Audit and Management Review of Entergy Mississippi, LLC Audit Period of 2018-2019

Docket No. 2019-AD-24

FINAL REPORT – PUBLIC VERSION
CONFIDENTIAL MATERIAL IS REDACTED

Presented to:

The Mississippi Public Service Commission

Presented by:

The Liberty Consulting Group

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Executive Summary

I. Introduction

We examined fuel and energy procurement and management by and for Entergy Mississippi, LLC (EML) for the period from October 1, 2018 through September 30, 2019. We conducted this examination under Mississippi Code Annotated Section 77-3-42. Our work included an assessment of the following elements required by this section, as interpreted by the Mississippi Public Service Commission (Commission):

- Practices for economical purchase and use of fuel and electric energy
- Relevant contract terms and conditions and any variations from contract terms
- Prudence of purchased-power transactions
- Operation of EML generating units, including Independence 1 and 2 and Grand Gulf.

We conducted an integrated review of all elements of EML and its Entergy affiliates to the extent they affected fuel and energy procurement and management during this period. Our report addressing the findings, conclusions, and recommendations of the examination we undertook employs the following major subjects, each of which forms a separate chapter of the following audit report:

- Organization, Staffing, and Controls
- Coal Procurement
- Coal Supply Management
- Natural Gas and Fuel Oils
- MISO Operations
- Power Plant Operations
- Nuclear Fuel.

II. Organization, Staffing, and Controls

We found the structure and alignment of roles and responsibilities for fuels and power purchasing appropriate, with sound division and coordination among roles. Entergy management effectively manages MISO participation. Staffing of fuel and energy procurement and management organizations includes sufficient numbers of well-qualified personnel operating under clear and appropriately designed responsibilities and accountabilities.

Sufficient training is provided, with required completion tracked. Performance management engages employees and supervisors throughout the year in setting and measuring progress against corporate, department, and individual goals and objectives, and in addressing personal development designed to enhance current performance and prepare personnel for expanded or changed responsibilities.

We found position descriptions, a subject of a recommendation by the previous auditor, sufficient when read in combination with these elements of the performance management program. However, as the previous auditor found, position descriptions continue to lack statements of minimum position qualification guidelines. ***We recommended that management add such***

statements, a broadly prevailing industry practice in our experience, recognizing that they provide guidelines, not firm, unalterable requirements.

We found written procedures governing fuel and energy procurement and management comprehensive and sufficient. We also found the goals and strategies for these matters clear and appropriate, having undergone significant change to support entry into MISO. Goals, strategies, and procedures clearly communicate to personnel what defines success, and how to pursue it. Similarly, EML operates under a comprehensively-designed, well-documented, and consistently and attentively executed set of controls. We also found appropriate attention by Internal Audit to fuel and energy procurement during the Audit Period.

III. Coal Procurement

Forecasts of expected coal burn guide procurement decisions each year and they form a driver of delivery scheduling during the year. The prior fuel auditor found large variations between Independence coal burns and forecasts. During this Audit Period, over-forecasting continued for the first seven months, but improved in the last five.

Recent experience at Independence highlights the variability that may exist in coal burn rates for a unit whose dispatch now occurs in a MISO market that has access to a large fleet of low-cost natural gas plants. Independence operation has become less regular and less certain over time. Plans to shut the units down, along with those at White Bluff, will have an increasing impact on unit operation and resulting coal burns, as an ever-shortening period remains to justify major capital and O&M work. ***We recommended a robust and risk-based analysis of forecasted coal requirements and required inventory levels, tied to a comprehensive overall plan for addressing the remaining life of Independence.***

The holistic examination of all factors we recommend will determine the range of value that Independence may be expected to have in the future, and what capital and operating plans and expenditures (including, but not limited to, fuel) should be. More than fuel purchases and costs, a sound assessment of that value will affect fuel plans and resulting costs and risks. We hope that the next audit's review of coal forecasting, planning, and procurement will occur in the context of the units' expected life spans now (and, of course, any uncertainties as to the finality of current expectations, if they exist). This more forward-looking approach appears to us more useful than probing the reasons for prior forecast variances.

This year's annual coal-supply solicitation, initiated in September 2018, produced agreements corresponding with forecasts, used reasonably selected durations, diversified supply sources, and promoted flexibility in dealing with Independence consumption uncertainties. [redacted]

However, there remains risk that the goal of locking in targeted needs at the current level used by management for the coming year will become a 100 percent or greater target. ***We therefore consider review of setting the first-year target the current percent used appropriate as a part of***

an overall reset of Independence planning we recommend. Nevertheless, for the 2018 RFP, management estimated its requirements carefully, designed the RFP to produce the necessary quantities, sent the RFP to a sufficiently broad range of suppliers, carefully analyzed the responses, selected the most economically attractive offers, and provided for significant supplier diversity in a market whose participants are severely challenged economically.

Delivered coal prices for Independence remained market-competitive during the Audit Period. Reported U.S. Energy Information Administration FOB-mine and delivered prices indicate competitive prices at Independence.

IV. Coal Supply Management

Independence receives coal from a very sizeable fleet of railcars, [redacted] of which it owns. That fleet has remained at the same size since our last audit in 2011. The fleet is effectively managed, but, given the cost position of Independence in MISO now and plans that will presumably lower its levels of operations as its life approaches its end, ***we recommend an analysis of optimum railcar fleet size and evaluation of the economics of phased reductions over the remainder of the life of the Independence units.***

We found the approaches, processes, and facilities for receiving, sampling and storing coal at Independence consistent with prevailing industry practices and appropriate. Management regularly took and used coal quality measurements to produce the price adjustments called for by contracts, and the Audit Period witnessed no material delivery, quality, or contract-compliance issues, or requests for contract amendment or relief.

Annual heat rate testing provided input to the cost calculations that drove dispatch of the Independence units at the time of our last audit in 2011. Now, following entry into MISO [redacted] Particularly with the impacts of low natural gas costs on the frequency of Independence unit dispatch now, ***we recommend that management undertake at least a two-year historical analysis designed to confirm that its*** [redacted] ***test cycle ensures effective pricing of MISO bids for Independence output.*** We hope to have that analysis available for the next audit.

We found coal performance reporting effective overall, but monthly reports lacked substantial narrative and analysis. ***We recommend that management establish a list of topics to regularly address in monthly reports, and that periodic internal audit examination of coal management performance occurs.***

V. Natural Gas and Fuel Oils

We found the resources responsible for gas procurement capable, but staffing perhaps thin for addressing the full range of needs involved, expanded in light of a review by Entergy's Internal Audit Services (IAS) made important findings and recommendations regarding the conduct of gas procurement. ***We recommend a review of gas procurement organization and staffing, focusing on the oversight functions and activities addressed in the IAS review.***

We found the gas purchasing strategy well suited to the role of gas-fired capacity in MISO markets. Pipeline capacity contracting is well coordinated with the role of Entergy's gas-fired capacity in power production. ***We share the view of the prior auditor about examining capacity contract renewals, but we recommend a broader inquiry that considers pipeline changes***.

