

**Balancing Authority/Transmission Operator
Reliability Readiness Evaluation Report**

**Florida Power & Light
Miami, Florida**

April 9–12, 2007

Table of Contents

Introduction and Evaluation Process	1
Evaluation Team	1
Organization Profile.....	2
Positive Observations.....	4
Recommendations.....	5
Discussion.....	6
1. Culture.....	6
1.1 General.....	6
1.2 Organizational Effectiveness	6
1.2.1 Foundation for System Reliability	6
1.2.2 Leadership and Management	7
1.2.3 Corporate Oversight and Monitoring.....	7
1.2.4 Human Resources	8
1.2.5 Corporate Communications	8
2. Fundamentals of Operations	9
2.1 General.....	9
2.2 Operational Focus	11
2.2.1 Operational Safety	11
2.2.2 Operational Decision-Making.....	11
2.2.3 Operational Alignment.....	11
2.3 Managing System Configuration	12
2.4 Emergency Preparedness	15
3. Fundamentals of Maintenance	16
3.1 General.....	16
3.2 Equipment Reliability	16
3.2.1 Equipment Performance.....	16
3.2.2 Work Management.....	18
4. Fundamentals of Operational Planning.....	18
5. Fundamentals of Training	20
5.1 General.....	20
5.2 Organizational Effectiveness	22
5.2.1 Human Performance	22
APPENDIX 1: Critical Infrastructure.....	23
APPENDIX 2: Entity Participants	24
APPENDIX 3: Documents Reviewed	25

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 Florida Power & Light Company (FPL) representatives on April 9–12, 2007. This report reflects the views and recommendations of the evaluation team regarding the readiness of FPL to meet its responsibilities as a balancing authority and transmission operator.

Evaluation Team

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**Observer

Organization Profile

FPL is the principal subsidiary of the FPL Group that has a presence in 26 states. FPL serves 4.4 million customers in Florida with a service territory spreading from the Georgia state line down the east coast of Florida to the Florida Keys and back up the west coast to just south of Tampa Bay. FPL operates within the Florida Reliability Coordinating Council (FRCC) region of NERC as a balancing authority and transmission operator for its service territory. FPL is also registered with NERC as a load-serving entity, distribution provider, transmission and generation owner, generation operator, planning authority, purchasing selling entity, resource planner, transmission planner, and transmission service provider.

FPL served an all-time peak integrated hour energy demand of 22,361 MWh on August 17, 2005 and a winter integrated hour peak demand of 20,190 MWh on January 24, 2003. FPL's generation resources total 23,768 MW, including 2,991 MW of firm purchased power contracts. The fuel source for the generation resources is approximately 12% nuclear, 11% coal, and 76% oil and gas.

FPL's transmission system consists of over 6,400 miles of transmission lines connecting 542 substations operated at 69, 115, 138, 230, and 500 kV. FPL interconnects with Southern Company at the Florida-Georgia border at 500 and 230 kV. Within Florida, FPL also interconnects with Progress Energy-Florida, Jacksonville Electric Authority, Tampa Electric Company, Seminole Electric Cooperative, Florida Municipal Power Pool, Gainesville Regional Utilities, City of New Smyrna Beach, and City of Homestead at operating voltages of 230, 138, 115, and 69 kV.

NERC 2007 Reliability Readiness Evaluation Report Florida Power & Light

Executive Summary

The evaluation team found no significant operational problems and concluded that FPL 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 reviewed the recommendations from the 2004 reliability readiness report and actions taken by FPL on those recommendations. The evaluation team determined that FPL has taken appropriate actions to implement and satisfactorily resolve all of the recommendations from the 2004 report.

FPL management shows a commitment to staff development and support for its operators. The company's philosophy is to hire and train personnel to reach the level of system operator. FPL provides its operators with quality tools and has an information technology group dedicated to the Power Supply department.

In cooperation with FPL representatives, the team identified three key recommendations. The recommendations encourage FPL to provide additional training on operating limits and generating reserves and to implement a document management process.

The evaluation team identified a number of positive observations and potential examples of excellence. It also offers seven recommendations that, if implemented, will enhance FPL's readiness to operate reliably to maintain the reliability of the bulk power system. The findings are listed in order of importance.

Potential Examples of Excellence

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

1. *See discussion in Appendix 1.*
2. *See discussion in Appendix 1.*
3. FPL calculates and displays for its operators real-time P-V curve data for key locations (Section 2.3).

Positive Observations

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

1. FPL demonstrates an outstanding communications culture among all areas of operations and support staff (Section 1.2.5).
2. FPL management has a philosophy of hiring entry-level positions with a focus toward achieving the highest level operating position (system operator) (Sections 5.1 and 1.2.4).
3. FPL system operators, power coordinators, and load dispatchers are well trained and proficient in the use of the many tools available to them (Section 4.b).
4. The FPL Power Supply department has its own information technology (IT) department, which is separate from the corporate IT department. The Power Supply IT department is well staffed with highly skilled personnel, some of whom are NERC-certified operators (Section 3.1).
5. FPL makes extensive use of customized advanced applications (Section 2.3).
6. FPL reconstructs actual system events in the dispatcher training simulator for operator training (Section 5.1).
7. FPL uses a sophisticated notification system to alert appropriate staff of critical system conditions (Section 3.2.1).
8. FPL uses a thorough process for documenting and reviewing the daily operation plan (Section 1.1).
9. FPL management promotes NERC certification for all personnel in support staff functions (Section 5.1).
10. FPL's operations planners are NERC certified and qualified for the operations desks (Section 4).

