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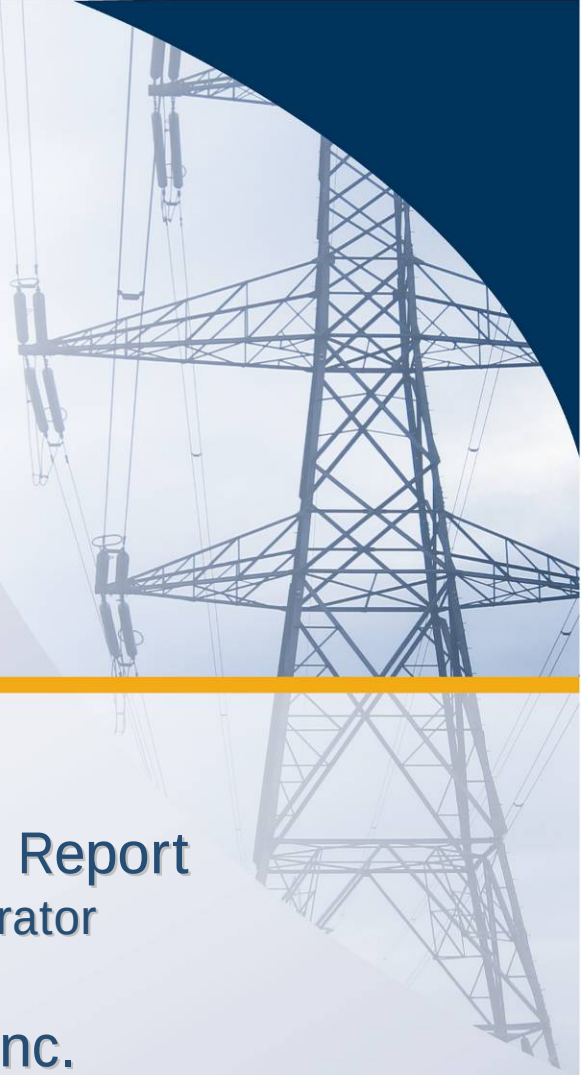

Reliability Readiness Evaluation Report

Balancing Authority/Transmission Operator

Alabama Electric Cooperative, Inc.

Andalusia, Alabama

to ensure the reliability of the bulk power system

November 5–8, 2007

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Introduction and Evaluation Process

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

Since its inception in 2004, NERC and the industry have been working collaboratively to enhance the program. The evaluation process is based on fundamental aspects of reliability: culture, operations, maintenance, planning, and training. Documents related to the program are available at http://www.nerc.com/~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 Alabama Electric Cooperative, Inc. (AEC) representatives on November 5–8, 2007. This report reflects the views and recommendations of the evaluation team regarding the readiness of the AEC to meet its responsibilities as a balancing authority and transmission operator.

Evaluation Team

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Jim Griffith*	Southern Company Services, Inc.
Robert Thomasson	Big Rivers Electric Corporation
James Thompson	Constellation Energy Control and Dispatch
John Blazekovich	Exelon Corporation
Darrell Anthony	Oklahoma Gas & Electric
Jeff Brown**	Big Rivers Electric Corporation

*Team Co-leader
**Observer

Organization Profile

AEC is a generation and transmission cooperative headquartered in Andalusia, Alabama. AEC generates and transmits electricity at wholesale rates for its 20 member-owners in 39 counties in Alabama and 10 counties in northwest Florida. The member-owners consist of 12 Alabama distribution cooperatives, 4 Florida distribution cooperatives, and 4 Alabama municipal systems that sell electricity at retail rates to nearly 400,000 member-consumers. The member-owners govern and set policy for AEC through a 40-member Board of Trustees, comprised of two voting delegates from each of the 20 member-owners. The day-to-day management of AEC is carried out by the president and chief executive officer and his staff.

AEC began operating as a control area in 1984 and was officially granted balancing authority and transmission operator certification in 2005. AEC is a member of the SERC Reliability Corporation (SERC), and the Southeastern Reliability Coordinator is the reliability coordinator for AEC.