We found management's approach to gas commodity purchasing sound and properly reflective of its operation as a very large consumer in a region with abundant supplies and suppliers. Those responsible for acquiring commodity supply have very sound knowledge of the markets, invite communication with and offers from a robust range of alternatives, employ sound procedures, and undertake secondary-market activities in a manner consistent with and supportive of company circumstances.

Fuel-oil supply management, while small in scope, has been performed effectively. EML's hedging program operates effectively in serving its established objectives.

Gas-supply transaction records maintained have, following a review by Internal Audit, become reasonably complete. Our testing of transactions and associated information regarding pricing, volume, counterparties, and other information verified that improvements have occurred, but we did encounter some gaps in information about offers made in competition with some accepted by the Company. We recommended continuation of tracking, recording, and follow-up investigations of transaction issues, and investigation of the nine transactions we found that indicated acceptance of an offer other than the most economic one available.

VI. MISO Operations

The EML planning and market operation functions operate effectively and under the direction of experienced personnel and management, featuring state-of-the art models and processes. Most EML energy dispatched is in MISO's day-ahead market, and is supported by a well-established and effective team and processes that submit bids for supply at specific price and quantity (MW) levels. A balancing real-time market is monitored effectively for opportunities to sell additional generation into MISO as needed based on market conditions.

In general, over the Audit Period, dispatch, as defined by capacity factor for our purposes, shows an appropriate negative correlation with dispatch cost -- units with lower dispatch costs had higher capacity factors. The exception is Independence which at times has lower dispatch costs than both Attala and Hinds CCs, yet a lower capacity factor. We did not find a basis for concluding that management sought to get Independence dispatched by MISO to reduce coal inventory, but, as noted earlier, we did recommend an analysis of how often heat-rate inputs should be revised.

We also found the costs that EML pays for Grand Gulf high when compared with the average market price in MISO's MS hub. Another issue raised by the prior auditor involved the implementation of a back-casting program. SPO is in the process of implementing the program. ***We recommend that SPO make completion of the implementation of the back-casting program a priority***, to ensure that its tools and processes are adequate in identifying opportunities and risks in the market.

The last auditor also addressed cybersecurity issues. SPO acknowledges the importance of ensuring that third-party vendors do not cause cybersecurity breaches, but the exact measures it takes remain unclear. Cybersecurity is of utmost importance in an environment facing increasing numbers and sophistication of cyber threats. Addressing them takes a structured, coordinated set of measures designed and applied by a large and sophisticated organization, and supported by training in behaviors to be applied by all employees and contract resources. The subject has implications well beyond fuel and energy management, and should be considered and, if undertaken, take a broad view of the subject.

VII. Plant Operations

We found the generation operations organization well designed and sufficiently staffed to support safe, reliable plant operations, but have some concern exists regarding the Independence units. Interviews with the plant manager at Independence indicated that the backlog of maintenance items is growing due to possible shortages in staff.

Management employs a well-defined, performance-oriented performance-management process. It employs clear goals set at year start and cascades those goals consistently down throughout the organization. We found comparatively high equivalent forced outage rates and low capacity factors for some units during the Audit Period. A number of maintenance program indicators trended negatively during the Audit Period as well (for example, completion of maintenance work items). ***We recommend an analysis of trends in maintenance backlogs.***

The prior auditor's recommendation for continued monitoring of performance indicators for certain stations showed performance degradation, rather than the performance improvement to be confirmed. ***We recommend an analysis of the causes of and possible solutions for deteriorating performance at those units, and a determination of whether solution costs and results are proportionate to the value that the units provide.***

Despite increases at some units, overall capital and O&M expense levels conformed to budget overall. However, several plant outages extended well past their scheduled durations. ***We recommend an analysis of the status and health of the fleet's flow accelerated corrosion (FAC) program, and a review of the status of heat-rate assessment and improvement programs at each station.***

VIII. Nuclear Fuel

Entergy employed a well-organized, experienced, and effective organization to manage nuclear fuels, operating as part of an integrated Entergy-wide Nuclear organization. Management has taken advantage of the size of that fleet to establish and maintain a highly experienced Nuclear Fuels Supply organization, tightly integrated with nuclear engineering and design resources.

Nuclear fuel costs for the Audit Period remained steady, with the substantial improvement over the prior Audit Period not driven by fuel costs per se, but by the higher capacity factor attained by Grand Gulf. A matter of concern in the recent past, capacity factor at Grand Gulf was strong in this Audit Period. This Audit Period included major nuclear-fuel procurements, [redacted]. These procurements resulted from competitive solicitations

responded to by a reasonable number of offerors. The competition showed a reasonably narrow range of prices among offerors and competitiveness with current market prices. Management carefully analyzed the pricing offered, and made reasonable selections from economic and diversity-of-supply perspectives. That diversity had heightened importance at the time of the solicitation, during which the potential for U.S. adoption of a significant U.S.-content requirement in a market increasingly served from foreign sources.

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I. Introduction

A. Background

The Liberty Consulting Group (Liberty) conducted for the Mississippi Public Service Commission (Commission) an audit and management review of Entergy Mississippi, LLC (EML, or Company). This work addressed EML fuel and purchased power costs and related documentation for the period of October 1, 2018 through September 30, 2019.

Mississippi statutes call for:

- An assessment of a utility's practices for economical purchase and use of fuel and electric energy
- An assessment of the relevant contract terms and conditions and any variations from contract terms.

These assessments are designed to allow the Commission to determine:

- Whether or not the utility is properly and correctly employing the use of the fuel adjustment clause or rider applicable to its operations and billing procedures
- Whether or not the utility has engaged in efficient and economical practices for the acquisition of fuel and purchased energy
- Whether there is reason to question practices, contracts, operations, or procedures for the purchase or acquisition of fuel and purchased energy relative to efficiency, economy and the public interest.

Two key events drive current energy procurement operations at EML. The first is EML's joining of MISO in December 2013. The second is EML's exit from the Entergy Service Agreement (ESA) in November 2015.

On December 19, 2013, the Entergy operating companies joined MISO. Prior to that point, Entergy Services Inc. (ESI) performed plant dispatch operations on behalf of each operating company remaining in the ESA on the basis of *Entergy* least cost. Upon joining MISO, economic dispatch decision-making authority transferred to MISO central operations, which dispatches on the basis of *MISO* least cost. ESI plays the role of providing MISO with bid prices for each level of load available by unit for both MISO's Day-Ahead Market (DAM) and Real-Time Market. MISO also dictates the reserve margin required and serves as the load balancing authority, both of which represent fundamental changes to EML.

