

**Balancing Authority  
Reliability Readiness Evaluation Report**

**Wisconsin Energy Corporation  
(Wisconsin Electric Power Company)  
Milwaukee, Wisconsin**

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## Introduction and Evaluation Process

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

Since its inception in 2004, NERC and the industry have been working collaboratively to enhance the program. The evaluation process is based on fundamental aspects of reliability: culture, operations, maintenance, planning, and training. The document [\*NERC Readiness Evaluation Procedure\*](#) describes and defines the process used for reliability readiness evaluations. This document and other documents related to the program are available at <http://www.nerc.com/~rap/>.

The reliability readiness evaluation teams, each led by a NERC staff member and a regional co-leader, include industry volunteers with considerable expertise selected to provide representation from other interconnections, other regions, and neighboring operating entities. The teams also typically include a representative(s) 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 Wisconsin Energy Corporation (WEC) representatives on May 7–10, 2007. This report reflects the views and recommendations of the evaluation team regarding the readiness of the WEC to meet its responsibilities as a balancing authority.

## Evaluation Team

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## Organization Profile

WEC provides electric and natural gas service to customers across Wisconsin and parts of northern Michigan. We Energies is the trade name of Wisconsin Electric Power Company (Wisconsin Electric) and Wisconsin Gas LLC, which are subsidiaries of WEC. Edison Sault Electric Company is another subsidiary of WEC and provides electric generation and distribution in northern Michigan.

The American Transmission Company (ATC) is a for-profit entity that owns, operates and maintains the electric transmission system serving five balancing areas including the WEC balancing area. ATC serves as the transmission operator for the WEC balancing authority area, and WEC has ownership interest in ATC. WEC also provides various reliability services for Edison Sault.

Wisconsin Electric serves approximately 1.1 million electric customers across Wisconsin and in northern Michigan. Edison Sault generates and sells power to approximately 22,000 customers in northern Michigan. The peak load during the summer of 2006 for Wisconsin Electric and Edison Sault was 6,505 MW. The winter peak load of 5,066 MW occurred in 2004.

WEC's balancing area has transmission interconnections with Commonwealth Edison, Alliant Energy, Wisconsin Public Service, Madison Gas & Electric, Upper Peninsula Power Company, and the Michigan Electric Coordinated System. Wisconsin Electric owns approximately 6,046 MW of generating capability. The Wisconsin Electric energy mix is approximately 60% coal, 19% nuclear, 3% natural gas and oil, 1% hydro, and 17% purchased power.

Wisconsin Electric is a member of the Midwest Independent Transmission System Operator (MISO) regional transmission organization and the Reliability *First* Corporation (RFC) regional reliability organization. Wisconsin Electric is a registered balancing authority and is the subject of this readiness evaluation; from this point forward; the abbreviation WEC will represent the Wisconsin Electric balancing authority and its associated support functions. MISO serves as WEC's reliability coordinator and provides energy market, reserve sharing, transmission scheduling, interchange balancing, and interchange accounting services for WEC.

## Executive Summary

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

WEC has a corporate culture that supports and encourages high levels of performance in all aspects of its business. It also supports the continuous evaluation of performance and identification of improvements. Within system operations, the culture provides strong support for system reliability and open communications. The management of system operations, system operators, and support personnel are all actively involved in activities to improve the operation of WEC's system and the industry.

The evaluation team identified two potential examples of excellence in WEC's operations. One example is a procedure and analysis tool developed by WEC to determine, in real time, the underlying causes of excessive area control error (ACE) in a multi-party membership organization dispatched by an independent system operator. This tool enables each balancing authority dispatched by an independent system operator to take timely action to improve the control of ACE. After the fact, the procedure provides a method of measuring and apportioning ACE performance responsibility, and provides estimates of the future regulation required to achieve control targets. WEC identified the procedure and the analysis tool as the "Componentized Market Based ACE and the ACE Burden Error."

The other potential example of excellence is the "Strategic Workforce Assessment and Planning Model." The model supports a process for identifying the long-term workforce needs of each department. The process includes the development of statistics on workforce turnover and detailed information on anticipated retirements. Combined with the annual review and implementation of individual development and training plans, this process provides a comprehensive picture of WEC's need to hire, develop, and retain employees in critical positions.

