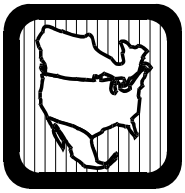
Balancing Authority and Transmission Operator Reliability Readiness Audit Report

Nebraska Public Power District

August 7–10, 2006

Doniphan, Nebraska



North American Electric Reliability Council

Table of Contents

Introduction and Audit Process

The North American Electric Reliability Council (NERC) Reliability Readiness Audit and Improvement Program is one of the commitments of NERC and the industry following the blackout of August 14, 2003, to strengthen the reliability of the North American bulk power system. The program conducts independent audits 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 audits identify strengths and areas for improvement in an effort to promote excellence in operations among these organizations. The document *NERC Readiness Audit Procedure* describes and defines the process used for reliability readiness audits. This document and other documents related to the program are available at http://www.nerc.com/~rap/.

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

The audit team for the Nebraska Public Power District (NPPD) met on-site with NPPD representatives on August 7–10, 2006. This report reflects the views and recommendations of the audit team regarding the readiness of the NPPD to meet its responsibilities as a balancing authority/transmission operator.

Audit Team

James Dodge*	NERC
Shel Berg*	Midwest Reliability Organization (MRO)
Bruce Poole	FERC
Larry Brusseau	MRO
Gerry Steffens	Rochester Public Utilities
Mike Sitarchyk	PJM Interconnection
Pete Miller	Western Area Power Administration

*Team co-leader

Organization Profile

Nebraska Public Power District (NPPD) is Nebraska's largest electric utility, with a chartered territory including all or parts of 91 of Nebraska's 93 counties. The company was formed on January 1, 1970, when Consumers Public Power District, Platte Valley Public Power and Irrigation District, and Nebraska Public Power System merged to become Nebraska Public Power District. Merger properties also included assets formerly operated by Loup River Public Power District. NPPD is a public corporation and political subdivision of the state of Nebraska. The utility is governed by an 11-member Board of Directors, which is popularly elected from NPPD's chartered territory.

NPPD's all time peak load of 2,670 MW occurred on Sunday, July 30, 2006 at hour ending 1900.

NPPD has interconnections with: Western Area Power Administration Upper Great Plains region, the MidAmerican Energy Company, Aquila, Associated Electric Cooperative, Inc., Sunflower Electric Cooperative, Inc., Omaha Public Power District (OPPD), Lincoln Electric System, and Western Area Power Administration Rocky Mountain region.

NPPD owns 3,178 MW of generating capacity. NPPD uses a mix of generating facilities to meet the needs of its customers. The mix includes a nuclear power plant, three steam plants (Canady, Gerald Gentleman Station, and Sheldon), a combined-cycle gas facility (Beatrice Power Station), two wind generation facilities, nine hydro facilities, nine diesel plants, and three gas-fired peaking units. NPPD also purchases electricity from the Western Area Power Administration, which is operated by the federal government. The average mix of fuel to supply NPPD's customers in a typical year is approximately 60 percent from coal, 20 percent from nuclear, 20 percent from hydro, and 0.1 percent from gas or oil.

NPPD operates transmission at 115 kV, 230 kV and 345 kV. NPPD operates 2,717 miles of 115 kV, 682 miles of 230 kV, and 895 miles of 345 kV.

NPPD is a member of the Midwest Reliability Organization (MRO). NPPD is a certified control area in the MRO. NPPD recently registered with the MRO and NERC as a balancing authority, transmission operator, transmission owner, transmission planner, distribution provider, load serving entity, purchase selling entity, resource planner, generator owner, and generator operator.

Executive Summary

The audit team found no significant operational problems and concluded that the NPPD balancing authority and transmission operator 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. NPPD operations and support staff work very effectively together as one cohesive unit, and NPPD's interconnected neighboring systems responded with a high degree of confidence in the NPPD system operators. The audit team identified a number of positive observations and potential examples of excellence. It also offers eight recommendations that, if implemented, will enhance NPPD's readiness to operate reliably and maintain the reliability of the bulk power system.

Potential Examples of Excellence

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

1. *See discussion in Appendix 1.*
2. *See discussion in Appendix 1.*
3. NPPD uses a morning shift-turnover tailgate meeting to exchange important information (Section 6).

