

# NERC

NORTH AMERICAN ELECTRIC  
RELIABILITY CORPORATION

## Reliability Readiness Evaluation Report Transmission Operator

American Transmission Company, LLC  
Waukesha, Wisconsin

to ensure  
the reliability of the  
bulk power system

**November 26–29, 2007**

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## Introduction and Evaluation Process

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

Since its inception in 2004, NERC and the industry have been working collaboratively to enhance the program. The evaluation process is based on fundamental aspects of reliability: culture, operations, maintenance, planning, and training. 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 American Transmission Company, LLC (ATC) representatives on November 26–29, 2007. This report reflects the views and recommendations of the evaluation team regarding the readiness of ATC to meet its responsibilities as a transmission operator.

## Evaluation Team

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## Organization Profile

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American Transmission Company, LLC (ATC) was formed in 2001 as the first multi-state transmission-only electric utility. The company is jointly invested in and owned by 28 separate utilities, municipalities, and electric cooperatives. ATC owns and operates electric transmission systems in parts of four states: Wisconsin, Michigan, Minnesota, and Illinois. ATC's rates are regulated by FERC, with its construction projects being reviewed and regulated by the states in which these transmission assets are located. ATC is the only transmission owner and operator for five balancing authorities and coordinates with other distribution providers and balancing authorities.

ATC is affiliated with both MRO and RFC as its reliability entities. ATC is registered with NERC as a transmission owner, transmission operator, transmission planner, and a planning authority. The Midwest Independent System Operator (MISO) serves as the reliability coordinator for ATC.

ATC has 480 substations and 9,081 circuit miles of transmission lines, which operate at 345, 230, 138, 115, and 69 kV. The approximate breakdown of the transmission circuit miles is 40 percent 69 kV, 6 percent 115 kV, 39 percent 138 kV, 1 percent 230 kV, and 14 percent 345 kV. These transmission facilities are operated from two primary control centers that are owned and operated by ATC. There are no local control centers (transmission owner control centers) that control transmission in the ATC transmission footprint. At the time of this readiness evaluation ATC had an agreement to provide control center operational services for the Alliant West transmission system in Iowa; however, Alliant Energy was the registered transmission owner and operator for that transmission system.

The ATC transmission system experienced its all-time peak load of 13,059 MW on July 31, 2006. The peak load in 2007 was 12,664 MW. ATC owns no generation.

At the time of this readiness evaluation, ATC had 162 interconnection agreements: 71 generator-transmission, 88 distribution-transmission, and 3 transmission-transmission. Of the generator-transmission interconnections, 58 were for synchronous generators.

## Executive Summary

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

Being the first multi-state transmission-only company in the United States, ATC has a strong focus on safe and reliable transmission system operations in a context of continuous improvement. A quote from a corporate publication simply states “all our efforts are driven by a single purpose — to help keep the lights on, businesses running and communities strong.” Within this single purpose, ATC takes the broad perspective, as a regional transmission company, to focus on the full scope of the transmission business unit by adding sustained value to all of its stakeholders.

The positive observations in this report focus on the effective implementation of a portfolio of advanced tools to strengthen the operating analysis of the transmission system, increase the effectiveness of operator training, and sustain the integrity of the monitoring and control of the interconnected transmission system. The other main area noted in the positive observations is that of the culture of striving for excellence in the context of professionalism.

The recommendations in this report identify areas in which existing processes can be enhanced or new tools identified that can increase functionality in a specific area. Some of the recommendations identify opportunities to further standardize operations that result from the protective tagging practices that were in use by the previous owner of that portion of ATC’s transmission system. There are no key recommendations identified, as this step was not included in this evaluation.

Overall, the evaluation team identified seven positive observations. In addition, the team offers 14 recommendations that, if implemented, will enhance ATC’s readiness to operate reliably and maintain the reliability of the bulk power system. The recommendations are listed in order of importance.

## Positive Observations

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

1. Confidential information on plans for loss of control facilities redacted from public report. See discussion in Appendix 1.
2. ATC's comprehensive *Transmission Emergency Response Plan* provides action checklists, lists assignments, and specifies outcomes (Section 2.4).
3. ATC has fully integrated the dispatcher training simulator (DTS) into the system operator training program as a primary training delivery tool (Section 5.1).
4. ATC has fully integrated the state estimator/real-time contingency analysis into system operations as the analysis tool of choice for the system operators (Section 2.3).
5. ATC has placed emphasis on a culture of professionalism as evidenced by the "wall of fame" (Section 1.2.2).
6. ATC has a dedicated energy management system (EMS) support staff located in the Cottage Grove Control Center and the training center (Section 9).
7. ATC has made operational excellence the central theme of the corporation — "operate well, operate well, operate well..." (Section 1.2.2).