The evaluation team made several positive observations related to WEC's corporate culture, recent enhancements in its energy management system (EMS) and associated telecommunication functions, and improvements in WEC's system operator training program. The evaluation team noted that WEC management requires its system operators and key system operations management personnel to be certified with reliability coordinator credentials and to be extensively involved in regional and national activities to improve system reliability. The evaluation team also noted that WEC's corporate culture supports open communications related to system reliability and corporate goals. The team agreed that WEC had made significant recent improvements in the configuration of its EMS and telecommunications capabilities that support recovery from equipment failures and provide reliable tools for system operations.

The evaluation team, jointly with WEC, identified two key recommendations related to WEC's system operator training program. These recommendations address incorporating the recently completed job task analysis into the initial system operator training and developing formal training based on lessons learned from post-event analysis.

Overall, the evaluation team identified six positive observations and the two potential examples of excellence. In addition, the team offers five recommendations that, if implemented, will enhance WEC'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 two potential examples of excellence in its reliability readiness evaluation:

1. The innovative "Componentized Market Based ACE and the ACE Burden Error" analysis and tools provide immediate system operator awareness of underlying causes that contribute to excessive ACE, indicate available sources and actions to correct ACE, and assists operators in meeting control targets (Section 2.3).
2. The WEC personnel succession planning process, "Strategic Workforce Assessment and Planning Model," when combined with WEC's annual development of individualized training plans, serves as an outstanding tool to address succession issues for employees at all levels of the corporation (Section 1.2.4).

## **Positive Observations**

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

1. WEC promotes a culture that supports electric reliability and safety, evidenced by the following (Section 1.2.2):
  - a) The statement of operator authority, signed by the senior vice president of customer operations, is well stated and widely distributed (internally, to MISO, and to ATC);
  - b) Corporate goals and company performance are communicated throughout the company;
  - c) All system operators and key management are certified with reliability coordinator credentials and certificates are displayed in the control room;
  - d) Employees are extensively involved in the activities of NERC, RFC, and MISO, and the results are regularly communicated throughout the company.
2. WEC has made significant enhancements in its EMS/IT department since the 2004 readiness audit. See discussion in Appendix 1.
3. The staffing level for system operators provides sufficient dedicated training time (Section 5.1).
4. WEC has significantly improved its ongoing system operator training program since the 2004 readiness audit, especially by including the Wisconsin System Operator Training Program (Section 5.1).

5. WEC screens system operator candidates using the Edison Electric Institute System Operator/Power Dispatcher Exam (Section 5.1).
6. The backup control center allows for easy transition and full capability to operate the balancing authority function. See discussion in Appendix 1.

## **Recommendations**

The evaluation team offers the following five recommendations:

1. Use the results of the completed job task analysis to revise the objectives of the initial system operator training program to prepare trainees for the on-shift functions and responsibilities (Section 5.1)\*.
2. Develop formal training modules from lessons learned derived from post-event analysis to supplement the existing ad hoc training (Section 5.1)\*.
3. Revise the document control process as follows (Section 2.2.3):
  - a. Train employees on the established document management process and revision protocol.
  - b. Establish a document management quality control system to ensure consistency.
  - c. Add a hard-copy document control protocol to document management process to ensure that there is a clear record of when documents are reviewed, whether or not an update was required.
4. Evaluate the possible security enhancements. See discussion in Appendix 1.
5. Improve housekeeping. See discussion in Appendix 1.

\*Jointly identified by WEC and evaluation co-leaders as a key recommendation

## Discussion

The reliability readiness evaluation team examined the following key areas during the evaluation. The detailed discussion that follows provides the foundation for the recommendations, positive observations, and potential examples of excellence that the team identified. The report uses the generic term “system operator” to refer to all on-shift operating personnel responsible for executing the functions necessary to operate reliably and maintain the reliable operation of the bulk power system. This term will be used for the discussions unless additional specificity is required, such as the *balancing* system operator, or *transmission* system operator.

### 1. Culture

#### 1.1 General

*The corporate organization provides the necessary leadership and management for system operations to sustain high levels of safe, reliable operation.*

WEC’s corporate vision and strategy statements place emphasis on customer satisfaction and reliability. In 2006, WEC received, for the fourth time in five years, the prestigious ReliabilityOne award from the Polaris award program of PA Consulting for superior electric system reliability in the Midwest region of North America. In support of the corporate vision, the system operations department’s mission statement stresses dynamically balancing generation to match demand and operating the system in a safe and reliable manner, while meeting or exceeding NERC operating and reliability standards.