11. *See discussion in Appendix 1.*

12. *See discussion in Appendix 1.*

Recommendations

The evaluation team offers the following recommendations:

1. Provide additional training to system operators on the identification, mitigation, and location of FRCC interconnected reliability operating limits (IROLs) (Section 2.3).*
2. Provide a visual indication to the control room staff of a “stalled” condition of the alarm system monitor (Section 3.2.1).
3. Provide information to the system operators to identify the limiting element associated with each transmission facility rating to aid in the understanding of various limits and to assist in evaluating appropriate actions and response times (Section 2.3).
4. Implement a formal document management process that includes information on ownership, author, approvals, revision dates, distribution, and acknowledgement of receipt and understanding to make sure operators can access and use the most up-to-date policies and procedures (Section 2.2.3)*
5. Provide additional training for the system operators and power coordinators to ensure they have a full understanding of operating, spinning, and quick start reserves as displayed on the EMS (Section 2.1)*
6. Train system operators how to enable multiple contingencies in the real-time contingency analysis application to help them prepare to meet load during unplanned system changes (Section 4).
7. Implement automatic failover capability for the backup server that is dedicated to the paging system to ensure that the support staff continues receiving critical alerts (Section 3.2.1).

* Jointly identified by the company and lead evaluators 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.

FPL practices continuous self-assessment on all aspects of system operations. The process for maintaining reliability starts every morning with a review of each past day’s operation and expected current-day operation on separate conference calls for the generation and transmission organizations. These calls serve to focus all operating personnel on any issues encountered during the last 24 hours and any issues expected for the current day. The vice-president, transmission operations and planning participates in the daily calls.

The FPL Power Supply personnel then hold a daily “state of the system” meeting every morning to bring all operating personnel up-to-date on any issues. The Power Supply management team is an integral part of these discussions and assessments on a daily basis. The evaluation team cited a positive observation for FPL’s thorough process for documenting and reviewing the daily operation plan.

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.

FPL monitors all system facilities in real time via the supervisory control and data acquisition (SCADA) and alarm monitor systems. FPL’s state estimator and associated contingency analysis applications as described above are used in maintaining situational awareness of system operating limit (SOL) and interconnected reliability operating limit (IROL) conditions throughout the FPL and FRCC reliability areas.

FPL maintains a risk-based methodology for identifying critical facilities. The methodology and resulting list of facilities are reviewed annually or as system conditions warrant.

The evaluation team observed that FPL has a long and distinguished history in quality improvement and a culture of continuous improvement. FPL also participates in benchmarking programs with other utilities. FPL is in the process of implementing the processes and procedures to become a Six Sigma organization to further its strong focus on operational performance through application of quality improvement concepts in operational management.

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.

FPL actively participates in industry forums, such as NERC and FRCC committees, working groups, and task forces, in order to enhance awareness of industry trends and continually improve its operation. The following are some examples of FPL operations management staff industry participation:

- Vice-President, Transmission — NERC and FRCC Operating Committees
- Director Power Supply — NERC Operating Reliability Subcommittee, FRCC Operating Committee, SERC Operating Committee
- Manager System Operations, Transmission — NERC Reliability Coordinator Working Group, NERC and FRCC Operating Reliability Subcommittees
- Manager System Operations, Generation — NERC Real-Time Best Practices Task Force
- Manager Operations Engineering — NERC Resource Subcommittee
- Manager Load Dispatch — NERC Critical Infrastructure Protection Committee
- Training Coordinator — FRCC System Operator Subcommittee

Various other FPL operations staff members participate in FRCC and NERC subcommittees, working groups, task forces, and drafting teams.

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.

FPL operates its system based on all applicable NERC and FRCC reliability standards and procedures. The FRCC security process and NERC standards govern FPL operator actions and decision-making with respect to risk on the FPL and FRCC systems.

FPL continuously tracks reliability using the standardized NERC indicators SAIDI, SAIFI, MAIFI, and CAIDI. FPL uses these metrics to evaluate project investment decisions and system reliability enhancements.

All FPL employees are required to have a formal annual review of their key responsibilities, and the review is tied to the individual merit and bonus program. The corporation requires individuals to assess their competencies and requires managers to rate employees. If an individual is lacking in an area, the manager designs a development plan to improve the

individual's performance that is tracked by the FPL human resources department. FPL also evaluates specific events in consideration of the individual's performance. There have been instances where an operator has been taken off-shift for more training and coaching.

FPL's operating philosophy is to maintain a safe, reliable, and economical electrical system for the customer at all times. Reliability is engrained in the corporate culture for FPL personnel. During interviews with the evaluation team, FPL managers stated the corporate mission is safety, reliability, and cost efficiency, in that order.