## Recommendations

The evaluation team offers the following recommendations:

1. Confidential information on physical security redacted from public report. See discussion in Appendix 1.
2. Confidential information on communications systems and support redacted from public report. See discussion in Appendix 1.
3. Develop, document, and implement a single "hold tag" clearance procedure that is common to both ATC control centers (Section 2.2.1).
4. Confidential information on plans for loss of control facilities redacted from public report. See discussion in Appendix 1.
5. Perform a job task analysis for all system operator positions to fully identify the job training requirements for each position and restructure the training curriculum accordingly (Section 5.1).
6. Revise and publish the shift-change procedure to strengthen the hand-off provisions (checklist driven) and specify the requirements associated with bringing a system operator back on-desk after an extended absence to ensure the system operator is fully prepared to assume the on-desk operating responsibilities (Section 2.2.3).

7. Confidential information on power supply for control facilities redacted from public report. See discussion in Appendix 1.
8. Evaluate and include, as appropriate, certain n-2 system contingencies in the list of contingencies solved by the state estimator and real-time contingency analysis tool to enhance the scope of transmission system contingency analysis (Section 2.3).
9. Require all operators to operate from their alternate control center at least once per year and document the training plan to include this requirement (Section 8).
10. Formalize and document the final competence evaluation requirements a system operator must meet prior to assuming on-desk responsibilities (Section 2.2.3).
11. Implement a document management tool to manage the life cycle of new and revised operating policies and procedures, including verification of reading and understanding by the system operators, cataloguing, and naming/numbering protocols (Section 2.2.3).
12. Confidential information on plans for loss of control center redacted from public report. See discussion in Appendix 1.
13. Implement a review process to monitor the impact of system operators serving as subject matter experts for training course development and instruction to ensure this dual tasking does not compromise operator effectiveness (Section 5.1).
14. Confidential information on plans for loss of control center redacted from public report. See discussion in Appendix 1.

## 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 and positive observations 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.*

ATC is a new and first-of-a-kind of electric utility organization that has a clearly defined mission and objectives with goals that are designed to not only fulfill the operating objectives but also function in a mode of continuous improvement. The primary purpose of ATC as stated in a corporate brochure is “to build, maintain and operate the transmission system to meet the needs of our customers and all electricity users.”

ATC develops corporate goals to achieve the objectives stated in the strategic plan. Metrics are used to drive the desired behaviors and to achieve the corporate goals. These metrics then translate into individual performance targets and responsibilities. Corporate goal performance is reported to employees on a regular periodic basis. Additionally, there is a structured annual individual performance process that holds employees accountable for performance goal achievement. For purposes of this report, it must be noted that safety and operations/reliability are respectively the top two of the six corporate goal areas for 2007.

ATC’s senior leadership is committed to determining the perceptions of the employees with respect to current culture and progress of the organization. In keeping with this commitment, an employee survey has been administered; however, the results are just in and the initial analysis has not been completed.

#### 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.*

ATC keeps its mission and goals center stage in corporate documents. ATC uses the phrase “*helping to keep the lights on, businesses running and communities strong*” to remind its employees of ATC’s corporate reason purpose. The formation of ATC was pursuant to the passage of a statute in the Wisconsin legislature stating that the sole purpose for the existence of

ATC is “*the planning, constructing, operating, maintaining and expanding of transmission facilities that it owns to provide for an adequate and reliable transmission system that meets the need of all users that are dependent on the transmission system and that supports effective competition in energy markets without favoring any market participant.*” The clarity of this statement, in the opinion of the evaluation team, adds significant meaning to the corporate mission statement and associated annual goals for all ATC employees and not just the senior staff.

### **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.*

ATC’s CEO has a saying that was quoted to the evaluation team in the operator interview as well as in the opening meeting of the evaluation “*operate well, operate well, operate well...*” This proactive leadership seems to have instilled a commitment to operational excellence in the entire staff of system operations.