#### 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.*

WEC has a culture that supports performance, evaluation, and improvement. Within system operations, a situational awareness team has been established to address operator information delivery. A research team tasked to address operating reserve optimization has developed new tools for monitoring control performance and is testing regulation performance. An energy accounting process improvement team is assessing the overall accounting process and developing changes to streamline the process. Internal audits are being performed to assess compliance with reliability standards, assist with training, and support the implementation of compliance programs. Another team is addressing the work environment and employee engagement.

In addition, system operators, supervisors, and support staff participate as team members in NERC Reliability Readiness and Improvement Program evaluations and are actively engaged in various committees focusing on reliability standards and compliance within the industry.

### 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.*

WEC's culture directly supports system reliability and safety, as evidenced by several actions and processes established by corporate management. For example, the senior vice president of customer operations developed a statement that clearly gives the system operators the authority to take the actions necessary to protect the bulk power system and had the statement posted in the control center, widely distributed within WEC, and sent to ATC and MISO. To keep the company informed, goals and performance data are communicated throughout WEC. In the system operations area, support is given for all system operators and key management to become certified with reliability coordinator credentials, for the extensive involvement of system operations personnel in industry (NERC, RFC, MISO, etc.) activities, and for ensuring that these activities are communicated to senior management on a regular basis. The evaluation team notes this support as a positive observation.

### 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.*

WEC has established several forums for the discussion of system reliability issues. Monthly "Office of the Chair" meetings are held by WEC's senior management team, and an operational report on overall electric reliability is routinely provided to WEC's Board of Directors. WEC's operations and regulatory executives attend monthly Federal Energy Regulatory Compliance Program Steering Committee meetings to discuss development and implementation of programs and regulatory compliance. WEC and ATC hold quarterly senior management update meetings, and ad-hoc meetings are held between MISO and WEC's senior management concerning performance and coordination.

A weekly MISO report covering control performance, system reliability, and communications evaluations is provided to WEC's chief executive officer, chief operating officer, and other leadership team members. A weekly MISO transmission outage exposure report, provided to WEC's operations and generation management, assesses the impacts of posted scheduled outages on system reliability and resources. Transmission outages that are posted on the MISO's OASIS and affect distribution or generation are discussed in a weekly forum. The indices of transmission and customer outages are measured and reported on weekly. In addition, a monthly conference call is held between ATC and WEC to discuss posted transmission outages, details of the response to these outages, root causes, and action items for process improvement.

### 1.2.4 Human Resources

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

WEC has developed a "Strategic Workforce Assessment and Planning Model" as a process for identifying, understanding, and addressing short- and longer-term workforce needs. The model

is adjusted to fit the unique operating realities and needs of specific areas and applied to all WEC departments. As a part of implementing the process, WEC developed historical data and statistics on workforce turnover and detailed information on expected retirement dates for all of its personnel.

The manager of electric system operations reviews the staffing of both operational and support staff personnel in the department with the senior vice president of customer operations each year. The staff is assessed on proximity to retirement and experience to determine if budgeted staffing levels are adequate to meet future requirements.

The readiness evaluation team identified the development and application of the Strategic Workforce Assessment and Planning Model, combined with WEC's annual development of training plans for each employee, as a potential example of excellence. The process provides critical input to WEC's personnel development and training plans and provides a complete picture of where the corporation stands with regards to maintaining adequate and properly trained personnel for all critical positions. The evaluation team considered this the most comprehensive corporate-wide program it had seen to facilitate the planning for recruitment, retention, development, and training of personnel for those critical positions.

### **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.*

WEC employs a formal corporate feedback process administered by the Gallup organization. Surveys are conducted of all employees annually, and results are provided to each work group. System operations results are analyzed by a cross-sectional team of employees charged with implementing an "Engagement Impact Action Plan" to address items for improvement. In addition, a system operation holds quarterly meetings for all operating personnel to review recent operational issues, lessons learned, and training. These meetings provide an open forum for discussion of any issue important to the operating personnel. Weekly meetings between the system operators and the support groups are held to discuss current activities and provide a similar open forum for discussions.

At the corporate level, regular meetings are held to discuss progress on corporate goals, including the overall goal to deliver world-class reliability. These meetings include the monthly "Office of the Chair" meeting attended by all senior management, the monthly Federal Energy Regulatory Compliance Program Steering Committee meetings attended by operations and regulatory executives to discuss WEC's compliance program, and the WEC/ATC quarterly senior management update meetings attended by operations executives and support staff of both companies. In addition, a system operation holds weekly departmental conference calls to discuss any significant system operations events and to review the indices tracked to measure performance of system operations.

