NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Balancing Authority/Transmission Operator Reliability Readiness Evaluation Report

American Electric Power
Columbus, Ohio

April 23–26, 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. The document *NERC Readiness Evaluation Procedure* describes and defines the process used for reliability readiness evaluations. This document and other documents related to the program are available at http://www.nerc.com/~rap/.

The reliability readiness evaluation teams, each led by a NERC staff member and a regional co-leader, include industry volunteers with considerable expertise selected to provide representation from other interconnections, other regions, and neighboring operating entities. The teams also typically include representatives from the Federal Energy Regulatory Commission (FERC) staff.

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

An evaluation team met on-site with American Electric Power (AEP) representatives on April 23–26, 2007. This report reflects the views and recommendations of the evaluation team regarding the readiness of the AEP to meet its responsibilities as a balancing authority/transmission operator.

Evaluation Team

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Organization Profile

Headquartered in Columbus, Ohio, American Electric Power (AEP) is a large electric utility with generation and transmission operations in 11 states and three NERC regions, RFC, SPP, and the Electric Reliability Council of Texas (ERCOT). This evaluation covers only AEP's operations in RFC and SPP. (The ERCOT portion of the AEP system will be addressed in a separate evaluation.) The RFC portion of operations is known as AEP-East, with PJM serving as the reliability coordinator. The SPP and ERCOT portions of operations are known as AEP-West, with SPP serving as the reliability coordinator for the facilities in the SPP region.

AEP is registered as a balancing authority and transmission operator in the SPP region, and as a transmission operator in the RFC region. AEP is considered a local control center in the RFC region and uses PJM manuals, which specify normal communications procedures. AEP has 138 interconnections with 19 other entities in RFC and 86 interconnections with 12 entities in SPP. For both regions, the utility splits its operations into the transmission control area operations and generation dispatch. AEP's market function resides with the generation dispatch group. The 2006 peak load for AEP-East (RFC portion) was 21,898 MW. AEP-West's (SPP portion) peak was 9,026 MW. AEP owns and operates over 39,000 miles of transmission lines, which makes it the largest transmission owner in the United States, and has over 38,000 MW of generation on its system.

Executive Summary

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

AEP exhibits a very positive culture of engagement, from the officer level throughout the company, as evidenced by various interviews. Employees are knowledgeable about their company's mission and operating characteristics. Management maintains communications with the workforce through a wide variety of methods, including a general open-door policy, company newsletters and memoranda, direct mailings to employees, and standardized feedback mechanisms for employee suggestions.

Overall, the evaluation team identified 10 positive observations and three potential examples of excellence. In addition, the team offers five recommendations that, if implemented, will enhance AEP's readiness to operate reliably and maintain the reliability of the bulk power system. Finally, the team offers one item for consideration. The findings are listed in order of importance.

Potential Examples of Excellence

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

1. The AEP training program takes into account and exceeds the system operator continuing education hour requirements published by NERC, which positions the operators well for any future standards that are developed in this area (Section 5.1).
2. AEP has an excellent document management system linked to an internal Web presence that includes features such as verified document receipt, controlled distribution lists, and company document templates for procedures and standards (Section 1.2.5).
3. AEP has a high level of engagement with the electric utility industry and a commitment to technology advancement (Section 1.1).

