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NORTH AMERICAN ELECTRIC
RELIABILITY CORPORATION

Reliability Readiness Evaluation Report Balancing Authority/Transmission Operator

Midwest Energy, Inc.
Hays, Kansas

to ensure
the reliability of the
bulk power system

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116-390 Village Blvd., Princeton, NJ 08540
609.452.8060 | 609.452.9550 fax
www.nerc.com

Table of Contents

Introduction and Evaluation Process	1
Evaluation Team	1
Organization Profile.....	2
Executive Summary	3
Positive Observations.....	4
Recommendations.....	4
Discussion.....	6
1. Culture.....	6
1.1 General.....	6
1.2 Organizational Effectiveness	6
1.2.1 Foundation for System Reliability	6
1.2.2 Leadership and Management	7
1.2.3 Corporate Oversight and Monitoring.....	8
1.2.4 Human Resources	8
1.2.5 Corporate Communications	9
2. Fundamentals of Operations	9
2.1 General.....	9
2.2 Operational Focus	11
2.2.1 Operational Safety	11
2.2.2 Operational Decision-Making.....	11
2.2.3 Operational Alignment.....	11
2.3 Managing System Configuration	12
2.4 Emergency Preparedness	14
3. Fundamentals of Maintenance	15
3.1 General.....	15
3.2 Equipment Reliability	16
3.2.1 Equipment Performance.....	16
3.2.2 Work Management.....	16
4. Fundamentals of Operational Planning.....	17
5. Fundamentals of Training.....	17
5.1 General.....	17
5.2 Organizational Effectiveness	20
5.2.1 Human Performance	20
APPENDIX 1: Critical Infrastructure.....	22
APPENDIX 2: Entity Participants.....	23
APPENDIX 3: Documents Reviewed	24

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. Documents related to the program are available at <http://www.nerc.com/>.

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 Midwest Energy, Inc. (MIDW) representatives on November 12–15, 2007. This report reflects the views and recommendations of the evaluation team regarding the readiness of MIDW to meet its responsibilities as a transmission operator.

Evaluation Team

Lee Gladish*	NERC
Glenn Eckel*	Southwest Power Administration
Vernon Marion	Oklahoma Gas & Electric
David Wilke	Northern California Power Agency
James Stanton	ICF International

*Team co-leader

Organization Profile

Midwest Energy Inc. (MIDW) is a customer-owned cooperative serving over 46,000 electric and 41,000 natural gas customers throughout western Kansas. Neighboring balancing authorities and transmission operators are Sunflower Electric Power Corporation and Westar Energy. MIDW operates transmission at 34.5 kV (826 miles), 69 kV (261 miles), 115 kV (501 miles), and 230 kV (78 miles). MIDW has eight interconnections with Sunflower Electric (seven at 115 kV and one at 230 kV); and seven interconnections with Westar Energy (three at 115 kV, three at 34.5 kV and one at 230 kV).

MIDW is registered with NERC as a transmission operator, transmission owner, transmission planner, and load-serving entity. Southwest Power Pool (SPP) serves as the reliability coordinator. MIDW directs all transmission operation functions from its system control center. Westar Energy provides the MIDW balancing authority functions.

MIDW owns and operates a small amount of generation at three facilities, totaling 24 MW, which are used primarily for emergencies or peaking purposes. The MIDW system peak of 338 MW occurred July 26, 2006. Power purchase agreements serve over 99% of the MIDW load.

Executive Summary

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

The evaluation team observed that MIDW has a culture of open communications and supports employee feedback at all levels of the organization. Safety and reliability are the highest priorities.

MIDW has a unique systematic approach to identify and analyze relay misoperations that the evaluation team identified as a potential example of excellence. Other notable findings include the corporate commitment to system improvements and training. Key recommendations include providing a real-time system overview display and system parameter trending capabilities to enhance the operator awareness of system conditions.

Overall, the evaluation team identified nine positive observations and one potential example of excellence. In addition, the team offers 17 recommendations that, if implemented, will enhance MIDW'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. MIDW developed a systematic approach to identify and analyze relay misoperations and documented it in its *Analysis of Protection System Misoperations* guide. This unique guide provides a flow chart that enables protection engineers to quickly determine the cause of a relay misoperation and take appropriate corrective actions to remedy the problem (Section 3.1).

