

NERC

NORTH AMERICAN ELECTRIC
RELIABILITY CORPORATION

Reliability Readiness Evaluation Report Balancing Authority/Transmission Operator

PacifiCorp
Portland, Oregon

to ensure
the reliability of the
bulk power system

August 13–16, 2007

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Introduction and Evaluation Process

The North American Electric Reliability Corporation (NERC) Reliability Readiness Evaluation and Improvement Program is one of the commitments of NERC and the industry to strengthen the reliability of the North American bulk power system. The program conducts independent evaluations of balancing authorities, transmission operators, reliability coordinators, and other key entities that support the reliable operation of the bulk power system to assess their preparedness to meet their assigned reliability responsibilities. The evaluations identify strengths and areas for improvement in an effort to promote excellence in operations among these organizations.

Since its inception in 2004, NERC and the industry have been working collaboratively to enhance the program. The evaluation process is based on fundamental aspects of reliability: culture, operations, maintenance, planning, and training. The document [NERC Readiness Evaluation Procedure](#) describes and defines the process used for reliability readiness evaluations. This document and other documents related to the program are available at <http://www.nerc.com/~rap/>.

The reliability readiness evaluation teams, each led by a NERC staff member and a regional co-leader, include industry volunteers with considerable expertise selected to provide representation from other interconnections, other regions, and neighboring operating entities. The teams also typically include representatives from the Federal Energy Regulatory Commission (FERC) staff.

The public version of the reliability readiness evaluation report contains the majority of the evaluation team's findings. Any discussion of findings pertaining to critical infrastructure will be contained in Appendix 1, a confidential appendix to the report that is sent privately to the evaluated entity and is not included in the public version of the report.

An evaluation team met on-site with PacifiCorp (PACX) representatives on August 13–16, 2007. This report reflects the views and recommendations of the evaluation team regarding the readiness of PACX to meet its responsibilities as a balancing authority and transmission operator.

Evaluation Team

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Organization Profile

PacifiCorp consists of three separate business entities — PacifiCorp Energy, Pacific Power, and Rocky Mountain Power — covering a service area of 136,000 square miles in six states: Oregon, Washington, California, Idaho, Utah, and Wyoming. The PacifiCorp electrical facilities include 15,580 miles of transmission lines, 59,510 miles of distribution service lines, 908 substations, and 69 generating plants throughout its footprint. The PacifiCorp transmission system is operated at the following voltages: 500, 345, 230, 161, 138, and 115 kV.

PacifiCorp operates two balancing authorities referred to as PacifiCorp East (PACE) and PacifiCorp West (PACW). Since many of the procedures and processes are shared between the two areas, and due to their physical collocation, this readiness evaluation report covers both areas, referred herein as PACX.

The main control center for PacifiCorp Grid Operations (the group responsible for the operation of the transmission system and balancing functions) is located in Portland, Oregon. PacifiCorp experienced a system peak load of 12,078 MW at 17:00 PDT on July 10, 2007. PacifiCorp has a generating capacity of approximately 10,000 MW, a mix of thermal (fossil fuel and geothermal), hydroelectric, and wind powered. Total generation in PacifiCorp's two balancing areas is approximately 12,400 MW, including Non-PacifiCorp generation. Purchases of 3,095 MW were made to supplement the online generation for the peak hour.

PacifiCorp has 146 synchronous interconnection points with multiple balancing authorities: California ISO; Bonneville Power Administration; Avista Corporation; Grant County Public Utility District; Idaho Power Co.; Portland General Electric; Northwestern Energy Montana; Black Hills Power; Western Area Power Administration — Loveland, Colorado; Western Area Power Administration — Phoenix, Arizona; Arizona Public Service; Nevada Power Co.; and Sierra Pacific Power.

PacifiCorp is a member of WECC, and its Grid Operations group is registered with NERC as balancing authority and transmission operator. The Pacific Northwest Security Coordinator (PNSC) serves as the reliability coordinator.

Executive Summary

The evaluation team found no significant operational problems and concluded that PACX has adequate facilities, processes, plans, procedures, tools, and trained personnel to perform the balancing authority and transmission operator functions necessary to maintain the reliable operation of the bulk power system.

PACX has undergone several changes in corporate management due to acquisitions in the past. The present management style is one of participation and is aimed toward total engagement of the workforce in its strategic direction. For example, operators play an important role in procedure development — PACX planning staff members contact operators to ensure operating procedures are workable from an operator's perspective.

PACX uses a number of methods to support its operators. Acknowledged by the team as a potential example of excellence is the implementation of a continuously staffed security and monitoring desk that relieves operators from monitoring location security. A well-organized tools support function and systematic approach to training also contribute to operator success.