Positive Observations

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

1. AEP utilizes a separate load flow routine that is dedicated to studies regarding the Cook nuclear facility, providing automatic notification of abnormal results to system operations and the nuclear plant operator (Section 2.3).
2. AEP security analysis studies are conducted over a very wide area to ensure that no contingency in the Eastern Interconnection will have a negative impact on AEP facilities (emergency overload condition or cascading voltage collapse scenario). If such a situation is found to exist, system operators take appropriate preventive measures (Section 2.3).
3. The formation of the Reliability Compliance Committee (with executive involvement) is commendable and shows a high level of corporate commitment to reliability (Section 1.2.1).
4. The contingency analysis program has high availability and solves very quickly (2.5 minutes on average), providing reliable results to system operations personnel (Section 2.3).
5. *See discussion in Appendix 1.*
6. AEP provides its system operators with both global and zonal system reactive reserve displays, which enhance the operators' ability to quickly assess reactive reserves in the AEP system (Section 2.1).
7. Upon the loss of energy management system (EMS) applications or other critical processes, the applications monitor generates an alarm and automatically pages support personnel without operator intervention (Section 2.1).
8. AEP has a succession planning process that includes both management and experienced skilled system operations personnel (Section 1.2.4).
9. AEP's training coordinator is required by his/her job description to be NERC certified (Section 5.1).
10. AEP is incorporating a "Human Performance Improvement Process" throughout the organization (Section 5.2.1).

Recommendations

The evaluation team offers the following recommendations:

1. Provide initial and continuing training to system operators in the following areas (system specific as appropriate): power system stabilizers, voltage reduction techniques, undervoltage load shedding, underfrequency load shedding, generator operations in degrading frequency scenarios, operating reserves determination, and system-critical facilities (Section 5.1)*.
2. Increase the frequency of modeling updates to the dispatcher training simulator (Section 5.1).
3. Provide opportunities for all system operators to use the dispatcher training simulator (Section 5.1).
4. Develop and implement a shift-change checklist and modify the shift-change procedure to incorporate the use of this checklist (Section 2.2.3)*.
5. Include EMS/IT support personnel in the periodic drills at the backup control center, as would be required in the event of implementation of the evacuation plan (Section 2.4).

*Jointly identified by the company and lead evaluator as a key recommendation.

Discussion

The reliability readiness evaluation team examined the following key areas during the evaluation. The detailed discussion that follows provides the foundation for the recommendations, positive observations, and 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.

AEP recognizes electric generation, transmission, and distribution as core activities of the company and has many internal programs and initiatives directed at improving system reliability.

The evaluation team was provided with a listing of AEP's participation in regional and national study efforts and working groups, including membership on numerous NERC, SPP, RFC, ERCOT, PJM, Institute of Electrical and Electronics Engineers, and Edison Electric Institute committees, subcommittees, and working groups, with a leadership position in many. In addition, AEP has been an active participant in the development of several innovations for the electric utility industry. In the area of technology development, AEP has been principally involved in two notable transmission technology achievements: 1) the installation at Laredo,

Texas, of a variable frequency transformer, or VFT, an innovative power flow control device to provide reliable power supply to the fast-growing Laredo area; and 2) the demonstration, in partnership with the Department of Energy, of an innovative high temperature superconducting cable at Bixby station located in central Ohio. The evaluation team recognizes this high level of engagement with the electric utility industry and a commitment to technology advancement as a potential example of excellence.

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.

AEP demonstrated through interviews and presentations that it has a corporate-level commitment to safe, reliable operation of the power system. The management team discussed the AEP vision and mission statements, which include the company's determination to maintain its leadership and commitment to technical innovation of transmission systems, set standards for transmission reliability, and facilitate optimal dispatch of generation assets.

The formation of the Reliability Compliance Committee with executive involvement is commendable and shows a high level of corporate commitment to reliability. The committee is responsible for ensuring compliance with all approved reliability standards as well as anticipating compliance needs for standards currently under development. The evaluation team notes the formation and activities of the Reliability Compliance Committee as a positive observation.

1.2.2 Leadership and Management

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

The evaluation team discussed AEP's organizational structure, finding it to be well aligned for effective communications. AEP places emphasis on personnel and equipment safety, and this effort extends beyond the workplace. AEP considers corporate safety among its key indicators and holds regular meetings at all levels to review any incidents and continually improve the operational safety program. AEP stresses to its employees the importance of maintaining situational awareness away from the office to avoid accidents and injuries. AEP's employees exhibit a high degree of ownership for personal as well as corporate safety.