In addition to overseeing the energy markets in which Entergy's operating companies compete, MISO also manages a capacity market through annual capacity auctions. MISO also oversees the management of congestion and the maintenance of system reliability. The roles now occupied by MISO have caused Entergy's generation operations to experience substantial changes, and managing the interaction with MISO has become a central focus.

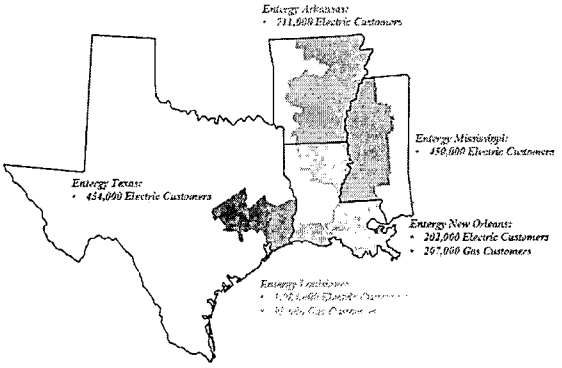
EML exited the ESA in November 2015. The ESA operated for many decades as the FERC-approved contract by which Entergy's operating companies were allocated the costs and benefits of system-wide operation. The ESA was designed to allow Entergy's operating companies to benefit from the scale of Entergy's large generation portfolio and transmission grid, while

providing least-cost system dispatch and the risk-management benefits of fuel diversity. Additionally, planning functions were performed centrally by ESI.

Entergy restructured its generation and transmission operation and planning in response to its entry into MISO. The basic reconfiguration of functions was examined in last year's audit. That audit recommended that Entergy continue to review and enhance its processes as it gains experience with operations under MISO

EML provides electric service to approximately 450,000 customers in 45 of Mississippi's 82 counties, essentially in the western half of the state. EML is one of five Entergy Corporation Operating Companies providing regulated electric-power service in a five-state region of the country. The Operating Companies are:

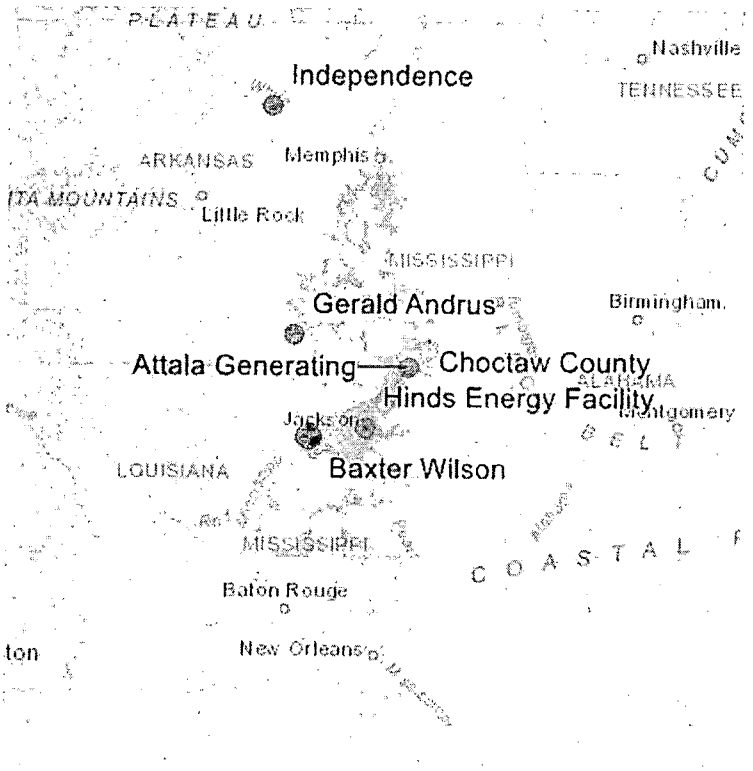
- Entergy Arkansas, LLC
- Entergy Louisiana, LLC
- Entergy Mississippi, LLC
- Entergy New Orleans, LLC
- Entergy Texas, Inc.



The next table identifies the EML-owned power plants. Not shown in the chart are the last of the two generating units at Rex Brown, which Entergy retired in June 2019. Entergy acquired the Choctaw generating unit after the close of this Audit Period.

Power Plant Name	Total Owned Capacity (MW)	Operating Ownership (%)	Prime Mover	Fuel Type	Year First Unit in Service
Attala Generating	491.99	100	Combined Cycle	Natural Gas	2001
Baxter Wilson	539.7	100	Steam Turbine	Natural Gas	1967
Choctaw County	884	100	Combined Cycle	Natural Gas	2003
Gerald Andrus	745.4	100	Steam Turbine	Natural Gas	1975
Hinds Energy Facility	494.8	100	Combined Cycle	Natural Gas	2001
Independence	414.25	25	Steam Turbine	Subbituminous Coal	1983

The following map indicates the locations of these generating units, and EML's service territory (shaded in red).



B. Project Scope and Objectives

The overall scope of this project was to accomplish the following matters:

- An assessment of the practices for economical purchase and use of fuel and electric energy
- An assessment of the relevant contract terms and conditions and any variations from contract terms.
- An examination of a sample of individual fuel and energy purchases.
- Determinations of the prudence of purchased power transactions including, but not limited to, transactions with affiliates.
- Requested reviews of plant operations, including Grand Gulf Nuclear Generating Station and Independence Station.
- Assessment of the appropriate level of fuel inventory at Independence 1 and 2.

The objectives that Liberty sought to achieve address the determinations as set forth in Miss. Code Ann. §77-3-42(5):

- Whether or not the utility has engaged in practices in the acquisition of fuel and purchased energy which are efficient and economical
- Whether or not there is reason to question the practices, contracts, operations, or procedures of the utility in the purchase or acquisition of fuel or purchased energy relative to efficiency, economy and the public interest.

C. Audit Work Structure

Liberty carried out the audit through an integrated set of steps and processes designed to accomplish the project's scope and objectives. Liberty divided its audit team by five functionally based task areas into which it has divided the work scope required by the RFP:

- Task Area One: Fuel Procurement and Management Organizations
- Task Area Two: Coal Procurement
- Task Area Three: Natural Gas and Oil Procurement
- Task Area Four: Planning, Dispatch, and Wholesale Power
- Task Area Five: Power Plant Operations.

This report presents the results of the audit in eight chapters:

- Chapter One: Introduction
- Chapter Two: Organization, Staffing, and Controls
- Chapter Three: Coal Procurement
- Chapter Four: Coal Supply Management
- Chapter Five: Natural Gas and Oil
- Chapter Six: MISO Operations
- Chapter Seven: Power Plant Operations
- Chapter Eight: Nuclear Fuel.