AEC's generation capacity consists of 20 generating units totaling 1,724 MW. AEC operates transmission at 230, 115, and 46 kV, and is interconnected with South Mississippi Electric Power Association (SMEPA) at 2 locations and Southern Company at 13 locations. In 2007, AEC's summer peak demand was 1,992 MW (August 22), and winter peak demand was 1,932 MW (January 29).

Executive Summary

The evaluation team found no significant operational problems and concluded that AEC 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.

The evaluation team identified 11 positive observations and a potential example of excellence — an area control error (ACE) calculation program for use in the emergency evacuation procedures. The evaluation team observed a corporate culture that is extremely focused on operating safety and encourages open communications among operators, line managers, and executive managers.

The team offers 10 recommendations that, if implemented, will enhance AEC's readiness to operate reliably and maintain the reliability of the bulk power system. Two key recommendations, as agreed upon by the team co-leaders and AEC, encourage AEC to (1) confirm recognition of the AEC system operator authority with the member distribution cooperatives, and (2) establish a process for the planning staff to periodically review system changes and performance with the system operators. The recommendations are listed in order of importance.

Potential Examples of Excellence

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

1. AEC developed an area control error (ACE) calculation program for use with its emergency evacuation procedures. The program is portable, can be based from any system, accepts multiple users via multiple data input vehicles, and can input all required area ACE parameters (Section 2.4).

Positive Observations

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

1. The AEC EMS group has a close working relationship with the system operators, providing timely and efficient updates, repairs, and issues resolution (Section 3.1).
2. AEC developed EMS displays that show relay target and fault distance information, providing a real-time virtual replication of the relay (Section 2.3).
3. AEC created an Alarms Working Group that has worked to reduce and redirect non-operational alarms and prioritize critical alarms via color coding and audible tone capability (Section 2.1).
4. The AEC Information System Working Group and System Operations group have a reporting structure that enhances alignment of goals and objectives (Section 3.1).
5. AEC implemented an emergency response team to direct non-operational storm recovery activities away from the control center, reducing traffic and operator distractions (Section 2.4).
6. The AEC EMS group is well staffed and highly capable (Section 3.1).
7. AEC is a NERC-approved continuing education provider (Section 5.1).
8. AEC uses an effective peer-review process to evaluate the accuracy of switching orders (Section 5.2.1).
9. AEC's culture encourages open communications among operators, line managers, and executive managers (Section 1.2.5).
10. AEC has demonstrated its commitment to high standards of performance by recognizing the need for and creating a dedicated transmission planning group (Section 1.2.2).
11. AEC has a practice of starting quick-start combustion turbines every 20 days to verify availability (Section 2.4).

Recommendations

The evaluation team offers the following recommendations:

1. Confidential information on physical security redacted from public report. See discussion in Appendix 1.*
2. Establish a formal document management program that includes attributes such as ownership, author, required approvals, review cycle, revision history, distribution, and

receipt verification to ensure system operators can access and use the most up-to-date policies and procedures (Section 2.2.3).

3. Develop a document with the distribution member companies to confirm recognition of the AEC system operator authority without local management approval (Section 2.2.3).*
4. Establish a process for the planning staff to periodically review system changes and performance (e.g. seasonal studies) with the system operations staff to ensure the operators' awareness of changed conditions (Section 4). *
5. Confidential information on power supply for control facilities redacted from public report. See discussion in Appendix 1.
6. Establish a routine schedule for all system operators to operate from the backup control center to improve operator knowledge and validate backup system functionality (Section 5.1).
7. Provide additional training for operators on procedures and capabilities for switching to alternative fuels (Section 5.1).
8. Improve housekeeping in the computer and communications equipment areas to enhance safety and security (Section 2.2.1).
9. Establish a training advisory committee with system operator participation to enhance the operator training curriculum (Section 5.1).
10. Establish a trouble-ticket tracking process for EMS and support systems maintenance to ensure appropriate action and verify completion (Section 3.2.2).

*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 example of excellence that the team identified. The report uses the generic term "system operator" to refer to all on-shift operating personnel responsible for executing the functions necessary to operate reliably and maintain the reliable operation of the bulk power system. This term will be used for the discussions unless additional specificity is required, such as *balancing* system operator or *transmission* system operator.