Monthly operating reports that cover the performance of system operations, and any imminent issues, are communicated to employees through newsletters, postings on bulletin boards, and on the WEC intranet site.

## 2. Fundamentals of Operations

### 2.1 General

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

WEC's EMS, which provides supervisory control and data acquisition (SCADA), generation, network, and alarm/event functions, is designed with redundancy and diversity to ensure constant monitoring availability. Remote terminal units (RTUs) are scanned at intervals of two, four, six, or eight seconds. Most of the RTUs are scanned on a four-second interval. All tie lines are scanned at six seconds or less.

Data exchanges with WEC's neighboring reliability entities and reliability coordinator are made through a real-time intercontrol center communications protocol (ICCP) connection. In addition, real-time ICCP connections from the WEC backup server to ATC and PJM were implemented in 2006. A connection from the WEC backup server to MISO is being installed and implemented and is expected to be available later this year.

Wide-screen monitors are located near the system operator, transaction coordinator, and support positions in the control center. The monitors provide status for all critical functions and maintain a wide-area system visibility. Information can easily be arranged to suit the specific functions of the operators and support personnel. Alarms are provided on all data errors and for each function being performed.

Three frequency sources are available through the EMS for the calculation of ACE. Two of the frequency measurements devices are located at WEC's primary control center, and the third is located at the backup EMS server site. For a loss of EMS, the system operators can obtain frequency readings from WEC's power plant control rooms. Additional frequency checks can be provided by neighboring utilities and ATC transmission system control operators. Procedures provide for field personnel being dispatched to area substations to monitor frequency readings as a last resort. A spreadsheet and associated operating procedures are available for the operators to manually calculate WEC's ACE, if required, when the EMS is unavailable.

WEC has automatic voltage regulators in operation on all generating units, except those that have been specifically designated by ATC as not having a material effect on the supply of reactive power or voltage control. Plant operators notify the system operators when an automatic voltage regulator must be taken off automatic mode. WEC also has power system stabilizers installed on several units. The power system stabilizers are always in service unless maintenance or testing is being performed. Exceptions for automatic voltage regulators and power system stabilizers are logged electronically, and the reliability coordinator and transmission operator are notified via telephone. WEC's control center coordinates these operations between ATC and WEC's generating plants.

## 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.*

WEC has a set of operating procedures that cover all normal and emergency operations of the balancing functions. A hard copy of the procedures is available at the system operator's desk and on the control center displays. WEC's shift-turnover procedure includes a face-to-face discussion between the operators going off shift and those going on shift. The operators review the electronic shift log and the clearance file and complete a shift-turnover checklist.

Infrequent activities in the control center are planned and performed in a manner to avoid interference with maintaining system reliability. Any activity that could have an impact on system reliability must be approved by system operations prior to occurring.

### 2.2.2 Operational Decision-Making

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

WEC's system operators use a disciplined procedure for making operational decisions. The procedure requires operators to analyze, evaluate, and apply information supplied by various analysis tools. The procedure also requires operators to determine alternative solutions, consider the consequences of each alternative before making a decision, and then evaluate the outcome. In real-time operations, when it is not feasible to perform a formal analysis, the operators are trained to perform a quick comparison of the possible worst-case consequences of each course of action. The operators have available a work procedure manual that delineates actions expected for predefined abnormalities.

In preparation for next-day operations, the operators have available the MISO daily report. All generation offers are submitted by market participants, and the balancing authorities provide requirements for regulating reserves, contingency reserves, fast-start generation and interruptible load available, and any firm transactions into and out of the balancing authority's regulation areas. The MISO daily report is developed for each balancing authority in the MISO area based on the load forecasts provided by each marketing participant in the MISO footprint and the scheduled interchanges into, out of, and through MISO.

### 2.2.3 Operational Alignment

*Organizational structure supports safe and reliable system operation.*

WEC has a set of operational procedures that direct the communications of WEC's system operators with MISO, ATC, and internally with WEC's generation group and marketing function. Based on agreements between MISO and WEC, MISO performs all functions related to scheduling interchanges into, out of, and through MISO — that is, receiving generation curtailment information from market participants, providing dispatch instructions for net interchange schedules, sharing reserves, reporting on ACE, administering inadvertent accounts

with external and internal balancing authorities, committing resources to serve load and reserves within MISO, and declaring energy emergencies.