1.2.4 Human Resources

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

All operating positions within the FPL Power Supply organization are designed to feed from the load dispatcher position up to the system operator position. FPL believes in training and development of operating personnel to achieve the level of FPL system operator as a career goal. The FPL training program takes this in to account when developing training material and plans to develop existing load dispatchers and power coordinators. The FPL system operator position is normally filled from within the Power Supply organization due to the highly specialized knowledge requirements of the position.

The FPL Power Supply management team discusses the operational performance of possible system operator candidates and subjects potential candidates to rigorous round-table qualification sessions prior to awarding the position of system operator.

The evaluation team cited the FPL management philosophy of hiring entry-level positions with a focus toward achieving the highest level operating position (system operator) as a positive observation.

FPL has adequate staff and is adding two more power coordinators to increase time off-shift for training. With the philosophy of promoting from the load dispatcher position upward through all other operating positions, FPL has an ample supply of qualified candidates for the power coordinator and system operator positions. An individual candidate for the load dispatcher position is typically trained and qualified within three to six months. The power coordinator and system operators can be trained in the same or even less time depending on the qualifications and experience of the individual candidate.

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 FPL operators are the owners of all of the processes and tools used in real-time operations. FPL promotes the open discussion of all ideas and suggestions for system improvements among operators, computer operations personnel, and management to develop effective energy management systems (EMS) solutions for the operators. The FPL Power Supply computer

operations department custom designs applications and displays from the suggestions and specifications of the FPL system operations personnel.

The FPL Power Supply department also encourages feedback from other corporate entities within FPL (particularly the field organizations) to enhance its operational effectiveness. For example, the idea for the automatic SCADA re-close feature came from the field organization working with Power Supply personnel.

FPL demonstrates a culture of outstanding communications among all areas of operations and support staff, and the evaluation team cited this as a positive observation.

2. Fundamentals of Operations

2.1 General

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

FPL performs the reliability coordinator duties for the FRCC on a continuous basis under agreement with the FRCC. FPL uses the Reliability Coordinator Information System (RCIS) to perform the FRCC reliability coordinator agent function. FPL uses the Florida Transaction Management System (FTMS) to exchange all operational outage data. The FTMS collects all this information and uploads data for the entire FRCC footprint to the NERC System Data eXchange (SDX) hourly. All real-time data are exchanged using the intercontrol center communications protocol (ICCP) via the FRCC reliability data link among all FRCC entities and the FRCC reliability coordinator. FPL also serves as the host for the NERC interregional security network (ISN) node for the FRCC.

FPL is part of the FRCC state hotline phone system as well as the FRCC satellite phone system. The state hotline is a “hoot ’n holler” type communication link that provides instant two-way voice communications among all users concurrently. The state hotline is used by all operating entities to discuss any operating issues in real time. FPL maintains satellite phones for backup communications with FRCC, other Florida operating entities, and with FPL generating plants.

The generation desk has a “turnover sheet” that is filled out on a daily basis. All three shifts use the same sheet to share information that includes expected peaks, generation capability, any individual unit issues, operating reserves, and time-correction activities.

All consoles have phones that are digitally recorded and accessible by managers and supervisors. The Local Joint Safety Committee uses the recordings to review incidents and to improve performance.

FPL maintains an energy marketing department that is physically separated from the system operation department and provides regular training on the standards of conduct.

The FPL system operators use a fully functional EMS that provides the ability to monitor the status of interconnected transmission system and bulk power system elements through data

communication links. All necessary operational data from and to neighboring systems are provided via the redundant FRCC reliability data link. Additional operational data from and to adjacent areas are provided via the NERCNet ISN link. FPL has an overview display that presents these various parameters (e. g., flowgate flows, 500 kV line statuses, and area control error (ACE) for each operating authority under FRCC) to monitor the FRCC region. This display provides system operators with a quick method to scan the state of the FRCC bulk power system and serves as a wide-area visualization tool for the FRCC footprint. The EMS alarm application provides the necessary visual and audible signals to alert FPL system operators of problems in neighboring systems.

The two-level control room is divided into functional areas. Five consoles for transmission (load dispatchers) are located on the lower floor and separated into five different FPL regions. The upper level has four consoles. A console in the center of the upper level is for the system operator who also serves as the FRCC reliability coordinator. A second reliability desk is manned during the summer to separate the functions of the FRCC reliability coordinator from the FPL system operator. Also included are an interchange scheduler console and the generation desk (power coordinator).

The control center provides ample operating space with a large dynamically driven mapboard with digital displays of major line flows and voltages. Green lights indicate lines that are open or switched out, and flashing green light emitting diodes signal a de-energized line. The mapboard also has lights to indicate if a line is tagged. Several trend charts, including frequency (driven from the incoming feeder), weather, generation, load, and ACE, are available for all to see in the upper console area.

The system operator has a single dynamic display for operating, spinning, and quick-start reserves, which shows available and required operating and spinning reserves. The system operator also has a display for reactive reserves including status (either on or off) and the capability of the devices. The operators interviewed by the evaluation team were unsure of some of the aspects and data available from the operating reserve display. The evaluation team recommends that FPL provide additional training for the system operators and power coordinators to ensure the understanding of operating, spinning, and quick-start reserves as displayed on the EMS.

