NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Reliability Coordinator
Reliability Readiness Evaluation Report

Pacific Northwest Security Coordinator
Vancouver, Washington

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

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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 Pacific Northwest Security Coordinator (PNSC) representatives on July 30–August 2, 2007. This report reflects the views and recommendations of the evaluation team regarding the readiness of the PNSC to meet its responsibilities as a reliability coordinator.

Evaluation Team

Paul Reber *	NERC
Paul Rice *	Western Electricity Coordinating Council (WECC)
Robert Ballerstein	New York Independent System Operator
Shel Berg	Midwest Reliability Organization
Jim Hartwell	Northeast Power Coordinating Council
Thanh Luong	FERC
Ron Maki	Aquila
Bert Peters	Arizona Public Service Company
Doug McEwen	Hydro One
Mahmood Mirheydar	FERC
Mitch Needham	NERC
Ed Dobrowolski **	NERC

*Team co-leader **Observer

Organization Profile

PNSC is one of three reliability coordinators in the Western Interconnection and is the reliability coordinator for the Northwest area of North America. PNSC provides reliability coordination for 16 balancing authorities in an area that includes British Columbia, Alberta, Washington, Oregon, Idaho, Nevada, Utah, western Wyoming, and most of Montana.

PNSC is connected to neighboring reliability coordination areas through several WECC transmission paths. The generation resources in the PNSC reliability area are approximately 82,000 MW, including nuclear, fossil, and hydro generation. The coincidental peak load in the PNSC reliability area was 59,971 MW at 6:00 PM on November 28, 2006. PNSC monitors the following transmission lines:

- 264 miles of 500 kV dc
- 40 miles of 260 kV dc
- 9740 miles of 500 kV ac
- 4358 miles of 345 to 450 kV ac
- 444 miles of 287 to 340 kV ac
- 20, 844 miles of 230 kV ac
- 27,396 miles of 115 to 161 kV ac

PNSC is responsible only for reliability coordination but provides some other services. It provides related contingency analysis evaluations for transmission providers as needed and provides training for the operators in its reliability area and neighboring reliability coordinators.

PNSC is a member of WECC. Its footprint is identical to that of the Northwest Power Pool (NWPP). NWPP and WECC provide operating plans, processes, and procedures that PNSC, the balancing authorities, and transmission providers in the area follow.

PNSC is an independent organization with no financial interest in any other entity or marketing function. PNSC is operated by an independent board, whose members are initially appointed by the balancing authorities and transmission providers for which PNSC provides reliability coordination services. To maintain independence, once appointed the board members cannot be removed from the board by the companies. The board training includes orientation outlining the board members requirement to put PNSC needs above any other entity while performing board duties. PNSC is funded by WECC. PNSC has a contract with WECC that specifies how PNSC is to respond to WECC and how WECC provides funding.

PNSC has a staff of 11 reliability coordinators, real-time and next-day planners, and office supervisors. PNSC has three levels of staff, including the president, the lead reliability coordinator who acts as the first line of supervision, and the operators, including the reliability coordinators and the real-time study technicians. The PNSC office is housed in the Bonneville Power Administration Transmission (BPA) facilities. BPA provides control room and office space, site and cyber security, and all energy management system computer and communications facilities and associated support.

Executive Summary

The evaluation team found no operational problems and concluded that PNSC has adequate facilities, processes, plans, procedures, tools, and trained personnel to perform the reliability coordinator functions necessary to maintain the reliable operation of the bulk power system. PNSC's limited scope, being responsible only for reliability coordination, leads to quality work.

PNSC has developed a vision of future reliability coordination trends that includes increased dependence on reliability coordinators, adherence to more standards, and increased job complexity. PNSC has also developed a multi-year plan to respond to these trends that includes additional staffing, additional study capability, and enhanced tools.

PNSC operates under the *Western Electricity Coordinating Council Reliability Coordinator Plan*. WECC is implementing a plan to operate the Western Interconnection reliability coordinators with common equipment, uniform procedures and a single model of the interconnection. With the information provided, the evaluation team understands that the WECC plan is to have the Western Interconnection reliability coordinators operate together as parts of one coordinated unit and provide backup services for each other.

PNSC assists member companies with various services. PNSC does contingency analysis and provides study results for the companies in its area when requested to evaluate the effect of proposed actions on the wide area of the interconnection. It also provides effective training that includes simulator time for the companies in its footprint. The companies participating in this training find it useful and well presented by PNSC.