WEC's generation outages are communicated directly to MISO and ATC through the AREVA Outage Scheduler and require MISO acknowledgement or acceptance. ATC and MISO provide the coordination for outages with neighboring reliability authorities. MISO is notified by e-mail or telephone of any data updates that require an information technology (IT) outage (e.g., ICCP upgrades).

The MISO daily report takes all of the approved outages into account and provides WEC's operational plan for the next day. The required coordination with other parties takes place before that plan is communicated to WEC. Each morning, MISO initiates a conference call with all member balancing authorities and neighboring reliability authorities to discuss significant transmission and generation outages and reliability concerns for the day. ATC directly contacts WEC's system operators if there is a need for a special operating guide or abnormal situation with regards to the transmission system. WEC's system operators hold a daily conference call with WEC's generation group to discuss the status of WEC units for that day.

The WEC control center is operated with a two-person rotating shift consisting of a power system supervisor and a transaction coordinator. The rotating shift operators report to a senior power system supervisor responsible for the overall supervision of the balancing authority function. System operations also include several support positions that concentrate on compliance, training, accounting, engineering, and project management issues. The senior power system supervisor and all of the support staff personnel report to the manager, electric system operations.

Power system supervisors are empowered with full authority to take whatever action is necessary to preserve grid reliability, including the authority to shed firm load during system emergencies. A letter from the senior vice president, customer operations details this authority and is posted in the control center. Transaction coordinators are responsible for maintaining the integrity of real-time data and supporting the power system supervisors in real-time operation of the balancing authority.

WEC's control center operations coverage is split into two 12-hour shifts. Each shift consists of a power system supervisor and a transaction coordinator. WEC staffs seven power system supervisor positions and seven transmission coordinator positions. Each position involves a six-person, six-week rotation. The seventh person in each position works an eight-hour day shift, Monday through Friday, to support operations, training, and project assignments. WEC requires personnel serving in both the power system supervisor and transaction coordinator positions to be NERC certified with reliability operator credentials.

The evaluation team found the documentation of WEC's operation procedures to be very thorough and accurate. However, with the documents being updated by multiple parties, the team found inconsistencies in document control. The team recommends that WEC train employees involved with the development, review, and updating of procedures on WEC's document management process and revision protocol, establish a quality control system to

ensure consistency, and add a hard-copy document control protocol to the process to ensure that there is a clear record of when documents are reviewed, whether or not an update was required.

### **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.*

WEC's EMS provides real-time data to WEC's state estimation program. The state estimation program runs load flows at five-minute intervals, modeling the n-1 system contingencies for the loss of any generating unit, any transformer operated at 138 kV and above, and any transmission line operated at 69 kV and above within the WEC balancing area. The list of contingencies is reviewed when system changes occur and includes all critical facilities. WEC uses a snapshot of the MISO state estimator model, updated every two years, as a transmission network configuration model for its state estimation database. Updates to WEC's internal transmission system model are provided by ATC as changes occur.

WEC's system operations has access to the MISO extranet, a password-protected Web site that provides information on the load forecast, resource availability, expected transactions, and MISO day-ahead security analysis. The extranet has quarterly updates of MISO's network model and daily state estimation snapshots. WEC uses a vendor-provided (OSI PI System) program to monitor and provide trending of control performance, frequency, interchange, load, generation, line flows, and voltages.

WEC has developed a process and analysis tool for determining, in real time, the underlying causes for excessive ACE in MISO's area. The "Componentized Market Based ACE and the ACE Burden Error" analysis tool enables WEC to take timely action to improve the control of the ACE. The tool breaks the ACE equation down into components that allow the causes of excessive ACE to be clearly determined. After the fact, the procedure provides a method of measuring and fairly apportioning ACE performance responsibility and provides estimates of the future regulation required to achieve control targets.

The evaluation team considered this an innovative approach to examining the components of the ACE and matching the components with the causes in a multi-party marketing group like MISO. The team identified the tool as a potential example of excellence because it provides immediate system operator awareness of the underlying causes that contribute to excessive ACE, indicates available sources and actions to correct the ACE, and assists the system operators in meeting NERC control performance standards.