FPL is a member of the FRCC Reserve Sharing Group. The reserve sharing group process is outlined in the FRCC operating reserve policy, which is part of the *FRCC Standards Handbook*. Deficient entities are entitled to request operating reserves in a multiple of 1/8 of the full operating reserve requirement of 910 MW within the FRCC. The reserves must be deactivated within 30 minutes. Within the FRCC, all members are required to maintain 25% of their reserve allocation responsive to frequency at all times.

The system operator has a display with about 25 frequency values monitored against pre-defined alarm limits. The frequency measurements are from diverse locations within the FRCC region and are indicative of the status of the individual areas, which is useful in the case of a widespread disturbance. There is also a display for the EMS frequency values with an automatic failover capability to a backup frequency point.

The FPL system operator monitors all voltages throughout the FRCC reliability area from 69 to 500 kV. All FPL equipment is represented in one-line, and system overview displays. All available voltage telemetry is shown on the company overview displays and station one-line displays of external entities. The system operator can control load tap changers and substation capacitors using the SCADA function.

The FPL generator operators provide daily reactive capability declarations to FPL system operations. These declarations are tracked in real time as loads increase, and discrepancies with real-time operations are flagged for plant operating personnel. All FPL generating resources are tested for reactive output on a yearly basis per FRCC requirements.

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.

FPL maintains special protection systems (SPSs) to protect for loss of transmission corridors and multiple unit trips as well as out-of-step conditions throughout the FPL reliability area. FPL's SPSs are documented in the FRCC SPS manual. The SCADA system has a display for each SPS listed in the manual.

FPL also has implemented two reactive overload schemes (east and west) to automatically shed load in the case of reactive deficiencies in these areas under contingency conditions.

2.2.2 Operational Decision-Making

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

The roles and responsibilities for each FPL operating position are clearly defined by job descriptions. Individuals who occupy positions that have the primary responsibility, either directly or through communication with others, for real-time operation of the interconnected bulk power system have a clearly defined responsibility and authority to direct and implement real-time actions to ensure the stable and reliable operation of the FPL electric system. Such actions include shedding of firm load to prevent or alleviate SOL or IROL violations. These actions are performed as required without obtaining approval from higher-level personnel within FPL. In addition, these individuals assess the risks associated in each decision. Numerous tools and operating procedures are available to assist operating personnel in making critical decisions. Risk management and assessment and critical decision-making skill sets are part of the FPL training program. These individuals are also responsible for complying with NERC and FRCC reliability standards and the FERC Standards of Conduct.

2.2.3 Operational Alignment

Organizational structure supports safe and reliable system operation.

When FPL initiates a functional or application change, the power supply change request process is used to evaluate the impacts on system operations. This process ensures that all aspects of a change request are detailed and captured prior to developing a solution. Functional or application changes that affect a current process are covered through training. FPL does not have a formal document management process; however, it has purchased a document management system that is not yet fully implemented. The evaluation team recommends that FPL continues with plans to fully implement a formal document management process that includes information on ownership, author, approvals, revision dates, distribution, and acknowledgement of receipt and understanding.

Under emergency conditions, the FPL operating shift staff is responsible for system posturing, event response, implementation of applicable FPL emergency plans, and notification of management. The FPL system operator is fully authorized to take any actions during a system emergency, including activating emergency response if necessary. FPL operates an emergency command center where all aspects of the organization are represented and all communications and operating data are gathered and disseminated in support of emergency response personnel. The FPL general office command center is activated during events such as hurricanes, capacity shortfalls, and any other emergency necessitating the full activation of the FPL emergency organization. FPL has a strategy for rapid communications within the corporation for emergency events requiring quick notification of key FPL personnel. This strategy facilitates communications with external entities, e.g., state and local government officials.

Once every five weeks, the top three operating positions have a “tailboard” meeting to update the system operators on changes to agreements or other issues. This meeting is given by various managers (trainer, operations manager, scheduling manager). FPL uses Lotus Notes to notify system operators of changes on an ongoing basis.

2.3 Managing System Configuration

Power system configuration is carefully designed, analyzed, maintained, and controlled throughout the life of the infrastructure, ensuring that system and equipment margins are understood, considered in decision-making, and managed consistent with design and system requirements.

The majority of the EMS applications are based on a proprietary software environment for real-time information systems. Basic and advanced functionality of the FPL EMS include but is not limited to the following:

- Centralized transmission operations and monitoring for the FPL reliability footprint from the system control center or emergency backup site (authorized users can access the EMS using Web-based PC consoles)
- Data repository of power system data for internal and external users
- Trend charts
- Dispatcher training simulator (DTS)
- Data acquisition and processing
- Supervisory control
- Block load shedding (includes feeders, voltage reduction, and voltage regulator blocking)

NERC 2007 Reliability Readiness Evaluation Report Florida Power & Light

- Disturbance analysis (replay or reconstruct an event)
- Fast-acting load shedding (part of the SPS schemes)
- Fault locator with lightning correlation
- Disturbance data analysis
- Cable thermal monitoring
- Remote distribution capacitor control
- Residential load control
- Commercial and industrial load control
- Application monitoring and notification (via pages, alarms, and/or e-mails)
- Alarm and event processing
- Load frequency control
- Reserves monitor
- Network analysis
- State estimator
- Contingency analysis
- Dispatcher power flow
- Outage and switching management system (automatic processing of clearances and preparation of switching orders)

The FPL system operators demonstrated the following features for the evaluation team: state estimator, real-time contingency analysis, operator power flow, load forecasting, weather data system, interchange transaction scheduler, e-tag tool, operating reserves display, manual load shedding display, and voltage reduction display. The evaluation team cited FPL's extensive use of customized advanced applications as a positive observation.