D. Audit Recommendations

The next chapters of this report detail Liberty's recommendations and the findings and conclusions supporting them. Each is set forth below, organized by report chapter.

Chapter II: Organization, Staffing, and Controls

1. **Include statements of minimum expected qualifications in the position descriptions for fuel and energy procurement and management personnel.**

Chapter III: Coal Procurement

1. **Perform a more robust and risk-based analysis of forecasted coal requirements and required inventory levels.**

Chapter IV: Coal Supply Management

1. **Perform an analysis of optimum railcar fleet size and evaluate the economics of phased reductions over the remainder of the life of the Independence units.**

2. **Ensure that timely and accurate heat rate measurements drive MISO offers.**

3. **Establish a list of topics for regularly addressing in monthly reports, and perform periodic internal-audit examination of coal-management performance.**

Chapter V: Natural Gas and Fuel Oils

1. Review organization and staffing for the gas procurement function.
2. Review alternatives as pipeline capacity contracts expire.
3. Ensure follow-up on plans to continue tracking, recording, and follow-up investigations of transaction matters.
4. Investigate potential occurrences of the selection of transactions that may not have been the most economical; proceed with plans to examine instances of high margins to index prices.

Chapter VI: MISO Operations

1. Investigate options for relief from Grand Gulf expenses.
2. Finalize and implement a back-casting process.

Chapter VII: Power Plant Operations

1. Analyze the deteriorating performance of the [redacted] units.
2. Analyze the maintenance backlog [redacted].
3. Analyze the status and health of the fleet's flow accelerated corrosion (FAC) program.
4. Review the status of the heat rate programs at each site.

II. Organization, Staffing and Controls

A. Background

Establishing clear organizational responsibilities for fuels- and purchased-power-related functions responds to an important need for:

- Assigning clear responsibility and accountability for the variety of different functions required and the expertise to perform them effectively
- Ensuring the effective correlation of cross-departmental interactions required
- Providing transparency and a sound basis for enabling senior-management involvement in fuels and purchased-power planning and acquisition.

The organization structures employed must bring all the required talents to bear without fractionalizing decision-making responsibility and accountability. Fuels-management activities involve particular skills in planning and operations. The adoption of comprehensive goals and objectives for the functions and activities under study here are important means for providing overall control of management and operations.

We reviewed organization, staffing and controls pursuant to the following criteria:

1. The organization should be effective when considered in the context of the operating environment.
2. Roles and responsibilities should be clear and well understood.
3. The qualifications and experience of staff people should be commensurate with their roles.
4. Performance management should be in place and effective.
5. There should be established procedures for fuels procurement and management.
6. Goals and strategies should be well thought out, suited to the operating environment, and clearly understood.
7. Establishment and operation of controls should receive proper and sufficient attention from management to ensure the integrity of procurement processes.

B. Findings

The regional transmission organization, Midcontinent Independent System Operator, Inc. (MISO) now plays a series of critical roles regarding the operation of all of Entergy generating units. MISO functions like the following provide important contributors to the context within which fuel and purchased power decisions affecting generating units across the Entergy footprint, including Mississippi, get made:

- Facilitating equal and non-discriminatory access to transmission systems
- Delivering improved reliability coordination
- Acting as the Midwest Certified Balancing Authority
- Coordinating regional planning
- Administering the Day-Ahead and Real-Time energy and operating reserves markets
- Operating a capacity market
- Fostering efficient market operations
- Managing congestion on the transmission systems of member companies.

Each of Entergy's operating companies acts a "Market Participant" within MISO.

A central Entergy organization, affiliate Entergy Services, LLC (ESL), provides management, accounting, legal, engineering and other services to EML, and to the other Entergy operating companies in Arkansas, New Orleans, Louisiana, and Texas. ESL also conducts gas-supply planning and management for Entergy's two gas-distribution operations, owned by ELL and ENOI.

1. Goals and Strategies

With entry into MISO, operations planning and fuel-supply planning have increased focus on the short-term; *i.e.*, conforming them to the means by which MISO effects the dispatch of their units. Rather than planning fuel supplies for generating plants sure to run, ESL has made changes to focus on fuel-supply arrangements that will provide reliable supplies, should the plants run.

Operations planning now includes production-cost modeling that produces Monthly Energy Plans. The Company uses those plans to begin fuel-supply processes, such as purchases of natural gas. Some gas may be bought on a monthly basis, but the Company's Gas Procurement Strategy calls [redacted]. Coal Procurement Strategy [redacted]. A major focus recently is an effort to control inventories in the event that the coal-fired plants operate at less than full capacity.

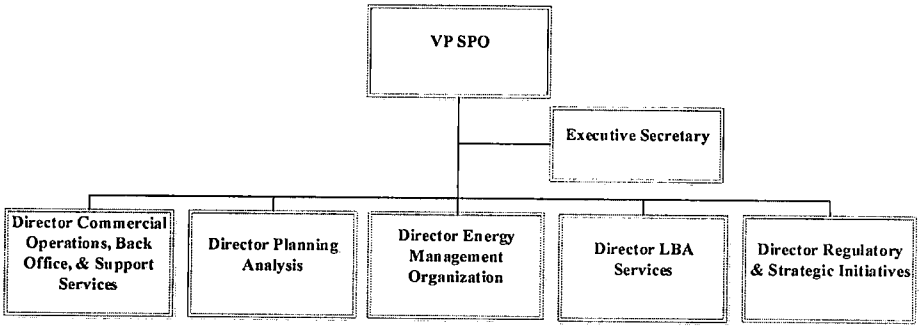
Within any month, ESL produces a rolling seven-day Unit Commitment Study, which allows the fuel buyers to anticipate what fuel requirements for each unit might be over the next few days. Actual fuel-purchase commitments are made pursuant to a Day-Ahead Process, which covers all of the processes necessary to get fuel to each plant that is selected by MISO for operation. Fuel for the gas-fired units often has to be bought or sold on intra-day markets, when required generation is greater than or less than the estimates in the Day-Ahead Process.

Longer-term generation planning, of course, uses analysis of fuel-supply options over a longer term. Pursuant to regulatory requirements, EML files an Integrated Resource Plan with the Mississippi Public Service Commission. As EML's generation fleet, except for the Attala, Hinds and Choctaw combined-cycle units, is older, the longer term is an active area of planning, but outside of EMO and its Fossil Fuel Supply organization.