Positive Observations

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

1. MIDW proactively worked in conjunction with neighboring systems to mitigate an identified potential voltage excursion following an n-1 occurrence at a key substation. MIDW's corrective action to upgrade a pre-existing 115 kV line to 230 kV was one of the key components to remedy this condition (Section 1.2.3).
2. MIDW internal culture supports open communications with senior-level management and all other levels of the organization, as evidenced by monthly meetings with system operators and management, monthly meetings with area superintendents and vice presidents, and annual meetings with the CEO and all MIDW employees (Section 1.2.5).
3. Management supports the system operator training that exceeds requirements set forth by NERC, as evidenced by significant increases in the training budget over the past few years and an expectation to continue this commitment (Section 1.2.2).
4. MIDW uses an online simulator as part of the annual system operator training plan (Section 5.1).
5. The MIDW radio system operator console is user friendly and has multiple alarm capabilities for various system failures (Section 2.3).
6. MIDW developed an innovative system operator training simulator for SCADA operation (Section 5.1).
7. MIDW has an education/training reimbursement program for all employees to support the cost of education for personal development (Section 5.1).
8. MIDW uses color-coded receptacles to identify critical circuits fed by uninterruptible power supplies (Section 2.2.1).
9. MIDW has a proactive employee succession plan (Section 1.2.4).

Recommendations

The evaluation team offers the following recommendations:

1. Confidential information on physical security redacted from public report. See discussion in Appendix 1.*

2. Provide a dedicated dynamic visual representation of the entire MIDW transmission system on a single display (independent of the system operator SCADA consoles) to improve system operator situational awareness (Section 2.3).*
3. Provide selectable trending capability of real-time SCADA data points to enhance system operator awareness of system trends (Section 2.3).*
4. Confidential information on Computer Systems and Support redacted from public report. See discussion in Appendix 1.
5. Add unit reactive loading to the generator information display (Section 2.3).
6. Enhance the system operator training program (Section 5.1):*
 - a. Provide annual refresher training on MIDW system restoration and capacity shortage plans.
 - b. Enable the manager of operations to attend NERC “train-the-trainer” seminars.
 - c. Develop training modules for system operators from review of lessons learned from past disturbances.
 - d. Employ subject matter experts to present seasonal assessments to system operators.
 - e. Staff critical locations during loss of primary control center drills.
7. Add more frequency sources in key locations to help system operators identify probable internal islands (Section 2.3).
8. Develop a coordinated capacity shortage plan with the host balancing authority to provide more certainty of receiving assistance during a capacity shortage since MIDW has limited options (Section 2.4).
9. Confidential information on plans for loss of control facilities redacted from public report. See discussion in Appendix 1.*
10. Automate customer gas trouble calls, similar to electrical trouble calls, to relieve the system operator workload (Section 2.2.3).
11. Establish a formal document management program that includes attributes such as ownership, author, required approvals, review cycle, revision history, distribution, and receipt verification to ensure system operators have the most up-to-date policies and procedures (Section 2.2.3).
12. Create a method to document abnormal alarm-level settings due to ratings changes or other factors to facilitate communication of abnormal conditions to system operators, the reliability coordinators, and neighboring systems (Section 2.1).
13. Install system analysis instrumentation, as appropriate, to facilitate system disturbance analysis (Section 3.1).
14. Develop a SCADA maintenance/update tracking system (Section 3.2.2).
15. Develop a formal process for notifying all operations personnel of SCADA revisions and updates (Section 3.2.2).
16. Add the attributes of the *Statement of Operational Authority* document to the system operator job description to enhance understanding of the system operator authority (Section 2.2.3).
17. Develop an alarm or other automatic notification method to alert the system operator of an alarm processor failure (Section 2.3).

* Identified by MIDW 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 the 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 *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.

System reliability on the transmission and distribution systems is a topic at each monthly Board of Directors meeting. MIDW senior management reviews monthly and annual reliability statistics. Each year, senior management develops a detailed business plan that includes reliability metrics and targets for the coming year; this plan is approved by the Board of Directors.

In order to achieve many of the goals, MIDW has plans in place to mitigate developing reliability issues. MIDW has several projects underway to enhance reliability, including a 230 kV transmission line upgrade, a new 115 kV line, a five-year plan that includes 230 and 115 kV line upgrades, several long-range projects identified in the SPP Transmission Expansion Plan, and numerous rebuilds on the 34.5 kV system.

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.

MIDW has a combined vision and mission statement and a “key values” statement:

Our Vision and Mission:

To be the premier regional provider of safe, reliable energy products and services, working to improve the lives of our customer-owners.

Our Key Values:

Safety, Integrity, Continuous Improvement, Collaboration, Community Focus, Innovation.

MIDW uses a clearly defined process when making critical decisions regarding system reliability issues. The process begins by identifying the issue and its implications, followed by the development, review, and approval of mitigation plans or other appropriate responses. The plans factor in compliance with NERC and regional standards. Risk factors and potential outcomes are then identified. The ultimate decision must balance these factors and provide a solution that maintains or improves system reliability in a reasonable manner.

Although MIDW is a smaller utility, and not central to the interconnected system, the evaluation team noted that the company makes a notable, significant effort to be involved at all levels of system coordination, operation, and training.