The system operator interviewed indicated there is a commitment to professionalism in not only appearance but also in communications and actions. In the hallway leading to the control room in the Pewaukee Control Center, there is a “wall of fame” that displays pictures of each system operator, each wearing a tie. The sense of pride and professionalism is contagious and has a positive impact on safety and reliability — no switching errors had occurred as a result of system operator actions in 2007 as of the time of this evaluation.

In the opinion of the evaluation team, ATC benefits from a number of key personnel that have significant experience in the industry at other companies. The blending of this talent pool brings a unique, strategically focused leadership perspective to the organization that has a significant impact on both safety and reliability of electric system operations.

ATC’s senior management personnel hold leadership positions on a number of industry committees. In turn, other ATC employees are active in either leadership or membership positions on a number of regional reliability committees as well as NERC committees and working groups. This active involvement by ATC as a whole brings an increased level of understanding of industry trends, new ideas, and lessons learned by others. This, in the opinion of the evaluation team, has a positive impact on the safe and reliable operation of the ATC transmission system.

### **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.*

ATC has well-defined corporate goal areas for 2007: safety, operations/reliability, reliability standards compliance, construction, customer satisfaction and financial. Each goal area has a set of metrics designed to measure performance.

Performance in the goal areas and the associated supporting metrics is reported periodically with quarterly corporate performance status reports (to all employees). Additionally, individual employee performance plans are structured to support these corporate goal areas. The system operator interviewed believes that his or her individual performance plan goals contribute to the corporate goals.

### **1.2.4 Human Resources**

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

An initial review of the ATC system operator workforce demographic indicated that approximately half the work force would achieve retirement eligibility in approximately five years. Given this statistic, ATC implemented a system operator-in-training program that added two system operators-in-training at each control center. The training time for a system operator-in-training to be ready to go on desk ranges from 18 to 36 months.

ATC is considering additional steps that can possibly increase the upward mobility of the system operator positions by increasing the number of job levels, evaluating the barriers to entry in the system operator career field, and adding a succession planning process.

ATC is also evaluating the supervisor and management level positions by evaluating talent pools to compliment the succession planning process. Other approaches, such as cross training, are being considered as a way to round out the skill sets of employees and increase the possibility of upward mobility. The evaluation team believes these actions to be essential, as the raising of the bar for system operators requires a corresponding raising of the bar for the associated leadership team.

In the opinion of the evaluation team, a proactive approach to addressing the system operator workforce demographic is essential in maintaining a trained, competent, and qualified system operator staff. These actions are essential for sustaining safe and reliable operations.

### **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.*

The ATC system operators give corporate communications high ratings. ATC holds informational monthly meetings and publishes a corporate newsletter periodically. These meetings and the newsletter generally cover the status of corporate goal performance as well as any other special emphasis areas of current importance. ATC continues to tie individual performance to corporate goals and communicates to employees the associated rationale for this approach.

ATC employees are encouraged to provide feedback to their managers regarding corporate initiatives, corporate and departmental goals, and recommendations for improvements. Though informal, this feedback process is judged by ATC's senior leadership to be effective.

## 2. Fundamentals of Operations

### 2.1 General

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

ATC uses the intercontrol center communications protocol (ICCP) to exchange data with its interconnected neighbors and establish a fairly large state estimator footprint to enhance the quality of the converged analysis. ATC system operators also have the MISO operator messaging communications terminal, which displays transmission loading relief (TLR) and other system conditions related to MISO's non-market customers. Additionally, ATC uses a system called System Condition and Event Tracking to capture details of significant system events and communicates these details to various internal personnel and affected local distribution companies served by the ATC transmission system.

ATC communicates with its reliability coordinator using the MISO operator messaging system as well as the regularly scheduled morning phone call. System operators are welcome to participate in this call; however, this is a busy time and this call is usually covered by the operations supervisor or manager.

For internal communications, the ATC system operators primarily rely on two tools, e-mail and the Action Book. Supervisors supplement this approach with detailed discussions, and system operator on day-shift will stay over to ensure the on-coming shift is fully informed.

### 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.*

ATC has placed operational safety at the top of its annual goal priority list. ATC meetings begin with a safety topic as did the opening meeting that ATC conducted with this evaluation team.

ATC has placed significant emphasis on safety with the contractor construction workforce. This emphasis has provided significant positive results in the areas of accident incident rates and accident severity. This effort has been managed by a specially appointed safety council, which includes ATC, contractor, and local distribution company personnel. In addition, ATC has active field and office safety committees to guide safety initiatives. Results have been positive — ATC has worked more than 1,000,000 work-hours without an OSHA-reportable lost-time accident in 2007.