### **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.*

WEC is a member of the Midwest Contingency Reserve Sharing Group. MISO is responsible for declaring system capacity and energy emergencies for its members when it is concerned

about maintaining the required level of operating reserves because all available resources may be committed to meet load, firm transactions, and reserve commitments. WEC, as a balancing authority in MISO's footprint, also can declare a system emergency when WEC's peak-hour load forecast is greater than 90 percent of the sum of available WEC generation and net firm transmission import capability. WEC makes this determination on a daily basis using the MISO *Day Ahead Balancing Authority Sufficiency Report* information and the WEC reserve report. WEC may also declare an emergency based on a projected or actual natural gas curtailment affecting WEC's generation.

WEC's underfrequency load shedding program automatically sheds load at the frequency set points of 59.3, 59.0, and 58.7 Hz. At each frequency, over 10 percent of system load is shed with a six-cycle delay.

As WEC's reliability coordinator, MISO is responsible for the overall coordination of blackstart and system restoration activities. MISO coordinates the interconnection of islands and informs all members in the MISO footprint and outside reliability areas of the progress of the restoration process. ATC's blackstart restoration plan defines the responsibilities of all parties within ATC's transmission system footprint. The ATC system operator is responsible for coordinating with the WEC's system operators and generator owners, concerning the generator cranking paths from the blackstart facilities to the power plants, and the establishment of local transmission systems in preparation for interconnecting any islands. At the direction of the ATC system operator, the WEC system operators coordinate with the WEC distribution controllers for load adjustments to control voltage during restoration procedures. The WEC system operators are responsible for starting and controlling generation and directing WEC's distribution controllers in re-establishing loads as generation and the transmission system configuration permit.

WEC has established an incident management team to provide a central point of coordination and support to efficiently allocate corporate resources and make decisions to ensure that the most critical functions of the company are maintained or recovered effectively. The main functions of the incident management team are to gather timely and accurate information about the incident, provide information to executives, coordinate activities with external stakeholders (e.g., local, state, and federal disaster response teams), and provide support for any local incident response team.

WEC's system operators utilize a system status notification e-mail group to communicate updates on system status and bulk power system conditions directly with a large number of employees. The system status update is used to keep executives and key personnel informed about the status of the bulk power system. E-mail updates are sent out periodically during capacity constraints or critical events. The update normally includes details on load, generating plant performance, critical system events, and MISO declarations and directives.

WEC's senior executives become directly involved when an outage lasts more than three hours. The officers make sure system operations has the resources needed (medical, police, fire, media relations) and that there is proper communication with customers. When there is a need for public appeals for voluntary curtailment, especially on a day-ahead basis, the executives are informed and work with external affairs. There is a formal trigger in the rotating outage plan to

initiate this involvement. The storm recovery plan and business continuity plan also have clear roles defined for executive involvement.

### **3. Fundamentals of Maintenance**

#### **3.1 General**

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

The manager, electric system operations is a member of the IT steering committee. Every two weeks, the IT support staff has a meeting with system operations only; on alternate weeks, IT meets with all clients to discuss enhancements and concerns. The EMS is supported by a team of 19 IT and engineering personnel, divided into three functional areas: architecture design and engineering, applications design and engineering, and operations support.

#### **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.*

WEC's EMS has redundant application servers and SCADA front-end servers at two SCADA sites. Critical RTUs have communication circuits terminating at both SCADA sites. WEC has automatic monitoring for its servers and the networks that support system operation. Failure of any of the servers or the networks generates an alert through a monitoring system that automatically generates trouble tickets to a problem management system, which automatically pages IT support staff on call around-the-clock. If the problem escalates, support management on call is also notified. Each incident is categorized, and before closing the incident, IT communicates directly with system operations to make sure the incident is resolved. A problem management process tracks repeated incidents.

WEC uses a situational awareness reliability tool based on its EMS network applications (state estimator, contingency analysis, and study applications) to verify the accuracy of telemetered data by comparing the data with state estimation results. All critical applications are monitored, and a failure causes the EMS application server to fail over to the hot standby, which generates an alarm. IT personnel perform daily system checkouts of all EMS applications. Database maintenance and one-line diagram updates are made at least weekly.

##### **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.*

All software updates and modifications associated with system operations start with an enhancement or service request. These requests are tracked in the same problem management system as equipment and application problems discussed above.

When changes are made to WEC's state estimation model, the new model is tested off-line before porting it over to the on-line system. Calculated flows from the state estimation model are checked against real-time data. The state estimation model and the EMS single-line displays are prepared by different personnel, and when linked together, discrepancies in the model can be visually identified. This ensures that both the state estimation and contingency analysis models are performing correctly before being used in real-time operations.