The evaluation team offered recommendations regarding training and documentation, of which two were jointly labeled as key recommendations by the team lead and PACX representatives. PACX is currently implementing a document management system, and the team encourages PACX to finish the project expeditiously. While the overall training program is effective, increased emphasis on load-shedding scheme overlap and automatic underfrequency trip scheme training would benefit operator situation awareness.

Overall, the evaluation team identified 13 positive observations and one potential example of excellence. In addition, the team offers 11 recommendations that, if implemented, will enhance PacifiCorp's readiness to operate reliably and maintain the reliability of the bulk power system.

Potential Example of Excellence

The evaluation team identified the following potential example of excellence in its reliability readiness evaluation:

1. PACX has established a continuously staffed security and monitoring desk, responsible for processing communication alarms and monitoring the security of the control facility, reducing the number of alarms that must be processed by the system operator (Section 2.1).

Positive Observations

The evaluation team noted the following positive observations during the reliability readiness evaluation process:

1. PACX has tested the redundant energy management system (EMS) by actually operating it from the long-term backup center servers for a considerable period of time (Section 2.1).
2. Control of access to critical facilities resides within the Grid Operations group, ensuring an appropriate level of review granting such access (Section 2.2.3).
3. PACX has a well-equipped hot-standby local backup facility, allowing for a nearly seamless transition of function if needed. See further discussion in Appendix 1.
4. PACX has extensive teleconferencing and videoconferencing capabilities (with ties to the long-term backup center) in the vicinity of the local backup control center for use in events and restoration, improving the communications capability during system emergencies (Section 2.4).
5. PACX is a NERC-approved continuing education provider, allowing the company to develop and support in-house training programs for its system operators (Section 5.1).
6. PACX utilizes a systematic approach to training including job task analysis, providing for a high level of efficacy in its training processes (Section 5.1).
7. PACX has hired a dedicated training coordinator, giving accountability for this important function to a defined individual (Section 5.1).
8. PACX utilizes a triggered strobe light and timer in the system operations center for generation trip events exceeding 140 MW, with event information also being shared with the generating station operators who pick up their reserves immediately, resulting in timely recovery for system events (Section 2.4).
9. PACX has internally developed an “available capacity remaining” tool and display to assist grid operators in knowing when flows on transfer paths are approaching limits, giving them the opportunity to mitigate problems before a violation occurs (Section 2.2.3).
10. PACX has a high level of operator participation in the development of operating procedures (Section 4).
11. The corporate succession planning program is thorough for covered positions, allowing for selection and development of employees in a timely fashion (Section 1.2.4).

12. PACX requires NERC-certification for the training coordinator as well as the supervisors of NERC-certified positions, increasing the credibility of management resources in system operations (Section 1.2.2).
13. The Enterprise Service Desk support group is well organized, with calls from system operators given priority based on the severity of the problem (Section 2.2.3).

Recommendations

The evaluation team offers the following recommendations:

1. Expedite, to the extent possible, the deployment of the state estimator, real-time contingency analysis program, and operator training simulator to enhance study capabilities of the system operators.
2. Provide additional resources to complete the six-person rotation for the balancing and interchange function position to allow for training and transition to the transmission operator function (Section 5.1).*
3. Assess the amount of overlap that exists between manual and automatic underfrequency load shedding (UFLS), provide an appropriate operator display, and conduct system operator training so that system operators have greater situation awareness during a frequency-related event (Section 2.4).
4. Develop and conduct training for system operators regarding the automatic underfrequency tripping of loads and generation to improve their understanding of the overall design scheme (Section 2.4).
5. Enable the mapboard's frequency-display functionality to provide consistent frequency data and a consolidated overview of conditions to improve operator situation awareness for normal and unexpected operating conditions (Section 2.3).
6. Update, organize, and make easily accessible hard copy reference materials, specifically the PACX operating procedures, WECC documentation, and NERC reliability standards, to improve the efficiency of system operator actions during operating events (Section 2.2.3).
7. Confidential information on physical security redacted from public report. See discussion in Appendix 1.
8. Conduct training for balancing and interchange operators on the automatic generation control system to increase their ability to respond to system conditions (Section 2.3).
9. Resolve issues related to determining the origin of tie-line errors in real-time and hourly values to allow the system operators to manually replace errors with credible values in a timely manner, relieving system operators of the administrative work related to the resolution of these errors with neighboring systems (Section 2.3).
10. Expedite, to the extent possible, the conversion of documents into a new document management system to provide greater control of critical documentation and procedures; as part of the conversion, incorporate required review dates, document ownership listings, and document distribution instructions (Section 1.2.3).*

11. Conduct periodic drills to improve system operator familiarity with the long-term backup location to ensure all operators can properly respond during a system emergency (Section 2.4).