2. Organization

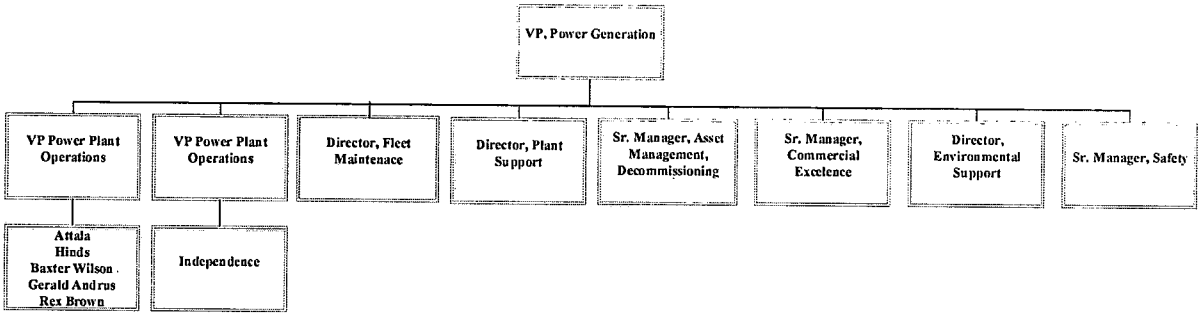
Within ESL, the System Planning and Operations unit (SPO) has responsibility for planning analyses, fuel procurement, energy management, regulatory support, and other services. The following chart shows SPO's components. Entergy moved to this structure in March 2013, anticipating its entry into MISO, which occurred on December 19, 2013. It was similar to the structure employed prior to Entergy's entry into MISO, except that the functions of the LBA Services component were transferred into SPO from Entergy's Transmission organization. The Company made some organizational refinements in 2016, but the structure has largely been the same since then.

SPO Organization



A separate Power Generation Organization, headed by a Vice President for Power Generation, operates the Company's fossil plants, including those owned by EML. The chart below shows that unit's organization.

Power Generation Organization



As we will explain below, a separate organization has responsibility for nuclear planning and operations, including fuel procurement and management.

a. SPO's Energy Management Organization

The Energy Management Organization (EMO) has the following responsibilities:

- Facilitate participation in the MISO Day-Ahead Market
- Manage interaction with Independent Market Monitor
- Staff and maintain a generation dispatch center 24/7 for participation in the MISO Real-Time Market
- Manage compliance with FERC, NERC, SERC, MISO rules and regulations
- Procure fuel and transportation services for generating plants and gas distribution operations
- Provide pipeline and transportation origination services to new-build generation
- Hedge natural gas prices
- Operational planning up to one year.

EMO has three subsidiary organizational units:

- Market Operations

- Real Time Operations
- Fossil Fuel Supply.

EMO is the largest component of SPO with 40 employees.

b. SPO Commercial Operations

The responsibilities of Commercial Operations consist of:

- Direct supply procurement activities with terms greater than one year
- Negotiate and administer long-term (greater than one year) contracts
- Manage RFP processes and unsolicited offers for supply acquisitions and purchased-power agreements
- MISO commercial model registration
- Shadow settlements for MISO market transactions
- Review and approve invoices from providers
- Submit and monitor disputes about billing issues
- Direct fuel and power billing settlement and reporting
- Ensure that procedures comply with FERC, NERC, SERC and MISO requirements
- Develop and conduct training programs and maintain documentation to support audits
- Perform sales and load forecasting.

It carries out these responsibilities through four subsidiary organizational units:

- Commercial Origination
- Settlements, Analysis & Reporting
- Training, Compliance & Support
- Sales & Load Forecasting.

c. PO Planning Analysis

SPO's Planning Analysis component has the following responsibilities:

- Direct development of Integrated Supply Plan and Integrated Resource Plans (IRPs)
- Oversee resource adequacy
- Oversee planning models and production-cost modeling
- Evaluate RFPs and IRPs.

It carries out these responsibilities through three subsidiary organizational units:

- Supply Planning & Analysis
- Generation Planning & Models
- Planning & Decision Support Analysis.

d. SPO LBA Services

The LBA (Local Balancing Authority) Services component has the following responsibilities:

- Staff and maintain a generation dispatch center 24/7 for operation in the MISO Real-Time Market
- Monitor system conditions

- Prepare and submit daily mid-term load forecast to MISO
- Conduct most Balancing Authority functions in Emergency Plans and Procedures
- Provide stakeholder outreach
- Collect and verify meter data to provide to MISO
- Perform the Meter Data Management Agent and Meter Data Quality functions (MDMA/MDQ) that are required for MISO operations for all of Entergy's operating companies and the embedded entities that contract with ESL, EAL and EML for those services.

LBA Services has two subsidiary organizational units:

- Real Time Operations
- MDMA/MDQ.

e. SPO Regulatory & Strategic Initiatives

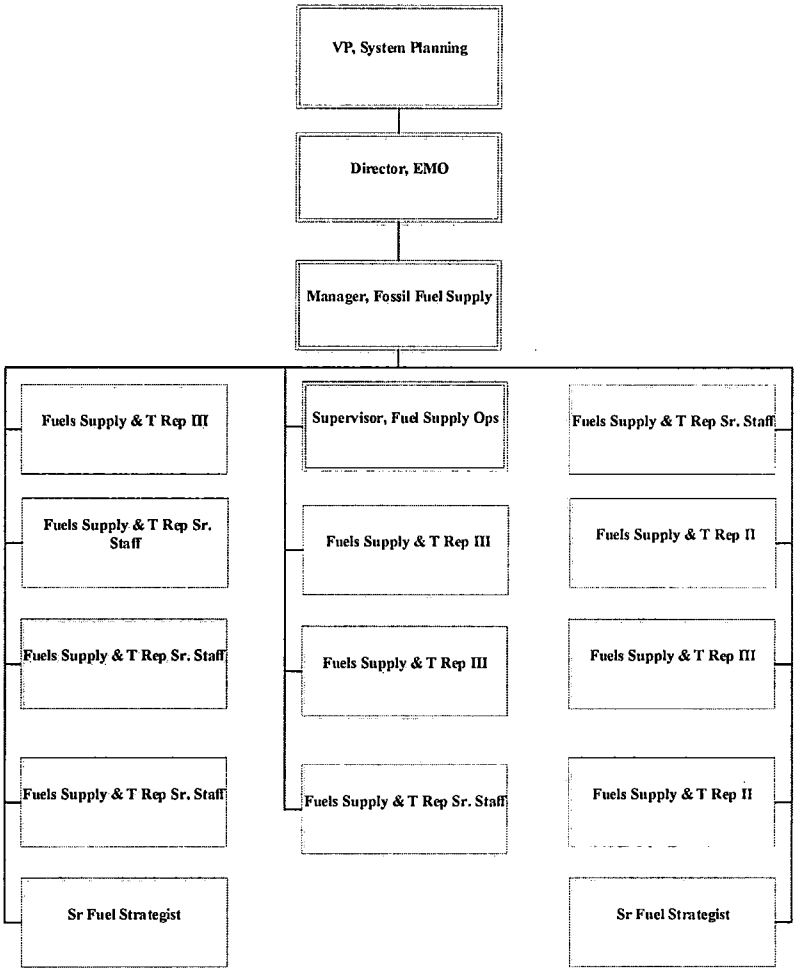
SPO's Regulatory & Strategic Initiatives component has the following responsibilities:

- Manage SPO strategic initiatives
- Oversee SPO regulatory activities
- Provide support for SPO's interaction with MISO
- Oversee operating company Auction Revenue Rights and Financial Transmission Rights (ARR/FTR) portfolio
- Coordination of Envision (strategic planning) efforts for SPO.

