- NERC Potential Example of Excellence 2: During the exit interview NERC evaluators expressed uncertainty over the exact number of frequency monitoring locations and asked for input. Tacoma Power has five such locations.

As a final note, I have attached a red-line version of the report. This red-line cleans up a few spelling and grammatical errors. It also suggests adding one possibly substantive statement at the end of section 10: "An after-hours call-out process is in place and working effectively."

To conclude, Tacoma Power is committed to reliable service and will work with the WECC to address the issues raised in the NERC Readiness Evaluation.

Sincerely,

William A. Gaines
Power Superintendent / COO

NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Balancing Authority/Transmission Operator Reliability Readiness Evaluation Report

Tacoma Power (TPWR)
Tacoma, Washington

June 4–7, 2007

116-390 Village Boulevard, Princeton, New Jersey 08540-5721
Phone: 609.452.8060 ▪ Fax: 609.452.9550 ▪ www.nerc.com

Table of Contents

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 Tacoma Power (TPWR) representatives on June 4–7, 2007. This report reflects the views and recommendations of the evaluation team regarding the readiness of the TPWR to meet its responsibilities as a balancing authority and transmission operator.

Evaluation Team

Anitha Neve*	Western Electricity Coordinating Council (WECC)
Mitch Needham*	NERC
John Tolo	Tucson Electric Power
Jerry Willms	Lower Colorado River Authority
Paul Cummings	Redding Electric Utility
Jim Pirro	Consolidated Edison Company of New York
Norm Stanley**	WECC

*Team co-leader
**Observer

Organization Profile

TPWR is a municipally owned utility and is a division of Tacoma Public Utilities. Tacoma Public Utilities is governed by a five-member Public Utility Board appointed by the Tacoma City Council. The board appoints the director of utilities, who, with board concurrence, appoints the TPWR superintendent. TPWR's revenues may not be used for any purposes other than ongoing utility operations and debt service on the utility's debt. Certain matters, such as system expansion, bonds, the two-year budget, and utility rates and charges, are initiated and executed by the board, but also require city council approval.

TPWR's 180-square-mile service area (all in Washington) includes the cities of Tacoma, Fircrest, University Place, and Fife; portions of Lakewood and Steilacoom; unincorporated areas of South Pierce County; and McChord Air Force Base and Fort Lewis. The service area extends from northeast Tacoma on the northern end to Roy in the southern end.

TPWR's 2006 peak load was 967 MW, set November 28, 2006. Average system load in 2006 was 567 MW. TPWR's all-time peak system load of 1,255 MW occurred on February 3, 1989. TPWR generation is 100 percent hydroelectric, totaling 713 MW of capacity.

TPWR interconnects with Bonneville Power Administration (BPA) at BPA Tacoma Substation (230 kV); a connection point six miles out of Mossyrock switchyard (230 kV); Mayfield switchyard (230 kV); and Cowlitz Substation (230 kV). TPWR's Wynoochee project interconnects with Gray's Harbor Public Utility District at distribution voltage. TPWR interconnects with BPA/Lewis County at the Mossyrock switchyard. Additionally, a number of BPA loads are located within the TPWR balancing authority area and dynamically transferred into BPA's balancing authority area. TPWR interconnects with Puget Sound Energy (PSE) at PSE's Starwood Substation (115 kV). TPWR's transmission voltages are 230 kV (45 circuit miles) and 110 kV (371 circuit miles).

TPWR is a member of WECC and the Northwest Power Pool (NWPP). The Pacific Northwest Security Coordinator functions as TPWR's reliability coordinator. TPWR registered for NERC functions through the WECC registration process in February 2006.

Executive Summary

The evaluation team found no significant operational problems and concluded that TPWR 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.

TPWR encourages a culture of maintaining reliability and safe operations. TPWR participated with other northwestern entities in identifying future needs based on load growth to position appropriate capital projects in future years. The company noted that the city had offered an early retirement option recently and that efforts are continuing to alleviate the staffing difficulties that arose. TPWR management and employees noted that a general open-door policy exists, including an open invitation coffee discussion group held periodically by the superintendent.