1. Culture

1.1 General

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

The AEC corporate culture is highly focused on safety and open communications. AEC has a corporate-wide standard that states all AEC employees go home in the same fashion they came to work. Safety is stressed all the way down to the individual level.

AEC assembled a strategic planning group consisting of both staff and management to determine what the utility stood for and to determine goals. The efforts of this group resulted in value and vision statements.

> *Value Statement:*
> With a commitment to MUTUAL RESPECT we choose to:
> Provide a SAFE working environment.
> COOPERATE with each other and our members.
> Build TRUST and demonstrate LEADERSHIP by example.
> COMMUNICATE openly and honestly to support COMMON GOALS and a SHARED VISION.
> EMPOWER employees to achieve AEC's goals.
> Treat all employees FAIRLY.
>
> *Vision Statement:*
> Strengthen the Federation by delivering reliable, competitively priced power and value-added services.

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.

AEC has successfully utilized internal committees consisting of employees from various divisions to suggest ideas and exchange information on improving system performance. Being a small organization, many departments work closely and are familiar with the work of other departments. These committees resulted from the AEC Strategic Plan (the origin of the value and vision statements) and are intended to assemble cross-functional working groups to evaluate and recommend improvement for issues such as risk assessment and critical infrastructure protection.

AEC's highest priority is safety. AEC management stresses and has demonstrated respect for the authority of the system operators to take emergency actions.

From the corporate level, the AEC managers stated that funding is not denied for reliability issues. The budget has never been denied for security matters, and AEC has never been in a situation where corporate objectives have hindered reliable operations.

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 AEC organizational goals and objectives support safe and reliable operations, as demonstrated by the actions and activities supported within the organization. Support is always given to improve reliability any time that a new initiative is implemented by NERC.

The priorities for funding set at the corporate level for system reliability improvements have always been adequate. Operational tools, additions, and improvements are acquired as needed, and the systems are kept up-to-date.

An example of organizational leadership is AEC's creation of its emergency response team. The team is activated during severe weather, such as a hurricane or ice storm. Each division within the company has a role, from securing hotels and food to providing media updates. This is discussed in detail in Section 2.4, Emergency Preparedness.

Another example of organizational leadership is the recognition and remedy of a shortcoming in the operational planning process. AEC managers realized that the operational planning effort was weak and took action for improvement by creating a new group for short-term planning. The evaluation team cites this initiative as a positive observation, as it shows AEC's commitment to high standards of performance.

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.

AEC executives and managers have an open-door policy; system operators are encouraged to speak to control room management or executive management.

During the activation of any AEC emergency plan, line management is involved as needed to support system operator actions. Corporate management becomes involved in operational decisions only if asked, letting the system operators perform their jobs without direct oversight. Corporate management is kept abreast of system conditions, typically by direct conversation with line management. Key management receives notification of outages lasting more than three minutes.

Operational lessons learned are incorporated into the corporate culture. After an event, AEC forms a team with representatives from each group involved to evaluate the event. Everyone on the team must agree to a recommendation for a policy or procedure change. Each representative on the team is responsible for communicating it to the respective groups ensuring the change is supported and implemented.

AEC develops a disturbance report on all unplanned outages. Any outage that lasts longer than two hours is analyzed by an outage review group; the group is responsible for processing action items listed in the report and assigning ownership.

1.2.4 Human Resources

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

AEC periodically reviews the system operator staff for potential retirements or other needs for additional trained system operators. New hires typically require 18 months of training to become a system operator. Management always supports requests for new hires to go into training.

The overall corporate succession plan is managed by the executive management staff. The AEC succession plan is controlled by the chief executive officer. AEC staff indicated there is adequate flexibility within the organization to add staff when necessary.

1.2.5 Corporate Communications

System operations communications inform and engage both corporate and system operations employees so they can contribute to the strategic priorities of the organization.

The evaluation team observed that the AEC culture encourages open communications among operators, line managers, and executive managers; the team cites this practice as a positive observation. The AEC vice president, bulk power & delivery visits the control room every work day at 6:00 am., and the chief executive officer periodically stops by the control room. The system operators are encouraged to visit with these executives and are free to communicate any operational issues or needs. The system operators also produce a “midnight report” detailing the day’s activities and provide a copy to the vice president. The vice president, bulk power & delivery host a joint staff meeting with his managers and other AEC vice presidents every two weeks, and each manager attends a Board of Trustees’ meeting every three months. When asked about an employee feedback process, the AEC staff all responded that there was no need for a formal process due to the extensive informal interaction presently in place.