1.2.2 Leadership and Management

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

The MIDW executives and managers work cooperatively to examine and resolve issues that may impact system reliability. When an issue is identified, they take an organized approach to mitigate the situation:

- Investigate what changed and the reason for that change.
- Evaluate the implications of the change and what impact it will have on reliability and system operations.
- Determine how to respond to the change and determine if employees possess the knowledge and tools to implement the change.
- Determine if supplemental training or equipment is needed to fully implement the change.

The MIDW management staff is active in industry groups and forums. In many cases, the policies and procedures governing day-to-day operations and the reliability of the bulk power system are a direct result of the work done in these committees or groups. Below is a list of groups and committees with members or active participants from MIDW:

- NERC Planning Committee
- Southwest Power Pool — Market Operations Policy Committee (Vice Chair), Regional Tariff Working Group, Transmission Working Group, Operations Training Working Group.
- National Rural Electric Cooperative Association
- Kansas Electric Cooperatives
- Kansas Transmission Authority (Chair)
- Utilities Telecommunications Council
- IEEE
- Midwest Energy Association

The evaluation team notes a positive observation that the MIDW management supports system operator training that exceeds requirements set forth by NERC, as evidenced by significant increases in the training budget over the past few years (this commitment is expected to continue in the future).

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.

MIDW holds at least one system operator meeting per month attended by all six system operators and the manager of transmission operations and scheduling. The vice president of energy management and supply also attends periodically or as conditions warrant. These meetings create the opportunity to review and assess performance on past events to determine what could have been done better and what was done well. MIDW calls special meetings after major storms to review events. New policies or changes in existing policies occasionally result from these meetings. Other departments within MIDW are invited to attend the monthly (or special) operations meetings to discuss any performance issues or policies about which they have concerns. At the end of each monthly operations meeting, the system operators have the opportunity to raise any other matters they believe require discussion and possible procedural changes.

In addition to monthly system operator meetings, area superintendents meet with the vice president of operations once a month, usually at the same time, to allow the opportunity for both field operations and system operations to have a joint session if necessary. If there are topics of discussion in one meeting that is of interest to the other group, these items are reviewed in advance, and a “liaison” is established to facilitate joint discussion.

MIDW has no internal mentoring programs and no formal performance review process; however, there are informal evaluations to benchmark employee performance. MIDW management offered incentive compensation tied to corporate financial performance to union employees (including system operators), but the offer was declined. This is an ongoing effort with the eventual goal to provide incentive compensation for all employees.

The evaluation team cites the results of the MIDW oversight and review of significant events as a positive observation. MIDW proactively worked in conjunction with neighboring systems to mitigate an identified potential voltage excursion following an n-1 occurrence at a key substation. MIDW’s corrective action to upgrade a pre-existing 115 kV line to 230 kV was one of the key components to remedy this condition.

1.2.4 Human Resources

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

The MIDW succession plan includes the flexibility of hiring employees in advance of the actual need. An informal mentoring program allows individual departments to identify potential internal replacement employees and have those employees “shadow” the more experienced subject matter experts. The evaluation team cites MIDW’s proactive employee succession plan as a positive observation.

MIDW senior management has identified succession planning as an area that needs to be addressed in more detail, and succession planning is addressed in the 2008 business plan. A formal written succession plan does not currently exist, but certain employees in key positions are cross-trained to perform a variety of tasks. One benefit MIDW has over many larger utilities is that many employees have a wide variety of task responsibilities and are exposed to a variety of issues. This allows for a broader understanding of day-to-day company operations and a general understanding of how things work in the industry.

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.

MIDW has a firm commitment to employee communications at all levels. MIDW engages in frequent meetings among the system operators and all other company departments, including the highest levels of management. Semi-annual supervisor meetings provide an open session to review the current business plan and suggest any changes or potential additions to future business plans. All supervisors have an open-door policy, and there are many monthly departmental meetings to facilitate this type of discussion. MIDW holds senior management meetings several times per month, providing shared discussions among all departments. All employees meet with the CEO two times per year in an open session and have the opportunity to suggest changes or comment on current practices.

In the event of a system emergency, the system control center is the clearing house for all communications, both internal and external. Depending on the magnitude and duration of the emergency conditions, MIDW may delegate some of the command, control, and communications to three major operations centers located in district offices. The district offices primarily address distribution operation issues. All decisions related to transmission and resources are coordinated through the system control center. The response team meets on a regular basis during emergency conditions to provide status updates, develop recovery plans, and coordinate restoration.

MIDW publishes a weekly newsletter from the CEO titled “Shoptalk” that is sent to all employees by e-mail or paper copy.

The evaluation team cites a positive observation for the MIDW internal culture supporting open communications with senior level management and all other levels of the organization. This is evidenced by monthly meetings with system operators and management, monthly meetings with area superintendents and vice presidents, and annual meetings with the CEO and all MIDW employees.

