment on tools and practices, and ensure they are assessing the state of the system constantly.

What the new TOP-001-3 R13 requirement does not necessarily do is change attitudes about real-time contingency analysis. It is not enough that an entity has the ability to study the system in real time—how an entity uses that ability is also important. In some cases, the entities that use HAA do not fully exploit its RTCA capabilities, or they rely solely on the HAA without validating or verifying the information. For example, simply having the ability to obtain the Peak RC RTCA results but relying on it only when issues arise is not acceptable. The Project Team also observed entities that maintain in-house RTCA tools that are not continuously monitored. Reliability is not served by an entity that has an RTCA but does not use it.

Visibility of External Elements

Most entities include some level of visibility into neighboring systems in their modeling, RTCA, next-day studies and EMS. However, the Project Team observed only one entity that has taken a systematic approach to identify and include impactful facilities. Several entities select a threshold number of buses to observe a portion of the neighboring system and change this number only in specific cases where circumstances or experience indicate they should. Most entities rely solely on professional judgement to make these determinations. While professional judgement is absolutely important, it cannot stand alone and should be backed by a systematic process to determine the extent of neighboring facilities that should be monitored.

There are some entities that do not consider impacts from or to neighboring systems. These entities operate under the assumption that they do not impact their neighbors and that they will be notified of any impact their neighbors have on them. While communication among neighbors is a strength in the Western Interconnection, it cannot be relied upon as the sole way to identify issues.
Many entities lack the ability to quickly view flows across their internal system. It is clear that operators need the overall view of broad-area flows and general loadings on their system. This gives the operator advance awareness so they do not have to wait for alarms or notice an increasing line loading on a single station view to know there is a problem. Operators noted how critical this visual is for situational awareness. Options exist for entities to add this ability, including in-house display design and the Peak broad-area displays available on PeakRC.org.

Next-Day Studies

Entity next-day study practices varied. There are two aspects to this issue. First, not all entities conduct a new unique study (or an equally as rigorous evaluation of a valid study) on a daily basis. Second, many of the studies that are conducted rely on experience and professional judgment to determine which outages to include, what contingencies to run, what sub-BES equipment to include, and how far into neighboring systems to look. While professional judgement is important, it should be coupled with a systematic process for identifying those elements that should be included in studies. This would serve two purposes: 1) to back up and strengthen professional judgement and 2) to ensure a successful transition when that expertise is no longer available.

In addition to how the studies are conducted, the Project Team found that entities can do more to review their neighbors’ and the RC’s next-day studies. A number of entities expressed frustration about the difficulties involved with viewing neighbors’ studies. In many cases, neighbors’ studies are posted too late to be of use to an entity. In other cases, reviewing neighbors’ studies can be cumbersome due to formatting differences. The WECC Next-Day Studies Work Group and Peak are working on solutions to address these concerns. At a minimum, entities should review the summary section of Peak’s OPA and compare it to their own study to ensure the two studies agree. As study formats are streamlined, entities will be able to more easily review neighbors’ studies.

Outage Coordination

A number of entities expressed concerns and frustration with outage coordination across the Interconnection. On a subregional and neighbor-to-neighbor basis, outage coordination seems to be functional; however, entities and subregions still use their own legacy methods to coordinate outages (e.g., subregional spreadsheets). Peak provides the Coordinated Outage System (COS) as an Interconnection-wide tool for entities to report outages; however, not all entities input all of their outages into COS, or input them in the 4-day timeframe required by Peak. A number of the entities stated that they would like neighbors’ outage information more than four days ahead of the planned outage. Entities also complained that COS is cumbersome. Peak is improving COS to address some of the user-identified issues. In addition, the new IRO-017 Reliability Standard that goes into effect April 1, 2017, should provide Peak the support needed to implement an improved outage coordination.
process. If these improvements are successful, they should provide entities more confidence in moving away from their legacy methods of outage coordination to one unified Interconnection-wide method.

**Path Operator Authority**

Path operator authority is still an issue within the Western Interconnection. In the majority of cases, operating agreements govern how a jointly owned path will be operated in general. However, in some cases there remains a residual lack of clarity about who has ultimate authority for the entire path. In one case, the path operator issue was described as “responsibility without authority.”

WECC’s Path Operator Implementation Task Force (POITF) addresses these path operator issues. The POITF is charged with developing and implementing recommendations to improve path operations in the Western Interconnection that take effect on April 1, 2017.

**Conclusions**

The Western Interconnection has undergone enormous change in the past five years. The biggest, and most important, needed change is a shift from a reactive to proactive mindset regarding situational awareness. There are clear leaders in the Interconnection who have made this shift, and there are clearly some entities that have not yet begun to make the change.

It is essential for entities to have and use tools that will assist their operators to proactively operate and monitor the system. Going forward, a proactive approach should be adopted by all entities within the Interconnection as they operate the system. This will require entities to adapt to changes in grid topology, accept new processes and technologies, and coordinate with neighbors across the Interconnection, not just next door. Entities should make this shift in mindset a priority, regardless of their size, location, or perceived impact on the Interconnection.