PNSC uses phasor measurements in the state estimation process. This effort is an industry leading application that enhances state estimator solution and increases the observability and accuracy of the solution estimates. This usage and capability is unique among reliability coordinators.

PNSC provides vital training to its own operators and the companies in its footprint. With the limited PNSC staff, however, this training uses time needed to advance other PNSC initiatives. PNSC is in the process of adding the modeling of remedial action schemes to its real-time contingency analysis to improve its evaluation process. The PNSC backup facilities would be improved by adding independent contingency analysis and WECC and NERC communications systems.

Overall, the evaluation team identified eight positive observations and one potential example of excellence. In addition, the team offers 10 recommendations that, if implemented, will enhance PNSC'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 example of excellence in its reliability readiness evaluation:

1. The use of phasor measurements in the state estimation process enhances state estimator solutions and increases the observability and accuracy of the solution estimates (Section 2.3).

Positive Observations

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

1. The PNSC reliability coordinators have system visibility that includes the state estimator model of the entire Western Interconnection and many strategic frequency points in a geographic display to assist in determining potential island boundaries (Sections 2.1 and 2.3).
2. The PNSC real-time study technician provides timely contingency analysis results to transmission providers lacking that capability (Section 4).
3. PNSC provides quality emergency operations and restoration simulator training to operators both within and outside of its reliability area (Section 5.1).
4. PNSC has a corporate culture that is committed to reliability, resulting in high morale and an engaged workforce (Section 1.1).
5. PNSC requires all staff to be NERC certified with the reliability operator credential (Section 5).
6. Confidential information on plans for loss of control facilities redacted from public report. See discussion in Appendix 1.
7. PNSC is implementing a documentation database that enforces review, provides procedure tracking, highlights changes, reminds the document owner of review dates, and includes testing to verify understanding (Section 1.2.3).
8. The system monitoring reactive reserve display has a depth of view that allows balancing authority reserves to be identified by individual sources (Section 2.1).

Recommendations

The evaluation team offers the following recommendations:

1. Confidential information on plans for loss of control facilities redacted from public report. See discussion in Appendix 1.
2. Expedite, to the extent possible, the addition of remedial action scheme modeling to the state estimator to enhance the real-time contingency analysis solutions and allow voltage stability analysis to provide meaningful results (Sections 2.2.1 and 2.3).*
3. Confidential information on plans for loss of control facilities redacted from public report. See discussion in Appendix 1.

4. Update documentation in operations manual at backup control centers and in evacuation grab bag to ensure operators have access to current policies and procedures (Sections 2.2.3 and 8).
5. Confidential information on plans for loss of control facilities redacted from public report. See discussion in Appendix 1.
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8. Add staff resources so that the training can continue while other initiatives, such as documenting and updating procedures and maintaining current training records, are also completed (Section 5.1).*
9. Request additional time for simulation training to ensure that it meets the specific needs of the PNSC reliability coordinators (Section 5.1).
10. Add support staff to perform administrative functions currently done by the reliability coordinators so that the reliability coordinators can focus on operations and operations support (Section 2.2.3).

*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 a 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.

PNSC has an experienced staff. The company obtains personnel with many years of experience, which reduces the training time needed to bring new reliability coordinators into the shift rotation. Personnel are selected based on operating knowledge and other abilities they bring to the organization. PNSC management evaluates organizational needs while hiring, creating an atmosphere in which employees work together to effectively achieve organizations goals. This interdependence develops a culture of mutual expectations of meeting high standards. These expectations help drive each person to achieve his or her individual goals or risk letting the other team members down.

Organizational goals are formed with significant input from all staff, and individual goals are tailored to align with the organization goals. This coordinated process results in an overall plan where each staff member has input for setting and responsibility for achieving corporate goals, which instills ownership in the process and outcome. The evaluation team commends PNSC for its corporate culture that engages its staff and results in high morale among all.

PNSC has a unique staffing arrangement. PNSC has a contract with each of its personnel — each person either has formed a corporation or works for a corporation that contracts to provide specified services for PNSC. The contracts define the tasks the service providers perform for PNSC, including specific goals. With this method, PNSC has been able to attract experienced personnel for shift reliability coordinators and real-time study technicians.