Positive Observations

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

1. All NPPD operators and a number of other staff members are certified at the reliability authority level (Section 4).
2. NPPD has two dedicated trainer positions (Section 5).
3. The system operator's work schedule includes dedicated training time (Section 5).
4. NPPD uses an operator training simulator for power system restoration drills (Section 5).
5. NPPD conducts thorough training for responding to partial or full loss of its energy management system (EMS) (Section 5).
6. NPPD has a very good document control process (Section 6).
7. Key staff personnel have remote access to the EMS (Section 12).
8. NPPD performs preventive maintenance ahead of schedule (Section 15).

Recommendations

The audit team recommends that NPPD take the following actions to address issues discovered during the audit process:

1. Develop a documented procedure or policy specifying that system operators follow the directives of its reliability coordinator (Section 2).
2. Provide system operator training for the manual update process of the mapboard (Section 5).
3. Provide scenarios on the operator training simulator for manual load shedding (Section 5).

4. Expand the backup control center training to include real-time operations, with and without EMS, verification of manual operation, and area control error calculation with real-time operations (Section 5).
5. Develop an energy supply operator process for loss of primary control facility (Section 9).
6. Expand the evacuation plan to include an interim operations plan for continued operation of the transmission and balancing area until the operators reach the backup control center (Section 9).
7. *See discussio*n *in Appendix 1*.
8. *See discussion in Appendix 1*.

Discussion

The reliability readiness audit team examined the following key areas during the audit. 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. Agreements

The balancing authority must have agreements that establish its authority as a balancing authority. The balancing authority/transmission operator must have agreements that establish the reliability coordinator for its footprint.

NPPD is an MRO member and a party to the *Mid-continent Area Power Pool (MAPP) Re-Stated Agreement*, which defines NPPD's roles and responsibilities as a control area. NPPD was certified as a control area in the MAPP region in November 2003. MAPPCOR has an agreement with the Midwest Independent Transmission System Operator (MISO) for reliability coordinator services. NPPD has interconnection agreements with its interconnected neighbors.

NPPD is a public power district in the state of Nebraska; however, NPPD does not fall under the definition of public utilities and is not a public utility under FERC jurisdiction. NPPD does have a policy for standards of conduct.

NPPD is a member of the MAPP generation reserve sharing pool (GRSP) and is also part of the MAPP regional transmission group.

2. Operator Authority

The balancing authority/transmission operator is responsible for establishing and authorizing the system operator position that will have the on-shift responsibility for the safe and reliable operation of its portion of the bulk power system in cooperation with neighboring operating entities and the reliability coordinator.

NPPD's procedures document that its system operators and energy supply operators have the responsibility and authority to take actions up to and including load shedding to operate NPPD's

system safely and reliably. The procedure for the system operators is signed by the vice president of customer services and delivery, and the procedure for the energy supply operators is signed by the vice president of energy supply. The procedures are in a notebook called *Procedure Book,* located at the operations desk.

While NPPD is a signatory to the *MAPP Re-Stated Agreement*, a document stating that MAPP members must follow the directives of the reliability coordinator, NPPD does not have its own documented procedure or policy for its system operators to follow the directives of its reliability coordinator. The audit team recommends that, to provide for additional clarity, NPPD develop a documented procedure or policy for the system operators to follow the directives of its reliability coordinator (Recommendation 1).

3. Delegation of Authority

Any functions that have been delegated must be clearly documented. The documentation must recognize that the balancing authority/transmission operator that is delegating the function continues to be responsible for that function.

NPPD does not delegate any of its balancing authority or transmission operator functions, and no other functions are delegated to NPPD.

4. Staff Certification

Balancing system operators and transmission system operators must be NERC-certified operators. The balancing authority/transmission operator must have sufficient NERC-certified operator staff for continuous coverage of the system operator positions.

All NPPD's operators (system operators and energy supply operators) and other specific staff members (transmission system control supervisor, transmission system coordinator, and training specialist) are required to be NERC-certified. These and several additional staff members are NERC-certified at the reliability level. The audit team identified all operators and other staff being NERC-certified at the reliability authority level as a positive observation. NPPD management has indicated they will continue to support the reliability authority level certification.

NPPD's primary control center has the following four system operator positions:

- A control area desk that is responsible for load-generation balance. This position is manned around-the-clock.
- A scheduling desk that is responsible for tagging. This position is manned 20 hours a day, seven days a week with the control area desk providing coverage from 0200 to 0600. There are nine system operators on the control area/scheduling shift schedule rotation.
- A voltage desk that is responsible for the operations of the NPPD transmission system. This position is manned around-the-clock.
- Two switching desks (S1 and S2) — one that is responsible for writing switching orders for work on transmission system equipment and one that performs the actual switching. The S1 desk is manned from 0600–1600 Monday through Thursday and from 0600–1800

on Friday. The S2 desk is manned from 0700–1900 Monday through Thursday. There are eight system operators on the voltage/switching shift schedule rotation.