The evaluation team reviewed the preparation and execution of switching orders. Switching orders are reviewed by multiple qualified people prior to being dispatched for execution, which in the opinion of this team is as it should be. One issue of concern, however, is that four different hold (clearance) tag procedures are used on the ATC transmission system. This is primarily a legacy issue of combining assets of the transmission system that were previously

owned by different companies. The utilities that previously owned the system that ATC has purchased have contracted with ATC to perform field operations; therefore, ATC has continued to administer clearances under the four different tagging procedures. In the opinion of the evaluation team, these procedures are not unsafe in their own right; however, since system operators are rotated and one center provides an alternate control center environment for the other, it is strongly recommended that ATC develop, document, train and implement a single hold tag procedure that applies to both control centers.

### **2.2.2 Operational Decision-Making**

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

The ATC system operators are authorized to take any actions necessary to provide for the safe and reliable operation of the interconnected transmission system up to and including the dropping of firm load. This authority is documented in the system operator's job descriptions as well as in an authority letter signed by the chief executive officer. This authority is also recognized by the interconnected neighbors, as indicated in the neighboring system questionnaires received as part of this readiness evaluation. The system operator interviewed as part of this evaluation is confident not only in the authority to operate but in his ability to operate the transmission system in a safe and reliable manner.

ATC system operators have good system visibility of facilities and data. Every transmission bus on the system is visible as well as a two or more buses in the interconnected neighboring systems. Additional neighboring system data are available via ICCP if needed. The ATC system operator interviewed by the evaluation team felt that the wide area system view is adequate in enabling the safe and reliable operation of the transmission system. In the context of continuous improvement, ATC is in the process of completing a project to increase the external network model by adding more telemetry points.

The EMS alarm system uses both color and audible tones to indicate the severity of the alarm. The alarms can be filtered into seven categories to facilitate alarm management, which is especially helpful when there is high demand on the system operator's time. The system operators can inhibit nuisance alarms, and abnormal alarms can be viewed on a summary page. The alarm system also has a colored bar chart display capability that is used to display voltage readings and various levels of alarms.

The EMS alarm processor is monitored by a program that monitors the proper functionality of a critical task, hardware, or essential database. In the event of a failure, this software initiates a failover to the redundant server or assumes the online or enabled role as appropriate. Additionally, the health of hardware and software components on each server is monitored using vendor-supplied operating system tools and third-party monitoring tools. In the opinion of the evaluation team, the redundancy of the alarm system as well as redundancy in monitoring the health of the alarm processor significantly enhances ATC's ability to sustain safe and reliable system operations.

ATC uses high-precision frequency time modules to monitor local system frequency at both control centers. These frequency data are displayed on the control center's mapboard; however, it is informational in nature and is not utilized directly in the system control process. ATC has more than 200 frequency monitoring points that are available to the system operators, of which 12 points are actively monitored at the Pewaukee Control Center and only one at the Cottage Grove Control Center. Since ATC has no generation, it can monitor system frequency but has limited ability to control frequency. This responsibility rests on the interconnected balancing authorities and the reliability coordinator.

The ATC EMS has displays that show all transmission system voltage and reactive information. These tabular displays show system voltage information, capacitor bank status, and generator real and reactive power capabilities. ATC is developing a screen to display the generator information in a geographic wide-area format. There is no single EMS summary screen for all the reactive power resources and the associated reactive reserve. In the opinion of the system operator interviewed, there would be limited value provided by such a screen based on the dynamics of reactive power flow.

ATC indicates that it does not have areas in which it cannot maintain scheduled system voltages; however, for various contingencies during peak load periods there may be requirements for system operator intervention. In these situations, the ATC system operators control system voltage by operating transformer tap changers (most are automatic but some are manual), placing capacitor banks on-line (ATC capacitor banks as well as those of the local distribution companies), and increasing the reactive dispatch of those generators in dispatch. Most of the generators in the ATC footprint have automatic voltage regulators, and the ATC EMS can monitor the status of these units.

ATC's policy is to maintain adequate dynamic and static reactive reserves as determined by real-time studies. ATC uses flow-based limits as proxies for voltage stability limits even though ATC has the VSAT tool to evaluate voltage stability margins. The generator capability curves are made available to the system operators. ATC coordinates the generators reactive capability testing; therefore, ATC is aware of the reactive capability of each of the generating units connected to its transmission system. Given this information, ATC works with MISO to re-dispatch and/or commit generation for voltage support as needed.