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.

PNSC's only function is to provide reliability coordination for the 16 balancing authorities and transmission providers that formed the organization. PNSC has no marketing responsibilities for selling or purchasing power or transmission services. This focused scope results in quality work.

The president sets high standards and expects those standards to be upheld by all members of the organization. PNSC has a goal-driven culture, and careful employee selection ensures that the personnel will accept the responsibility to set and meet goals that result in maintaining and improving reliability.

Management leads by example and empowers the operators through high levels of engagement. As mentioned previously, operators participate in and have an ownership of the goal-setting process. The operators are empowered to purchase materials and software or make other decisions that will improve performance. They are also responsible for completing their training, which is included in individual goals.

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.

To reach high standards of performance, PNSC includes the operators in establishing the organizational goals. Management and the operators develop individual goals based on the company needs and each individual's abilities.

PNSC is increasing its planning staff so that it can have around-the-clock planning coverage. As the use of the transmission system increases, better monitoring will help maintain reliability. PNSC management has a multi-year plan to increase the monitoring capabilities in an orderly fashion.

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 organization reviews issues and actions that influence reliability at the highest level. The PNSC board reviews each directive issued by the operators. Since the board consists of personnel from the 16 balancing areas and transmission providers, it is aware of the operational effects of PNSC operator actions. The board interfaces with the president in developing goals for the organization. The president interfaces with the operators to develop a consistent set of goals from the bottom to the top of the organization. The individual operator goals are reported to and reviewed by the board as part if its responsibilities to monitor the organizational goals.

PNSC has purchased and implemented a software database program to monitor its documentation. The database enforces operator review of new documentation and changes to existing documentation, tracks documentation change status, highlights documentation changes for operator review, logs review dates and keeps an updated schedule, and provides a method for operator testing to verify that new documentation or changes to existing documentation are

understood by the operators. This process is coordinated with the other Western Interconnection reliability coordinators so documentation can be shared and easily referenced. This will assist in joint document development and help reduce the differences between the reliability coordinators. The evaluation team commends PNSC for the purchase and implementation of the document management system.

1.2.4 Human Resources

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

PNSC is a small organization — the president and lead reliability coordinator are the human resources department. The president has plans for expanding the staff and has engaged in discussions with prospective individuals to fill the new positions or replace operators who may leave. While PNSC does not have a formal succession plan for its officers, it has an informal plan that has been reviewed with the board.

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.

As a small operation, PNSC does not have any standard corporate communications. The president has a "no door" policy. The president and lead reliability coordinator share an office off the control room, and there is a doorway with no door between the control room and their office. Conversations can take place between the two leaders and between them and the operators on a continual basis. This no-door policy is intentional and is symbolic of the communications at PNSC. The doorway was added to the office, and the door was purposely not included.

2. Fundamentals of Operations

2.1 General

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

PNSC operates on the BPA energy management system (EMS). BPA has a modern EMS with the advanced applications needed by PNSC. The PNSC contract with BPA has provisions for BPA to add applications needed by PNSC, and BPA has supplied those applications. BPA provides a high level of support to the computer systems and associated communications.

PNSC has complete visibility of virtually all of the 100 kV and above equipment in its reliability area and complete visibility of the 345 kV and above and critical 230 kV for the rest of the Western Interconnection. This information is supplied to the PNSC state estimator and real-time contingency analysis. PNSC is adding lower voltages to its state estimator model outside of its reliability area. The evaluation team commends PNSC for wide-area view and modeling of the Western Interconnection.

PNSC primarily monitors the actual flows on the paths as defined by the system planning studies performed by the WECC companies. PNSC can view the individual lines that form each of the predefined paths to investigate flows and determine that all lines are within first contingency limits. PNSC has a frequency display with enough points to assist in identifying Western Interconnection system separations. The frequency points are strategically located in areas of potential separations.

The EMS collects data on most PNSC system voltage points above 100 kV. The operators monitor the central voltage points as appropriate for a reliability coordinator. These voltages are graphically displayed on the trending package included in the PNSC historical database. PNSC has a good system display to monitor the voltage and reactive power. The system displays reactive reserves by area: total reactive power available, the required reactive reserves, and the available reactive power. The operator can determine the reactive power source by individual plants, other dynamic reactive devices, or static devices in each balancing area. The team commends PNSC for providing these resources for monitoring reactive reserves.