It has no subsidiary organizational units.

3. SPO Staffing

Our work has particularly focused on EMO's Fossil Fuel Supply group, which manages fuel supply on an integrated basis across the Entergy fossil-fueled generation fleet generating units, including those in Mississippi, and the two large, coal-fired Independence units in which EML has an ownership share. Fossil Fuel Supply also performs natural gas supply management for two Entergy gas-distribution systems that operate in Louisiana. The diagram below shows the organization of the Fossil Fuel Supply unit.



Fossil Fuel Supply operates under the direction of a Manager, Fossil Fuel Supply who reports to EMO's top manager, its Director. The Manager's reports include:

- A Supervisor, Fuel Supply Operations
- A Senior Fuel Strategist
- 2 Fuel Supply and Transportation Representatives (Level II)
- 3 Fuel Supply and Transportation Representatives (Level III)
- 4 Fuel Supply and Transportation Representatives (Senior Staff).

The group has responsibility for:

- Leading the development of fuel strategies and commercial terms of supply arrangements
- Managing operations of coal-supply logistics
- Managing fossil-fuel and transportation-agreement solicitations
- Monitoring and reporting performance
- Developing and maintaining supplier relationships
- Ensuring compliance with agreements
- Overseeing management and maintenance of storage and transportation assets.

The Supervisor, Fuel Supply Operations has responsibility for coal contracting and a range of day-to-day operations, including scheduling transportation, managing inventories, and current-day pipeline monitoring for the SPO Energy Management Organization (EMO).

The Senior Fuel Strategists have responsibility for long-term origination (*e.g.*, gas transportation agreements) and for long-term decision-making regarding fossil-fuel procurement and delivery. These other, longer-term responsibilities include areas such as addressing supply and market conditions and trends, fuel supply portfolios and risks, and assessment of potential generation sites.

The nine Fuel Supply and Transportation Representatives have coal, natural gas, oil, emissions and transportation responsibilities for:

- Developing business relationships with fuel and transportation suppliers
- Analyzing and modeling purchasing opportunities
- Preparing monthly forecasts and price-variance analyses
- Facilitating the development of new sources of supply and transportation.
- The nine Representatives are functionally divided as one for coal, and the others for fuel oil and natural gas.

Entergy separates fuels accounting and controls from the fuels-management functions performed in EMO by the Fossil Fuels Supply group. Fuels accounting falls under a separate SPO group; *i.e.*, Commercial Operations. Settlement Analysis and Reporting operate within Commercial Operations under the direction of the Manager, Fuel & Generation Accounting. This manager's group oversees expense recording, calculation of deferred fuel balances, providing data for regulatory filings, FERC tariff calculation and accounting, management reporting, and ensuring proper controls over the accounting for all accounting process controls. The group's resources include a Senior Staff Accountant, four Lead or Senior Accountants, and two Accountants.

A Fuel & Special Riders group, operating within Entergy's regulatory and utility rates organization, has responsibility for calculating rates, preparing rate filings, analysis and testimony associated with various recovery-rider filings, including EML's annual ECR filing. That group is headed by a Manager, Fuel & Special Riders, and includes a Regulatory Project Coordinator and five Regulatory Analysts.

Managing emissions forms an important part of fuels management at Entergy. The Power Generation organization operates under its own vice president, separate from the one who heads SPO. A Power Generation Director, Environmental Support manages emission allowances for all Entergy entities, including EML, and co-owners. The group's Environmental Analyst tracks emission data and allowances for each facility, and provides monthly allowance purchase quantities. One person performs this function.

4. Job Responsibilities and Accountabilities

Entergy's position descriptions list the following for each position:

- Job Summary/Purpose
- Job Duties/Responsibilities
- Other Attributes.

The Other Attributes section lists qualities that the incumbent should possess, including

- Functional Knowledge
- Business Expertise
- Leadership
- Problem Solving
- Impact
- Interpersonal Skills.

The Duties/Responsibilities section contains succinct statements of key responsibilities. Each description contains a legend describing it as providing a general overview, rather than a complete list of responsibilities, job functions, and duties. The descriptions also state that duties and functions may change over time. The report of the most recent fuel audit of EML observed that:

> *... job duties and required qualifications summarized in job description documents, while adequately presented, were sometimes not very specific and, in LEI's opinion, sometimes lacking in details.*

The report recommended as follows:

> *Entergy should ensure the standardization of job description documents with respect to minimum employee qualification parameters, including specific requirements for education, experience, knowledge, tool expertise, etc., to ensure that qualified personnel are selected, especially for senior and managerial positions.*

We recommended improvements to job descriptions in our 2010 audit of EML. Our report for the following year found improvements. We believe that communication of job requirements takes a combination of effective position descriptions and effective one-to-one performance planning and review between employees and their supervisors. We found Entergy's formal Performance Planning and Review process and documentation an effective complement to the enhanced job descriptions following our 2010 audit.

We share the prior auditor's emphasis on the need for clear and reasonably complete descriptions of position responsibilities and accountabilities. We therefore examined the performance measurement process to determine how clearly and completely, taken in conjunction with position descriptions, they serve to provide such clarity and completeness. Our review of current job descriptions did not disclose the qualifications information recommended by the last audit. Identification of minimum and expected requirements for education, experience, knowledge, and familiarity with tools and systems forms a fairly standard part of position descriptions.

We also continue to believe that the combination of the two processes, summary job descriptions with more-detailed performance reviews, serves the purpose of setting position expectations adequately. Employees participate in Entergy's Performance Management process which includes a minimum of three formal meetings between employees and their supervisors:

- The first to create the coming year's goals
- A second to check and adjust in the middle of the year
- A final meeting to close out the performance at the end of the year.

Supervisors and employees may check and adjust goals at shorter intervals within the year as needed. At the final meeting, the employee is given an overall rating for the year's performance.