With respect to routine corporate communications, there are four primary methods of disseminating information to the operations staff: e-mails with a required reading acknowledgement, the control room log book, and the energy control center procedures book, and one-on-one discussions with all levels of management on a daily basis. System operators have access to operating policies, procedures, and standards via hard copy in the control room, and electronic versions are available on AEC's Web site.

Corporate goals are communicated from the top management down through the ranks using memos or e-mail. Goals are also printed in a weekly corporate bulletin and a quarterly magazine called *Power Lines*.

During a 20-minute shift-change period, the operators communicate operational information verbally and review detailed notes and updates to the shift log book.

2. Fundamentals of Operations

2.1 General

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

AEC maintains a professional atmosphere in the control room. The energy control center manager stays in contact with the operators to ensure that they have everything they need to do their job to the best of their ability. The manager strives to make the control room atmosphere as pleasant as possible. AEC allows the system operators to wear blue jeans on nights and weekends, but during weekly business hours business casual is required.

The system operators told the evaluation team that they have adequate and appropriate system tools to operate the system reliably. Southern Company assists AEC in analyzing the ability to safely remove lines from service. Southern Company uses state estimator and contingency analysis tools to examine the proposed switching of transmission lines 115 kV and above and advises AEC on the system reliability for the proposed actions.

The AEC operating reserve requirement is 80 percent of its largest resource (200 MW), and AEC normally carries this reserve on two generators. AEC is not part of a reserve sharing group, but has a contract with Southern Company providing up to 250 MW of contingency reserves for the current and next hour. AEC evaluated becoming a member of the Southwest Power Pool Reserve Sharing Group and determined there are no problems meeting the NERC disturbance control standards using the Southern Company contracted reserves. The AEC system operators monitor the operating reserve margin using a reserves summary display on the EMS.

AEC controls voltage to predetermined set points, not necessarily reactive flow with neighboring systems. The system operators monitor individual tie lines for unusual flows, but generally control voltage to maintain +/-5 percent of nominal voltage. AEC manages voltage with extensive, well-placed groups of capacitor banks operated remotely by supervisory control and data acquisition (SCADA). They are generally not in service during off-peak and off-season periods. AEC also has automatically operated load-tap changers to assist with voltage control.

The AEC system operators monitor reactive resources using a reactive reserve summary EMS display.

All AEC generators have automatic voltage regulators. The generating plant operator will notify the system operator if there is a problem with a regulator, and the system operator logs this and notifies the reliability coordinator. AEC has a schedule to test the reactive capability of the generators, and has retained a consultant to perform these tests.

The AEC system operators monitor transmission-line loadings and use two alarm levels at 90 and 100 percent of the summer line rating. The line ratings are based on physical limits, such as metallurgy, ambient temperature, and wind speed, and the system operator has the tools and training to manually calculate real-time limits as needed.

AEC monitors frequency at one generating plant and at seven substations that interconnect with neighbors. AEC uses two satellite frequency standard sources for a primary and backup source.

AEC has an underfrequency load shedding program that conforms to the requirements of the region. The manual and underfrequency load shed programs utilize different loads, so there is no overlap. The AEC generators trip for underfrequency at levels from 59 to 57 Hz. The load underfrequency relays will operate at higher frequencies than the generators and the generators have longer time delays than the underfrequency load relays. AEC also has interruptible industrial load customers, who curtail load based on direct communication with AEC. Some customers can respond within 15 minutes. If the customers fail to comply, the AEC system operator can open the breakers manually. AEC does not have an undervoltage load shedding program.

AEC created an alarms working group that has worked to reduce and redirect non-operational alarms and prioritize critical alarms via color coding and audible tone capability. The system operators indicated that this has been a huge improvement to the operation. The evaluation team cites the efforts of the alarms working group as a positive observation.

AEC has no special protection schemes.

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.