TPWR includes its system operators in key initiatives. For example, operators participate on certain working-level committees that address items such as switching and tagging, procedures review, and training. Since TPWR's system is winter peaking, planning personnel present the results of winter assessment studies to the system operators in formalized training sessions.

In cooperation with TPWR representatives, the team identified three key recommendations.

Overall, the evaluation team identified eight positive observations and three potential examples of excellence. In addition, the team offers 11 recommendations that, if implemented, will enhance TPWR's readiness to operate reliably and maintain the reliability of the bulk power system. The findings are listed in order of importance.

Potential Examples of Excellence

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

1. TPWR has created a very robust communications network by installing a Synchronous Optical NETwork (SONET) (Section 2.3).
2. TPWR has frequency monitoring at five locations throughout the system, prioritized by the quality of the input signal with automatic switching upon signal failure (Section 2.1).
3. TPWR's extensive Dispatcher Candidate Training Program includes the use of a designated trainer (Section 5.1).

Positive Observations

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

1. TPWR forms working-level committees to address specific issues (switching and tagging, procedures review, training) and includes system operators when appropriate (Section 1.2.1).
2. The planning department's 15-year horizon document positions TPWR for ongoing reliability improvements (Section 4).

3. Results of winter assessment studies are presented to the system operators by planning personnel in formalized training sessions (Section 5.1).
4. Organization safety meetings are videotaped and made available to employees (Section 1.2.5).
5. TPWR's backup load controller provides for continuing area control error (ACE) calculations from the primary control center if the EMS is disabled (Section 2.1).
6. The power management group (real-time traders) is supported by TPWR to maintain NERC certification (Section 5.1).
7. The internally developed scheduling tool "Trade Capture" is well-integrated and user friendly (Section 2.3).
8. The power management group has high-quality, internally developed trending tools that incorporate real-time weather information to plan for system changes (Section 2.1).

Recommendations

The evaluation team offers the following recommendations:

1. Develop and implement system operator training activities for items specific to the reliable operation of the TPWR system, including system restoration and emergency operating procedures (Section 5.1)*.
2. Train and conduct drills for all dispatchers and real-time power traders in the activation and use of backup control facilities at least annually to ensure a smooth transition during an emergency (Section 5.1)*.
3. Utilize the supervisory control and data acquisition (SCADA) system to tag devices electronically as a supplement to the current manual mapboard process and to help facilitate a move to the backup control center (Section 2.2.3).
4. Implement automatic time error correction without manual intervention to enable quicker access to data through the EMS (Section 2.3).
5. Develop a formal EMS callout support process for after-hours and weekend response to increase process consistency and better define roles and responsibilities (Section 3.1).
6. Address future system operator resources and shift scheduling to mitigate concerns with upcoming vacancies, required overtime, and limited off-shift training opportunities (Section 1.2.4)*.
7. Confidential information on physical security redacted from public report. See discussion in Appendix 1.
8. Define EMS alarm assignments for specific areas of responsibility in the control center to ensure acknowledgement by the appropriate operator (Section 2.1).
9. Provide the transmission system operators with access to the information available from the system load forecast trending tool used by the power management group (Section 2.3).
10. Develop a system operator shift turnover procedure and include a checklist of important items to be reviewed to increase the consistency of information exchange (Section 2.3).
11. Add a specific statement in the dispatchers' job description regarding his/her authority to operate the system during normal and emergency conditions to ensure the stable and reliable operation of the bulk power system up to and including load shedding (Section 2.2.3).

12. Develop a detailed TPWR system restoration plan that uses TPWR units capable of blackstart (as is assumed in the current plan by indirect reference) or, alternatively, remove the reference to this activity in the published plan (Section 2.4).
13. Confidential information on plans for loss of control facilities redacted from public report. See discussion in Appendix 1.

*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 examples 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.

TPWR is a public municipality with a management team that is knowledgeable and concerned with both public perception and employee engagement. Due to its unique status as primarily a radial load center in the northwestern area, the potential impact of TPWR operations on the western interconnection is minimal, but not overlooked by system management. TPWR places emphasis on planning for system load growth and improving reliability of the loads it serves.