1.2.3 Corporate Oversight and Monitoring

Line management is used to strengthen reliability and improve performance. System reliability is kept under constant scrutiny through techniques such as self-assessments, performance indicators, and periodic management meetings.

The evaluation team examined several corporate documents dealing with key performance indicators, noting that the information is presented at the highest levels of the company. AEP

tracks multiple facets of transmission system and generation reliability and continually seeks to improve upon past performance.

1.2.4 Human Resources

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

AEP is staffed adequately to perform its reliability functions and assesses this status on a regular basis. Discussions with AEP system operators and management indicated a corporate commitment to planning for and retaining a skilled workforce. There is a desire to determine which positions may become open in the near term and to identify appropriate replacement staffing. AEP has a succession-planning process that includes both management and experienced skilled system operations personnel, a program that the evaluation team recognizes as a positive observation.

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.

AEP's system operators expressed a high level of satisfaction with corporate communications that have affected their work. The evaluation team observed examples of corporate directives related to new initiatives and found the tone to be professional and respectful.

AEP noted that there are many new processes and procedures being written as new NERC reliability standards are developed. It has acknowledged the importance of placing this new information in a system that provides for distribution and control across multiple facets of the organization.

In order to facilitate this growing need, AEP has acquired an excellent document management system that is linked to an internal Web presence; the system includes features such as verified document receipt, controlled distribution lists, and company document templates for procedures and standards. The evaluation team commends AEP for this aggressive approach to document control.

2. Fundamentals of Operations

2.1 General

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

AEP's system operations department consists of the system control center and six remotely located transmission dispatch centers. AEP's EMS and supervisory control and data acquisition (SCADA) systems are connected via the transmission SCADA network, which serves the system control center and each of the six transmission dispatch control centers with dual redundant servers. AEP-East uses Advanced Display with Extensions (known as ADX) displays, and AEP-West uses Control Area Monitoring System displays. In the AEP-East area, PJM is the

transmission operator for 230 kV and above facilities plus key 138 kV facilities, and AEP is the transmission operator for the remaining facilities less than 230 kV.

AEP's system operators have adequate communications mechanisms in place for both normal and emergency communications. Established communications protocols are in place for internal information exchange as well as for communications with neighboring systems and reliability coordinators.

The evaluation team met with representatives of the generation dispatch organization, aligned with AEP's marketing operations. The team noted a high degree of attention paid to standards of conduct with regard to allowable discussions and topics. AEP reinforces standards of conduct through reiterative training on a regular basis.

The evaluation team observed AEP's system operators' tools, such as the real-time contingency analysis program and the company-developed "e-terra*vision*" visualization tool, and found them to be excellent. The AEP system operators have the ability to observe and monitor voltages across both east and west systems and have a tool to indicate overall voltage trends in the systems. For monitoring reactive reserves, the system operators have several displays available, which are updated on a real-time basis, showing both global and zonal system reactive reserves. This allows system operators to know what reserves are available for deployment, whether machine reserves or static capacitor reserves. The evaluation team notes this as a positive observation.

AEP is a member of the SPP Reserve Sharing Group, and the AEP-West requirements are determined by SPP. PJM is the balancing authority for AEP-East in terms of operating reserve requirements. AEP designates PJM as the planned reserve sharing group for AEP-East. AEP-East participates in PJM's *Fixed Resource Requirement Capacity Plan*. Discussions with the AEP system operators indicated a need for additional technical training in a few areas, including the company's employment of power system stabilizers, which is addressed in the Fundamentals of Training section of this report.

AEP system operators have numerous frequency monitoring points available for use by the EMS, both for AEP-East and AEP-West. The evaluation team verified that AEP had developed a visual display for AEP-West operators showing the locations of the frequency monitoring points as recommended in the 2004 reliability readiness audit.

In addition to the monitoring of all appropriate real-time system operations data, AEP has a software program that monitors the overall and individual health of the monitoring systems as well as critical applications. AEP will continue supporting this internally developed program with the upcoming move to a new EMS. Upon the loss of EMS applications or other critical processes, the applications monitor generates an alarm and automatically pages support personnel without operator intervention. The evaluation team recognized this development and support as a positive observation.