AEC has a corporate-wide standard that states all AEC employees go home in the same fashion that they came in to work. Safety is stressed down to the individual level, and AEC incorporated safety into its value statement: safety is the highest priority with reliability second. Only safety would impact reliability as a priority. Supervisors perform a daily safety audit, and the safety section performs a weekly audit. AEC has monthly safety meetings and hosts safety recognition luncheons where safety awards are awarded to employee teams that meet goals of set time periods without accidents.

The evaluation team observed loose items and combustibles in a disorganized state throughout the computer and communications areas; the team recommends that AEC improve housekeeping in these areas to enhance safety and security.

2.2.2 Operational Decision-Making

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

AEC system operators have independent decision-making authority to take any reliability-related system action. AEC trains the system operators to make decisions with three considerations: first, ensuring safety of personnel and the public; second, protecting equipment; and third, maintaining the reliability and integrity of the interconnection. Safety is always the primary concern when making critical operational decisions. AEC stresses that the system operator must have good situational awareness when evaluating risks, while considering the possibility that the switch may not open or the breaker may not close. The system operator must consider other options when developing a plan of action to account for equipment failures and other unforeseen problems that may occur. The system operator job descriptions define the role and responsibilities for decision making.

For routine switching procedures, an outage request will typically originate from a line maintenance supervisor. The switching order is written by a system operator and checked by a second operator. Both operators initial the switching order to confirm it is safe and accurate. The system operator who issues the switching order reviews it again, and field personnel executing the switching will check and read back each step to the system operator to confirm correct receipt. Once completed, the field personnel read each step and the time completed to the system operator. The system operator then repeats back to field personnel to confirm correct action was taken. During switching sequences, the system operators monitor system parameters, such as line loadings and voltage levels, to compare expected with actual results. If unacceptable conditions occur, the system operator can stop and reverse the process or seek another solution.

For unusual or infrequent activities, such as unusual switching procedures, system reliability concerns are managed using extra assistance, or supervisory personnel may become involved to review and help manage the processes.

2.2.3 Operational Alignment

Organizational structure supports safe and reliable system operation.

AEC operates as a vertically integrated system, as it is FERC non-jurisdictional. The evaluation team inquired if this structure affects AEC's ability to receive reliability data. The AEC executive managers explained that AEC signed confidentiality agreements with Southern Company to obtain real-time data that will not provide AEC operators with neighboring entity market-valued information. The performance under the agreements is audited by an independent entity. AEC has stressed to its system operators that reliability comes first, before any market concerns. AEC is not an active market participant, being mostly a purchasing company, and does not provide any incentives for system operators based on market activity.

AEC system operators have independent authority to take any reliability-related system action necessary. This authority is documented in system operator authority letters (one for each system operator) signed by the vice president, bulk power & delivery and each system operator. For manual load shedding, the AEC system operator directs the distribution member cooperative operators to actually perform the curtailments. The member cooperatives participate by providing 5 to 10 percent load reduction. If the load is not reduced in a timely manner, the AEC system operator will shed the load using SCADA. The evaluation team inquired if there is a document at the local distribution member companies that instruct the local operators to comply with the directives of the AEC system operator. AEC management responded that the member managers are aware of it, but no formal documentation exists at this time. The evaluation team recommends that AEC develop a document with the distribution member companies to confirm recognition of the AEC system operator authority without local management approval.

The normal routine for real-time communications with the reliability coordinator is inclusive with clear and proactive discussions when in a first-contingency situation, and discussions include the impacts of a second contingency. In an emergency, there are clear, concise communications with no question of authority for the reliability coordinator to direct actions.

Information exchange between system operators at shift change is informal. The system operator on duty records the daily activities in a log book, and the incoming system operator reviews these notes. There is no formal checklist or sign-off requirement. The evaluation team determined that the process is adequate but suggests that AEC consider formalizing the shift-change information exchange process.

For major policy changes, system operators receive an e-mail and reply to confirm understanding. Minor policy changes may also be by e-mail without the required confirmation or may be a note in the system operator logbook. Operating policies, procedures, and standards are available to the system operator by electronic copy on the AEC intranet and on hard copy in the control room.