TPWR management indicated that the system is experiencing internal load growth as the load base changes from a primarily winter-peaking system to one of a dual-peaking nature. As existing home heating and ventilation systems become obsolete and are replaced, the local population is switching to heat-pump technology and using air conditioning during summer months. The company is well prepared for this continuing trend and is successfully funding and building transmission resources to reliably serve the load.

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.

The evaluation team noted that TPWR forms working-level committees and teams to address specific issues, such as switching and tagging methods, existing procedure review and management, and training needs for system operators and support personnel. These teams include system operators and other operations personnel when appropriate. The evaluation team notes this as a positive observation, as it increases the corporate engagement level of operations personnel.

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.

The organizational structure of TPWR is aligned to provide for an efficient flow of information between management and employees as well as across functional lines. The evaluation team found that TPWR managers are actively engaged in issues affecting employees, and a friendly and efficient atmosphere exists in the workplace. The operations and planning groups work closely to solve both short- and near-term problems. Discussions with system operations personnel indicated a willingness to initiate communications with planning personnel if unexpected results occur on the power system during approved activities.

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.

The superintendent of TPWR pursues several opportunities for interaction with employees on a regular basis. Most notable of these is an open forum conducted with employees around a coffee break scenario. Discussions with both management and system operations personnel indicated that this is a very well received and attended function that is open to all TPWR employees. The operators described the event as a free-wheeling discussion of issues, including project issues, safety concerns, and employee morale initiatives. The evaluation team was impressed by the effectiveness of this forum, but acknowledges that it is difficult for on-shift operators to attend.

1.2.4 Human Resources

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

System operators at TPWR discussed the current resource levels, particularly regarding relief for training activities. At the time of the evaluation, TPWR had three relief system operator positions approved, but only one was actually in place. The system operators expressed a desire for a relief week that could be devoted to training activities. The evaluation team is concerned with the expected attrition in the system operations organization and recommends TPWR address future system operator resources and shift scheduling to mitigate concerns with upcoming vacancies, required overtime, and limited off-shift training opportunities.

Company management noted that the city of Tacoma had offered an early retirement option recently and that efforts are continuing to alleviate the staffing difficulties that arose. The evaluation team recognizes that this impacts many parts of the operations organization, including training.

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.

TPWR has an extensive internal communications network, including newsletters and press releases. With multiple public service organizations within the municipality, TPWR does have some specialized opportunities, including but not limited to the organization specific safety program. The municipality also has safety programs not specifically related to the electric power system, and the TPWR employees also take part in those programs. Organizational safety meetings are held on a routine basis. The meetings are videotaped and made available to employees, including those on other than day shifts. The system operators expressed appreciation for this inclusion and its positive effect on the operation organization. The evaluation team notes this process as a positive observation.

Internal to the TPWR organization structure, communications are typically undertaken on an as-needed basis. The system operators indicated that this is normally sufficient, but where major events take place, such as the design and construction of the new system operations center, the evaluation team believes improvements can be made. Specifically, the evaluation team believes TPWR should consider a specialized communication process with its system operators about the pending move to a new energy control center to alleviate operator concerns and to improve their engagement with this major project.

2. Fundamentals of Operations

2.1 General

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

The evaluation team determined that TPWR has a well-planned and executed operational communications infrastructure. Gathering and moving operational data is accomplished through the use of company-owned data paths with a high degree of redundancy.

Discussions with TPWR indicated that primary ACE calculation is performed on a system totally independent of the SONET system. In addition, TPWR's backup load controller (a separate computer system) provides for continuing ACE calculations from the primary control center in the event that EMS is disabled. The team notes this backup calculation mechanism as a positive observation.

TPWR's system is largely a radial load center in the northwestern United States. This configuration leads to the potential for system islanding during any catastrophic event. The evaluation team noted that TPWR has frequency monitoring at five locations throughout the system, prioritized by the quality of the input signal, with automatic switching upon signal failure. The team believes this sophisticated frequency monitoring approach constitutes a potential example of excellence within the electric utility industry and commends TPWR for its development.