*Jointly identified by the company and lead evaluator as a key recommendation

Discussion

The reliability readiness evaluation team examined the following key areas during the evaluation. The detailed discussion that follows provides the foundation for the recommendations, positive observations, and potential example of excellence that the team identified. The report uses the generic term “system operator” to refer to all on-shift operating personnel responsible for executing the functions necessary to operate reliably and maintain the reliable operation of the bulk power system. This term will be used for the discussions unless additional specificity is required, such as the *balancing* system operator, or *transmission* system operator.

1. Culture

1.1 General

The corporate organization provides the necessary leadership and management for system operations to sustain high levels of safe, reliable operation.

The evaluation team discussed with PACX corporate management its history and current status. The team learned that PACX has undergone several major ownership changes in recent years, each one having a slightly different overall management strategy and focus. Within the operations department, there have been several recent changes, following the retirement of a department leader. PACX is currently working on increasing the knowledge of the newly selected management staff. PACX operations management uses an internal promotion philosophy that provides the operations groups with flexibility, as the managers selected for new opportunities are still available for consulting and advice related to their former positions. PACX is actively involved in knowledge retention efforts, documenting important aspects of each key position.

PACX uses a scorecard method of tracking key performance indicators and makes a concerted effort to ensure that all local or organization indicators are closely tied to corporate objectives. PACX operations department management noted that these performance indicators are updated at least monthly and are routinely evaluated at the corporate level. PACX operations personnel verified that individual compensation is impacted by whether or not the key indicator goals are met, primarily in the form of year-end bonuses. The objectives and goals that are assessed pertain to all levels of the corporation, from individual performance to department objectives and finally to the corporate goals of safe, reliable power delivery.

1.2 Organizational Effectiveness

1.2.1 Foundation for System Reliability

The organization's values and behaviors—modeled by its leaders and practiced by its members—serve to make system reliability a top priority.

PACX's parent holding company, MidAmerican Energy Holdings Company, states the following in its 2007 business publication: "We are focused on delivering reliability, dependable, fair prices and exceptional service to our customers around the world." The corporate emphasis on reliability within its mission statement provides a foundation for system reliability at the highest level. As noted earlier, there are corporate goals directly related to reliability, further enhancing this focus within the company.

PACX's system operations department personnel are actively engaged in analyzing and meeting the corporate objectives, and discussions with individuals within the group show a good knowledge of the focus on reliability.

1.2.2 Leadership and Management

Managers, by leadership, commitment, and example, establish and reinforce high standards of performance and align the organization to achieve safe, reliable system operation.

As noted earlier, PACX has experienced changes in recent years in its leadership and management chains. With these changes, contact by senior management with system operations has received a great deal of attention. Discussions with the system operations personnel indicated that this could still be improved, and the evaluation team understands that PACX is seeking innovative ways to improve corporate communications methods with respect to the system operations group.

The team noted further evidence of the corporate emphasis on reliability in that PACX requires NERC-certification for its system operations training coordinator as well as for the supervisors of its system operations positions that require NERC operator certification. The team notes this as a positive observation, a practice that will serve to increase the credibility of PACX management resources in area of transmission system operations.

1.2.3 Corporate Oversight and Monitoring

Line management is used to strengthen reliability and improve performance. System reliability is kept under constant scrutiny through techniques such as self-assessments, performance indicators, and periodic management meetings.

Corporate oversight and monitoring at PACX is implemented through regular corporate staff meetings where key performance indicators are reviewed. PACX operations management noted that maintaining and improving system reliability is factored into the corporate goal-setting process, and new initiatives are discussed and formulated, as appropriate.

One such new initiative is the document issuance and control process. At PACX, documentation is managed and maintained internal to the transmission and distribution system operations group. Discussions with system operations management indicate that the group has recently obtained a

new document management system that will allow for improved ownership and accountability of process and procedure documents. The process of converting documents into the new document management system is ongoing, and the evaluation team recommends that PACX expedite, to the extent possible, this initiative to provide greater control of critical documentation and procedures. As part of the conversion, the team recommends that PACX incorporate required review dates, document ownership listings, and document distribution instructions. The evaluation team believes this is a critical component of knowledge retention and, given PACX's history of staff turnover, will be a key to its continued success.

In particular, the evaluation team noted the need for periodic reviews of certain procedures, including updating industry nomenclature related to the reliability standards themselves. Some organization documents refer to former "policies" rather than reliability standards. The team understands that this will be corrected as documents are converted into the new control mechanism.