The procedural guidance for ATC voltage and reactive management is *TOP-20GN-00004 Voltage/Reactive Control*. Voltage schedules/operating limits are typically plus or minus five percent for normal operations and plus or minus 10 percent for emergency operations. The MISO Operations Planning Working Group publishes the MISO voltage and reactive power management document that provides guidance for voltage and reactive management for certain n-1 contingencies. ATC periodically performs dynamic voltage stability analysis on its transmission system to ensure the operational integrity of the system. ATC coordinates the voltage limits for the critical bus with each respective nuclear power plant in its transmission system.

### **2.2.3 Operational Alignment**

*Organizational structure supports safe and reliable system operation.*

ATC has transmission interconnection agreements with all of its interconnected neighbors, the generators that interconnect to the ATC transmission system, and the local distribution companies that take service from the ATC transmission system. These documents were executed with ATC after the formation of the company and conform to the operational interconnection requirements defined in regional, NERC, and FERC requirements. As a transmission operator, ATC has no formal relationship with the neighboring balancing authorities. MISO fills this role for the balancing authorities in the ATC transmission footprint.

ATC is a signatory of the *Agreement of Transmission Facilities Owners to Organize the Midwest Independent Transmission System Operator* that defines the roles and responsibilities of each MISO member. Additionally, this document defines MISO's role as the reliability coordinator for ATC. No reliability coordinator responsibilities have been delegated to ATC by MISO nor have any balancing authority responsibilities been delegated to ATC by the interconnected neighboring balancing authorities. ATC has not delegated any transmission operator responsibilities to the interconnected neighboring balancing authorities or to MISO as the reliability coordinator.

At the time of this readiness evaluation, ATC had an operating agreement to provide control center operational services for the Alliant West transmission system in the state of Iowa. Alliant Energy was the registered owner and operator of the Alliant West transmission system. This operating agreement defined the operating related services that ATC provided to Alliant Energy in support of the operation of the Alliant West transmission system. A signed letter of authority from Alliant Energy was posted in the ATC control centers empowering the ATC system operators to perform the operating services defined in the agreement up to and including the shedding of firm load.

ATC has comprehensive, well-documented operating policies and procedures available electronically and in hard copy. New or revised operating procedures or policies are sent to the system operator via e-mail. There is no formal feedback process; however, informal feedback is provided to authors (each document indicates the author). The evaluation team recognizes that the informal operating environment surrounding the management of new and/or revised operating guides, policies, and procedures is working; however, the evaluation team recommends that ATC implement a document management tool to manage the life cycle of new and revised operating policies and procedures. The system should include review and revision management, verification of reading and understanding by the system operators, and cataloguing and naming/numbering protocols.

ATC does not have a formal shift-change procedure; however, a solid body of practice exists that needs to be documented by an appropriate operating procedure. The evaluation team recommends that ATC develop and implement a shift-change procedure that is checklist driven. The team also recommends that this procedure cover the requirements associated with bringing a system operator back on desk after an extended absence.

Outage coordination is managed by the ATC outage coordinator in accordance with ATC operating procedure *TOP-20GN-000007A Transmission Outage Planning*. ATC coordinates with the interconnected neighbors regarding proposed transmission outages as well as with the

reliability coordinator using the MISO Outage Coordinator. The generation outages are scheduled on a rolling 24-month generation plan that is submitted by the generation owners to ATC for each generating unit for each month. ATC performs preliminary outage studies and reviews MISO study results, down to the day-ahead studies that MISO performs and distributes daily. ATC outage schedules are typically contained in Microsoft Project. In the opinion of the evaluation team, the outage coordination process is well managed and carefully communicated so as to maintain system reliability.

### **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.*

ATC has a complete portfolio of operating tools in addition to the advanced EMS applications. The EMS provides real-time graphical trending, large control room projection displays, and historical data recording. The EMS advanced applications includes the state estimator, real-time contingency analysis, STNET on-demand power flow and contingency analysis, and the dispatcher training simulator (DTS).

The non-EMS tool include a computer-based weather application, a data historian application (e-terra Archive), the MISO Outage Scheduler, MISO Operator Messaging, and a PSM Analyze tool that shows neighboring system connectivity (special custom design for ATC). Not only does ATC have a good array of operating tools, but it has crafted unique ways to use these tools to add value to the operational process.