The power management group has good (internally developed) trending tools that use real-time weather impacts in their processes. Through the use of these tools, TPWR's balancing authority is able to anticipate changes in system loading due to weather occurrences and can plan for

mitigation in advance. The evaluation team believes this is a positive observation, particularly with the use of real-time weather information.

TPWR uses both visual and audible operator notification of system alarms (with audible alarms being based on the importance of the initiating event). The alarms are all available to the system operators, and any system operator is able to acknowledge any alarm. The evaluation team noted that this could lead to an inappropriate acknowledgement, particularly during a major system event or disturbance. The evaluation team recommends that TPWR define EMS alarm assignments for specific areas of responsibility in the control center to ensure acknowledgement by the appropriate operator.

TPWR has adequate reactive reserves deployed throughout the system. Aside from the system generators, these reserves are primarily located on the distribution system, using automatic load tap changing transformers. In addition to these resources, there are capacitor banks available that are typically switched manually on a seasonal basis.

TPWR is a member of the Northwest Power Pool Operating Committee and its Reserve Sharing Program, which is a reserve sharing group. As a member of the program, Tacoma Power is required to determine its share of the contingency reserve requirement including spinning reserves, determine and communicate available reserves, and be ready to assist other group members if needed (in addition to other requirements).

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.

TPWR reported that risks are considered on a real-time basis by the system operators through a situational awareness of current system conditions and operational constraints present. In addition to the use of EMS and SCADA tools, long-term constraints are documented on the system operators "mimic board" as "cautions."

TPWR does not use any special protection systems or remedial action schemes.

2.2.2 Operational Decision-Making

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

TPWR system operators use a systematic process for making critical operational decisions. This process consists of five primary directives: evaluate, mitigate, communicate, restore, and report. The process is promoted and reinforced by WECC regional training and through internal training processes.

2.2.3 Operational Alignment

Organizational structure supports safe and reliable system operation.

TPWR has sufficient agreements in place for the provision of reliability coordination functions and contingency reserves. None of the functions associated with the transmission operator or generator operator responsibilities have been delegated. Outages planned for the system are carefully studied and coordinated with the reliability coordinator. TPWR has work management systems in place to optimize the work done during any specific outage.

TPWR system operators maintain an online log that contains details of operational events. In addition, they exchange information between shifts via e-mail and hard copy notes. The system operator logs are electronic, and the operators always have a printed copy available on the desk. Any hydro system spill issues are available in logs. TPWR's mimic boards are updated to show the current conditions across the system.

TPWR has developed an internal Web site, which is updated in real-time, for disseminating unit operating data, including generation constraints. Unit priority, related pool elevation constraints, and minimum and maximum generation capabilities are available on this Web site. Information, such as unit operating limits, from the generation constraints Web site is manually entered into the EMS. EMS changes automatically generate entries that are placed into the EMS log. An internal generation unit intranet Web site alerts operators to any changes.

TPWR system operators use a primarily manual system for managing hold order tags. Once the tag is approved, it is recorded directly into the system operator's log and is physically documented on the mapboard in the control center. There is also a clearance issue book in hard copy on each system operator's desk. The evaluation team recommends that TPWR utilize the SCADA system to tag devices to supplement the manual mapboard process with electronic records. Electronic tag data would also facilitate any move to the backup control facility.

The evaluation team is satisfied that TPWR system operators understand their authority to operate the power system to promote reliability. The team noted, however, that the system operator job descriptions can be improved in this area. The evaluation team recommends TPWR add a specific statement in the system operator job description regarding his/her authority to operate the system during normal and emergency conditions to ensure the stable and reliable operation of the bulk power system up to and including load shedding.

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.

TPWR uses an industry-accepted EMS/SCADA that was upgraded in 2006. This new version uses Microsoft XP consoles with both UNIX and Microsoft servers. Work is continuing to finalize this upgrade using a remotely located development system. PI servers act as the historian. The corporate local area network is separated from the EMS/SCADA via firewalls. A

standalone load controller, separate from the EMS network, can calculate ACE if the EMS failed. All EMS/SCADA equipment at the primary control center is on an uninterruptible power supply (UPS), with generator backup.