All FPL digital points are scanned every 2 seconds and reported on an exception basis. The delay to process an event may take from 1 to 4 seconds before an alarm is generated to the system operators. Most FPL analog points are scanned every 10 seconds and reported on an exception basis. Several stations have analog points scanned every 2 seconds.

FPL has data links to many neighboring systems. The digital points are reported to FPL on an exception basis. Analog values are received by FPL from most of the systems at a 4-second periodicity. The others range from 2 to 10 seconds. The remote thermal units scan rates range between 1 and 10 seconds.

The FPL EMS was available for 99.9936% of 2006. Total downtime was 32 minutes and 35 seconds. This downtime includes time required to perform failover operations during database loads and other maintenance.

The real-time contingency analysis (RTCA) model has 3,982 buses with 1,171 contingencies and is triggered every 5 minutes with an average execution time of two minutes. The system operator has numerous user-friendly RTCA displays and a SCADA display available to select additional contingencies. The system operator does not usually add these contingencies. Normally, the transmission scheduler has the computer support group to add or remove contingencies. The system operator demonstrated a power flow run for the evaluation team. If

the RTCA trigger is disabled, an alarm to the system operator is issued and a page is sent out to the support group.

FPL calculates and displays for its operators real-time P-V curve data for key locations. As an indication of the voltage stability of the system for pre-determined contingencies, FPL's P-V plot application displays post-contingency voltage conditions for different levels of power transfers. The system operators monitor this application to ensure that voltage stability is maintained at all times and to determine the operating range available given current generation dispatch within the FPL system. The system operator demonstrated the P-V plot application showing the knee of the voltage curve. The application is updated every 4 to 10 minutes. The evaluation team cited FPL's use of the P-V application as a potential example of excellence.

The system operator demonstrated the unit fast acting load shed (UFALS) application that is used for the loss of a large unit. A display shows the logic of the UFALS as it proceeds to activation.

An outside vendor provides weather forecast data and real-time hourly weather data. The generation scheduler prepares the next-day load forecast using a vendor-supplied application, which has been further modified by FPL. Weather monitors in the control center provide local and state radar displays.

The system operator has numerous displays summarizing the interchange transactions between FPL and all interconnections and a display that shows the schedules between all Florida balancing authorities. The system operator has access to the e-tagging application with full capability.

FPL has the ability to trend all critical system data points at the system operator desks as well as control room trend charts for select data, such as ACE, frequency, and net interchange. Trend charts provide the capability to view real-time data (typically SCADA analog values) plotted against time in a horizontally or vertically oriented graph. A trend chart display can consist of multiple data points, with each plot depicted in a different color. It also provides the ability to assign a pair of limits for each plot and to select shading to emphasize the areas inside and outside the limits. The FPL generation area status display shows time error correction.

The current ACE, actual net interchange, and the scheduled net interchange are available from each FRCC balancing authority. The scheduled net interchange value assists in the monitoring of ACE and helps in determining missing schedules. Various displays are provided for the system operator to be able to view the information for the FRCC. FPL checks the information from FRCC control areas with ties to Southern Company against the data that Southern Company is sending to the FRCC.

The operator interviewed did not have a copy of the FPL specific list of critical facilities. FPL has a risk-based methodology for determining critical facilities on its system. The system operator has a system operation manual with a list of 500 kV threat limits and potential congestion problems. The operator knows to re-dispatch to alleviate any problems. FPL's philosophy of reliable operations coupled with its extensive use of contingency analysis and

power flow applications by the system operators allow all system problems to be addressed as soon as they surface. FPL operates with the requirements of the FRCC Security Process whereby all post-contingency conditions are analyzed and classified as SOL or IROL conditions. Any IROL conditions are mitigated immediately by the operating staff. However, the list of FRCC IROLs was not present on the operator's desk. The evaluation team recommends FPL provide additional training to all system operators on the FRCC IROL list.

The system operators are aware of the various system operating limits on each facility for various ratings, such as normal and emergency; however, they are not aware which is the limiting element of any given facility — conductor size, current transformer, wave trap, etc. To aid in the understanding of various limits and to assist in evaluating appropriate actions and response times, the evaluation team recommends that FPL provide information to the system operators to identify the limiting element associated with each transmission facility rating.

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.

The FPL emergency plan for capacity shortages has three levels of activation. FPL issues a capacity advisory whenever temperature projections reach applicable trigger levels throughout the state. A capacity alert is issued whenever operating reserves are less than the largest generating unit. Finally, a capacity emergency is issued whenever it is expected that energy supply will not be sufficient to serve all of the utility's firm load customers. Causes of capacity shortfalls include generation outages, extreme weather conditions, hurricane, or transmission limitations. The FPL system operator implements applicable portions of the plan in response to system events and initiates communications to open the FPL command center for emergency events. The FRCC state capacity emergency coordinator monitors data from all balancing authorities on a daily basis via the FTMS capacity assessment application and is the reliability coordinator agent to coordinate emergency actions on a statewide basis.