AEC documents are dated and filed electronically. The energy control center manager is responsible for writing documentation for NERC standards and managing the process. The process is slow because the documents are being written in house. AEC is developing software to formally handle the NERC standards, including when to update internal documents, send messages to operators to review documentation and procedures, etc., but there is no corporate policy for formal document management. The evaluation team recommends that AEC establish a formal document management program that includes attributes such as ownership, author, required approvals, review cycle, revision history, distribution, and receipt verification to ensure that operators can access and use the most up-to-date policies and procedures.

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.

AEC uses an online analysis package for transmission networks that integrates with the EMS. The program provides the system operator with operator power flow, state estimation, and contingency analysis applications. The operator power flow application allows the system operator to examine the effects of actual or hypothetical operational changes to the system. The state estimator identifies bad telemetry and calculates flows and voltages for areas that are unobservable. The contingency analysis package determines which transmission line and generator outages pose the most severe threat to system security, given the present state of the power system. These real-time applications run every 15 minutes and take less than a minute to solve. The result of each application is displayed in tabular format or on graphical one-line overview displays. All displays are color coded to show flow violations and voltage violations. These applications are fully functional; however, since the applications are relatively new, the system operators are not fully trained on their use. AEC expects to complete this training by March 2008.

The AEC transmission studies group is responsible for developing and maintaining the power flow models and supporting the EMS power flow applications. The information systems group maintains the real-time intercontrol center communications protocol (ICCP) data links with Southern Company and SMEPA. The current model contains approximately 1,600 busses and 2,300 lines and solves in under a minute. The external model from Southern Company is updated annually; the SMEPA model is updated approximately two or three times per year; and the internal AEC model is updated daily.

The evaluation team inquired if the health of the alarm system is monitored. The interviewees were unsure; but by the end of the interview (30 minutes later), the EMS personnel had installed a heartbeat monitor.

AEC developed EMS displays providing system operators immediate availability of relay-target and fault-distance information. The displays provide a real-time virtual replication of the relay. The evaluation team cites this enhancement as a positive observation.

The evaluation team also made the following observations:

- AEC does not have any defined interconnection reliability operating limits in its footprint, and based on the SERC definition does not have any known system operating limits.
- For trending, AEC uses wall-mounted displays that are driven by the EMS and configured as needed by the system operator.
- AEC uses an Internet based load-forecasting tool that analyzes historical load patterns versus forecasted temperatures and provides a seven-day load forecast.
- AEC has a dynamic EMS display that provides operating reserve information.
- AEC performs interchange scheduling using instant messaging or telephone calls.
- All voltages are displayed on one EMS display. When a monitored point alarms, the line will turn red; the operator can click on the alarm and go to the display specific to that point.
- A voice recording system records all phones in the control center, except one. Only supervisors and managers have access to the recordings.

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.

AEC developed a procedure to activate an emergency response team during severe weather, such as a hurricane or ice storm. Each division within the company has a role from securing hotels and food to providing media updates. There is a designated "storm room" that serves as a command center and does not interfere with the control center operations. The emergency response team is activated and meets three days before a hurricane is expected to hit. At 24 hours before the hurricane, team members take actions such as hotel reservations, transportation arrangements, and food procurement. Meetings are held in the storm room to avoid distractions in the control room, and there is an EMS display for system data availability. The evaluation team cites the emergency response team and storm room as a positive observation.

The AEC system operator has the authority to declare a capacity emergency anytime AEC can not meet its firm load obligation. The system operator follows the energy emergency alert, or EEA, level guidelines of the subregion to recognize and initiate the capacity and emergency plan. In accordance with the specific plan requirements, AEC notifies the reliability coordinator, affected entities, and government agencies as various steps in emergency plans are implemented.

AEC gained experience during hurricane Katrina (preparing for possible gas shortages) and developed a plan to ensure that fuel oil tanks are full and created plans for load curtailment of interruptible customers. AEC performed a system restoration drill in January 2007, and a hired consultant issued a lessons-learned report summarizing each participant's findings. AEC revised the restoration plan based on these lessons learned but did not reveal specifics of the drill as it will be used again with different participants.

The AEC system operator initiates manual load shedding by requests through its distribution member cooperatives, as previously discussed in Section 2.2.3. AEC also has interruptible load customers it can curtail in blocks of 30 MW in less than 15 minutes, totaling 147 MW. AEC does not have a voltage reduction plan.