TPWR has created a very robust communications network by installing a SONET system, which it owns and operates. This system, when coupled with a microwave link into major substations, provides TPWR with an excellent data communications network. The control center communicates with the local substations via the SONET network. "CLICK," a local Tacoma Power cable network, uses the same fiber bundle (fibers that are not associated with the control center). The evaluation team believes the TPWR SONET system is a unique approach to data security and constitutes a potential example of excellence.

The remote generation facilities also use a microwave system for additional communications redundancy. TPWR also has ICCP connections and data exchange with five other northwest electric utility entities.

Discussions with TPWR system operators and management indicated that TPWR does not currently have advanced network applications, such as state estimation and real-time contingency analysis, available for its system operators. The evaluation team believes the availability of these tools would improve the system operators' understanding of the power system and suggests TPWR consider providing state estimation and contingency analysis to system operators.

TPWR system operators indicated that all shift personnel understand the shift turnover process. Time is allotted for oncoming operators to review the previous shift notes, review the abnormal condition log, and have a brief discussion with other operators. The mimic board provides system information and is updated in real time. Shift notes regarding generation parameters are listed by project with all constraints and other information. Shift notes relevant to the transmission system are kept by geographic area and typically contain information about any outstanding items, such as relay issues. The evaluation team noted that the distribution operator has the same set of notes for their review. An examination of the shift notes showed that they are entered as line items based on system events with the date and initials of person who entered the note. The evaluation team recommends that TPWR develop a written system operator shift turnover procedure and include a checklist of important items to be reviewed. The team believes that this will increase consistency of information exchange.

Real-time energy traders in power management demonstrated an internally developed scheduling tool referred to as "Trade Capture." The evaluation team cites this well-integrated and user-friendly tool as a positive observation. In addition, the power management group has developed a system load forecasting and trending tool used to anticipate load changes due to weather patterns in the area. The evaluation team believes this would be a useful tool for the system operators and recommends that TPWR provide the transmission system operators access to the information available from the system load forecast trending tool.

TPWR's system operations personnel are aware of identified critical facilities and have procedures and tools to actively monitor and, if necessary, mitigate any changes to the facilities. The design of the TPWR system, being largely a radial load center, mitigates most if not all

transmission system congestion issues. TPWR noted that the company stands prepared to implement any congestion relief measures the reliability coordinator deems necessary.

TPWR manually enters time error correction data into its EMS. The evaluation team recommends TPWR implement automatic time error correction without manual intervention, as is presently done in other WECC entities.

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.

TPWR is a participant in the NWPP system restoration processes. There is a specific section of the NWPP system restoration plan that is dedicated to stabilization of the TPWR system and reconnection with BPA. The section introduction states "Tacoma Power's (TPWR) role in the NWPP restoration plan is to stabilize systems internal to Tacoma Power's Operating Authority area and be available to reconnect with Bonneville Power Administration's (BPA) base grid when directed by the Pacific Northwest Security Coordinator. All loads will be dropped to allow BPA to energize TPWR's system. TPWR will then synchronize to BPA from our Generation Plants."

The evaluation team noted that TPWR has blackstart capability at its hydro facilities, but this is only referenced indirectly in the regional restoration plan. The evaluation team recommends that TPWR develop a detailed system restoration plan that uses TPWR units capable of blackstart (as is assumed in the current plan) or, alternatively, remove the reference to this activity in the published plan.

TPWR has a capacity and energy emergency plan, and its system operators are trained in its implementation. System operators discussed several aspects of the plan with the evaluation team, including load shedding (both manual and automatic); reactive reserves deployment; communications with management, media services, the real-time energy department, and the substations on the system. The plan is segregated based on the type and level of the emergency, involving only those agencies that have a role or are required to be notified.

There are no nuclear power plant facilities within the TPWR system.