PNSC also monitors real-power reserves and operates the reserve sharing system on behalf of NWPP.

The PNSC system has a historical database management system with extensive user-friendly trending capability. PNSC trends all of the major path flows. The EMS alarms on paths close to or above limits, voltages out of limits, or first contingency overloads. The alarm system has three levels of priority and the higher two include an audible alarm. Operators have the ability to set their own "close to limits" alarm points to provide a greater margin when system conditions make that prudent.

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.

PNSC's sole focus is maintaining system reliability. All of its efforts including training, contingency analysis, and new equipment acquisitions are directed towards maintaining or improving system reliability.

The PNSC area has over 50 remedial actions schemes. The schemes are monitored and controlled by the transmission operators, but the status of each is provided to PNSC. PNSC is adding the status to its real-time contingency analysis to improve the accuracy of the solutions.

PNSC is a small organization with all of its employees in an office environment. The operators do not direct any switching. The balancing authorities and the transmission operators handle the real-time actions necessary to protect craftsmen working on the system or the public. PNSC does not have a safety program, but some safety material is available from BPA.

2.2.2 Operational Decision-Making

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

PNSC has a procedure to alleviate operating transfer capability limits within 30 minutes and stability limits within 20 minutes. The procedure has detailed scripts and a timeline for actions to resolve the operating transfer capability limits.

2.2.3 Operational Alignment

Organizational structure supports safe and reliable system operation.

PNSC was formed to perform reliability coordination functions and is not responsible for anything else. While PNSC has an extensive contract with BPA for facilities and support, it does not delegate any of its authority to BPA.

PNSC has agreements with each of the 16 balancing authorities within its footprint, giving PNSC the necessary authority to operate as a reliability coordinator. The agreements are somewhat dated in that they refer to security coordinators and control areas rather than using the current NERC definitions. The evaluation team did not evaluate other areas of the agreements that may need updating.

Outage coordination is achieved through the NWPP Coordinated Outage Subcommittee System. While PNSC does not operate this system, it obtains the necessary outage information for completing the current-day and next-day studies. PNSC does not participate in the outage coordination process other than deferring or canceling outages that jeopardize the security of the electric system as determined by the PNSC current-day or day-ahead planning studies.

PNSC operators have the necessary authority to perform the reliability coordinator function. The authority is outlined in the *Authority of PNSC Staff* memo sent to the PNSC staff and posted on the control room wall.

PNSC operating procedures have recently been updated to be incorporated into PNSC's recently acquired document control program. Many of the procedures have not been put into the procedure books in the control rooms. The evaluation team recommends that PNSC review all policy and procedure hard copies and update them as necessary. Reliability coordinators update the procedures, enter them into the procedure database, and distribute completed copies. Lack of available time has prolonged the process of adding documents into the document control system. The evaluation team recommends that PNSC obtain clerical support staff to relieve the operators and management of the administrative functions they currently perform.

The PNSC operators have a check-off procedure for shift changeover. It uses a standard form that has a field for entering normal and abnormal situations. The operators go over all entries with the incoming shift, starting with outages. The procedure covers any problems the exiting operators experienced or expect.

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.

Through planning studies, the Western Interconnection operators use predetermined paths and calculated transfer limits to maintain the system within its operating limits. Knowing these paths and limits helps operators make decisions regarding the system.

PNSC has three primary tools to identify and respond to system loading limits and manage system congestion. The first is monitoring flows on the predefined WECC paths against the limits determined for those paths by system planning studies. The limits are monitored against schedules and actual flows. PNSC monitors the actual flows on the path and works with the path operator to reduce flows that exceed limits. PNSC has a good working relationship with all the path operators. The path operators will usually assist PNSC in reducing the flows, but PNSC has the authority to reduce flows and on occasion has issued a directive to do so. The actual path flow is determined by summing the individual line flows on the lines that make up the path.

The second tool PNSC uses to verify that the system is operating in a safe state or to identify problems is the real-time contingency analysis program. The real-time contingency analysis shows lines that would reach or exceed operating limits if another line were to be taken (or trip) out of service. If loss of a line would cause a loading problem, the PNSC reliability coordinator works with the transmission operators to bring the first contingency line flow back within its limits. The real-time contingency analysis program runs 500 contingencies. Additional contingencies can only be added through a database change made by system support. The real-time contingency analysis also is capable of analyzing predetermined multiple contingencies to which the reliability coordinator can respond. The real-time contingency analysis program runs every 10 minutes or every other state estimator run. The operators can initiate a contingency run with a click of the mouse.