The energy supply desk is responsible for the marketing activities and is staffed around-the-clock with a five-person rotating shift. The energy supply operator is located in an area of the primary facility separate from the primary control center facility, and does not have security card access to the primary control center.

5. Training

The system operators must be adequately and effectively trained to perform their roles and responsibilities. The balancing authority/transmission operator must have documents that outline the training plans for the system operators. The balancing authority/transmission operator must have training records and individual staff training records available for review.

NPPD has a structured and formal training program. The training program is administered by two training specialists. The audit team identified NPPD having two training specialist positions as a positive observation.

NPPD's system operator work schedule provides for a dedicated 30-hour training week for eight schedule rotations. The audit team identified dedicated training time included in the system operator's work schedule as a positive observation.

NPPD provides training to its system operators in the following areas:

- Initial training for operator candidates

  NPPD utilizes an outside vendor video training program and performs on-the-job training using a checklist of system operator skills and knowledge requirements. In addition, a corporate safety program is provided that includes evacuation plans and general company information.

  NPPD will not allow any system operator trainees to work an independent shift position that requires NERC certification.

- Normal operation

  NPPD's normal operation training is included as part of the initial training program. NPPD's continuing education, which is based on NERC's continuing education hours requirements, includes training in annual operating guides, power system restoration, relay, emergency response, backup control center, and online vendor self-study programs.

- Code of Conduct

  Code of conduct training is provided as one of the first training items. Currently, a new code of conduct training program is being developed. It is scheduled to be rolled out in 2006 and provided annually thereafter.

- Physical and cyber security

  Physical and cyber security training is provided on the first day of employment and annually thereafter.

- Energy management system operation

  NPPD's EMS operation training program is quite extensive. The system operators review a set of Power Point slides on the general operation of the EMS, then go to the simulator and spend several hours on practice, going through every screen to become familiar with all the functions. Operators also spend on-the-job training time with the duty operator to get an idea of what takes place during a shift.

- Procedures and plans for partial or full loss of EMS

  NPPD holds annual EMS-loss training for all system operators. The system operators train on the entire procedure. NPPD's classroom-based session instructs operators in three EMS-loss scenarios: loss of EMS or loss of total communications with remote terminal units, loss of the building with EMS (personnel evacuation of facility), and loss of the building and loss the EMS (control center destroyed or damaged beyond use). The classroom review includes performing a manual calculation of the area control error. After the classroom session, the system operators go to the backup control center and set up EMS terminals and perform a control function.

  The audit team identifies the NPPD's training method for partial or full loss of EMS as a positive observation. However, the audit team recommends that NPPD expand the backup control center training to include real-time operations from the backup facility with and without the EMS, and verification of manual operation and area control error calculation with real-time operations (Recommendation 4).

- EMS/SCADA (supervisory control and data acquisition) tools

  NPPD provides classroom training that includes the use of Power Point slides and then administers operator training simulator tests. Supplemental training materials include job aid sheets and an EMS manual that is located in the control room.

- Capacity and energy emergency plan

  The capacity and energy emergency plan is covered as part of NPPD's annual operating guide training program, which is provided two times per year. NPPD reviews the plan with the system operators and also reviews any specific events that occurred the last time the plan needed to be implemented.

- Blackstart and system restoration

  NPPD drills operators on system restoration during the semiannual MISO reliability coordinator drills done with the Nebraska subregion group. All drills are done from the operator training simulator consoles in the training room, with scenarios provided/revised by the supervisor from another console. The system operators believe this gives them a good feel for various kinds of conditions on the NPPD system.

  NPPD's system operators complete two annual emergency training drills, a power system restoration drill in the spring and an emergency response drill in the fall. All drills are completed on the NPPD operator training simulator, designed to mirror real-time system conditions. The spring drill begins with a six-hour classroom training period. The classroom training consists of a review of NPPD's *Power System Restoration* plan, MISO philosophy, and NERC standards. After the classroom training, the system operators take part in a blackstart drill utilizing the NPPD operator training simulator. The drill is designed to simulate a restoration of service to both Nebraska's eastern and western islands from a blacked out condition. The system operators must identify blackstart units, provide off-site power to the Cooper nuclear power plant, and keep voltages and frequency appropriate for system conditions. The goal is to restore system conditions to normal. The fall emergency response drill, also set up on the operator training simulator, is a set of system conditions for which the system operator needs to respond. It is the system operator's responsibility to react to the situation provided. The goal is to prepare for the next contingency so as not to lose customer service, or keep loss of service to a minimum. NPPD uses the operator training simulator for power system restoration drills rather than table-top exercises; the audit team identified this as a positive observation.