The state estimator automatically runs every five minutes with a run time of approximately 30 seconds; however, the system operator can manually initiate a run from the EMS screen. The convergence rate is very high; however, the exact number is not tracked. The state estimator models are updated with MISO each Wednesday so as to maintain solution compatibility. The real-time contingency analysis tool contains a total of 1,799 contingency definitions with a typical solution time of 40 seconds. The results of these runs are presented to the system operator on an EMS workstation or a large screen projection. Alarms are triggered to alert system operators of potential abnormal conditions, such as unsolved contingencies or voltage limit violation. The evaluation team commends ATC for fully integrating the state estimator/real-time contingency analysis into system operation analysis as a tool of choice by the system operators.

The evaluation team noted in the review of the contingencies analyzed by the state estimator that these contingencies were all n-1 contingencies. The evaluation team recommends that ATC evaluate and implement as appropriate certain n-2 system contingencies to enhance testing the system in determining the level of contingency survival or more properly stated sustainable operations.

ATC has eight special protection schemes (SPSs); seven are static and no arming is required. There are two SPSs in the Upper Peninsula that perform generator tripping to prevent thermal

overloads of transmission lines and another that protects a transformer from overloading. These SPSs are displayed on an EMS screen that shows status and configuration.

ATC currently manages SPS documentation as required in *MAIN Guide 10 Appendix B, Special Protection Schemes*. The ATC system operators may arm, disarm, or change the settings on an SPS depending on system configuration and loading conditions; however, the system operator can only remotely monitor the status but not operate the SPS. ATC will notify MISO of any known changes in SPS status.

MISO manages transmission system congestion, and ATC complies with any directives issued by MISO. Load generation balance is performed by the interconnected balancing authorities, as ATC is a transmission-only company and has no generation.

There is one interconnected reliability operating limit (IROL) on the ATC transmission system that is addressed using a SPS. If the SPS is not effectively controlling the overload, ATC system operators will take whatever action is necessary to get loading down, even if it includes shedding firm load. Additionally, ATC will respond to any MISO directives related to IROL or security operating limit (SOL) violations.

ATC maintains a critical facilities list in the control center evacuation plan and on-line, and in the system restoration plan. The list includes all 345 kV facilities and other facilities of material importance to reliability. The list includes the reason the facility is considered material to reliability and any other associated data.

### **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.*

ATC does not have an underfrequency load shedding (UFLS) program for real power load because it does not directly serve any load; however, it does have an automatic underfrequency tripping plan for several bulk power capacitor banks to coordinate with the UFLS programs of the interconnected balancing authorities. These capacitor banks are tripped in accordance with two of the UFLS programs tripping set points. The UFLS requirements being adhered to are those specified by the MRO and the RFC.

The EMS has a load shedding screen that lists the load that can be shed by using the transmission breakers. Additionally, load can be shed by dispatching personnel to substations or by contacting local distribution companies and directing the shedding of load. The local distribution companies have control algorithms with rolling blackout capability; however, ATC does not specify that this action be taken due to the need for the load to be dropped in a specific area.

ATC participates in the review and updating of the UFLS studies in its transmission system footprint. The participation by ATC is to ensure coordination of trip settings, including generator frequency trip points.

ATC has an excellent *Transmission Emergency Response Plan* that provides action checklists, assignment of responsibilities, and specifies outcomes. The evaluation team commends ATC for this comprehensive plan. ATC is also a participant in the Wisconsin Mutual Assistance Program so as to expedite system recovery after a severe storm or act of nature. ATC also has a business continuity plan and a control center evacuation procedure to address the responses to various contingencies.

ATC has a *Blackstart System Restoration Plan* that identifies the facilities and procedures needed to energize the transmission system. Multiple cranking paths, alternate cranking paths, and interconnection paths are identified to improve the synchronization of islands. This plan is reviewed and updated annually and used in the regional MISO system restoration drills.

ATC is a minor player in the capacity and energy emergency plan implementation process, as it is a transmission-only company. ATC will respond to any directive issued by the reliability coordinator in the implementation of this plan.

The updated final safety analysis reports for the nuclear power plants in the ATC footprint are maintained by the plant operators. ATC has identified and carefully monitors the critical bus voltages at the nuclear power plants in its transmission footprint. Nuclear power plant operators and ATC system operators carefully maintain communications in order to properly respond to any system event.