The FPL system operator implements manual load shedding using EMS displays with pre-arranged feeders and a program that cycles out-of-service feeders. There are also displays for block load shedding. The operator has one poke point to shed the calculated amount. A display for load management implementation to control swimming pool pumps, air conditioners, and water heaters allows the system operator to implement load reduction by service area and shows the amount of available load reduction in MW.

The FPL system restoration plan includes procedures for using blackstart resources to restore the FPL system. FPL coordinates with the FRCC reliability coordinator throughout the process of restoring the system. The FRCC reliability coordinator has the overall responsibility for coordinating and supervising the restoration effort, including, any synchronizing activities between two systems.

Nuclear plant requirements are assessed as special requirements when performing planned generator overhaul assessments and transmission line outages. FPL adheres to the nuclear plant voltage operability limits for both pre-contingency and post-contingency conditions. The system

operator has generation displays with voltage limits. The SCADA display prompts the operator to notify the nuclear plant operator prior to closing a relayed-out line. When preparing switching orders for a transmission line at a nuclear plant, two or more load dispatchers prepare duplicate switching orders. They compare these switching orders to determine if they are electrically the same. If the orders are the same, the switching may proceed with that order. If the orders are different, the system operator determines which one to use. The load dispatcher must notify the nuclear plant switching coordinator of any outages that will affect the plant.

3. Fundamentals of Maintenance

3.1 General

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

The computer operations group is under the FPL Power Supply department and provides the 24-hour support for voice communication and data collection facilities. The FPL Power Supply department has its own IT department that is separate from the corporate IT department. There are 46 programmers and engineers with an average of 17.5 years of experience. Three of the IT staff are NERC certified with the reliability operator credential.

The EMS computer support structure is a hierarchical organization headed by a director and two managers. One manager is charged with new deployments, cyber security, and major EMS enhancements. The second manager is responsible for the operational availability and maintenance of all EMS applications. The operations manager has five support supervisors: infrastructure systems, infrastructure hardware, SCADA/EMS, power system applications, and power system modeling.

A response team is available for any issues related to voice communication and data collection facilities. The system operator can access the current callout rotation list directly available on EMS computers as well as on the Power Supply Web site in case of an EMS failure. The evaluation team cited a positive observation for the FPL Power Supply IT department that is well staffed with highly skilled personnel, some of whom are NERC-certified operators.

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.

As part of normal operations, all major applications and systems are proactively monitored and alarmed by the AREVA EMS. In the event a major EMS failure of a critical application or system, the on-duty power system personnel is automatically notified by the alarm subsystem of the EMS. The infrastructure group has implemented overlapping pager alerts and alarm e-mails to prevent a single point of failure. These notifications include all critical servers and applications. In addition, the SCADA/EMS and power system application groups have implemented their own monitoring applications and scripts. The application monitor resides in

the EMS and provides the capability to monitor any analog value, flag, and timestamp against specific criteria. If a criterion is met, the application alerts an operator and support personnel via alarms, pages, and e-mails. The evaluation team noted that the alert paging system has a backup server that requires a manual transfer in the event that the primary server fails. The evaluation team recommends that FPL implement automatic failover capability for the backup server that is dedicated to the paging system.

Monitored critical infrastructure systems include the following:

- Physical servers
- EMS
- Oracle relational database engines
- Web servers

Monitored critical applications include:

- Alarm/Event Processing — A digital point in the EMS toggles every 10 seconds, and an application (external to the EMS) samples the alarm function to ensure the point is toggling. If the point does not toggle for two minutes, this external application will issue a page to the SCADA support personnel to investigate. The evaluation team learned that although the page is issued to support staff, there is no direct alert to inform the system operator of an alarm processor failure. The evaluation team recommends that FPL provide a visual indication to the control room staff of a “stalled” condition of the alarm system monitor.
- Historical Data Recorder — A flag is monitored by the applications monitor (APPMON) to ensure the data recorder is enabled. The flag is checked once a minute, and if the recorder is down for more than three minutes, a page is issued to the SCADA support group to investigate.
- Mapboard — A script is executed twice a day to compare the mapboard database against the SCADA database. If a discrepancy is detected, it will issue a page to the hardware group to investigate.
- Remote Capacitor Control System — The application updates files every 15 minutes and sends the values of these files to the EMS. APPMON is set up to check that these values are changing and if they do not change for one hour, it will issue a page to the SCADA support group to investigate. Additionally, APPMON ensures that the power factors are consistent between the EMS and the Remote Capacitor Control System. If the values are different, it will issue a page to the SCADA support group to investigate.
- Remote Data Links (inter-utility links) — Each data link is monitored by APPMON to ensure that the values are updating in the EMS.
- SCADA Topology Processor — APPMON monitors a timestamp field that is updated by the SCADA topology processor each time it evaluates the system. If the timestamp does

not change for three consecutive minutes, a page is issued to the SCADA support group to investigate.