The third PNSC tool is an off-line voltage stability analysis. The current conditions are downloaded from the real-time system and used for the voltage stability analysis. Many of the Western Interconnection limits are stability limits, and this tool is useful to ensure that PNSC is operating within those limits.

PNSC is expanding its extensive state estimator model. The real-time contingency analysis runs off a state estimator model that includes the entire Western Interconnection. The portion inside the PNSC footprint model includes all elements at 100 kV and above. The Western Interconnection portion outside the PNSC footprint includes all path lines and many of the lower voltages. PNSC continues to model additional lower voltage lines outside of PNSC. The evaluation team commends PNSC for the extent of the state estimator model and for including all of the Western Interconnection. PNSC has 80 percent measurement observability in its network model. The state estimator solutions include phase angle estimations. The state estimator runs every five minutes or when initiated by the operator.

PNSC updates the state estimator model every week. Transmission operators within the PNSC area provide regular updates of electric system changes. The area outside of PNSC is also updated regularly, but sometimes PNSC is not notified of actual changes made. PNSC verifies that the state estimator is correctly modeled by comparing the actual flows with the state estimator calculated flows. Errors greater than 30 MW within the PNSC system, or greater than 80 MW in the rest of the Western Interconnection, are researched and resolved. The model is also verified by a comparison of actual flows to the state estimator projected flows after a system disturbance.

PNSC is adding the status of the remedial action schemes to the state estimator. This will enhance the real-time contingency analysis solutions and allow the voltage stability analysis program to provide meaningful results. The evaluation team recommends that PNSC expedite, to the extent possible, the incorporation of the remedial action schemes and status into the state estimator and the real-time contingency analysis.

PNSC receives phase angle information from 35 phasor measurement unit installations in the WECC area. The information provides measurements and inputs to the state estimation process to increase the observability of the network model and the accuracy of the state estimator solution. This usage and capability is unique among reliability coordinators. The process relies on the availability of phasor measurement information and requires special algorithms to process the information from the devices. PNSC has access to the individual phasor measurement unit information and has implemented this capability well. The evaluation team commends PNSC for using the phasor measurements in its state estimator and is cites this as a potential example of excellence.

PNSC uses the new Western Interchange Tool that provides information on all schedules and also uses a tagging vendor tool to provide information for use in congestion management.

The PNSC reliability coordinators participate in two daily conference calls among the reliability coordinators in the Western Interconnection to discuss operating issues that require coordination. PNSC does not have a prescheduled periodic conference call with the balancing authorities and the transmission providers in its area. Either PNSC or one of the companies under its reliability coordination can request a conference call if needed to discuss system conditions or coordinate actions.

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.

PNSC has the necessary procedures for emergency operation. It has an evacuation plan for the loss of control center equipment, a procedure for line loading relief, emergency coordination procedures, a procedure for capacity deficiencies, special nuclear plant requirements, and restoration plans.

PNSC has one nuclear plant and one other nuclear facility in its footprint. The transmission operator has an agreement for the power requirements and has developed standing orders

Bonneville Power Administration System Dispatchers' Standing Order No 134 and *Bonneville Power Administration System Dispatchers' Standing Order No 133* to meet these requirements. PNSC has copies of the standing orders and has modeled the orders' requirements into the real-time contingency model, which shows when one of the conditions could be potentially violated.

PNSC coordinates and directs system restoration according to the NWPP restoration plan. The plan calls for each balancing authority to restore its resources according to its own plan. Each balancing authority would be in contact with PNSC, which would coordinate that balancing authority with others as necessary.

Each balancing authority has a capacity and energy plan. In the event of a capacity and energy emergency, each balancing authority would implement its own plan. Coordination is outlined in the *Northwest Power Pool - Energy Emergency Plan*. The PNSC role is largely coordination and notification through the NERC Energy Emergency Alert procedure contained in NERC reliability standard EOP-002-0, Capacity and Energy Emergencies.

The operators were familiar with the emergency plans and processes.