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.

AEP's system operators are well trained in safety and reliability, exhibiting a high degree of alertness to system conditions. AEP employs one special protection system, in AEP-West, which affects the dc ties in SPP. The system operators are aware of the special protection scheme status at all times (it is normally in service continuously) and know the operational characteristics and importance of the scheme.

2.2.2 Operational Decision-Making

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

AEP bases operational decisions on study results as well as operator observations and an informal risk analysis. AEP has numerous procedure documents detailing available operator responses in various scenarios. AEP system operators noted that there are no long-term workarounds in place for operational problems. Historically, when such a scenario developed, an operating procedure was designed for use until the problem was rectified.

AEP reported that through a partnership with five other utilities and an industry software vendor, it began a research and development project to develop an advanced "Decision Support System" tool to improve the system operator's visibility. The project was recently completed and a product offering of e-terra*vision,* an advanced visualization tool for system operators, was the result. AEP is in the process of implementing this new tool in the system control center and six transmission dispatch centers, continuing throughout 2007.

2.2.3 Operational Alignment

Organizational structure supports safe and reliable system operation.

AEP has reliability coordination agreements with SPP and PJM to provide services as appropriate. The system operators are aware of the agreements and routinely communicate in an effective manner with their respective reliability coordinator.

Outage coordination and communications are handled according to internal procedures as well as with the respective reliability coordinators. The AEP system operators explained that they are comfortable with voice communications with the respective reliability coordinators and said they do not have any difficulties discussing operational problems with any neighboring systems.

The AEP system operators have full authority to take action regarding reliability matters without obtaining any additional approvals, up to and including shedding of firm load. A letter posted in the control room specifies this authority. Neither AEP-East nor AEP-West delegates any authority to other parties by contract or by mutual agreement. With respect to capacity and energy emergency plans, the two operating areas have different responsibilities. AEP-West,

being both transmission operator and balancing authority, has the authority to declare an energy emergency and to enter the 13-step process for relief. AEP-East operates under the auspices of PJM, which serves as the balancing authority.

AEP has an extensive set of internal operating policies and directives, and provides for online access to these and the NERC reliability standards via intranet. The system operators are notified of any changes via e-mail, at shift changes. Major changes are discussed with the operators in person or during periodic safety meetings prior to actual implementation. The evaluation team examined the shift-change process and noted that there is not a consistent approach applied across all shift changes. The evaluation team recommends AEP develop and implement a shift-change checklist and modify the shift-change procedure to incorporate the use of this checklist. The team discussed AEP's use of e-mail for notification of policy and procedure changes and suggests AEP develop a definite feedback and acknowledgement mechanism for policy and procedure changes.

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.

AEP's state estimator and other security-related software were developed in house. There is no specific software version, and any needed changes are carefully monitored and fully tested prior to implementation. AEP has initiated a project to replace the AEP-East and AEP-West EMS, state estimator, and security applications with an industry vendor's products during 2007. The new tools are scheduled to be operational in late 2008 and will run in parallel with the existing tools for one year. The total implementation of the new software is projected to take place in late 2009.

AEP performs contingency analysis studies to determine whether there might be adverse impacts on the AEP system under those scenarios. These security analysis studies are conducted so that AEP can determine that no outage in the Eastern Interconnection will have a negative impact (emergency overload condition or cascading voltage collapse scenario) on AEP facilities. The evaluation team believes this wide-area visibility and contingency analysis are a positive observation.

The contingency analysis program solves very quickly (2.5 minutes on average), providing reliable results to system operations personnel. The team noted that the AEP contingency analysis program ran successfully almost 100 percent of the time in 2005–2006. The quick solutions, reliable results, and availability are another positive observation.