The Performance Management process focuses on performance on goals and behaviors related to practices or competencies. The process also includes individual development and career planning. Employees review their practice or competency ratings to identify their strengths and weaknesses. This self-assessment and formal review process with their supervisor feeds into the individual development plan.

A final performance rating is based on the accomplishment of performance goals and proficiency in exhibiting the employee practices or competencies. The rating scale has six levels:

- Exceptional
- Exceeds Expectations
- Meets Expectations
- Meets Some Expectations
- Improvement Required
- New In Position.

This scale enhances the three-rating approach that existed the last time that we reviewed the system.

We also found previously that Entergy uses an Operations Bench Scan (OBS) process to serve as a succession planning tool. Management reports that the OBS process was replaced in 2014 with a new, enterprise-wide tool for performance management, development and succession planning named *SuccessFactors*. The new processes include formal guidance and expectations, supported by an enterprise software platform, that drives employees and managers to focus on aligning performance to corporate goals, meaningful professional development and career planning, and formal succession planning for certain roles.

5. Training

Personnel involved in the procurement and management of fuel and purchased power participate in various types of training, including the following:

- Cyber Security Training
- FERC Affiliate Rules Training
- FERC Market Behavior Rules Training
- FERC Code of Conduct Training
- FERC Gas Rules Compliance Training
- FERC No-Conduit Affiliate Rules Training
- Arkansas Affiliate Transaction Rules
- Entergy Information Security
- Utility Risk Manual
- Corporate Risk Controls Standards
- 2018 Application of the Affiliate Rules
- 2018 MISO Market Rules
- NERC Operator Training and Certification.

All EMO staff members undergo the training listed above, except for FERC Gas Rules Compliance Training and NERC Operator Training and Certification. Personnel who perform fuel transactions undergo FERC Gas Rules Compliance Training. NERC Operator Training and Certification is required for personnel who are required to maintain that certification.

New employees receive training tailored to their individual positions, and ongoing, annual training related to their specific functions. Recurring refreshers addressing ethical behavior include reports listing all personnel who have completed them. Ethics training includes programs related to the Company Code of Conduct, and Gas Supply Behavior Rules. Non-bargaining-unit employees must acknowledge the Code of Entegrity annually. All employees must complete General Ethics training every two years.

Entergy updates the necessary programs as necessary to stay current with changing market rules. Ethics and Compliance courses undergo annual review by assigned subject matter experts. The SPO organization maintains a tracking system that is effective in identifying who has participated in the required training and when such training occurred.

The performance management process includes a fairly typical personal development and career planning component. It permits identification of short-term opportunities, which support skills enhancement for current positions and identification of ways to build a foundation for long-term advancement, thus supporting succession planning efforts as well. As with the other elements of the program, mid- and end-year meetings with supervisors permit measurement and adjustment.

6. Procedures

Since entering MISO, Entergy no longer participates in bilateral power purchases. All power-purchases come through MISO participation, with MISO making ultimate decisions about which units get dispatched. Accordingly, MISO's procedures underlie dispatch and purchases. Entergy has long used Desk Manuals for each generating plant to record its procedures for fuel purchasing, revising them to fit the new operating environment as part of the Company's entry into MISO.

The Desk Manuals have historically been detailed. For the natural gas-fired plants that now comprise the predominant portion of EML's resources, each manual contains the pertinent plant operating characteristics, such as generating capacity, maximum and minimum fuel requirements, and details of gas-delivery arrangements. The Desk Manuals specify the necessary steps in gas procurement.

Each Manual describes required purchase-verification and record-keeping steps. Each Manual also specifies the Gas Buyer's role in ensuring that bought gas is delivered through correct pipeline nominations. Each Manual also has lists of key contacts at typical suppliers and delivering pipelines.

Similarly-detailed Desk Manuals for the coal plants were developed after our 2010 Audit. They were to be completed soon after the conclusion of our 2011 Audit. Management no longer uses the desk manuals for the coal plants, but procures coal pursuant to the EAL fuel procurement

strategy, which relies primarily on annual RFP processes. The next chapter of this report describes that strategy. The chapter following that describes established procedures for handling coal delivered to the plants.

The Company advises that, while all of the Desk Manuals were revised with the entry into MISO, they are now updated individually as any aspect of fuel supply to each plant changes. New contact information for any new supplier, for example, would be added to the Manual for the plant (or plants) to be supplied as that supplier was authorized to do business with Entergy.

7. Controls

Two over-arching policies guide performance of Entergy's regulated business activities:

- Entergy System Approval Authority Policy (ESAAP), approved by the Board of Directors with notification to the Entergy Corporate Compliance Committee: sets approval and execution authority requirements and levels for committing the enterprises.
- Corporate Risk Control Standards, approved by the Entergy Corporate Compliance Committee: these standards provide general parameters for managing market, credit, liquidity and transactional risk for utility business activities. They serve as the overall Risk Manual for Entergy.

ESAAP: The matrix-based ESAAP lists by position individual levels of authority for specific contracting decisions. It lists the applicable transactions, including expense transactions, capital funding transactions, procurement and sales contracts, fuel and revenue contracts, financial transactions, and regulatory ratemaking transactions. The ESAAP also covers "Payment Events" resulting from such transactions. This policy document contains extensive detail, and includes an Appendix that lists each position and the dollar authority limit for that position for each of the above categories of transactions, as appropriate.[1] The ESAAP undergoes regular updating.

Corporate Risk Control Standards – Regulated: These standards ensure that commitments made by SPO and the operating companies align with parent and business-unit risk strategy. The Corporate Risk Committee – Regulated reviews each fuel or revenue contract with a Risk Transaction Value over set thresholds, or that substantially alters Entergy or the business unit's market or credit-risk exposure. The Office of Corporate Risk Oversight reviews all binding market pricing and credit terms in the contract. Then the Corporate Risk Committee-Regulated must approve before a contractual commitment becomes final. After that approval, SPO or the operating companies are responsible for ensuring:

- That all appropriate systems, including deal capture, risk management, accounting, billing and customer systems are populated
- Completion of all required documentation, and submittal of contracts to business unit Contract Administration and Corporate Accounting for compliance and records
- That all required collateral support is obtained or provided
- That executed transactions do not materially differ from terms presented to the Corporate Risk Committee - Regulated.

[1] Not every position considers every type of contract.

The *Entergy Utility Risk Controls Manual* contains more-detailed prescriptions for managing risk. The Corporate Risk group developed and maintains this manual to guide wholesale commodity procurement and hedging activities for Entergy's utility business operations. Its purpose is to formalize the methods for effectively managing, monitoring and evaluating the various risks associated with the regulated businesses' wholesale commodity business activities. This Manual supplements the two over-arching policies described above. It presents:

- Risk-management objectives as they apply to the wholesale commodity procurement and hedging activities for Entergy's regulated business units
- Authorized strategies for wholesale commodity procurement and hedging, and
- The roles and responsibilities of the front, middle and back office functions.