- Substation/Power Plant Data Communication Servers — An alarm and a page are issued to support personnel if the server goes down.
- Contingency Analysis (RTCA) — An alarm and a page are issued to support personnel if the RTCA application fails.

The overlapping alarms, pagers, and e-mails contribute to ensuring that several key responsible groups are notified of an event leading to or caused by a failure. The evaluation team cited FPL's sophisticated notification system to alert appropriate staff of critical system conditions as a positive observation.

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 FPL operating shift staff is responsible for system posturing, event response, and implementation of all applicable FPL normal and emergency operating plans. The FPL system operator is fully authorized to take any actions to ensure the reliability of the FPL system.

FPL uses color-coded tagging on the SCADA one-line diagram to indicate various situations, such as clearance work, hotline permits, and unavailable equipment. Other tags exist for issues such as switches that are difficult to operate. Once a clearance has been given, it is tagged out to the field person, who has control over it until the clearance is released and the tag is removed. If more than one field crew is working on a piece of equipment, the tags are cross-referenced. The system operators have a list of what entities are authorized to perform switching procedures.

4. Fundamentals of Operational Planning

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

The FRCC operations planning coordinator prepares various studies for operations, including seasonal studies in advance of every operating season and monthly and weekly studies (per the FRCC security process) that highlight any special operating condition expected. FPL prepares mitigation plans in conjunction with the FRCC reliability coordinator, operations planning coordinator, and any involved FRCC operating entity.

All of these studies are made available and special operating conditions explained to system operators by the FPL transmission scheduler and the manager of system operations - transmission. The FPL operations planning coordinators present plans to the system operators and power coordinators. If something changes, the system operator can run power flow studies and change plans as necessary. The operations planning coordinators are available if needed

nights and weekends. FPL's system operators attend two yearly training sessions as well as weekly training sessions as required when special operating conditions warrant individualized training.

The FPL system operator ensures that all unit commitment issues as well as transmission clearance work are executed according to the pre-established plan. At any time, if unplanned system changes occur, the FPL system operator has the ability to add to the saved plan case to ensure that expected loads can be met reliably. The evaluation team observed that the system operators were not sure of how to enable multiple contingencies on a study. The evaluation team recommends that FPL provide additional training for the system operators to enable multiple contingencies in the real-time contingency analysis application.

FPL's operations planners are NERC certified and qualified for the operations desks. The evaluation team cited this as a positive observation.

FPL uses PSS/E for its operational planning studies and the FRCC transmission working group base cases as the source model. All Florida companies are fully modeled. The Southern Company systems use some equivalence modeling at lower voltage levels. The generator dispatch scenarios are developed using FRCC data. Equipment ratings changes are picked up through the FRCC equipment status report and through the FRCC Available Transfer Capability Working Group e-mail process.

Operational studies use voltage limits of 105% to 95% with allowable excursions to 90% for post-contingencies. For base case conditions, all equipment must be within its normal thermal rating. Post-contingency transformers are allowed to go to their applicable short-term emergency ratings. Transmission lines are allowed to go to 120% provided a remedial measure, such as re-dispatch or switching, can be implemented within 10 minutes.

For voltage stability, FPL's P-V application monitors the health of the FPL and FRCC bulk system to voltage collapse for pre-defined contingencies. This tool is displayed to the FPL system operator in graphical and tabular form.

FPL is a member of the FRCC Transmission Working Group that looks at stability and other seasonal assessments. FPL also participates on the Operating Reliability Subcommittee that performs seasonal assessments and monthly, weekly, and day-ahead reliability studies.

The FRCC security process details all planning activities performed by the FRCC reliability coordinator agents and operating authorities that are responsible for maintaining system reliability. The FRCC operations planning coordinator develops study cases on a seasonal, monthly, weekly, and daily basis for the expected topology and generation mix of the entire FRCC reliability footprint. FPL, along with all other FRCC entities, provides all outage information for population in the FRCC operations planning coordinator studies. Any resulting power flow or contingency analysis conflicts are discussed by the operations planning coordinator agent with all operating authorities, and mitigation strategies are developed well in advance of real-time operations.

FPL performs all day-ahead reliability analysis for the FRCC as the FRCC next-day reliability coordinator agent. The FPL transmission scheduler uses EMS-based power flow and contingency analysis software to study all planned outages, forecast loads, generation profiles, etc., for all FRCC operating authorities. Conflicts are discussed in conference calls as required and mitigation plans developed as necessary in order to arrive at expected reliable operations. FPL unit commitment is performed by the FPL generation scheduler, who provides load forecast data, expected interchange levels, and final unit commitment plan to the FPL transmission scheduler for inclusion in reliability studies.

Within the FRCC, all outage planning data are exchanged via the FRCC FTMS. All real-time data exchange with the adjacent reliability coordinator is done via the ISN (NERCNet). Outage data are provided to all NERC parties via the NERC SDX system.

All real-time reliability data are exchanged among entities via the FRCC reliability data link in ICCP format. The balancing authorities and transmission operators within the FRCC footprint publish their available telemetry data on a yearly basis. These files are posted on the FRCC Web site.

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.