- Load shedding

  NPPD provides operating guide and power restoration training (stages 1, 2, and 3) on the operator training simulator, but there are no scenarios for manual load shedding procedures. The audit team recommends that NPPD provide scenarios on the operator training simulator for manual load shedding procedures (Recommendation 3).

- Nuclear power plant requirements

  NPPD provides training to its system operators on nuclear power plant requirements during operating guide training or when there is a change to the requirements. In addition, there are a limited number of scenarios on the operator training simulator.

The mapboard has the capability to be manually updated by the system operators for loss of EMS mapboard control, but the manual process has not been used much other than when the system was being upgraded. The audit team recommends that NPPD provide system operator training for the manual updating process of the mapboard in event the EMS mapboard driver fails (Recommendation 2).

NPPD's system operators use the operator training simulator often, and they can ask the trainer to set up new operating conditions or parameters.

The transmission system control supervisor makes the final decision on a new system operator promotion to shift work based upon successful completion of the training courses and on discussions with the duty system operators.

6. Operating Policies and Operating Procedures

The balancing authority/transmission operator must have an established procedure to ensure that system operators and operations staff are aware of any changes to NERC, regional, and/or local policies or procedures prior to taking over control of a shift position.

The balancing authority/transmission operator must have shift change procedures for updating incoming shift personnel on the current status of the system.

NPPD has a very good document control process, and the audit team identified this process as a positive observation. NERC, regional, and NPPD operating guides are available to the system operators by electronic access or hard copy. The same documents are available electronically at the backup control center from the backup control center server.

NPPD takes care to inform system operators of new or revised policies and procedures and verify that the operators understand the changes. System operators receive an e-mail when a change is made to operating policies or procedures; they are then required to sign off that they have read and understood the changes. These new/change topics are also brought up at the morning tailgate session. To make sure changes are prioritized, there is a procedure difference between emergency action type items and routine updates or revision of policies. An administrative assistant will check and verify the system operators have signed off on revised guides and will follow up and send them reminders until it is done.

NPPD has a detailed procedure for required shift turnover information and also has a shift turnover tailgate meeting with on-shift system operators and staff personnel. Safety issues are always a part of the tailgate session as well as covering operations activity from the day or night

before, or the last weekend, and then covering the expected conditions and events of the upcoming day.

The audit team believes the shift turnover tailgate meetings should be considered as a potential example of excellence.

7. Planning

The balancing authority/transmission operator and its supporting planning organizations must have a process for day-ahead planning, and for longer-term planning, such as week-ahead, seasonal, and year-ahead, for the operation and outage scheduling of transmission facilities and generation and reactive resources.

The balancing authority/transmission operator and its supporting planning organizations must have agreements with its reliability coordinator to ensure that day-ahead and longer-term plans for the operation and outage scheduling of transmission facilities, and generation and reactive resources, will not jeopardize the reliability of the bulk power system.

NPPD's transmission planning group is responsible for performing long-term planning, including peak studies.

Long-range planning
NPPD participates in the following regional study groups:

- Nebraska Subregional Planning Group — responsible for the development of the ten-year subregional transmission plan
- MAPP Transmission Planning Subcommittee — responsible for the development of the MAPP regional plan
- MAPP Design Review Subcommittee — responsible for coordinated review and approval of all new generators, transmission facilities, and long-term transmission service
- Nebraska Operating Review Working Group — responsible for coordinated review and approval of all operating studies and operating guides
- MAPP Transmission Reliability Assessment Working Group and MRO Transmission Assessment Subcommittee — responsible for seasonal and long-term reliability assessments
- MRO Model Building Working Group — responsible for development of regional planning and operating models
- Ad Hoc Study Groups — responsible for coordinated studies of new generator interconnection requests and underfrequency load shedding

The planning group utilizes ten-year load and capability forecasts, individual substation load projections, and detailed modeling data for the network. The group performs studies to identify system weaknesses and develops project plans to correct the situations. Resource adequacy is studied and assessed in various reports as part of NPPD's membership in state, regional, and national organizations. As a member of the MAPP generation reserve sharing pool, NPPD is required to maintain a 15 percent reserve capacity obligation.