### 3. Fundamentals of Maintenance

#### 3.1 General

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

ATC has documented procedures and a carefully implemented maintenance program designed to ensure the accurate and reliable operation of the EMS, data communication systems, and voice communication systems. Each of the two control centers has a test system for loading and validating any changes, allowing extensive testing without jeopardizing the operational integrity of the EMS and/or the associated communication networks. Additionally, based on the complexity of the change, ATC develops training for the system operators so that the enhanced user skill sets are in place before the change is implemented.

#### 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.*

ATC does not have specific performance goals for EMS availability. The EMS has performed well and the level of reliability has been more than acceptable; all critical elements are redundant with automatic failover.

ATC experienced a problem caused by an external communications services company (actual cause was difficult to identify). ATC performed a root-cause analysis to identify and analyze all the factors related to this problem. ATC has taken steps to prevent future occurrences and has initiated a focused effort to build a stronger working relationship with the public telephone company involved.

The evaluation team considers the performance of the ATC EMS to be consistent with what is required to support the safe and reliable operation of its transmission system. With the high level of redundancy at two separate locations, the performance level is excellent.

### **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.*

The EMS group has an on-call rotation with one person in the Pewaukee Control Center and one person in the Cottage Grove Control Center. The EMS has a display that indicates the person on call with phone numbers. There is a primary as well as a backup IT person on call that has an 800 number that changes each week. System operators report problems to the on-call person. Platform-related issues are entered into a tracking system with the vendor. For other types of problems, ATC uses an informal tracking process that involves an inbox with one line changes; the inbox is cleared daily.

If an upgrade has the potential to disrupt operations, the system operator is notified prior to initiation. Software upgrades are loaded on the test platforms (one at each control center) and monitored for weeks before being placed in an operational mode. The supervisory control and data acquisition (SCADA) database downloads usually take place on Wednesdays; and as a rule, these downloads do not affect the system operators.

ATC has a hardware maintenance contract with the manufacturer of the EMS that specifies a four-hour on-site turnaround. ATC also has a software contract with the EMS manufacturer. These contracts cover spare parts availability, which is a key factor in system availability. ATC also has maintenance contracts for the communications equipment.

## **4. Fundamentals of Operational Planning**

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

ATC has registered with NERC as a planning authority, among other categories in the functional model. As a transmission-only company, ATC performs a full range of transmission system studies using the Power Technologies International Power System Simulator for Engineering (PSS/E) steady state load-flow study analysis tool as well as the PSS/E dynamic simulation module.

The annual base case models are built from the models that are available from the Eastern Interconnection Reliability Assessment Group, Multiregional Model Working Group, and

regional data banks. The loads that are connected to the ATC buses are developed by the load forecasting group working with the distribution providers. In the peak load cases, generation is dispatched either on an individual balancing authority merit order basis or an ATC area-wide merit order basis. Wind generation is dispatched at 20 percent of maximum output and hydro generation is dispatched at 40 percent of maximum output. For non-peak cases, generation is dispatched on an individual merit order basis.

Transmission system equipment ratings and operating characteristics are based on the criteria in the ATC Substation Equipment and Line Database. The rating of legacy equipment is that of the previous owner until the value can be validated using the database criteria. Voltage settings for transformers are specified by ATC's system protection personnel, and generator voltage settings reflect a typical historical value.

ATC transmission planning personnel participate in the MISO Operations Planning Working Group, Operations Working Group, and the Real-Time Reliability Working Group. The MISO Operations Planning Working Group oversees the MISO Coordinated Seasonal Assessment Process. ATC uses additional seasonal assessment studies performed by MRO and RFC to gain an increased level of understanding of expected seasonal transmission system performance and identify areas needing additional analysis. ATC also participates on the Eastern Interconnection Reliability Assessment Group to assist in the multi-regional seasonal assessment of the strength of the interconnected transmission system and help identify any thermal constraints associated with inter-regional transfers.