PACX system operators are diligent in the performance of their shift turnover duties. The requirements for the shift turnover process are part of an overall document that details many aspects of daily requirements for the system operator. The shift turnover process consists of the provision of written information to the oncoming shift system operator as well as an opportunity for oral discussions of events with the outgoing system operator. The company procedure notes that this knowledge transfer is the expectation for every shift change.

For changes to industry standards or for internal operating procedures, PACX uses a combination of emails, meetings (both group and individual), and the previously described shift-change process. PACX operations management noted that system operations personnel are given the opportunity, upon learning of a new policy, standard, or procedure, to seek clarification of any questioned part or intent of the new document.

PACX reported that it participates in performance improvement activities, quality management, and benchmarking programs. In particular, PACX obtains customer feedback in addition to input from interconnected neighbors and the reliability coordinator regarding its work activities and interactions with others. PACX management expressed a desire to maintain good working relationships with other entities.

1.2.4 Human Resources

Personnel resource needs are anticipated and individuals are systematically recruited, developed, and assigned positions in the system operations organization.

PACX uses a centralized human resources group for filling job positions within the system operations group. The evaluation team learned from corporate-level personnel that PACX is part of a formal corporate succession planning program. The corporate succession planning program is thorough for covered positions, allowing for selection and development of employees in a timely fashion, and the evaluation team noted that this is a positive observation. The discussion indicated that this process is at present primarily related to certain management and highly skilled positions within PACX, and is not particular to the system operator function.

Discussions with system operations management indicated it typically would take from six to eight weeks to hire a replacement for any sudden vacancy in the system operator ranks. The individual would then be required to undergo appropriate training prior to actually taking a position as a system operator. Discussions with PACX system operators indicated an expressed concern about the loss of system operations staff to other local outside opportunities. PACX management indicated that it is aware of this situation and is seeking to identify and recruit top talent for the future.

1.2.5 Corporate Communications

System operations communications inform and engage both corporate and system operations employees so they can contribute to the strategic priorities of the organization.

PACX's corporate communications staff uses a number of methods to communicate corporate information to employees, including email, employee meetings, and other group opportunities as needed. The PACX operators indicated that they would appreciate additional contact with corporate management, particularly in light of recent corporate ownership and direction changes. PACX's corporate support groups are located in Portland, the main company headquarters, approximately 20 miles from the system operations center.

PACX indicated that there is an emergency communications plan in place that includes public notifications of certain system events, relieving system operations of this responsibility. In addition, PACX participates in drills conducted by other entities, including the Department of Homeland Security.

2. Fundamentals of Operations

2.1 General

Operations personnel monitor and control the system in a manner that ensures safe, reliable operation.

PACX power system operators are knowledgeable about their supervisory control and data acquisition (SCADA)/EMS monitoring tools. The evaluation team observed several operator tools used for direct control of the power system and trending various measured quantities. PACX does not currently employ any advanced network applications such as state estimation, real-time contingency analysis, or voltage stability studies. PACX indicated that these tools have been procured and are to be made available to the system operators as appropriate development occurs (see section 2.3 for more detail).

PACX has established a continuously staffed security and monitoring desk, responsible for processing communication alarms and monitoring the security of the control facility, reducing the number of alarms that must be processed by the system operator. The evaluation team identified this new approach as a potential example of excellence for several reasons. The monitoring function is performed in an office adjacent to the system operations control room, providing for good communications between the security monitoring staff and the system operators. PACX indicated that it plans to use the personnel occupying the security and monitoring desk as a potential pool for system operator positions, and that those personnel will be required to hold NERC system operator certification.

PACX uses a redundant EMS at its remote, long-term backup facility. PACX has tested the EMS at that location by actually operating it from the remote servers for a considerable period of time, verifying the system's operability from that location. The evaluation team notes this tested redundancy as a positive observation.

The evaluation team toured the control facility and noted in its discussions that the control room is adequate at present but is constrained in its physical layout. The team believes that this could become a problem in the future if additional tools or displays are needed by the system operators. PACX indicated that it is aware of the potential lack of space and is considering potential fixes if the situation arises.

The evaluation team noted through PACX demonstrations that the system operators have a good view of the balancing areas. System alarms and other critical applications are monitored and annunciated as appropriate within the control room and the security and monitoring desk ensures that the alarms are being received and processed.

2.2 Operational Focus

2.2.1 Operational Safety

System operation activities are conducted in a manner that maintains high levels of safety and reliability for all system conditions.