NPPD's transmission planning group performs power flow analysis on all near-term operational models to evaluate seasonal voltage adequacy and reactive requirements. The planning group also performs power flow analysis on the five- and ten-year summer peak load models during the annual long-term planning analysis work to address voltage and reactive adequacy.

The long-range study models include the generator characteristic data and the steady state model requirements as well as detailed dynamic representation. The data also includes reactance data, time constants, and inertia as well as excitation system and governor system data. The transmission system data would include detailed transformer modeling data, transmission line impedance data, load data, and reactive compensation data. The dispatch scenarios involve an economic merit order dispatch scenario for each season loadflow base case.

Peak-season preparation
Various groups take part in peak-season preparation. The MRO reliability assessment committee develops regional reliability assessments (summer and winter) for the MRO region. The planning group develops various operational models built from the present year MAPP/MRO regional models. A contingency analysis is performed on the models, and the results are provided to the NPPD operations group, which is responsible for short-term planning, for evaluating outage requests and other operational issues.

The planning group also determines the limitations and corrective actions for the *Standing Operating Guides*. The information is provided to the system operators for review and the system operators develop the specific operating procedures to accommodate the limits and the corrective actions. The final standing operating guide development is coordinated between the planning group and the system operators.

The seasonal models include the base case models developed from the long-range models. The seasonal models are developed through load scaling, generation redispatch, shunt switching, and net interchange modifications.

Short-range/operational planning
The network applications engineer studies weekly outages, on a week-ahead basis, using the real-time contingency analysis program. The day-ahead process is done in a similar manner. The planning group supports the operations group by performing studies for planned transmission outages, if requested by the transmission system coordinators or the system operators.

NPPD's transmission system is operated to n-1 criteria. The voltages and equipment ratings for an n-1 condition must be within emergency limits, and the system must be able to be returned to a secure state within 30 minutes.

The short-term/operational study models include the base case models developed from the long-range models. Short-term operational models are developed by the planning group

based on operational load levels, regional transfer conditions, and prior outages. In addition, the models are developed through load scaling, generation redispatch, shunt switching, and net interchange modifications. These models and the seasonal models are validated through ongoing coordinated operational analysis between the transmission group and the system operators. The planning group also uses the EMS to review real-time data, state estimator results, and security analysis results. Historical data during disturbances is utilized to validate the off-line models.

Operating guides are issued by the planning group, when required, and communicated to the operations staff. NPPD's *Interface Operating Agreement* with its nuclear power plant identifies the nuclear power plant requirements for off-site power and the requirements are included in the planning process.

Currently, manufacturers' data are used in accordance with capability curves for reactive capabilities of NPPD's generating units. NPPD's model is validated when system disturbances occur, unless reactive capability support has been limited, as determined by the generating plant personnel.

8. Outage Coordination and Communication

Planned outages of transmission facilities and generating units must be coordinated with the reliability coordinator to ensure that conflicting outages do not jeopardize the reliability of the bulk power system.

Information relative to forced outages of transmission facilities and generating units that may jeopardize the reliability of the bulk power system must be shared with affected balancing authorities, transmission operators, and the reliability coordinator as expeditiously as possible.

NPPD's outage coordination and communication involves multiple internal and external groups. Each quarter there are meetings involving the planning group, substation personnel, and field crews before the work is done, and the information is put into the Systems, Applications and Products in Data Processing (SAP). SAP is used as a work management system. A preliminary plan is prepared with most outages scheduled for spring and fall, while some could be completed in the winter. A pre-construction meeting is held and may include the neighboring systems that would be impacted by the maintenance being performed.

NPPD's operations group submits a proposed facilities list of transmission outages to the transmission planning group. The planning group performs load flows analysis. System conditions are set up in the base cases to see if a load level would create any violations on NPPD's system. The operations group will make the final decision on the outages using the compiled data.

All planned transmission work is entered in the MISO outage scheduler. In addition, transmission outages are coordinated via telephone, e-mail, and the MAPP communications network system with neighboring systems.

The energy supply manager coordinates planned generator outage scheduling with the plant's operator. The energy supply operator is responsible for the forced generator outages and uses the MISO outage scheduler to notify the reliability coordinator and neighboring systems.

The system operators contact the reliability coordinator approximately 30 minutes before switching occurs to see if the planned outage is still okay to go. The system operators will immediately notify the reliability coordinator and any affected neighboring system of any forced outages.

9. Plans for the Loss of Control Facilities

The balancing authority/transmission operator must have a workable plan to continue to perform the balancing authority/transmission operator functions that are required to maintain a reliable bulk power system following the sudden catastrophic loss of its primary control facility, or the partial or full failure of its computer facilities or monitoring tools at the primary control facility.