3. Fundamentals of Maintenance

3.1 General

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

All maintenance is performed by an experienced BPA staff, based on BPA procedures. BPA performs the maintenance on the computers, software, and communications system. PNSC operators are pleased with the maintenance support they receive.

The EMS and communications are monitored by the control systems monitor. The control systems monitor consists of systems and personnel to verify correct operation of the control systems equipment, applications, and communications around the clock. The control system monitor staff also is the first point of contact for control system problems. It is operated by BPA for BPA and PNSC systems. Often times, hardware, software, or communications problems are found and resolved without the operators knowing a problem existed. The control systems monitor monitors the alarm system and will resolve any problem discovered. The operators will not get an alarm if a problem is detected in the alarm system.

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.

PNSC operates on BPA equipment. BPA does not track EMS downtime or system availability but calculated that the availability was above 99.9 percent with available information. The operators stated that the system is seldom down. Operators did mention that the system had a

bug that caused a couple of outages during system failovers from one system to another, but the outages were only about 20 minutes long.

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.

PNSC and BPA use a work-order system for requesting and tracking significant changes. Resolutions of problems or minor system changes are done with a telephone request.

The control systems monitor staff detects and repairs malfunctioning equipment. The staff at the backup control center tests the backup equipment daily and corrects or repairs any problems discovered.

4. Fundamentals of Operational Planning

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

The PNSC real-time study technician runs next-day and current-day studies using the contingency analysis program. The technician inputs expected system configuration into the current conditions or a saved case that is similar to the expected weather and load pattern for the period to be studied. If the current conditions are used, the technician adjusts the loading for the expected peak, or for the expected conditions for the time he or she is studying. If the technician finds a problem, the reliability coordinator will work with the balancing authorities and transmission providers to resolve it.

PNSC does not approve outages. Unless PNSC or another entity finds a problem with a planned outage, the outage will proceed as scheduled. PNSC started performing next-day studies in December of 2006 and is expanding the staff to enhance this capability. The team supports this expanded study capability.

Seasonal planning is not performed by PNSC. WECC performs summer, winter, and spring/fall period planning studies, and study results are available to PNSC. The WECC studies include sensitivity studies and are used to set the path limits.

NWPP has developed a list of critical electrical facilities that have significant impact on the transmission system. Outages on these systems must be scheduled 45 days in advance. Transmission operators enter outages into the NWPP Coordinated Outage Subcommittee Scheduling System. This system makes all outage requests available to PNSC, and the real-time study technician can retrieve the outages and include them in the current-day and next-day planning studies. The load forecast is provided by each of the individual balancing authorities. Prior to this year, PNSC had difficulty obtaining scheduled outage information from the independent market power generators, but with the now mandatory NERC standards and the associated reporting requirements, PNSC now gets all the scheduled generation outages.

Some of the transmission providers in the PNSC area do not have the capability to run real-time contingency analysis. At the request of a transmission operator, PNSC will run study cases by downloading the current system conditions, modifying those conditions for planned configuration changes, and then performing a contingency analysis. These results are then provided to the transmission operator. The evaluation team commends PNSC for providing this on-demand contingency analysis to help its members ensure that they are operating in a secure state and enhancing the reliability of the system.

The PNSC state estimator and real-time contingency analysis model is the same model used by BPA, and BPA is responsible for maintaining and updating it. BPA does not use the WECC model because the BPA model has been revised by BPA due to differences found between the model flows and actual flows. The Western Interconnection reliability coordinators are developing an interconnection-wide planning model, called the West Wide Model, to use in planning studies, which should resolve the differences between the WECC and BPA models.

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.

PNSC has been adapting its training program over the past several years as the responsibilities of the reliability coordinator and real-time study technician expand and the NERC training requirements increase. PNSC training includes both initial training for newly acquired staff and ongoing training for existing staff. PNSC is a NERC-approved continuing education provider.

For new reliability coordinators, PNSC requires a minimum of 5 years experience as a senior dispatcher at a major control center, but in actuality no one has started with less that 20 years experience. This level of experience has reduced the amount of training needed for new reliability coordination staff. PNSC has developed a checklist of material that the reliability coordinator must know before assuming shift responsibilities independently. Since incoming staff arrive with a basic understanding of electrical system operation, initial training focuses on the wide-area view, the response to system-wide problems, and the PNSC tools. Initial training usually takes about two to three months to complete. The lead reliability coordinator and president periodically review the progress of the trainee and make the final determination whether or not the candidate is ready to assume independent operational responsibilities. The process is not documented. As part of Recommendation 8, the evaluation team recommends that PNSC document that the trainee meets the qualifications to be released to unsupervised operations.