AEC follows the transmission loading relief process for congestion management when requested by Southern Company.

The evaluation team cites a positive observation that AEC has a practice of starting quick-start combustion turbines every 20 days to verify availability.

AEC developed a backup EMS laptop program that is used for disaster recovery. The program allows the system operators to enter MW values for ties, generators, and schedules and calculates load and ACE, allowing the system operators to regulate units to meet system load. The program stores the real-time values that are entered and performs some energy accounting calculations to provide historical hourly data. The program can be used as a standalone application. The system operators carry a laptop with them when they evacuate the primary control center facility. If other laptops or PCs are available, they can be connected together with a network switch to allow multi-user access. This allows multiple operators to enter and access data at the same time. The

program also accommodates personnel dispatched to unmanned tie stations and generating facilities to relay the MW flows to the system operators. At one time, this was the only backup option available if the primary control center was unavailable or destroyed. AEC now has a fully functional off-site backup control center for disaster recovery, but maintains the emergency laptop program as a third-level backup. The evaluation team cites this ACE calculation program as a potential example of excellence.

3. Fundamentals of Maintenance

3.1 General

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

AEC employs five EMS support technicians who rotate on a weekly on-call schedule. Each technician has a cellular phone for 24-hour access and the ability to remotely diagnose and correct EMS problems. The evaluation team cites a positive observation that the AEC EMS group is well staffed and highly capable.

The evaluation team cites a positive observation that AEC's information system working group and system operations group have a reporting structure that enhances alignment of goals and objectives. The AEC EMS group has a close working relationship with the system operators and provides timely and efficient updates, repairs, and issues resolution.

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.

AEC's EMS is designed with redundant equipment for high availability. There is only a momentary loss of functionality for EMS maintenance or a failover between the redundant systems.

The EMS automatically monitors the process and application heartbeats, ICCP connectivity, remote terminal unit communications, and server status; the system alarms if a problem is detected. The EMS group reviews alarms and system logs each work day for potential hardware and software problems. AEC is currently evaluating monitoring software to automate some of this process and possibly notify EMS support personnel via e-mail or page of a potential problem. The state estimator is monitored on a regular basis to determine telemetry or calibration problems.

3.2.2 Work Management

Work activities, including corrective, elective, and preventive maintenance, surveillance testing, and modifications, are managed effectively to support safe, reliable operation during both outage and routine periods.

The reporting process for problems with the EMS is very informal, typically phone calls and e-mails. The system operator provides verbal approval for EMS software updates and modifications. The evaluation team recommends that AEC establish a trouble-ticket tracking process for EMS and support systems maintenance to ensure appropriate action and verify completion.

AEC requires authorization by the system operator prior to any maintenance that would disable a protective relay system.

4. Fundamentals of Operational Planning

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

The planning organization had been a problem area for AEC, with a gap between next-day and long-term planning activities. AEC recently instituted an organizational change to separate transmission planning from system planning. The transmission planning group now performs the mid- and long-range transmission planning and transmission outage planning, and a new group was formed for short-term operations planning.

The system operators provide input to the planners for outage requests before final decisions are made and to the energy resource personnel before energy sales and purchases are scheduled. The operations planners provide the AEC system operators with a schedule of outages for generation and transmission, AEC system energy sales and purchases (including sources, sinks, and tag IDs), generation schedules, and next-day load forecasts. The evaluation team determined that the process is adequate and the information provided is complete.

The seasonal study results are documented in the AEC contingency analysis report. This report gives both a written description and tabular view of the problems and solutions. This information is provided to the operators and placed in their work area for reference. The planners meet with the control center manager and supervisor to present seasonal study results. The control center manager and supervisor then provide important results to the system operators. The evaluation team recommends that AEC establish a formal process for the planning staff to periodically review system changes and performance (e.g. seasonal studies) directly with the system operators.

5. Fundamentals of Training

5.1 General

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

AEC initially solicits applicants for system operator trainees from within the company; if no qualified candidates are available internally, AEC advertises externally. AEC requires a four-year degree in math or science for the operator position. The last four operators hired were external candidates. AEC does no formal testing of the applicants, just interviews. The AEC

human resources department performs full background checks and reference checks on the candidates. It takes about three months from the initial posting of an opening to the final selection of the successful candidate and an average of 18 months of training for a trainee to be released to work independently as a system operator.