#### 4. Fundamentals of Operational Planning

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

Since MISO is responsible for the overall planning process for the balancing authorities in its footprint, WEC's operational planning process primarily involves the interaction with several parties, internal and external to WEC. WEC's power plant data are manually updated daily for system operations by power plant operators and includes the status of generating units and unit minimums and maximums. The status of WEC's peaking units is provided daily by WEC's marketing function, the Wholesale Energy and Fuels department. WEC's marketing function uses in-house and commercially available load forecasting tools to generate and supply system operations the short-term load forecasts for WEC's loads. Short-term load forecasts are also received from the non-associated load-serving entities in WEC's footprint. WEC's marketing function also provides a report showing the generation units expected to be available to the market (and at what levels) for the following day.

WEC's system operators provide MISO a daily update of WEC's data for the coming week, including generation status, load forecasts, interruptible loads available for reserves, status of fast-start units, and generation capacity sales and purchases internal and external to MISO. MISO collects similar data from all balancing authorities in its footprint, and data on the generation that has been bid into the MISO market. MISO uses these data to generate a daily report that identifies if each balancing authority has sufficient reserves for the next day. Reports from MISO include the next-day hourly net scheduled interchange and unit dispatch levels. The reports also identify all major generating unit outages, existing and planned transmission line outages, and all constraints and voltage stability limits. These reports are reviewed by WEC's system operators starting the evening before the effective day.

Every weekday morning, a conference call is initiated by MISO with all balancing authorities and transmission operators in its footprint and control areas adjacent to MISO to discuss significant outages, transmission constraints, and stability limits. WEC's system operators follow up on the MISO conference call with an internal conference call that includes WEC's power plants, marketing function, and fuel supply. WEC's power plant capabilities are reaffirmed, and any new limits or outages that were not previously identified are discussed and planned.

The MISO daily report is the next-day operational plan for WEC. The coordination and analysis of system impacts by both MISO and ATC take place before that plan is communicated to WEC. MISO can deny transmission outages or reschedule generator outages if there is an operating

issue. ATC contacts WEC system operations if there is a need for a special operating guide or an anticipated abnormal situation that could affect WEC's balancing functions.

WEC's system operations uses EMS-based study applications and contingency analysis tools to perform operational planning analysis as required for special situations. The source of the study applications network model is a snapshot of the MISO network model. The WEC system operations support engineer is responsible for ensuring that the network model is up-to-date and for providing updates to EMS support modelers for implementation. The support engineer also provides updates to equipment characteristics and ratings based on a current snapshot of the MISO network model or by contacting the owner of any facility in question. Through the ICCP from ATC and MISO, WEC receives real-time breaker status, power flows, and voltages for select ATC-owned facilities located in the neighboring systems. Generator dispatch scenarios are developed on a case-specific basis for the studies being performed.

The WEC system support engineer has access to a software tool that can retain about 72 hours of EMS data to reconstruct events and conduct post-event analysis. Routine analysis is performed for switching errors and safety events, and training material is developed for all the significant events. WEC also holds a monthly conference call with ATC to review any transmission events that affected balancing functions. ATC provides WEC a post-event report for all transmission-related events. WEC does not have a training simulator in house, but does have Web access to the ATC dispatcher training simulator that allows WEC's system operators to review system events.

WEC participates with MISO and RFC in developing seasonal system assessments and constraints. WEC's system operators and support staff participate in mandatory training each year before the summer peak load season. The training and discussions cover how WEC will meet its obligations and procedures that might be needed during capacity emergencies. The training presentations cover topics such as planned outages, reserves, seasonal capacity contracts, reserve sharing, MISO emergency operations, internal emergency operating procedures, and fuel issues.

WEC currently uses a Mid-America Interconnected Network, Inc., or MAIN, guide adopted on an interim basis by RFC for annual testing of the real power ratings of its generating units. WEC develops a monthly spreadsheet of real power ratings for its generating units and provides that information to RFC. Reactive power testing is beginning this year and a five-year requirement has been established to complete this testing.

## **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.*

To be considered for a system operator position within WEC, candidates must have significant technical experience and knowledge of bulk power system operations, and they must pass the

Edison Electric Institute System Operator/Power Dispatching Exam. The senior power system supervisor, working with the manager of compliance and training and receiving input from the manager of electric system operations, operations support staff, and operators, develops the initial training plan based on the background and knowledge of each individual trainee. The initial training is balanced between on-the-job training, required NERC certification training, Wisconsin System Operator Training modules, and other training opportunities identified. The Wisconsin System Operator Training modules come from a joint training effort between several Wisconsin electric utilities and ATC. The goal of the consortium is to provide relevant system operator training for the fulfillment of NERC certification and continuing training requirements and to improve operator performance.