Each existing employee has a goal to complete 80 hours of ongoing training, including 40 hours of emergency training. PNSC uses vendor, off-site, and internal training to meet these requirements and has contracted with a NERC-approved consultant to provide resources for its vendor training. PNSC also sends its staff to WECC training events; the California regional

restoration training; training events run by balancing authorities, such as the Alberta Independent System Operator restoration training; and training offered by the other Western Interconnection reliability coordinators.

PNSC uses the BPA dispatcher training simulator to offer exercises on abnormal system conditions and system restoration. PNSC is restricted to using the simulator when it is not scheduled for BPA's own use. The simulator is exactly like the operating system, and the system model is downloaded to the simulator so it has the latest configuration. PNSC schedules three weeks in June to train staff on abnormal system condition response and potential operating issues as derived from the summer planning study. The operators praised the simulator training and mentioned that additional training time on the simulator would be beneficial. Obtaining more simulator time is difficult because of staffing limitations and simulator availability, due to BPA use. The evaluation team recommends that PNSC request additional time for simulation training to ensure that it meets the specific needs of the PNSC reliability coordinators.

PNSC also uses the dispatcher training simulator for restoration workshops for two weeks in the spring and two weeks in the fall. All of the PNSC reliability coordinators attended one of the restoration workshops last year. The restoration workshops are also open to employees from balancing authorities and transmission operators in the PNSC area and to neighboring reliability coordinators. They include both lectures and simulator time, with emphasis on the simulator time. The PNSC lead reliability coordinator presents most of the training material, but two other staff members are now ready to start delivering training. This training was highly praised by the PNSC staff and in the surveys returned to NERC from the balancing authorities and transmission providers in the PNSC area and the neighboring reliability coordinators. The evaluation team commends PNSC for providing this highly regarded restoration training.

Each year, tutorials are developed for problems that may occur on specific WECC transmission paths due to expected conditions for that year. Each directive issued by PNSC is reviewed. Any lessons learned will be reviewed with the operators and, if necessary, a training module will be developed. The training includes issues that involve coordination with neighboring systems. PNSC also provides training for specific needs, such as operation of the recently upgraded EMS. PNSC receives feedback from course participants and uses this information to improve future offerings.

PNSC sends its lead reliability coordinator, who is also performing the trainer duties, to the WECC train-the-trainer program, and he has also been a presenter at that function. The two employees preparing to lead courses have also participated in train-the-trainer events.

PNSC has developed a spreadsheet for tracking the staff training, with a page for each employee; however, these documents were not up-to-date. While the evaluation team believes that the staff is achieving its training goals, that conclusion was difficult to verify with the PNSC training tracking documentation.

Offering training to other entities and providing simulator training to others strain the PNSC staff. While completing the training courses, other items, such as procedure updates and training-record maintenance, fall behind schedule. Presently, only the lead reliability coordinator

can build scenarios for the training simulator. PNSC plans to add a staff training position, and the evaluation team agrees that this position would improve the training program and help relieve other issues. Also included in Recommendation 8, the evaluation team recommends that PNSC add the resources needed to accomplish training initiatives.

PNSC also provides drills on its emergency procedures. Each reliability coordinator moved to both the interim and long-term backup centers during the past year, operating for several hours from the long term-backup center. While the backup control center is always hot, the drill includes shutting it down and going through a cold startup. Since the long-term backup center was new last year, this was the first year for operation from that site. The interim center is close to the primary center, and the operators have participated in evacuation drills to it for the past several years.

All PNSC staff members are NERC certified with the reliability operator credential. PNSC requires its entire staff to hold this credential, and the evaluation team commends PNSC for 100 percent certification.

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.

All training is directed towards reliability coordination since that is the only function PNSC performs. The operators stated that training reinforces the high priority of reliability, and they believe the system is safer than it was 10 years ago.

PNSC has a small staff of 11 who assist each other and perform an informal peer-pressure review of each other's performance. Since PNSC does not actually operate any equipment, the risk of operator error is lessoned. All actions are open to review by the operators at the entities with whom PNSC interfaces.

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.