Discussions with system operators and operational planning engineers indicated that PACX has developed operating procedures for problem areas within the system. These procedures are the result of studies conducted both internally and regionally, based on seasonal loads as well as planned outages and construction.

Operators receive training for new/revised procedures via discussions with the supervisor and email. PACX management indicated that discussions among the staff and supervisors are also used to clear up any problems with understanding of new/revised procedures.

2.2.2 Operational Decision-Making

Operational decisions are reached using a systematic and thorough approach that supports safe, reliable, and efficient system operations.

System operators at PACX rely on personal knowledge and experience in making operational decisions. PACX management indicated that personnel do not routinely move from the balancing desk to the transmission system operations desk, nor do they move from one geographic region to another.

2.2.3 Operational Alignment

Organizational structure supports safe and reliable system operation.

The evaluation team observed that access to the facility requires several different credentials. PACX management indicated that control of access to critical system operations facilities resides within the Grid Operations group, ensuring an appropriate level of review prior to granting such

access. In addition, the operations building has access restrictions to certain internal areas. The team recognizes this control of access within the operations group to be a positive observation.

Discussions with system operators indicated that PACX has developed an “available capacity remaining” tool or display to assist grid operators in knowing when flows on transfer paths are approaching limits. This monitoring and understanding provides the operators with the opportunity to mitigate problems before a violation occurs. The evaluation team finds this to be a positive observation, one that indicates PACX’s progressive approach to monitoring the transmission system.

PACX system operators indicated a high level of satisfaction with the support they receive for both communications and computer-related problems. PACX utilizes a “one-call” support group that is well organized and efficient in answering trouble calls. The team found through discussions with support personnel that calls from system operators are given priority, verifying the fact that focus on reliable operations is a top priority.

The evaluation team observed documentation at both the primary and backup control facilities. While there was some concern with overall organization, system operations personnel were able to locate and discuss various operational documents. To improve the efficiency of system operator actions during operating events, the evaluation team recommends that PACX update, organize, and make easily accessible hard copy reference materials, specifically the PACX internal operating procedures, WECC documentation, and NERC reliability standards.

Notwithstanding the challenge to better organize critical documents, PACX personnel have a sense of ownership of operating procedures. The team found that system operators are routinely involved in the development of any required new or revised procedures. This involvement can occur at any stage, but is typically brought to bear in the initial and final review processes.

PACX system operators have the authority required by NERC and WECC standards, documented in various forms. PACX has not delegated any of its reliability functions, making communications fairly straightforward.

2.3 Managing System Configuration

Power system configuration is carefully designed, analyzed, maintained, and controlled throughout the life of the infrastructure, ensuring that system and equipment margins are understood, considered in decision-making, and managed consistent with design and system requirements.

PACX utilizes an industry-accepted EMS platform that has been specialized to some degree based on PACX system operators’ needs. For example, PACX has designed displays for system operators to show the status of reactive reserves for each operational area. The system operators indicated that this gives them a good sense of the extent to which they can rely on system resources for voltage support. In discussions with the system operators, they indicated that during certain training activities they had observed a slightly advanced voltage display for the total system, one which can provide a more general, visual indication of voltage patterns. PACX management indicated that it is aware of the tool but have not decided whether to obtain it.

PACX is a registered user of the Coordinated Outage System, common in WECC. This tool allows for thorough outage coordination with all interconnected neighboring utilities as well as with the reliability coordinator. Equipment outages are specifically scheduled using a program called Compass, giving system operations a chance to review the upcoming schedule of planned outages. Additionally, PACX takes part in a daily telephone call with the PNSC reliability coordinator.

Discussions with PACX system operators indicated that PACX does not employ any advanced applications, such as state estimation or contingency analysis. PACX management indicated that it has made plans to procure and implement these applications, including an operator training simulator. The evaluation team recommends that PACX expedite, to the extent possible, the deployment of the advanced network applications and operator training simulator to enhance study tools of the system. The current schedule is as follows:

- a. State estimator by the end of the 2nd quarter, 2008
- b. Real-time contingency analysis by the end of the 4th quarter, 2008
- c. Operator training simulator by the end of 2009

PACX system operators monitor balancing area frequency at multiple locations. The evaluation team observed the tools available to the system operators and noted that the mapboard does have a frequency indicator installed, but that it is apparently not operational. The team was concerned that this might lead to confusion during a system event and recommends that PACX enable the map board's frequency displays to improve operator situation awareness.

Discussions with system operators performing the balancing and interchange function indicated a limited understanding of the total capabilities of the automatic generation control functions. These would become important during certain system events, and the evaluation team recommends that PACX conduct training for balancing and interchange operators on the automatic generation control system to increase their ability to respond to system conditions.