AEP has developed a voltage contingency analysis tool for use by its system operators. Transmission Operations Engineering is currently refining the tool prior to releasing it for control room use.

AEP utilizes a separate load flow routine dedicated solely to studies regarding the Cook nuclear facility. The routine provides automatic notification of abnormal results to system operations and the nuclear plant operator. The evaluation team feels that this is an additional positive observation.

With regard to transmission system congestion, the AEP system operators indicated that they follow the directives of the two reliability coordinators for relief activities. The reliability coordinators verify that there exists an excellent working relationship with AEP in both the AEP-East and AEP-West operating regions.

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.

AEP has plans and procedures, including communications protocols, in place to provide direction to its personnel in the case of system emergencies. The evaluation team determined that the procedures were adequate for the postulated scenarios. The procedures include interim operations plans, if needed, as well as roles and responsibilities of EMS and information technology (IT) support personnel. The team visited the backup control center, where an actual drill was taking place. All systems were functional, but interviews with system operators on-site indicated that during these routine drills, nonfunctioning systems require support from personnel not normally involved with the drills. The evaluation team recommends that AEP include EMS/IT support personnel in the periodic drills at the backup control center as would be required in the event of implementation of the evacuation plan.

AEP's *Transmission Emergency Procedures* manual details many possibilities for dealing with capacity emergencies, up to and including shedding of firm load. PJM, as the balancing authority, is responsible for identifying such a need for AEP-East (time permitting), while the AEP-West system operators monitor the AEP system for any similar circumstance. AEP noted some overlap between the manual load shedding program and locations where automatic load shedding relays are installed.

The AEP manual mentioned above also contains information relating to system restoration in the case of a cascading blackout. The plan states: "Following the complete loss of system generation (blackout), it will be necessary to establish initial generation that can supply a source of electric power to other system generation and begin system restoration. These initial generators are referred to as system Black Start generators. They must be able to self-start without any source of off-site electric power and maintain adequate voltage and frequency while energizing isolated transmission facilities and auxiliary loads. Generators that can safely load reject down to their auxiliary loads are another form of Black Start generation."

AEP's capacity and energy emergency plan is also in the AEP manual, and is referenced as the "Capacity Deficiency Program." It contains operational procedures for both AEP-East and AEP-West, with the sets of procedures clearly separated by geographical region. The plan covers all of the necessary steps, including communications with the reliability coordinators and neighboring systems.

AEP has one nuclear power facility, the Cook nuclear plant. Specific operation planning studies are conducted for the Cook nuclear plant to evaluate the thermal and voltage performance of its off-site power sources. Any transmission constraints or operating procedures required to satisfy U.S. Nuclear Regulatory Commission off-site operational requirements are included in seasonal and operational planning studies. AEP system operators indicated that a Cook nuclear plant operating procedure is followed during routine or emergency operations.

3. Fundamentals of Maintenance

3.1 General

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

Internal AEP staff performs maintenance activities related to the control center and communication system equipment. AEP has a corporate staff responsible for providing continuous support for its EMS and SCADA equipment, as well as the required computer equipment used in the control centers. Support personnel are available on a continuous basis and may be called by system operations personnel or alerted automatically if a need occurs.

AEP supplies the system operators with a display that shows the identities of on-call support personnel and details how they can be contacted if needed.

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.

AEP reported very high levels of availability for its critical processes. Interviews with appropriate maintenance personnel indicated a highly redundant system at both the primary and backup control centers. This redundancy allows AEP to support the legacy system while a new system is procured and implemented.

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.

As noted in Section 2.1, AEP has an application that provides for immediate notification of response personnel for the failure of any critical EMS or system application processes. AEP operators noted that they are pleased with the quick responses and rapid resolution of any problems encountered in the control centers. AEP uses a careful systematic approach to making any changes in the control centers, including thorough testing of any new program or equipment prior to its being implemented.

AEP has an approval process that ensures adequate reviews are completed for work relating to control center equipment.

