Background

In 2019, WECC concluded its work on operational practices assurance. Through this work, WECC has evaluated entities’ operational practices, identified areas that need improvement, and highlighted exceptional practices. The assurance work has shown the challenges of operating the system in a dynamic landscape.

Over the last four years, WECC has visited 47 Transmission Operators (TOP) in the Western Interconnection to discuss and evaluate operational practices in five categories:

1. Next-day studies;
2. Real-time tools and assessments;
3. Wide-area view;
4. Communication and coordination; and
5. Operational paradigm and relationships.

The 2019 findings are like those of previous years. Detailed findings from previous years can be found in the public reports available on WECC.org. This document provides a high-level summary of the assurance work over the last four years.

Key Takeaways

Operational practices have improved in the last eight years.

Since the 2011 Desert Southwest Blackout, entities have addressed the specific operational practices recommended by FERC and NERC. However, the ability of industry to proactively address new challenges remains a concern.

Most entities are adapting to system changes, some going above and beyond.

The pace with which entities applied FERC and NERC recommendations was slow following the 2011 blackout. The pace has increased as entities adapt to the dynamic challenges of grid security, natural disasters and climatic shifts, a changing resource mix, and changing legal and regulatory landscapes. Top-performing entities pursue continuous improvement and use challenges as a catalyst to identify areas for growth. These entities make not only technical changes, but cultural and strategic changes in pursuit of continuous improvement. They lead their peers in several operational practice areas, such as providing operating plans in Real-Time Contingency Analysis (RTCA) to help operators know what actions they may need to take.

Assurance visits are another tool to evaluate practices beyond compliance.

Assurance work is an effective tool for WECC to evaluate entity practices and to build relationships. The conversational nature of the work allows for greater understanding of the challenges that entities
face and helps entities understand risks and concerns from WECC’s perspective. Through assurance work, WECC gives new value to the industry. WECC shares feedback, exemplary practices, and recommendations for improvement with each entity. Entities have given positive feedback on the value of the assurance work and expressed appreciation for the face-to-face interaction. The visits give WECC the opportunity to build and maintain relationships.

The assurance project has given entities an opportunity to learn from each other.

Operating personnel are curious about the challenges and solutions encountered by their colleagues at other companies. While operators and planners communicate with their immediate neighbors, many do not—or are just beginning to—go beyond their neighbors for ideas and information. WECC’s independent role and Interconnection-wide perspective make it a great partner in identifying issues, sharing information, and setting up peer-to-peer conversations.

The assurance visits spurred real change at entities.

From its first year, details about the assurance visit findings have been shared through both a public report and confidential, individual entity reports, which were communicated directly to entity CEOs. After the first year, requests from entities for visits prompted WECC to commit to visiting all TOPs in the West. Many entities that were visited in the first years of the assurance work have made changes, some even inviting WECC back to see the changes. In other cases, entities visited later in the project had already applied many of the recommendations from the public reports.

Entities rely heavily on the expertise of their engineers and operators, but many do not back that up with other approaches.

The value of expertise cannot be understated; however, a sole reliance on expertise exposes entities to potential issues because experts can make mistakes and will eventually leave. Backing up expertise with systematic, analysis-based approaches will help entities hold on to critical institutional knowledge by making it part of their processes.

Alarming has become an area where entities can benefit from sharing their experience, concerns, and exemplary practices.

Providing operators with the appropriate alarms is a challenge most entities are trying to address. Alarms are a key tool in real-time operations; however, most operators with whom the assurance team spoke complained of a multitude of “nuisance alarms,” for which no operator action was needed. Most entities expressed interest in how others addressed alarm overload.
Next-Day Studies

Next-day studies allow entities to proactively identify potential issues on the system and develop operating solutions before the operations horizon. TOPs are required to perform next-day studies (TOP-002-2b R11) or Operational Planning Analyses (TOP-002-4 R1). The assurance project focused on study quality, study processes, and how studies are used.

Summary

The evaluation of the 2011 Desert Southwest Blackout revealed weaknesses in how entities perform next-day studies. At the time, a significant number of TOPs did not perform next-day studies. Of those that did, many lacked rigorous practices to ensure quality, up-to-date studies. Today, TOPs across the Western Interconnection perform some manner of study to determine potential issues in next-day operations. Most entities perform these studies on a daily, rolling basis and include forecast information for the next day.