Overall, the evaluation team was impressed with the communication processes between PACX and its neighboring entities. In one area, it was discussed that for tie-line metering issues (some tie-line reading values double intermittently), the system operators discuss the differences and determine which of the two company-reported values is correct for interchange use. The evaluation team believes this is cumbersome to the system operators and recommends that PACX improve the communications process with neighboring systems to minimize tie-line errors in the hourly values, relieving the system operators of any administrative response.

2.4 Emergency Preparedness

The organization is prepared to manage and mitigate the impact of system emergencies in order to preserve the reliability of the system and to protect the interests of the public.

During review of company process and procedure documents, the evaluation team noted that PACX has an extensive *Capacity and Energy Emergency Handbook*, the reference that would be used by its system operators during any such event. The handbook itself contains specific operator procedures as well as many other documents, raising a concern among the evaluation team of possible problems with future revisions.

PACX indicated that it will consider making a change to this process in the future. For system events that cover a large geographic area, there is an area emergency plan referred to as *PowerForward* that includes several public agencies and governmental authorities. The evaluation team found that this collaboration with other entities would improve reliability during stressed system conditions. In addition to this regional effort, PACX has emergency coordination procedures and agreements in place with neighboring entities and the reliability coordinator. Blackstart and system restoration plans are in place and training events are conducted with all involved parties.

At the interim backup control center location, PACX has extensive video and voice conferencing capabilities (with ties to the long-term backup center) in close physical proximity for use in events and restoration. The evaluation team notes this comprehensive communications infrastructure as a positive observation, one that improves communications capability during system emergencies.

The evaluation team observed that internal to the primary control center, PACX utilizes a triggered strobe light and timer for generation trip events exceeding 140 MW. It was noted by PACX management that such event information is also shared with the generating stations via a similar mechanism, and the expectation is that generator operators will pick up their reserves immediately, resulting in timely recovery for system events. The evaluation team notes this automatic dissemination of recovery information to the generating facilities as a positive observation.

PACX has both an automatic underfrequency load shedding plan as required by WECC as well as infrastructure available for manual load shedding if the system operator determines such a need exists. Discussions with PACX personnel indicated that there is not a definitive listing of any possible overlap between these two emergency mechanisms, leading to the possibility that system operators could shed load manually without realizing it is also part of the underfrequency load shedding program. The evaluation team recommends that PACX assess the amount of overlap that exists between manual and underfrequency load shedding, provide an appropriate operator display, and conduct system operator training so that system operators have greater situation awareness during a frequency-related event. The team believes that this will help the system operators operate the system aggressively while keeping primary protection in place for its generation fleet.

Discussions with PACX system operators indicated a lack of understanding of the underfrequency load shedding program and its coordination with any underfrequency tripping of generation. The evaluation team recommends that PACX develop and conduct training for system operators regarding the automatic underfrequency tripping of loads and generation to improve their understanding of the overall design scheme and to provide a means for operators to anticipate system events during frequency-related problems.

The long-term backup control center is located in another geographic region of the PACX footprint, requiring lengthy travel to make use of it. Through examination of training records and discussions with system operators the team learned that not all operators have had the opportunity to visit the remote backup center to gain a familiarity with its location and operation. The evaluation team recommends that PACX conduct periodic drills to improve system operator

familiarity with the remote, long-term backup location to ensure all operators can properly respond during a prolonged system or local emergency.

There are no nuclear power generation facilities located within the PACX balancing area.

3. Fundamentals of Maintenance

3.1 General

Maintenance is conducted by skilled personnel to achieve safe, reliable control center equipment and system performance.

The PACX EMS provides a function for monitoring critical applications that provides alarms to system operators for any problems. Support activities for PACX's EMS and telecommunications network are provided by corporate support groups. Discussion with the support personnel indicated that there are usually three communications technicians that report to the operations facility during regular business hours. These individuals are responsible for maintaining the operations center equipment as well as the associated remote transmitting units.

The systems supported include the EMS/SCADA, dispatch system, communications infrastructure, advanced applications, and voice and data networking. The corporate support group provides daily client support activities — both system upkeep and configuration for the EMS and associated general computer controls.

In addition to these individuals, PACX has field technicians located throughout eight geographic districts. The maintenance groups indicated that support is available continuously via callout and includes multiple layers escalating to management if needed. All of the PACX communication technicians that support the operations center have remote access to the system and can view event logs, outage reports, and other necessary event documentation.

PACX has recently developed a new security team that will monitor security alarms as well as physical security parameters at remote facilities. The new function will be continuously staffed and is located adjacent to the operations center. PACX indicated that this new function will relieve system operators of having to monitor and assess security issues. In addition, the positions will be used as a training opportunity for future power system operators.