4. Fundamentals of Operational Planning

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

Internal staff performs AEP operational planning activities and coordinates as necessary with neighboring systems and reliability coordinators. AEP is an active participant in many regional and interregional study groups involving both RFC and SPP, as noted below.

AEP develops seasonal performance appraisal base models for system analysis using the Power System Simulator for Engineering, or PSS/E, load flow program for each summer and winter peak load period. AEP reported that models of neighboring systems are the latest seasonal models developed for regional and interregional studies, and typically include detailed representations for all voltage levels 100 kV and above, with some limited representations of lower voltage levels (where needed).

AEP actively participates in seasonal, near-term, and long-term regional and interregional study groups involving RFC, SPP, the Midwest Reliability Organization (MRO), and SERC Reliability Corporation (SERC), including the RFC-SERC East and MRO-RFC-SERC West-SPP study groups. The outcomes of each study group identify possible thermal and/or voltage transmission constraints under a wide range of stressed system operating conditions. From those results, the study groups assess coordinated operating procedures to mitigate those transmission limitations.

AEP's Transmission Asset Management organization is responsible for determining appropriate facilities ratings. This group uses a database for compiling this information, which is coordinated with neighbors. If a rating change is indicated, PJM or SPP is notified, as appropriate. AEP's planning personnel noted that changes to ratings, once determined, are submitted to the reliability coordinators through an electronic data posting, and that is where neighboring systems would retrieve the data. Written procedures govern the development and implementation of these ratings.

Equipment characteristics and ratings are maintained and validated by AEP's Transmission Planning group. These data are compared to data used by the AEP EMS, and any discrepancies are resolved through a detailed investigation of the transmission equipment. AEP has established normal and emergency thermal and voltage limits for all of its transmission facilities. The system is to be maintained within its normal limits with all facilities in service. The system is to be operated within its emergency limits under contingency conditions.

Daily studies

AEP uses the results of seasonal planning studies to determine the list of contingencies to be studied on a daily basis. Others can be added if system changes have occurred. AEP stated that studies results are informally assessed against actual operational data on a routine basis. Following the 2003 blackout, the regional reliability group initiated a benchmarking activity to look at load flow results (this was part of the blackout recommendations). At the time of this

benchmark activity, AEP reports that there was good correlation between the actual and modeled results. For state estimation, comparisons are made routinely with any corrections needed taking place. AEP noted that these corrections are typically impedance issues.

AEP has a procedure for analyzing system disturbance events. The procedure includes information to be gathered, determination of the appropriateness of any automatic operations, tracking and reporting of compliance data, involvement of field services and technical support, and tracking resolutions to completion. AEP noted that it has a corporate goal of 90 days for any corrective action resolution to take place. There have been incidents where the corrective action took longer than the 90 days, as in the case of relay replacement activities.

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.

AEP's comprehensive training program is supported by the corporate culture. The evaluation team notes that the training coordinator is required by his/her job description to be NERC certified as a system operator, and identified this as a positive observation. AEP stated that it uses personnel with education backgrounds for delivery of much of its training. The program coordinator has completed many hours of training with respect to delivery of training, administration of training programs, design or training modules, and course work regarding the training of trainers.

AEP provides for an initial training period for new system operator candidates in two distinct areas: transmission operations and generation dispatch.

For new transmission system operators, there are two training tracks — transmission dispatcher and transmission control area coordinator. The training program has guidelines for completing each step, leading to an applicant being placed in a system operator position to act independently. In all, AEP has identified five levels of progression, starting with a probationary period and ending with Dispatcher I, essentially the most senior-level job. It takes six years to complete the steps, with specific experience required at each progressive level. The training program is subdivided into multiple modules for each level, and each module may include computer-based, classroom, or on-the-job training. Completion of a given module requires acknowledgement by the trainee, successful completion of a knowledge/skills test (if applicable), and discussion with the dispatcher supervisor. At the senior level, ongoing training is supported for required NERC subjects such as emergency system operations, as well as attaining other required continuing education credits to maintain credentials.