NPPD has a documented *Backup Control Center Plan* for evacuation of the primary control facility. The audit team observed that there was no procedure for the energy supply operator to use for evacuation of the primary facility. The audit team recommends that NPPD develop an energy supply operator process/procedure for loss of the primary control facility (Recommendation 5).

The audit team observed that it could take over an hour to reach and startup the backup control center during an evacuation of the primary control center. The audit team recommends that NPPD expand the evacuation plan to include an interim operations plan for continued operation of the transmission and balancing area until the operators reach the backup control center (Recommendation 6).

NPPD provides its system operators with a box marked for the backup control center, as a grab-bag. The box contains a grab procedure and phone book, work schedule book, switching folders from the transmission desk, and a grab control center cell phone. The system operators would also take a switchman certification book during an evacuation.

10. Tools

The balancing authority/transmission operator must have adequate analysis tools to perform the balancing authority/transmission operator functions. Such tools include state estimation, precontingency and postcontingency analyses capabilities (thermal, stability, and voltage), mapboard (static, dynamic, hardwired, or projected), eTagging program, weather service, interchange scheduling system, outage scheduling system, trending tools, and a voice recording system.

NPPD provides the following tools to its system operators at the primary control center:

- A Siemens SPECTRUM Power 3 EMS system — the EMS has a Network Applications package that includes a state estimator, parameter adaptation, network sensitivity, security analysis, and voltage scheduler.

- Dynamic mapboard with breaker indications, generator status, hot line holds, and other operating information.
- A digital voice recording system.
- One call capability — this allows the system operator to make one call for emergency conditions. The call center then would notify all appropriate NPPD departments, neighboring control centers, and the reliability coordinator.
- SAP system to coordinate outage scheduling.
- Transmission outage reporting/planned outage reporting system.
- Open Access Same Time Information System (OASIS) for transmission service requests.
- Open Access Technology International, Inc. (OATI) software for tagging functions.
- Historical information system for graphing.
- MAPP communications network for communications within the MAPP region.
- Satellite phone.
- Curve tool for trending of data.
- Scheduling program — energy and transmission tracking (ETrak).
- MISO outage scheduler to report generation and transmission outages to MISO.
- Meteorlogix system for weather monitoring.

The EMS, state estimator, and real-time contingency analysis programs are available to the system operators at the backup control center, providing the EMS in the primary facility is operational. In addition, the system operators would have access to OASIS, OATI, and the ETrak tools for e-tagging.

NPPD uses a Badger System to monitor voice and data communications 24 hours a day, seven days a week. The system displays an alarm and sounds an audible alarm to the system operator on a voice or data communications system failure.

11. Load Shedding Plans

The balancing authority/transmission operator must establish plans for automatic load shedding for underfrequency or undervoltage conditions, coordinate load shedding plans with other interconnected entities, implement load shedding in steps to minimize further uncontrolled events, and have plans for operator-controlled manual load shedding to mitigate violations of system operating limits (SOL) or interconnection reliability operating limits (IROL).

NPPD has an automatic underfrequency load shedding program and a manual load shedding program. There is no overlap between the automatic underfrequency load shedding and manual load shedding programs.

NPPD has a documented *Manual Load Shed Procedure,* and system operator information on the load shedding plan is accessed from the Guides & Link page on the EMS. The page contains a listing of load shed blocks on the EMS, and each load shed block indicates the amount of load shed at each particular breaker.

12. Real-Time Monitoring

a. System Visibility

The balancing authority/transmission operator must monitor operating data and status in real time for its area and adjacent areas as necessary to maintain situational awareness of its system.

NPPD provides system operators with SCADA at every major substation and at every substation with a primary voltage of 115 kV and above with 115 kV circuit breakers or circuit switchers.

A single EMS display shows all generation in the NPPD footprint. Another generation display shows current operating points and available operating reserves. There is an overview display that can be zoomed in at any of the substations or generating stations.

NPPD's key staff personnel have remote access (read only) to the EMS via a terminal server. The audit team identified this remote EMS access as a positive observation.

b. Alarms

The balancing authority/transmission operator must have effective and reliable alarming capability. This should be supported in the energy management system (EMS) and/or supervisory control and data acquisition (SCADA) system by alarm priority.