PACX's system operators noted that they have the option to call either the first name on the callout list or the network operations center for support. The network operations center performs an initial analysis of the problem and then calls the appropriate support staff. PACX indicated that calls from the system operators always receive the highest priority. PACX has a system to track all system incidents, including notes related to the trouble call. All incidents are reviewed weekly for open remediation items by PACX senior management. To identify any patterns, PACX prepares a monthly outage report that includes total outage minutes by system.

PACX support personnel related that a lightning strike in the long-term backup control center resulted in the destruction of nearly all communication equipment at the site. The support organizations achieved a 24-hour return to service (involving extensive rebuilding) using the

service of equipment manufacturers among others in the restoration. The event was reviewed in the weekly meeting mentioned previously.

Any EMS changes or upgrades are applied to a test server prior to moving to a staging server and finally on to the production server. All such events are carefully coordinated with system operations to avoid any unnecessary problems during high system loads or abnormal circumstances.

3.2 Equipment Reliability

3.2.1 Equipment Performance

The organization achieves high levels of equipment reliability. Equipment problems that impact reliability are resolved in a thorough and timely manner.

PACX system operators noted that EMS downtime is minimal due to redundancy and careful outage and upgrade planning. In addition, they noted that response time from the corporate support groups is excellent, due in part to the availability of remote access capabilities. In addition, the system operators appreciate the ability to place a single call for support rather than having to seek available support from a callout list.

PACX installed a new EMS/SCADA in late 2006. System operators reported that there have been a limited number of incidents resulting in system downtime. The events were primarily due to the new system being initially tested and put into production. Incident reports were generated after each event to investigate root causes, and mitigation strategies were developed. The operators noted that there have been no additional issues since that time.

3.2.2 Work Management

Work activities, including corrective, elective, and preventive maintenance, surveillance testing, and modifications, are managed effectively to support safe, reliable operation during both outage and routine periods.

PACX support services are coordinated by a corporate staff, the Enterprise Service Desk support group. The support staff manages work to be done in the control center according to priority and schedule. As noted earlier, trouble calls from system operators are expedited as a top priority. For routine maintenance or upgrades, the support staff coordinates all such activities with system operations.

PACX management noted that requests for changes and upgrades to control center equipment and systems follow the corporate change management process. The change management process takes requests from users (system operations), prioritizes the requests, and investigates possible risks and impacts. If the change/upgrade is approved, it is acceptance-tested and scheduled with a software release. Once in production, the system operations staff provides feedback regarding the performance of the product prior to the work order being closed.

4. Fundamentals of Operational Planning

Operational planning provides the technical information and support necessary for safe, reliable system operation.

The evaluation team discussed several aspects of operational planning with PACX operational planning staff members. System models for the footprint are developed and shared among all WECC entities according to WECC procedures. PACX indicated that all data goes through the regional entity.

PACX engineers noted that the planning studies are based on the most conservative case — the peak loads for the two primary seasons, winter and summer. Spring studies are also run for the western part of the PACX system due to the impacts of the hydroelectric availability during the rainy season. Load forecasting is performed by the Commercial and Trading group in PACX and shared as appropriate with the operations department. Outage information is taken into account when running any special studies due to changing conditions.

With regard to dynamic modeling, PACX indicated that not all units have been tested for reactive capability, but that a plan is in place to perform the tests and incorporate the actual dynamic response data. The dynamic models presently used rely on original nameplate data unless the reactive testing has occurred.

The PACX model data is routinely updated with each seasonal analysis, primarily summer and winter. A seasonal study that is performed every two years identifies capacitor banks that must to be in service during peak times, and that information is used to determine other system limits. System operators use this information to ensure capacitors are available as needed, but PACX notes that the system limits are based on worst-case conditions. The studies verify that PACX can incur the loss of any single reactive element while remaining in a stable operating state. PACX noted that it employs synchronous condensers in its footprint, typically set to maintain unity power factor to allow for proper dynamic response during any loss-of-reactive event.

PACX uses a system of emails, sign-off sheets, and training sessions to provide information to its system operators regarding the results of the seasonal analysis studies. In particular, any change to the operating transfer capabilities (known as the OTC process, which is similar to the Eastern Interconnection transmission loading relief process) is specifically addressed. PACX indicated the information is typically sent to supervisory personnel who are expected to have discussions with the system operators. For changes to the system configuration, such as energizing a new transmission line, the operations planning group is accountable for the development and delivery of needed training for the system operators.