WEC's *Power System Supervisor Qualification Guide* is the procedure used throughout the initial training to ensure a comprehensive understanding of job tasks and responsibilities. The trainee works closely with several experienced system operators to learn the details of the job and the tools used in real-time operations. Upon completion of the qualification guide and demonstrated proficiency in performing required tasks, an experienced system operator reviews the trainee's readiness to operate. If the trainee is found to be proficient in all areas, the qualification guide is signed as complete, and the trainee is added to the shift schedule.

WEC's senior power system supervisor, with input from the manager of electric system operations, manager of compliance and training, other operations support staff, and system operators, also develops ongoing training plans for each operator. Individual training plans are developed with the input of the operator; the plans take into account the operator's previous training, WEC's training program guidelines, NERC requirements, the Wisconsin System Operator Training program, current events and issues impacting the balancing functions, and the needs of the department. The training is delivered by formal classroom training, operational drills, and simulations.

Wisconsin System Operator Training program holds formal training sessions three times a year. In the spring, a four-day session is held to concentrate on courses designed for newer operators and emergency operations topics. There are currently 16 courses in the program covering power system technical concepts, regulatory issues, and standards of conduct. Fall and winter training sessions are typically two-day, short courses designed to keep the experienced operators abreast of industry changes or cover advanced technical topics.

Each operator's training plans and accomplishments are documented in the operator's performance management plan. Additional training opportunities are identified during the year by the Electric System Operations support staff and the operators themselves. Each operator has a mid-year and annual performance appraisal. The performance appraisal process includes detailed discussions of training progress and any modifications or additions needed.

Feedback from the system operators on the training programs is obtained through the Wisconsin System Operator Training program, from operators' periodic sessions with operations managers, and from detailed course evaluations by the operators as they complete each course. Also, multiple mandatory tests are administered during the training and provide a means to objectively

measure course effectiveness. Course evaluations and quiz results for operators are reviewed by the senior power system supervisor and manager of compliance and training.

In reviewing WEC's training program, the evaluation team recognizes several positive observations. First, the team notes that the staffing level for system operators provides sufficient dedicated training time for the operators. Second, the team notes that WEC has significantly improved its ongoing system operator training program since the 2004 readiness audit, especially by including in the Wisconsin System Operator Training Program. Finally, the team commends WEC for screening system operator candidates using the Edison Electric Institute System Operator/Power Dispatcher Exam.

WEC is completing a job task analysis to identify the tasks performed by the system operators and to determine the training required to maintain appropriate skills and knowledge. A job task interview questionnaire was developed to prepare a training database, and interviews with individual system operators were conducted to determine the skills and knowledge necessary to complete assigned tasks. On-shift observations were also made to verify job tasks and descriptions. WEC plans to use the job task analysis to identify required job skills and knowledge and to revise objectives for the system operator training program. The evaluation team recommends that WEC use the completed job task analysis to incorporate objective evaluation criteria in its initial system operator training program.

After any significant system event on WEC's system, there is a post review to determine the actions taken during the event and the optimum response. Alternative actions are evaluated for possible improvements in resolving the situation, and prevention techniques are evaluated. If the incident involves ATC or MISO, a joint review is performed. An incident report is developed that addresses the root causes and lessons learned. The report, along with its review, at regular meetings of the system operators, is used to make all operators aware of the lessons learned. The evaluation team recommends that WEC develop formal training modules for new employees derived from post-event analyses to ensure that they receive the benefit of the lessons learned.

## **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.*

Critical decisions faced by WEC's system operators are typically analyzed in a collaborative manner involving other WEC departments, ATC, MISO and neighboring reliability authorities. The process WEC's system operators use is designed to identify and communicate the various threats, determine the system vulnerabilities, and devise any necessary alternatives.

WEC's operating procedures delineate actions expected of system operators for predefined events. The EMS displays have reference poke points that provide the system operators additional guidance for system locations that require special operating considerations. In other real-time situations, the system operators are trained to perform quick comparisons of the possible consequences of each action and determine the impact of additional events occurring.

## **APPENDIX 1: Critical Infrastructure**

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

## **APPENDIX 2: Entity Participants**

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

### **APPENDIX 3: Documents Reviewed**

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