The system operators utilize priorities and groups of alarms. All alarms are in red initially and use a single tone. When the system operator acknowledges an alarm, the alarm tone is silenced and the message in the alarm summary changes color. Green is used for return to normal. Other colors are used for other status indications. The system operators use three levels of alarming on major lines. An early alarm indicates an approaching problem, but not a limit at that point, a second alarm is triggered at the normal limit, and a third signifies that the system has reached the emergency limit.

The alarms are categorized by two factors: technological area and message class. The technological area is a higher level assigned to groups of database points such as at a substation or voltage level within a substation or a device. The message class is a database setting that is assigned at the lowest database level.

The system operators will receive a status alarm if the alarm processor fails. The system operator then notifies an EMS applications analyst. In addition, NPPD has another process, outside the normal alarm processing, to notify the system operator of a processor failure via an audible tone.

c. Frequency

The balancing authority/transmission operator must monitor frequency, direct actions to resolve significant frequency errors, and correct real-time trends that indicate potentially developing problems. Frequency monitoring points should be of sufficient number and from several locations with sufficient area coverage to allow the balancing authority/transmission operator to effectively monitor the balancing authority/transmission operator footprint to determine possible islands.

NPPD system frequency is indicated on several EMS displays. There are 13 frequency sources distributed about the NPPD footprint. Four of these locations will alarm in the EMS when a difference of 0.1 Hz is detected. The primary frequency source will automatically failover to a selected secondary source.

d. Voltage/Reactive Reserve

The balancing authority/transmission operator must monitor voltage levels and take appropriate actions to support the bulk power system voltage if real-time trends indicate potentially developing problems. Voltage measuring points must be of sufficient number and from several locations and voltage levels to allow the balancing authority/transmission operator to effectively monitor the voltage profile of its footprint.

The balancing authority/transmission operator must ensure that reactive reserves are available and properly located to satisfy the most severe single contingency.

NPPD provides it system operators with dynamic voltage information and Mvar data on EMS displays. The system operators have a single reactive display for all static devices. Dynamic reactive reserves are determined by viewing individual generating stations.

NPPD's procedure *DCC-VV-01 Voltage Control Switching* indicates that NPPD's system voltage shall be maintained between 95 percent to 105 percent of nominal. NPPD's approach to voltage control is to keep generators at unity as a rule and use the static devices. The NPPD system is spread out, and var support is very local in nature. So when looking for voltage support in a certain area, the system operators would go to the generating units in that area for reactive support. Any voltage reduction is done from the Kearney control center on the distribution system.

Automatic voltage regulator status is displayed on each EMS generator page, and the system operator will receive an alarm if the status is changed.

e. Critical Facilities

Monitoring of facilities that are critical to the reliability of the bulk power system is a joint responsibility of the balancing authority, transmission operator, and the reliability coordinator.

An established process must determine which facilities are critical to the reliability of the bulk power system. Real-time operating information (data and status) and operating limits for these critical facilities must be provided to the balancing authority, transmission operator, and the reliability coordinator.

NPPD defines critical facilities as:

- All circuits that are elements of the NERC book of flowgates, unless the transmission owner excludes them.
- All circuits that are directly related to the off-site power supply to nuclear power plants and any circuits whose outage causes unacceptable voltages on the off-site nuclear power plant bus, regardless of their proximity to the plant.
- Other circuits determined and agreed to by the transmission owners, reliability coordinator, and the regional reliability organization.

Interconnected reliability operating limits (IROLs) and flowgates are critical facilities, along with the equipment associated with them at the substations. There are four constrained interfaces on the NPPD system.

f. Transmission System Congestion

The transmission operator must monitor transmission flowgates and be prepared to take actions to alleviate congestion in conjunction with, and as directed by, its reliability coordinator.

NPPD's system operators monitor NPPD's flowgates and work with NPPD's reliability coordinator to initiate congestion management, as needed. NPPD's system operators will follow the directives of the reliability coordinator.

g. Load Generation Balance

The balancing authority must monitor the balance of load, generation, and net scheduled interchange in its balancing area. The balancing authority must take actions to mitigate unacceptable load, generation, and net scheduled interchange imbalance.

NPPD's system operators have an automatic generation control display showing status of its generating units. Automatic generation control can automatically be suspended for specific parameters such as loss of tie-line data, bad data, or other reasons determined by the system operator. The system operators, who have primary responsibility for area control error, work with the energy supply operator to return area control error to zero, e.g., by calling units on-line or purchasing additional power.