2. Fundamentals of Operations

2.1 General

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

MIDW has a high-quality supervisory control and data acquisition (SCADA) system, which has evolved through several upgrades and modifications. The operators are satisfied with the performance, data received, and the operational capability. It has no advanced applications or energy management system (EMS) software, but the evaluation team does not see a need for these in the MIDW system.

MIDW established operating limits based on SPP planning criteria. MIDW's normal voltage operating range is plus or minus five percent of nominal, while contingency voltage limits are plus or minus 10 percent of nominal and constitute a system operating limit (SOL). If an element is close to reaching an SOL level, the MIDW system operator calls the reliability coordinator for assistance and notifies neighboring transmission operators. The parties jointly agree upon and implement action plans. MIDW does not have any areas with recurring problems meeting scheduled voltages or where specific levels of reactive reserves are required. MIDW deploys capacitor banks to maintain reactive reserves on a local basis and minimize the import of reactive power. A minimal amount of generation is also available, though not always on-line, to assist with maintaining reactive reserves. Automatic voltage regulators are installed on all generating units modeled in the MIDW area. Changes in the status of AVR's are coordinated with SPP.

MIDW monitors all transmission facilities 69 kV and above in real time. SCADA information and alarms are the primary means to alert system operators of system operating limits. All monitored elements have established operating limits set in the SCADA system and available in hard copy in the control room. Monitored facilities include bus voltages, transformer ratings, and thermal line ratings. The reliability coordinator has no voltage or transient stability issues identified within MIDW transmission system. MIDW updates the list of critical facilities annually and when changes are warranted. Internally, MIDW considers all facilities 115 kV and above as critical.

Any time that a system element is de-rated, the information is immediately conveyed to the system operator. The system operator updates the rating of the equipment and corresponding alarm limits in the SCADA system. If this information impacts reliability to the bulk power system, it is to be shared with the reliability coordinator and neighboring systems immediately. The evaluation team noted there is no documented record of changes to the alarm values and recommends that MIDW create a method to document abnormal alarm-level settings to facilitate communication of abnormal conditions.

MIDW monitors voltages at 230 kV, 115 kV, 69 kV, 34.5 kV and various distribution voltages. Voltage values are available on three system one-line displays and on individual substation one-line displays. MIDW uses shunt capacitors on the 34.5 kV system for voltage control and as a source of reactive power. Some shunt capacitors are automatically switched by voltage level controllers, and others are switched remotely by the system operator. MIDW has load tap changers on all 230/115 kV, 115/69 kV, and 115/34.5 kV transformers. Under normal operating conditions, all load tap changers are operated in the automatic voltage regulation mode. The system operator has the ability to switch to manual control and step the transformers as needed. The system operators use a capacitor bank status display that shows status, capacity, and output of all static capacitor banks on a single screen.

SPP runs all real-time contingency analysis and state estimation calculations for MIDW.

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.

MIDW has a policy that requires “tailgate” meetings before any work on control or communications systems in the control center. The control center staff discusses anything abnormal with the system operators. The evaluation team notes as a positive observation that MIDW uses color coded receptacles to identify critical circuits fed by the UPS to prevent unintended use.

Field crews also have a tailboard meeting prior to starting all jobs. Field personnel inspect jobs performed by contractors during and after completion. All contractors are subject to the MIDW safety standards, and all contract personnel are constantly escorted while in a secure area.

MIDW requires five days notice for planned switching procedures. The MIDW system operators check switching orders for accuracy and monitor line loadings and voltage levels to compare actual results with expected results.

There are no special protection systems or remedial action schemes in the MIDW system.

2.2.2 Operational Decision-Making

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

In many cases, the system operator is forced to make a decision when information is scattered and/or incomplete. The MIDW system operators are trained to consider key factors:

- Recognize anomalies in the situation
- Develop a potential course of action
- Prioritize duties
- Develop expectations for course of action
- Identify reasonable goals
- Implement the required course of action
- Continue monitoring system conditions

MIDW has no formal process for congestion management; the only required response is to curtail transactions as directed by the reliability coordinator. MIDW has no interconnection reliability operating limits (IROLs) or SOLs as defined by the region.

2.2.3 Operational Alignment

Organizational structure supports safe and reliable system operation.

The MIDW organizational structure is typical of a control center environment. MIDW has adequate staff, supervision, and management to effectively operate in a reliable manner.

MIDW relies heavily on monthly meetings of system operations personnel to disseminate information on new policies or procedures and changes to existing ones. MIDW also uses intercompany e-mail, but there is no confirmation requirement. MIDW has an informal policy to review operational documents annually but does not track the progress of the effort. Most documents have a record showing when they were reviewed and by whom; however, not all documents have a record of ownership or responsibility. The evaluation team recommends that MIDW establish a formal document management program that includes attributes such as the following: ownership, author, required approvals, review cycle, revision history, distribution, and receipt verification.