Those entities in greatest need of improvement in this area usually think that their systems change so little that advanced methods of predicting system conditions are not necessary. While it is the case that some system conditions are predictable, there is still a potential for broad changes to affect smaller systems. Regional or Interconnection-wide issues like changes in generation diversity, such as the impacts of large amounts of inverter-based resources and rapid growth of behind-the-meter resources, are challenges that touch every corner of the Interconnection.

Exemplary Practices

The highest-performing entities in this category combine experience and expertise with a systematic approach to define study inputs (e.g., next-day load, generation, weather forecasts) and set thresholds and trigger points for actions like refreshing studies and running additional contingencies. Also, the best performers had strong connections between their operations engineering and system operations teams. These teams each do their part to ensure reliable operation of their system. The next-day study was viewed as a product that provides operators all the useful information available to operate the grid and anticipate potential issues.

Recommendation

There is great depth of experience in the operations personnel across the Western Interconnection. Entities rely heavily on this expertise to determine study inputs and thresholds for taking actions like re-running a study or performing additional studies. While this expertise is critical, relying solely on professional judgement creates single points of failure for entities. To mitigate the potential failures that can occur with human error and workforce turnover, entities should implement systematic, data-driven approaches to determining study inputs and action thresholds.
Real-Time Tools and Assessments

Real-time assessments provide information about potential contingencies on the system so operators can create mitigation plans ahead of time. Real-time assessments are a critical component of a proactive approach to system operations. All TOPs are required to conduct real-time assessments (TOP-001 R13). The assurance work focused on the tools, contingency selection, and use of the results in operations.

Summary

Approaches to and attitudes of real-time assessments have shifted over the last several years. Inadequate real-time visibility was a major contributor to the 2011 Desert Southwest Blackout. In 2011, roughly half of the TOPs in the Interconnection had no contingency analysis tool, and many entities that did lacked adequate visibility of impactful external elements. Today, entities maintain much better system awareness and understand the importance of studying the system in the real-time horizon.

Generally, entities have invested in the tools and expertise necessary to maintain real-time awareness and plan for contingencies. At first, some entities were slow to adopt real-time assessment tools; however, changes to mandatory standards have pushed those entities to use tools and processes to conduct real-time assessments. Most Transmission Owners have in-house RTCA tools. Others use tools hosted by the RC.

Exemplary Practices

The standouts in this area quickly adopted advanced RTCA tools and have enhanced them over the years. Top performers have continuously honed the inputs and assumptions they use in their tools. They have improved data quality and increased the frequency of their contingency analyses. Overall, the best performers have shifted their mindset: they understand the critical importance of real-time assessments and put forth great effort to enhance their tools and capabilities.

Recommendations

- Many entities still lack a systematic approach to determine the inputs and contingencies they include in real-time assessments. Like next-day studies, entities rely heavily on experience, but should couple that with practices like sensitivity studies to determine how far into neighboring systems they should model.

- To keep up with the dynamic challenges of operating the system, entities need to continuously enhance and improve their tools. WECC and the industry should continue to host events with focused peer-to-peer conversation about real-time analysis challenges and solutions.

- Most of the TOPs the team visited were concerned about alarm overload. This is an area where peer-to-peer sharing can be valuable. WECC can facilitate conversations on this topic.
Wide-Area View

A wide-area view gives entities real-time and planning information about what occurs outside their systems that may affect their operations, as well as how events and conditions on their system affect the larger network. The assurance work focused on the tools, scope of visibility, and information display.

Summary

In 2011, most TOPs had limited external visibility, if any. Typically, if an entity monitored external systems, it looked at a standard number of buses into the neighboring system. Generally, entities have improved their tools and capabilities for wide-area view; however, there is still room for improvement. TOPs look farther into their neighboring systems than they did eight years ago, but few use advanced methods to determine how far to monitor. Most still monitor a predetermined number of buses into their neighbors’ systems.