Discussions with PACX system operators indicated a high level of involvement with the development of any needed operations procedures. The system operators are contacted during this activity and their input is used to ensure that the resulting operating procedures are optimized and workable from the operators' perspective. The evaluation team notes this involvement of system operators in the development of operating procedures as a positive observation.

As noted earlier, PACX does not yet make use of real-time contingency analysis by the operations department. Line-outage studies have already been conducted to predetermine the outage limits for the system, and nomograms have been developed to provide guidance to system operations for abnormal situations. PACX indicated that all first-contingency studies have been conducted for the Wyoming and Wasatch portions of the system and are included in the EMS. In the event that a system operation has the need for such support, there are two on-call individuals with home study capabilities to examine any existing or postulated outages.

PACX utilizes automatic undervoltage load shedding (UVLS) schemes for multiple contingencies, particularly in the Utah area. The UVLS can trip up to 15 percent of the load in the area. PACX indicated that it is installing a static VAR (SVAR) system for one particular area that will provide voltage support for double contingencies. The SVAR is scheduled to be in service for the 2009 peak load season. In addition to the SVAR installation, PACX is installing switched capacitor banks throughout the system and expects two 345 kV transmission lines to be energized in 2010.

5. Fundamentals of Training

5.1 General

Training in both specific job-related skills and broader technical fundamentals is used to provide highly skilled, knowledgeable personnel for safe, reliable operations, and to achieve performance improvement.

The evaluation team met with PACX personnel involved in system operator and engineer training. PACX incorporates a systematic approach to training, which begins with a thorough job task analysis for identified activities. PACX uses the acronym “ADDIE” — Analyze, Design, Develop, Implement, and Evaluate — to identify the steps involved in the training process. PACX indicated that a number of courses are available, and the feedback from the trainee is used to improve the individual training activities. The evaluation team recognizes this classical systematic approach to training as a positive observation, a process that provides for a high level of efficacy in its training processes.

PACX training for its certified system operators is focused on maintaining certification. The training staff indicated that an operator training simulator is planned for the future, and plans are in place to support this activity. PACX indicated that it is aware of the need for highly skilled personnel to effectively implement a simulator training environment.

PACX uses drills as appropriate for its emergency preparedness procedures, including emergency evacuation activities and the startup of the backup control center facilities. PACX also participates in regional blackstart and system restoration training activities. The training staff and system operators indicated that training activities occur in February and August to cover any procedures that have been developed for the upcoming season. There is also an opportunity to review existing guides and operating procedures. PACX indicated that all system operators are required to attend the training, which takes place over several sessions to allow participation of all operators.

System operators indicated that they feel confident in their individual training, which routinely includes on-the-job training, classroom activities, vendor-provided training, and computer-based training. Operators expressed concern however, regarding the increased training requirements and that the balancing and interchange position does not include a sixth position to allow for proper training. Operators indicated this position is viewed as a training position for the transmission operator function. The evaluation team recommends that PACX provide additional resources to complete the six-person rotation for the balancing and interchange function position to allow for training and transition to the transmission operator function.

In order to properly track and manage its training initiatives, PACX has hired a dedicated training coordinator, giving accountability for this important function to a defined individual. The evaluation team notes this as a positive observation, as it provides PACX with a resource to actively monitor industry developments and proactively position PACX's training program.

PACX is a NERC-approved continuing education provider, which allows the company to develop and support in-house training programs for its system operators. The evaluation team determined that this is a positive observation, indicating PACX's dedication to understanding the NERC continuing education process and meeting the challenges of a changing industry.

5.2 Organizational Effectiveness

5.2.1 Human Performance

Personnel select and apply appropriate human error prevention techniques commensurate with the importance of assigned tasks to minimize the frequency and consequences of events.

PACX actively promotes human error prevention in its system operations group. Discussions with system operators and operations managers indicated that the expectation and practice is for system switching orders to always receive second-party review and verification. In the control center, the switching orders are to be reviewed by other system operators or control center personnel. In addition, PACX expects field switching personnel to provide an additional level of review prior to implementing the switching. All PACX switching orders receive official approval prior to being issued and initiated.

PACX indicated that it is in the process of developing a training module strictly designed for its system operators, focusing on typical error scenarios for this position. The training will include a review of previous events and discussion of circumstances that led to each event.

APPENDIX 1: Critical Infrastructure

The following discussion will be presented under private letter to the evaluated entity only and will not be included within the public version of the report.

APPENDIX 2: Entity Participants

The following will be presented under private letter to the evaluated entity only and will not be included within the public version of the report.

APPENDIX 3: Documents Reviewed

The following will be presented under private letter to the evaluated entity only and will not be included within the public version of the report.