The system operators use several items to make the shift change efficient, and document shift events for future reference. They use a “daybook,” commonly known as an operator logbook, a whiteboard for scheduling and notification of major items, switching program forms, alarm logs and tags (SCADA system based), and personal notes. The incoming system operator reviews these items and discusses the system status with the outgoing system operator prior to taking over the shift position. The only official record of a shift change occurs when the system operator makes a log entry. Once a system operator logs on to the computer, any entry he makes is identified with his name.

The system operators have complete authority, without needing management approval, to implement the MIDW operational plans, to implement all MIDW emergency plans, and to address system reliability issues. This authority is documented in a *Statement of Operational Authority* signed by two vice presidents and the control center manager. A copy of the letter is posted on the wall of the control room along with the NERC operator certificates. The evaluation team recommends that MIDW add the attributes of the *Statement of Operational Authority* document to the system operator job description to enhance understanding of the system operator authority.

The MIDW system operator answers the telephone for routine customer outage and general complaint calls for both electric and natural gas customers. MIDW has an automated call system for electric complaints but not for gas complaints. The evaluation team recommends that MIDW automate customer gas trouble calls, similar to electrical trouble calls, to relieve the system operator workload.

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.

The MIDW operations control center has a conventional layout, with two fully functional operator stations on a common console with SCADA and radio systems. The evaluation team

notes a positive observation for the user-friendly MIDW radio system operator console that has multiple alarm capabilities for various system failures.

MIDW does not have a traditional EMS, as all balancing responsibilities are performed by Westar Energy. The SCADA system has three sub-system overview displays, a generation overview display, and a capacitor bank overview display. There is no overall system display, nor is there a dynamic system mapboard or display. Paper system diagrams are posted on walls and on each operator station. The lack of a single system overview SCADA display, combined with a lack of a dynamic map display system introduces the possibility of a delay between a system event(s) and operator awareness of the existence, nature, and extent of the event(s). For a major system event(s), the system operator must visually sort alarms, scan multiple system displays, and evaluate the presentations to grasp the true system status. The evaluation team recommends that MIDW provide a dedicated dynamic visual representation of the entire MIDW transmission system on a single display independent of the system operator SCADA consoles to improve system operator situational awareness.

The MIDW SCADA has telemetry, status, and control of the transmission system and selected distribution devices. MIDW uses the trending application to monitor only irrigation loads at certain substations, although the interviewed operators report that MIDW intends to expand the trending application to other unspecified items in the future. There are no dedicated strip chart recorders; all trending is from within SCADA environment. The evaluation team recommends that MIDW provide selectable trending capability of real-time SCADA data points to enhance system operator awareness of system trends.

The time delay for the SCADA to recognize a status change is (on average) three seconds. MIDW monitors all alarms in SCADA and has alarm set points for all key components. Stage 1 alarms (typically 5%) are based upon either transducer alarms or physical equipment overloads, and Stage 2 (10%) is true equipment limitations. Some alarm limits are based upon SPP criteria to avoid steady state overload criteria.

The SCADA system provides conventional color-coded alarm tabular displays and audibly differentiated tones. In addition to typical system parameter alarms, there are remote terminal unit (RTU) failure alarms, communication system failure alarms, SCADA system failover alarms, and ICCP system failure alarms. The system operators do not have a discrete alarm indicating failure of the SCADA alarm processor. The evaluation team recommends that MIDW develop an alarm or other automatic notification method to alert the system operator of an alarm processor failure.

MIDW uses Retail Office for its interchange scheduling program. It automatically imports hourly meter data from SCADA and calculates hourly interchange values. Retail Office also uses a forecasting tool that compares historical load data and current weather forecasts to derive a load forecast. Additional weather data — including short-term forecasts, warnings, and radar coverage — are available through a variety of commercial and Internet services. Remote temperature indication is available from two MIDW substation sites. MIDW uses a vendor (OATI) program for tagging applications.

Generator reactive reserves are monitored on individual generating unit displays, not on a single display as is available for other generator data. The evaluation team recommends that MIDW add unit reactive loading to the generator information display.

MIDW has two frequency monitoring points displayed only on two substation one-line displays. The two frequency monitoring points are too close to each other to give a good indication of an island condition. All frequency input signals are delivered through SCADA; there is no additional means to monitor system frequency in the event of total SCADA failure. The evaluation team recommends that MIDW add more frequency sources in key locations to help system operators identify probable internal islands.

MIDW uses a digital voice recorder to record all telephone lines in the system control center. The control center manager has access to the voice recorder; the system operators do not.