For new generation dispatch operators, the program specifies an initial period of six months to complete training objectives and attain NERC certification. Beyond that period, training is referred to as continuing education training and is delivered in several manners: regional transmission organization-sponsored training, commercial-operations training, simulator

training, and training delivered by vendors. The primary objective of this ongoing training is to retain the acquired certification (for balancing and interchange system operators), as well as to enhance skills and provide for general employee development.

The evaluation team examined AEP's training programs for system operators and found that the programs take into account and exceed the system operator continuing education hour requirements published by NERC, positioning them well for any future standards that are developed in this area. The evaluation team notes that this company commitment to a high level of continuing education, including the use of overtime if needed, shows a corporate culture that greatly values the skills of its system operators. The team commends AEP for this and identifies the AEP training program as a potential example of excellence.

The interviews conducted with the training personnel as well as with system operators showed that AEP conducts a minimal amount of cross-training. In discussing this with AEP management, the team learned that AEP had previously considered and adopted an aggressive cross-training program, but that it did not carry the anticipated value-add for the AEP system. The program, following extensive review, was discontinued by AEP.

In 2006, AEP implemented an industry standard dispatch training simulator (DTS) and is continuing in 2007 to extend the model and create new training scenarios. The team discussed the DTS with system operators, who were pleased with its procurement and deployment. As of the evaluation, AEP was still in the process of conducting the initial DTS sessions for its system operations. The evaluation team recognizes the value in this tool and recommends AEP continue and expedite providing DTS opportunities to all system operators to maximize the benefits of this educational resource.

Further discussions were held with individuals involved in support of the DTS, and the team noted that there is currently no process or provision for routinely updating the system model used in the DTS. Some changes to system configuration and parameters had been made and were understood by the involved individuals, but a general revision had not been undertaken recently. The evaluation team recommends AEP increase the frequency of modeling updates to the DTS and make this an ongoing process.

Discussions with individual system operators were conducted by the evaluation team, and it was noted that AEP has provided a great deal of system-specific information to the operators. In some instances, however, there was a lack of understanding of AEP's configuration or specific technical topic areas that could be important to the AEP system. The team examined the training program documentation and noted that these specific topics are not addressed individually. The evaluation team recommends AEP provide initial and continuing training to system operators in the following areas (system specific as appropriate): power system stabilizers, voltage reduction techniques, undervoltage load shedding, underfrequency load shedding, generation operations in degrading frequency scenarios, operating reserves determination, and system critical facilities.

The AEP system operations staff, whether transmission or generation dispatch, all hold NERC certification designation with either reliability, balancing and interchange, or transmission operator credentials, with the exception of individuals in the initial training programs. In

addition, most of the AEP operators in transmission and market operations (which include generation dispatch) are certified operators under the PJM program.

AEP does not have a formalized lessons-learned training plan but does use event-specific information if appropriate. In addition, the system operators indicated there is an informal mentoring effort, and this, combined with classroom discussions, often incorporates discussions of a lessons-learned nature.

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.

AEP is incorporating a new corporate program called the "Human Performance Improvement Process" throughout the organization, a program that has its roots in specific event analysis at a generation station. AEP stated that upper-level management was already involved in the program and that plans are in place to involve higher-risk job categories, which would include system operations, in the next phase.

For ongoing activities, AEP uses a half-hour shift-turnover process as one avenue to lessen the likelihood of human errors. During this time, operations personnel discuss activities that have occurred or are planned and note whether there are risky scenarios involved. In addition, interviews with the system operators indicated that AEP uses its internal safety meetings to discuss error-related scenarios and how to avoid them.

AEP approaches risk analysis in a studied manner, using results from appropriate studies to determine the feasibility of proposed operations. AEP corporate management typically is not involved in any way with operational decisions, but rather has the expectation that the appropriate methods are used to minimize risk. AEP system operations management stated that they do provide situational briefings to corporate management if needed.

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.