While entities have many of the tools and displays necessary for a wide-area view, in many cases they have not honed the tools to provide necessary information as effectively as possible. Information overload is a widespread challenge, and entities are addressing it with varying degrees of success. Few entities had very effective quick overviews of system information. Most had overviews that require a great level of detailed system knowledge, including system history.

Exemplary Practices

Entities with exemplary practices for wide-area view recognize that the goal must be to give the operator adequate and appropriate information to make key decisions promptly. These entities have honed their tools to give quick overview information, easy access to critical information, and easy-to-process visual displays. These entities have also added tools like GIS maps and weather displays to provide additional useful information to operators. The layout and design of these entities’ control rooms reflects their goal to give operators the information they need to operate the system.

Recommendations

• Entities need to further hone their information displays to ensure they are giving only the information that operators need and giving it concisely.
• Many entities still lack a systematic approach to determine the external facilities that should be modeled and monitored. Entities that performed sensitivity studies had greater confidence that they included all impactful facilities to their system.
Communication, Coordination, and Data Sharing

The communication of information and data, and review of that information, is critical to the reliability of the interconnected system. The assurance work focused on entity-to-entity communication, outage coordination, and data sharing.

Summary

Communication, coordination, and data sharing between entities have undergone the greatest amount of growth since 2011. Lack of information sharing and communication contributed to the 2011 Southwest Blackout. Since that time, entity communication and information sharing has improved substantially. Entities reported that they can get operational information from their neighbors whenever they need it and they regularly communicate on operational matters. Inter-Control Center Communications Protocol (ICCP) data has been widely shared since 2011, and conversations with entities have shown a willingness to be helpful and transparent with their information.

Generally, entities have a better understanding of the interconnectedness of the system and the need to work together to operate it.

Outage coordination, which was also lacking in 2011, has vastly improved at the neighbor-to-neighbor and regional levels. Peak Reliability (Peak) and operating entities worked to improve the Coordinated Outage System tool. Outage coordination is one of the topics being addressed in the RC transition work.

Exemplary Practices

Entities in close geographic or electric proximity have a shared history and interest in coordinating their systems. These groups communicate, coordinate, and share information very well.

Recommendation

As the Western Interconnection transitions to multiple RCs, communication, coordination, and data sharing should be reexamined. The improvement after the 2011 Southwest Blackout was due in part to Peak’s efforts to improve communication and cooperation with entities. Collectively, we need to make sure that the work Peak has done to improve communication and cooperation continues in the multiple-RC environment.
Operational Paradigm
This topic generally covers the relationships between TOPs and the RC, TOP mitigation plans, and operational paradigms around System Operating Limits (SOL).

Summary
Following the 2011 Southwest Blackout, the relationship between the RC and TOPs was strained, especially after WECC bifurcated and Peak became the stand-alone RC for the Western Interconnection. Some entities complained about the accuracy of Peak’s model and felt that Peak did not understand the nuances of how to operate their system. When the assurance work started, the relationship was getting better, but the team noted some residual tension. In the last two years, that tension seems to have mostly dissipated and relationships have improved.

In 2011, entities relied on post-contingency mitigation plans, acting only after a contingency happened. In addition, while TOPs used post-contingency mitigation plans to stay below normal ratings, many relied on Remedial Action Schemes (RAS) to stay below emergency limits. This approach puts TOPs in a reactive operational stance in which many relied solely on RAS to stop disturbances from cascading. Today, entities develop mitigation plans for normal and emergency limits and will take pre-contingency mitigating action to preserve emergency limits.

Some of the entities that the team visited believed their size or position in the grid made them less significant to the larger system. Some entities did not recognize the interconnectedness of the system and their role in it.

Exemplary Practices
Neighboring entities coordinate well when managing system disturbances. In addition, operating entities work well with Peak and have a relationship of trust and respect.

Recommendations
• Once the RC transition is complete, the work on building new RC and operating entity relationships will begin. It is critical that entities have strong working relationships with the RC. The new RCs should make building these relationships a priority.
• Under the new RCs, SOL methodologies will be maintained by each RC. While the RCs are coordinating their methodologies, the opportunity for gaps remains. This should be watched closely.
• Entities should continue to refine their mitigation plan methods to ensure their triggers for pre-contingent load shedding are as effective as possible.