In summary, the evaluation team observed that the MIDW system operations tools are adequate to good, with a few deficiencies as noted. MIDW maintains a professional attitude regarding system reliability and has a strong commitment to the safe operation of the system.

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.

MIDW has several emergency plans. The *Emergency Operations and Energy Emergencies* plan addresses staffing, fuel supply and inventory, generator availability, environmental constraints, system energy use, load management, public load reduction appeal, and non-critical substations and feeders subject to service interruption. The *Black Start Guide and Plan* addresses roles and responsibilities, generation restoration, transmission restoration, load restoration, and tie-line restoration. The *System Restoration Plan* addresses assessing the extent of the blackout, communication and responsibilities, restoration, and substations and feeders with critical loads. The *Loss of Control Center Functionality* plan is discussed in detail in Appendix 1. These documents are all available in the system operations center and are sufficiently detailed and adequate with respect to procedures, prioritization, and required actions.

The MIDW capacity shortage plan is based upon NERC energy emergency alert procedures and is highly dependent upon the reliability coordinator and the host balancing authority, Westar Energy. MIDW is not a balancing authority and has minimal responsibilities in implementing a capacity or energy emergency plan. Available responses for MIDW are mostly related to load reduction. MIDW has no long-term agreements in place; most transactions are short-term bilateral deals through the market. The evaluation team recommends that MIDW develop a coordinated capacity shortage plan with the host balancing authority.

The MIDW system operators perform manual load shedding using a SCADA display. The load shed procedure prescribes a prearranged order to open distribution feeders. There is no automated program to cycle feeders. MIDW participates in the SPP underfrequency load shedding (UFLS) program through coordination with Westar Energy. The frequency trip settings and amount of load shed at each frequency is determined by coordination studies.

Westar Energy files compliance documents on behalf of MIDW, and it is understood that MIDW UFLS is included in Westar Energy's reported values. There is no overlap of the manual load shedding and the UFLS program. Trip points and time delays on generation protection equipment are designed to protect generating units from damage while coordinating with the UFLS program.

MIDW does not own any blackstart units capable of carrying significant non-local load. MIDW has no specific plan of action dictating an order of restoration because there is no defined path to a generation facility, creating uncertainty as to which area or substation will be energized first. SPP has the overall responsibility for coordinating blackstart restoration.

The MIDW synchronizing capabilities include synchrosopes at manned generating stations and sync-check relays at interconnection points. It is highly probable that MIDW would black out during a separation. Synchronizing would be accomplished at the power plants.

MIDW has limited ability to take corrective action to aid neighboring systems beyond voltage control, self-generating to the extent possible, and shedding load. The MIDW system operators have experience in all these areas, primarily due to past weather-related events, and are well prepared to implement corrective actions.

3. Fundamentals of Maintenance

3.1 General

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

MIDW employs a communication, relay, and SCADA supervisor and three technicians dedicated to the support of the control center, with SCADA support as the primary responsibility. There is at least one system support technician available 24 hours per day, 7 days per week. The maintenance staff reviews all off-hours support events on the following day for technicians to have a common understanding of control center support issues. The evaluation team noted an effective maintenance effort by MIDW, evidenced by a record of no unexpected loss of SCADA in the last five years.

The control center support group is also responsible for relay maintenance; the group reviews all relay operations on a case-by-case basis, gathering and analyzing relay target information. Relay misoperations are identified using a systematic approach documented in the *Analysis of Protection System Misoperations* guide. This logic diagram-type illustration is a flow chart that enables protection engineers to quickly determine the nature of a relay operation; after determination, the engineers can either substantiate a correct response or investigate other factors that may have caused an incorrect relay response and take appropriate corrective actions. The evaluation team cites this process as a potential example of excellence.

There is no disturbance monitoring equipment within the MIDW system. MIDW has planned upgrades of a major substation that includes the installation of a digital fault recorder and new digital protective relays to assist with fault location and reduce outage duration. The evaluation

team recommends that MIDW install system analysis instrumentation, as appropriate, to facilitate system disturbance analysis.

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.

All SCADA data is marked with a data quality flag to confirm validity, and a communication failure alarm will alert the system operator of a data failure. The MIDW area control error (ACE) calculation is done by Westar Energy, but MIDW provides the metered data that is validated on an ongoing basis by the MIDW system operators. In the event of a data failure, the system operator can derive a calculated value from adjacent meters and enter an override value for the ACE calculation.

MIDW calibrates relays and frequency devices at three-year intervals.

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.

MIDW has a software support agreement with the SCADA vendor and receives notifications of potential changes and updates. MIDW approves modifications informally for minor changes and participates in factory-acceptance testing for all major upgrades prior to allowing implementation. During the acceptance testing, the manufacturer converts as much MIDW data as possible to create a realistic test. System operators receive training on updates prior to installation in the production, or live, environment.