NPPD's area control error calculation includes a dynamic schedule with the Western Area Power Administration-Upper Great Plains region. The schedule is used to assist in controlling the area control error. In addition, NPPD receives a dynamic schedule

from Tri-State Generation and Transmission for Tri-State load, located in the western part of NPPD's system.

h. Contingency Reserves

The balancing authority must monitor the required reserves and the actual operating reserves in real time, and take action to restore acceptable reserve levels when reserve shortages are identified.

NPPD provides its system operators with an EMS display that shows contingency reserves on individual generating units and a total amount, spinning and nonspinning. The data is automatically sent to the reliability coordinator via an intercontrol center communication protocol link.

i. Special Protection Systems

The balancing authority/transmission operator and the reliability coordinator must be aware of the operational condition of special protection systems that may have an effect on the operation of the bulk power system.

NPPD has two special protection systems installed on its system. These are individually displayed, with associated information, to the system operators on EMS displays.

13. System Restoration

The transmission operator must have a documented system-restoration plan that is consistent with NERC Reliability Standard EOP-005-0 — System Restoration Plans. This restoration plan must be provided to its reliability coordinator.

The transmission operator must be prepared to restore its transmission area following a partial or total collapse of the system and coordinate system restoration with its neighboring transmission operators and with the reliability coordinators.

NPPD has a good *Power System Restoration* plan that covers all NERC requirements.

NPPD participates in the MISO emergency response and power restoration working group and the Nebraska power system restoration working group. The objective of both working groups is to coordinate and share restoration plans and processes.

14. Capacity and Energy Emergency Plan

Each balancing authority must have a capacity and energy emergency plan that address the applicable requirements of NERC Reliability Standards EOP-001-0 — Emergency Operations Planning and EOP-002-0 — Capacity and Energy Emergencies.

NPPD has a *Capacity and Energy Emergency Plan* that covers all NERC requirements.

15. Equipment Maintenance and Testing

Transmission and generator owners must ensure that maintenance of transmission lines, substation equipment, transmission protective systems, and generator relays is carried out according to company, regional, and/or NERC requirements.

NPPD performs transmission protection system and interconnection relay maintenance and testing in accordance with the acceptance tests in the manufacturer's instruction manual to the following schedule:

- All electromechanical and solid state relays every six years
- All microprocessor relays every 12 years
- Electric high-voltage relay functional tests every six months

An Aspen database is used for tracking all maintenance and it has the requirements that NERC and the MRO require for testing of relays. In addition, the SAP work management program is used to tie all the databases together. NPPD's transmission line and relay maintenance is on schedule.

NPPD's generator relay maintenance and testing is on schedule and is performed at a maximum interval of every three years.

NPPD performs transmission-related maintenance and testing on the other parts of the system as well. Substation equipment maintenance is done on circuit breakers and transformers. NPPD performs walk-down inspections of transmission lines that may result in the following types of maintenance: tree trimming and cutting, replacement of hardware, maintenance on structures, and checking conductors.

NPPD performs preventive maintenance ahead of schedule to prevent failures. The audit team identified this practice as a positive observation.

16. Vegetation Management

The transmission operator must have a documented vegetation-management program.

NPPD has a vegetation-management program that covers 5,000 miles of transmission lines. The vegetation-management program appears to be adequate, as no trips on the transmission system related to vegetation-management issues have occurred for many years.

NPPD's technicians foot patrol every mile of NPPD's transmission system and a contractor does an aerial patrol six times per year. Problem areas identified are entered into NPPD's SAP work management system, so that maintenance can be prioritized and scheduled. The program includes monitoring danger trees, for which clearances are determined by voltage class and IEEE standards.

17. Nuclear Power Plant Requirements

Transmission operators must support nuclear power plants in meeting regulatory requirements that allow the plant operators to maintain voltages within design limits and adequate off-site power sources in both normal and abnormal operating conditions (n-1 and system restoration).

There is one nuclear power plant in NPPD's footprint, and NPPD places emphasis on monitoring voltage levels at the plant. NPPD's requirements are identified in the *Interface Operating Agreement*. There are several EMS displays available to its system operators to show nuclear power plant voltage levels. Special alarm settings exist for nuclear area facilities, and there are special procedures for outages and certain coordination activities with OPPD under certain conditions. Also, there are alarms and specifications for operation on equipment surrounding the nuclear power plant.

The system operator demonstrated, using the real-time contingency analysis program, that there are several outage/scenarios available to start from pertaining to how the nuclear power plant voltages are modeled and analyzed.

APPENDIX 1: Critical Energy Infrastructure

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

APPENDIX 2: Audit Participants

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

APPENDIX 3: Documents Reviewed

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