3. Fundamentals of Maintenance

3.1 General

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

TPWR has an in-house support staff of four who are available for any required corrective actions. This support group is normally available during working hours and uses an "unofficial" on-call list for support needed during evenings and weekends. The system operators noted that there is no standard protocol that specifies how the on-call list will be managed or used, but that

the operators have been successful in obtaining assistance when needed. In response to abnormal EMS scenarios, the system operators will call or send a text message to an EMS support person's cell phone. The method of notification selected is dependent on the severity of the problem. All of the employees in the EMS group carry company cell phones and make themselves available to facilitate any needed repairs. The evaluation team recommends TPWR develop a formal EMS callout support process to address after-hours and weekend response. This will lead to greater consistency and better understanding of roles and responsibilities within the organization.

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.

The evaluation team determined that the system operations personnel are satisfied with the reliability of the equipment used to monitor and operate the power system.

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.

TPWR uses a "trouble ticket" system to manage corrective actions in the control center. The tickets are issued to system operators and support personnel when a problem is reported and then tracked to completion using an internal software program. Discussions with system operations and management personnel revealed no problems with outstanding work issues in the TPWR control facility.

4. Fundamentals of Operational Planning

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

TPWR involves three primary groups in the analysis of outages being planned on the system: generation, transmission and distribution, and power management. The main objectives are to verify generation and transmission system availability, and results are obtained on a quarterly basis. The power management group performs studies to verify power supply adequacy. The studies take into account system constraints such as reservoir levels, river flow requirements, and any unit deratinges in effect. The rivers play the key role as TPWR relies on seven hydroelectric projects, the Grant County Public Utilities Department, and the Bonneville Power Administration for its generation requirements. The studies look 13 months forward, identifying resource and load balance and any risk exposure in the forms of surplus or deficit generation.

For shorter term analysis, the long-range studies are further refined. TPWR performs daily analysis up to four months in advance, taking into account planned outages and known

constraints. Next day studies provide generation prescheduling and allow for market transactions. TPWR utilizes several tools to increase the accuracy of hourly forecasting, including an online weather service, a database of weather characteristics, and a vendor tool that gathers data from local sites and develops an hour-by-hour forecast.

TPWR's planning group annually produces a 20-year load forecast showing the monthly peak demand and energy requirements. The results are shared with WECC and BPA. TPWR planners noted that the system load is very weather dependent, with an abundance of electric space heating in the residential sector. Studies are coordinated with the system dispatch office, accounting for any anticipated system outages or constraints. TPWR also examines the possible weather extremes, primarily associated with expected system temperatures for a given season. TPWR planners noted that their energy forecast is typically within two percentage points, but peak forecasts can have a wider variance due to the weather impacts.

The Transmission and Distribution Planning group produces a 15-year horizon document used by corporate management to plan and fund transmission system projects. The evaluation team examined the 2005 report, which identified 28 major system projects. The evaluation team believes this approach positions TPWR for continued reliability improvements and notes this as a positive observation.

In addition to the studies mentioned above, TPWR conducts a regular power system load-flow analysis, which compares the SCADA values observed by the system operators with the results anticipated for any contingency scenario. This validation of system parameters is documented via e-mail to the system operators and includes outages as well as load forecasts.

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.

TPWR uses a comprehensive training program designed to adequately equip its system operators for all aspects of normal and emergency system operations. The program consists of both initial and ongoing, reiterative training for all certifiable positions. In particular, TPWR's Dispatcher Candidate Training Program is extensive and includes the use of a designated trainer. The team believes this candidate training program constitutes a potential example of excellence, providing TPWR with an efficient mechanism for the development of new system operators. In particular, having a designated trainer is a commendable step for a utility the nature and size of TPWR.

Discussions with TPWR indicated that real-time energy traders in power management have primarily received on-the-job training due to the long tenure within the group. The group has experienced a low turnover rate, noting that there has not been a new hire in the group for the past five years. In the event that a new real-time energy trader is hired, TPWR would utilize on-the-job training combined with two to three intensive programs to prepare them for the workload. TPWR stated that specific training would be required relating to several in-house

tools, and would be delivered by working with a current expert. Recent changes in the industry have led TPWR to be in a "continuous training mode," with individual supervisors being held accountable for the training of their employees; the evaluation team notes that this activity requires an appreciable amount of the supervisors' time. The training manager noted that TPWR has not established a complete program to maintain certification for the real-time energy traders. At present, TPWR is using one primary vendor for the delivery of NERC continuing education coursework. In the future, TPWR intends to use an external simulator training system for power management's real-time energy traders.