Voice communications systems are monitored by the providers and by on-site personnel. Data communications failures alarm through SCADA. Calibration problems also alarm through SCADA if they exceed a predetermined threshold. MIDW performs weekly satellite phone tests. MIDW tests and calibrates mobile radio repeaters and microwave equipment annually. MIDW treats control center equipment outages much like transmission outages and contacts neighboring systems and the reliability coordinator if there is a potential impact to others.

The system operators report problems with computer systems and other operator tools by directly communicating with the control center manager or the communications, relay, and SCADA supervisor. There is not a defined procedure for reporting trouble, and MIDW does not have a formal trouble-ticket system. The evaluation team recommends that MIDW develop SCADA maintenance and update tracking system and implement a formal process to notify all operations personnel of SCADA revisions and updates.

4. Fundamentals of Operational Planning

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

MIDW follows the seasonal planning procedures prescribed by SPP and includes a detailed review of summer, winter, and shoulder (spring and fall) power-flow cases over a two-year horizon and a review of summer and winter models at five- and ten-year horizons. The MIDW engineering staff reviews these models for voltage violations and thermal overloads under normal (base case) and n-1 contingency conditions and develops mitigation strategies for violations as necessary. MIDW reviews the results of seasonal studies, potential contingencies, and mitigation plans with system operators at monthly operator meetings. A copy of the most recent study is made available to the operator at all times.

If particular conditions dictate (i.e. significant transmission outages, new transmission load, or proposed modifications to transmission topology), MIDW performs additional interim reviews using updated power-flow models. SPP power-flow models are the basis for these updated models, with specific changes applicable to MIDW incorporated as required. MIDW models the entire Eastern Interconnection 69 kV and above in PowerWorld and PSS/E. SPP validates equipment ratings through its member transmission and generation operators. SPP also develops generator dispatch scenarios in cooperation with its members.

MIDW has the internal capability to provide real-time operational analysis support for the transmission system. The procedure requires transfer of load and power-flow data from the SCADA system to an appropriately scaled SPP seasonal power-flow case. The transfer is performed manually, as is the scaling of the surrounding transmission control areas. The MIDW engineering staff can then model any operational contingency necessary to determine system impacts and determine if a particular switching solution for a particular contingency can be safely implemented.

MIDW forecasts load for the next seven days. Most MIDW power purchase agreements require day-ahead schedules. After the load forecasts are updated, MIDW schedules adequate resources to meet the expected demand. Real-time regional transmission operations are monitored by SPP. All regional transmission outages 115 kV and above are reported to and scheduled through SPP, allowing the Interchange Distribution Calculator to provide an accurate available transfer capability calculation. MIDW is not a transmission provider and therefore does not offer transmission service or calculate available transfer capability.

With the assistance of SPP, MIDW system operators review and must approve all requests for unplanned transmission outages on the MIDW system.

5. Fundamentals of Training

5.1 General

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

The MIDW system operator is a bargaining-unit position, and new operator trainee candidates are first solicited internally by the bid process. The system operator job description contains minimum qualifications that are recognized within the bargaining-unit contract. MIDW has the ability to change these qualifications without reopening the bargaining unit contract. If a qualified candidate is not found within the bargaining unit, MIDW will recruit outside of the bargaining unit and outside the company if necessary.

MIDW uses a prepared list of about 60 questions during interview process. The interview process has objectives to determine if the candidate has the desired attributes necessary to become a successful system operator, including the ability to work under pressure and ability to work shifts. The MIDW human resources department performs a criminal background check on candidates.

Initial training for new trainees includes the basic operation and general physics of a transmission system followed by training on the safe operation of the transmission system. MIDW uses a combination of on-the-job training, online training, and off-site workshops. After a trainee completes the initial stages of training, the next step is to obtain NERC certification. The control center manager makes the recommendation for when a trainee is sufficiently trained to operate independently in a shift position with the concurrence of the vice president, energy management & supply.

There are three levels of system operators: junior operator, which is entry level; assistant operator; and system operator. Progression to the next level depends upon the ability of the system operator to demonstrate a comprehensive understanding of stated objectives. The learning objectives in the MIDW training program are derived from the skills, responsibilities, and authority required for each level.

MIDW employs a staff of six system operators, and many days two operators are on duty, allowing one operator to participate in training activities. MIDW provides adequate training time to allow completion of all training requirements. When system operators must travel to training events, MIDW makes appropriate arrangements to cover shifts.