The control room supervisor is responsible for training and has attended two NERC train-the-trainer sessions, a SERC train-the-trainer seminar, a vendor sponsored train-the-trainer course, and a management training program sponsored by the University of Alabama. The control room supervisor stated that executive management has been supportive of training efforts, and the NERC requirements have been accepted without an issue. The operations vice president supports and encourages more training.

The training program for new operators is a 32-week schedule using a structured training manual. Trainees initially review training videos and workbooks and must successfully complete tests from the training courses. Trainees visit generating stations and substations and review system configurations. AEC also administers a "switching school" that includes relay and substation topics. AEC provides online training for NERC certification and in-house NERC practice tests. The control room supervisor administers tests to trainees at six-week intervals. If a trainee fails a test, the supervisor reviews the test results with the trainee and provides additional training. The lead system operators also oversee trainees and provide on-the-job training. The control room supervisor makes the recommendation for when a trainee is ready to assume shift duties independently based on personal observation, test results, and consensus of the lead system operators. The manager of energy control has the final authority to determine when a trainee is ready to take a shift position.

Ongoing training for existing system operators is based on the NERC guidelines from the old NERC *Policy 8A*. AEC uses videotapes, some vendor-provided training, SERC system operator conferences, and American Power Dispatcher Association offerings. AEC provides timely training for hurricane season and participates in joint training with Southern Company for summer and winter seasonal preparation. AEC is a NERC-approved continuing education provider and has 13 approved courses covering topics such as emergency conditions, hurricane preparation, interruptible load management, recovery from major disasters, system restorations, substation fundamentals, switching concepts (an in-house school), and synchronizing islands. The continuing education courses are classroom sessions (mostly one-on-one instruction) or field visits. The evaluation team cites a positive observation for AEC being a NERC-approved continuing education provider.

AEC has no formal process to develop individual training plans; everyone participates in the same ongoing program. If the control room supervisor sees a deficiency, he will address it on an individual basis and will adjust individual programs to ensure required training hours are completed. The control room supervisor also uses annual performance reviews of the system operators as a reference; however, the review is general and does not directly impact the annual training program. AEC is in the process of performing a job task analysis for the system operators to aid in the development of training topics. AEC reviews the training program annually and makes updated as needed. The AEC system operator shift schedule provides for a

relief shift and a training shift built into the rotation so that no overtime is needed to accommodate training needs.

AEC has an operational training simulator, but the power system model is not accurate. An engineer who was focusing on the state estimator model left AEC, causing the project to be left unattended. AEC is in the process of hiring a replacement with a goal of March 2008. In the mean time, AEC is considering contracting for the use of a neighboring system's simulator.

The evaluation team finds that the AEC training program is adequate but offers three recommendations for improvement:

1. Establish a training advisory committee, including system operator participation, to enhance the operator training curriculum.
2. Establish a routine schedule for all system operators to operate from the backup control center to improve system operator knowledge and validate the backup system functionality.
3. Provide additional training for system operators on procedures and capabilities for switching to alternative fuels.

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.

AEC provides training in human error prevention techniques using Strategic Team Awareness and Response (STAR) training provided by a training vendor. Three-part communication techniques are included in initial operator training and in the AEC switching school. AEC also provides critical-thinking and decision-making courses for the system operators. AEC uses an effective peer-review process to evaluate the accuracy of switching orders, and the evaluation team cites this process as a positive observation.

AEC reviews disturbance reports to verify system operators' responses to actual system events and conditions were appropriate and timely. AEC investigates operating errors by listening to telephone recordings, analyzing alarms, and interviewing operators. AEC does not have a formal corrective action program in place. For infrequent activities or unusual switching procedures, AEC provides extra assistance, and if necessary supervisory personnel become involved to review and to help handle the processes.

AEC uses a "clearance box" mounted on the mapboard in the control room to store paper copies of outstanding clearances. The system operators review the contents of the clearance box weekly to ensure the required hold orders and clearances are still in place.

APPENDIX 1: Critical Infrastructure

APPENDIX 2: Entity Participants

APPENDIX 3: Documents Reviewed