TPWR has not determined that power management real-time energy traders are required to hold NERC certification. However, the TPWR power management real-time energy traders are supported by TPWR to maintain NERC certification. The evaluation team recognizes this fact as a positive observation.

Transmission system operators and system coordinators have a separate training plan that is structured according to the NERC requirements for training. TPWR noted that it sends all transmission system operators to regional training activities, which are scheduled a year in advance. Following the regional training, additional training hours are determined for each operator based on NERC requirements for emergency operations training. The regional entity has specific training requirements, and the region provides appropriate classes to meet those needs. At the time of the evaluation, TPWR had only one system operator for whom they were scheduling continuing education hours.

Newly hired transmission system operators spend one year working with field operations personnel prior to beginning training in the operations center. TPWR discussed the fact that acceptance into the training program is not a guarantee of success on the part of the trainee, and trainees are not eligible for a permanent system operator position without successful completion of the program. This "apprentice" training program is monitored by an internal training committee. TPWR provides specific topic course work for trainees, and that content is developed internally by TPWR staff. Training for experienced operators is provided by external organizations and vendors.

The evaluation team discussed training objectives and opportunities with TPWR's system operators and noted a general lack of TPWR-specific training. The evaluation team recommends TPWR develop and implement training activities for items specific to the reliable operation of the TPWR system, including system restoration and emergency operating procedures, for TPWR system operators. This training would ensure a consistent application of the procedures developed for these scenarios.

Discussions with power management real-time energy traders and transmission system operators disclosed an inconsistent training philosophy. Essentially, not all real-time energy traders and system operators are trained in the activation and use of the backup control facilities. The evaluation team recommends that TPWR train and conduct drills for all transmission system operators and power management real-time energy traders in the activation and use of backup control facilities at least annually. The team believes this will better facilitate an orderly transition to the backup facility should the need arise.

TPWR does not employ a specific shift schedule that facilitates a training period. Employees involved in training activities have shift coverage provided through the use of overtime for other operators. In addition, TPWR management is willing to pay overtime specifically for training activities.

The TPWR system operators discussed some specific internal training sessions that occur on a regular basis. Of particular note to the evaluation team was the information regarding seasonal assessments. Since TPWR is a winter-peaking utility at present, the results of the winter assessment studies are presented to the system operators by planning personnel in formalized training sessions. The evaluation team notes this direct interaction between system operations personnel and the planning organization as a positive observation.

Unusual system operation events, such as accidents and near-misses, are reviewed by an internal, cross-functional team. Any findings from such a review, including lessons learned, are presented to the company management team. Once they have been fully evaluated, these lessons learned are documented, and new processes are prepared and disseminated back to the work crews, including system operators and field operations personnel.

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.

TPWR power management personnel utilize scheduling tools to reduce the possibility of human errors. For instance, a shift-planning tool developed in-house provides alerts for incorrect coding, duplicate entries, and other discernable errors. Transmission system operators, who are more involved with switching on the power system, make a practice of repeating all instructions verbally if received by phone. For the instances where switching orders are developed, the preferred method is to fax them to a local office. If that is not practical, the system operator, via phone or radio, will read the switching order to field personnel, who must document the instructions and repeat them verbatim to the system operator.

Once switching has commenced for a job, the system operators indicated that if an unexpected result occurs (line flows not as anticipated, power outages, etc.), work is to stop immediately until the situation can be analyzed. When a switching error occurs, it is considered a safety issue, and an incident response review team is formed to fully investigate the event. The outcome of the investigation, which may include changes to work practices or procedures, is formally presented to all involved parties within TPWR.

TPWR system operations management noted that human performance is considered in the development of switching and tagging procedures, and training is used to emphasize prevention of human errors. During initial dispatcher candidate training, the candidate is called on to issue mock switching orders to staff downtown, using the correct methods and procedures. The TPWR policy is to provide this training to field personnel as well. Power management personnel are also provided with ongoing training related to human performance.

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.