FPL has three operating positions in the control room: the load dispatcher, the power coordinator, and the system operator. FPL performs the reliability coordinator function under contract with the FRCC and uses its system operator in a dual role during most times. Under peak conditions and other abnormal situations, FPL uses an additional shift position (from the staff of system operators) to perform the reliability coordinator function. The hierarchy of authority in the control room is from reliability coordinator to system operator to power coordinator to load dispatcher. As mentioned previously, FPL management has a philosophy of hiring entry-level positions with a focus toward achieving the highest level operating position (system operator).

FPL develops initial training for system operations personnel based on the candidate's previous experience and present skills. The initial training program consists of classroom, self-study, and on-the-job training. FPL has completed a job task analysis to provide a consistent direction for both the trainee and the trainer in mastering a task, to use as a tracking mechanism for the trainee's progress while training on the job, and to provide documentation of targeted training activities. The evaluation team reviewed the initial training checklists for each operating position.

The initial training for a load dispatcher uses a series of four steps. At the end of the load dispatcher initial training, FPL administers an exam on work practices that is both verbal and written.

The initial training for a power coordinator position also has a four-step set of topics. Some fundamentals may be skipped depending on the knowledge of the candidate. The majority of training is by mentoring on-shift with an experienced power coordinator. The final evaluation includes a written and oral exam and an evaluation of performance on everyday tasks using the dispatcher training simulator (DTS). Both the department manager and the training coordinator must agree to the final approval for the candidate to work on his or her own. The initial training for a power coordinator ends with NERC certification.

FPL uses a different process for the final evaluation of a system operator candidate. Candidates take a written exam typically covering 4 or 5 scenarios. A panel consisting of the three managers (generation, transmission, interchange) evaluates written answers and administers an oral evaluation of the candidate.

For ongoing or continuing training of existing personnel, FPL holds training sessions throughout the year, with a one-week classroom session both in the spring and in the fall. FRCC holds a regional training seminar each year, and FPL requires each operator to attend. FPL also conducts training on an as-needed basis: as new tools are developed, operating conditions change, or an evaluation shows a need for targeted training. The spring training session is focused primarily on emergency operations topics, and the fall session tends more towards standards and requirements. For both sessions, FPL uses training delivery methods that include classroom, state estimator analysis, contingency analysis, and DTS. FPL provides weekly refresher training throughout the year to train on new issues. In addition, an annual system operations meeting with the system operators and power coordinators serves as a forum for general operations issues. FPL holds monthly safety meetings where the topics are driven by the operators.

In general, most of the learning is classroom-type training, supplemented with on-the-job training, simulator training (40–50 hours/year), and computer-based modules purchased from an outside vendor. The training framework includes imperatives and objectives and leads to the development of the major elements of the training program. Tools are an essential part of the FPL training program. The DTS is a very important part of the training delivery. FPL maintains detailed training records and assessments.

FPL gathers feedback after a training session using the NERC individual learning activity process through evaluation sheets, verbal contact, and test scores. Department managers are key in identifying areas for training development and consider the feedback when developing future training. FPL also surveys system operators before each training session via e-mail regarding any items deemed necessary to cover in training classes. FPL is a NERC-approved continuing education provider. The training courses are titled and are classified as individual learning activities.

FPL reviews all system events after the fact among operations staff and management to ensure that lessons are learned and processes are put in place to maintain reliability. FPL also reconstructs actual system events in the DTS for operator training, and the evaluation team cited this as a positive observation.

FPL management promotes NERC certification for all personnel in support staff functions, and the evaluation team cited this as a positive observation.

The FPL training director attended a five-day “train the trainer” course in 2006. He has also received some internal instructor training and has years of experience. FPL also identifies in-house subject matter experts to provide specialized training. Two of these recognized experts teach at a local university.

FPL is in the process of adding two more power coordinators to the staff to implement a six-week shift rotation to allow for a dedicated training week. The additional time will also be used to have the power coordinators help develop additional training activities.

The system operator position already has sufficient staffing for the dedicated training week in the shift rotation. FPL uses a minimum amount of overtime to allow for time off-shift for training.

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.

FPL system operators, power coordinators, and load dispatchers are well trained and proficient in the use of the many tools available to them. The evaluation team cited this as a positive observation.

After a significant event, FPL runs a simulation to analyze actions taken during the situation. FPL also gathers all alarms to check for proper operation of equipment, verify units provided reactive output as expected, check SPS systems for proper operation, and check to confirm that capacitor banks were switched correctly.

FPL requires operators to obtain a second-party review and/or verification of switching orders. Switching orders are written by one load dispatcher and a second load dispatcher reviews and signs off on the order. The steps are developed independently each time — no canned orders. A second load dispatcher will always independently review and verify the sequence of steps. The load dispatcher reviews switching requests for any contingencies that may be present and confers with the transmission scheduler if necessary to approve and coordinate with the FRCC.

FPL has a digital voice recording system accessible by management at their desks or at the individual operators’ desks.

Numerous tools and operating procedures are available to assist operating personnel in making critical decisions. Risk management assessment and critical decision-making skill sets are part of the FPL training program. FPL does not have a formal risk analysis training program at this time but is looking at what vendors may currently have available.

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.