The operational planning focuses on the period from day-ahead to 12 months into the future. The ATC operational planning group usually uses both the PSS/E load flow tool as well as the study mode on the EMS. The process usually begins with the seasonal assessments followed by reviews of outage requests, construction projects in-progress, and the impact of any forecasted extreme weather conditions. MISO performs the day-ahead studies and real-time generator commitment/dispatch studies and makes these results available to ATC. MISO also performs studies to determine the interconnected transmission system's total transfer capability and the available transfer capability for imports and exports; MISO also compiles flowgate information and/or operating guides. ATC operational planning and system operators perform multiple layers of checks and balances to ensure the accuracy of the day-ahead plan. Operational planning moves into a real-time and/or near real-time operating environment via the use of the state estimator and the real-time contingency analysis tools used by the system operators.

## 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.*

ATC has initial and ongoing training programs for system operator trainees and experienced system operators respectively. The training program is managed by two full-time employees: a program manager and a DTS instructor. ATC utilizes system operators, system control

management and operations support personnel as subject matter experts to assist in the development of training modules and serve as an additional training resource. This is a creative way to resource training requirements and brings significant expertise into the instructional arena. The evaluation team believes this process can pose a down-side risk of task saturation and compromise the effectiveness of the employee as a system operator; therefore, the team recommends ATC implement a method to monitor and manage the impact of these additional tasks to sustain the win-win environment.

The training program involves multiple delivery styles to accommodate the various learning styles represented by the workforce. Methods include instructor-led training by internal as well as externally supplied instructors, on-the-job training using mentors, computer-based training modules, and field trips to transmission and generation facilities. Possibly one of the most valuable training delivery tools is the DTS, and the evaluation team commends ATC for fully integrating this training tool as the primary training delivery tool used by ATC. The DTS replicates the real-time operations experienced on desk, and ATC uses it to train on new procedures and equipment, share the lessons learned, train on system restoration and blackstart drills, and deliver a number of other training applications.

Another unique aspect of the ATC training program is the Wisconsin System Operator Joint Training Program. This is a long-standing joint effort by several electric utilities — an open forum with a posting on OASIS that has a target audience of NERC-certified operators. ATC is the continuing education provider and program administrator with the instructors being subject matter experts supplied by the participating companies.

In 2008, ATC is implementing a creative cycled training program in which each of five training cycles is offered six times, and each system operator must attend four of the five training cycles. The goals of this program are to review ATC lessons learned, train on new and revised procedures, and provide regular exposure to simulation exercises.

The initial training program for the operator-in-training and the system operator candidate is comprised of 17 training modules, Bismarck State College's electrical transmission systems technology program, NERC-certification, and shadow/mentoring of on-the-job training. This training takes approximately 12 to 36 months depending on the background and initial education of the candidate. To become an ATC system operator, the candidate must complete and/or successfully test out of the courses. The evaluation team recommends that ATC formally document the final competency evaluation requirements for a system operator prior to assuming on-desk responsibilities.

ATC developed the training curriculums based on the system operator job responsibilities; however, a formal job task analysis has not been performed to validate the current analysis and associated training program. The evaluation team recommends that ATC perform a job task analysis on the system operator job family to validate the associated training.

The training program for the experienced system operator is not limited to technical courses; professional and personal development courses are also available, and ATC Human Resources department assists in resourcing these requirements. The system operator interviewed

appreciated the option to participate in developing his personal annual training plan. The combination of employee accountability and management review is seen as a positive step in individual system operator development.

ATC seeks employee feedback on the training program. The systems operations management team meets twice per year with the training team to discuss feedback on past activities and seek input on future training opportunities.

## 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.*

ATC has fostered an open environment of effective up and down communications along with individual respect for the system operators. The system operator interviewed indicated there is no hiding of anything in the control rooms or in system operations. If an error is made, operators report the event immediately; a review of the event is initiated, causes are identified, and lessons-learned training is initiated. ATC uses mentoring, counseling, and training to improve employee performance, but an employee that continues error-prone performance will ultimately be discharged. In the opinion of the evaluation team, this approach to human performance by ATC is proving to be successful.

ATC is approaching the area of incorporating risk assessment into operational decision making. The initial area of consideration is that of maintenance activities versus asset-renewal activities. ATC is considering areas such as the assessment of the health of an asset to drive the associated maintenance or evaluating a performance-based versus a time-based approach to maintenance management.

With each approach, risk is associated with the continued operation and maintenance of the asset versus replacement of the asset. ATC's ultimate goal is the continued safe and reliable operation/performance of its transmission system in an economically responsible manner.

## APPENDIX 1: Critical Infrastructure

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

## APPENDIX 2: Entity Participants

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

## APPENDIX 3: Documents Reviewed

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