The detailed steps of initial training are:

1. Gain a thorough knowledge of the MIDW service territory, the gas and electric transmission system, and the elements of the electric and gas distribution system.
2. Develop a complete understanding of the safety and operating policies and procedures used in system control, including switching, operations, and service restoration.
3. Acquire the ability to perform logging and reporting functions associated with power purchases, transmission reservations, and transaction tagging systems.
4. Obtain the skills and ability to execute system control functions independently in a reliable manner, under the direct supervision of a system operator.
5. Demonstrate an understanding of the procedures and standards set forth by SPP and NERC.
6. Obtain the NERC balancing, transmission, and interchange certification.

To attain the required knowledge, MIDW uses the following training methods:

1. On-the-job training in day-to-day operation working with all the current system operators to learn concepts from multiple perspectives; at least one full week on each shift with each system operator in the initial year of training.
2. Basic training modules on natural gas, gas leak classification, carbon monoxide, and other potential hazards associated with natural gas, delivered in a classroom setting by the safety manager or other qualified personnel.
3. Basic modules dealing with transmission, distribution, substations, and electric principles delivered in a classroom setting by the safety manager or other qualified personnel.
4. Training time with field personnel identifying and learning about devices found in substations, switchyards, and power plants.
5. Vendor-provided self-paced training modules on general operation of a transmission system and the nature of various devices utilized.
6. Online vendor-provided training modules on current NERC standards and operating procedures to prepare for NERC certification.

MIDW provides ongoing training for system operators using continuing education, emergency training, and monthly meetings. Training topics include:

1. Safe and reliable operation of the electric system, from generation systems and interchange points with neighbors down to the distribution level.
2. Balancing energy resources with demand, monitoring the status of the transmission and distribution system, coordinating and authorizing switching operations and maintenance with field personnel, other utilities and the reliability coordinator, and directing the safe and efficient operation of the transmission network, under both normal and emergency conditions.
3. Monitor and control of electrical devices using the MIDW SCADA system.
4. Maintaining acceptable operating conditions on the transmission system, responding to alarms or abnormal conditions, and ensuring the safe and stable operation of the network, including load-shedding as required under abnormal system conditions.
5. Buying and selling power, energy, and transmission services through interconnected systems.
6. Responsibilities and duties required to comply with NERC reliability standards.
7. MIDW safety rules and regulations.
8. Five days of emergency operations training annually.
- 9.

To provide the desired training, MIDW uses the following training methods:

1. Monthly safety meetings explaining potential hazards in the field and how to mitigate those hazards.
2. Monthly operator meetings with discussions on lessons learned from significant system events and impacts on future events.
3. Continuing education in accordance with the system operator certification program.

4. At least five days or 32 hours of emergency operations training using simulation or table-top exercises on restoration processes, load shedding, and other emergency conditions. This may include local in-house training, regional training, or vendor-provided courses.

In general the evaluation team observed that MIDW provides adequate training for its system operators. Below are other team observations:

- All of the MIDW training processes — including training plans, training schedules, course content and objectives, and training records — are developed and managed by the control center manager.
- Overtime is occasionally required for travel to off-site multi-day training activities. Approximately 15 percent of training is done using overtime.
- MIDW is not a NERC continuing education provider but is considering it.
- The control center manager is the designated trainer and has attended training workshops sponsored by SPP; however, he has not attended any NERC-sponsored “train-the-trainer” seminars.
- MIDW uses an online training simulator as part of the annual training schedule at least once every three years. Some system operators have 50 hours of simulator training.
- Training on blackstart and restoration is provided by the region.
- The MIDW training budget has increased three-fold over the past two years and continued increases are anticipated. Executive management supports these increases.
- MIDW system operators participated in a recent training on critical decision making provided by SPP — a full day session including exercises.
- MIDW supports the costs of any job-related education that operators want or need.

The evaluation team cites three positive observations regarding training: 1) MIDW uses an online simulator as part of the annual system operator training plan; 2) MIDW developed an innovative system operator training simulator for SCADA operation; and 3) MIDW has an education/training reimbursement program for all employees to support the cost of education for personal development.

The evaluation team offers these recommendations to enhance the system operator training program: 1) provide annual refresher training on the MIDW system restoration and capacity shortage plans; 2) enable the manager of operations to attend NERC “train-the-trainer” seminars, 3) develop training modules for system operators from the review of lessons learned from past disturbances, 4) employ subject matter experts to present seasonal assessments to system operators, and 5) staff critical locations during loss of primary control center drills.

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.

For human error prevention, one or more system operators develop switching orders and compare them with existing archived pre-executed orders. The control center manager has final

review and approval of planned switching procedures. The system operator can independently authorize urgent switching procedures. MIDW requires a complete “read and repeat” communication procedure when issuing switching orders.

MIDW and SPP provide human error prevention training. Operations staff meetings include topics to illustrate potentially dangerous or error-prone situations and preventive actions for such situations.

APPENDIX 1: Critical Infrastructure

APPENDIX 2: Entity Participants

APPENDIX 3: Documents Reviewed