This Manual is also updated at least annually, and more often as necessary.

Additional relevant Entergy policies include:

- Corporate Risk Standards Policy
- Discipline Policy
- Reporting Violations Policy
- Antitrust, which includes a section on Anti-Market Manipulation.

8. Compliance

Entergy has for an extended period operated under what it refers to as its "culture of compliance," which includes established policies, procedures and plans applicable to all levels of the SPO organization. Administration of this framework has long been the subject of various internal controls, including a software application and applicable attachments that contains automated processes, tests and controls that must be completed by specific individuals. The attachments are mostly manually-performed internal controls.

Last year's auditor reported that the Company replaced its former Enterprise Compliance and Risk Tool (ECART) with RSA's Archer eGRC module. The new system provides enhanced functionality to manage additional risk and compliance programs across the organization.

9. Auditing

Entergy's Internal Audit Services (IAS) assesses, and makes recommendations to improve, governance processes for the following:

- Making strategic and operational decisions
- Overseeing risk management and controls
- Promoting appropriate ethics and values within the organization
- Ensuring effective organizational performance management and accountability
- Communicating risk and control information to appropriate areas of the organization
- Coordinating the activities of, and communicating information among, the Audit Committee, external and internal auditors, other assurance providers, and management.

IAS also evaluates Entergy's ethics-related processes, as well as assessing whether the information technology governance supports Entergy's strategies and objectives. IAS reports to the Vice

President and General Auditor, who reports functionally to the Audit Committee of the Board of Directors. The Audit Committee approves each year's internal audit plan.

IAS performed four audits related to fuel or power procurement and management, emission allowances, accounting for fuel adjustment clause-includable costs, portfolio optimization, energy sales, and any other fuel-adjustment-clause-related subject matter during the current and previous Audit Periods:

1. Grand Gulf Spent Fuel Storage Damage Claims Cost Audit (2018)
2. Report on Management's Assessment of Internal Control Over Financial Reporting as of December 31, 2017 (February 2018)
3. Report on Management's Assessment of Internal Control Over Financial Reporting as of December 31, 2018 (February 2019)
4. Gas Procurement Audit (2019).

The Grand Gulf Spent Fuel Storage Damage Claims Cost Audit was performed under attorney-client privilege; consequently, Liberty was not provided with a copy of the report. We were provided with copies of the others.

The assessments of internal control address Sarbanes-Oxley Act of 2002 (SOX) Section 404 requirements that management of public companies provide its assessment of those controls in each year's Securities and Exchange Commission (SEC) Form 10-K. The Act, applicable SEC rules and related guidance, and applicable Public Company Accounting Oversight Board (PCOAB) Auditing Standards guide the design and conduct of these assessments. Ahead of the 2017 review, Entergy's Internal Audit Services and functional business personnel identified Entergy's core financial functions, related financial reporting risks and control activities designed to manage or mitigate risks. The results of the review serve as the basis for Management's assessment.

Each of Entergy's operating companies is a Registrant under the terms of the applicable regulations. Thus, the managements of each has responsibility for establishing and maintaining adequate internal controls over financial reporting. Each operating company therefore operates under internal control systems intended to provide reasonable assurance regarding the preparation and fair presentation of their financial statements. Entergy's IAS works with individual-entity personnel to test key controls to determine whether they were sufficient, reliable and functioning as intended by Management.

A three-category structure rates deficiencies identified through these SOX-driven management assessments, with the most serious, Material Weaknesses, requiring 10-K or interim 10-Q reporting:

- Control Deficiency
- Significant Deficiency
- Material Weakness.

The 2017 review found no Material Weaknesses or Significant Deficiencies as of December 31, 2017, but did disclose 10 Control Deficiencies. One Significant Deficiency was identified during

the fourth quarter of 2017, but was remediated by the end of the year. IAS worked with Company personnel to address the Control Deficiencies. None of the identified Control Deficiencies involved fuel supply or energy transactions.

In 2018, IAS performed "roll-forward" inquiries to test the design and operating effectiveness of a sample of (182 of 687) SOX controls. The results showed 179 effective. IAS worked with Management on the remaining three to improve their effectiveness. Again, none of the three ineffective controls involved the fuel-supply or energy-transaction functions.

The 2018 review found no Material Weaknesses or Significant Deficiencies as of December 31, 2018, but did disclose 22 Control Deficiencies. As with the 2017 review, IAS worked with Company personnel to address them. None of the identified Control Deficiencies involved fuel supply or energy transactions.

IAS performed a Gas Procurement Audit that began in late 2018, and led to a report in June 2019. IAS's examination produced an overall assessment that performance "Needs Improvement" in the areas reviewed. More specifically, the report identified:

- A medium-priority finding of inadequate oversight of the gas procurement process
- A medium-priority finding regarding manual records of potential deals
- A low-priority finding of insufficient definition in strategy documents
- A low-priority finding of outdated process and procedures documentation.

The inadequate-oversight concern arose because no one outside of the day-to-day gas-purchasing process reviews whether the buyers are complying with the established gas-purchasing strategy and internal controls. The manual-documentation concern was because rejected offers were poorly documented. The strategy-documents concern was that those documents were general in nature and did not include detailed guidelines or requirements surrounding gas-purchase transactions. The concern about outdated process and procedures documentation was that the current documentation did not always reflect current practices.

SPO and IAS initiated remedial work as soon as the report was completed. We present a more complete discussion of the audit's findings and the associated remedial work in the *Fuel Oil and Natural Gas Procurement* chapter of this report. For purposes of this section, we found the audit an important measure of attention by IAS to fuel and energy matters in its planning and execution of audit work during our Audit Period.

C. Conclusions

1. The structure and alignment of roles and responsibilities for fuels and power purchasing is comprehensive and effective.

The division of roles among organizational units is appropriate. Coordination among roles is effective, responsibilities are clear. Roles and responsibilities responded substantially and effectively to address operation within MISO. There has been some organizational fine-tuning since then, but the principal features of the organization were settled at the time of MISO entry.

2. Fuel and energy procurement and management organizations are staffed with sufficient numbers of well-qualified personnel, who operate under clear and appropriately designed responsibilities and accountabilities.

The qualifications and experience of SPO staff are commensurate with their responsibilities. The Company provides ample opportunity for additional training, and tracks completion of required training. Performance management is consistent with prevailing industry practices. Working with position descriptions and functional statements, employees get clear guidance regarding what is expected of them.

3. Position descriptions and the performance management process make job responsibilities clear, but those descriptions continue to lack statements of minimum qualifications. *(See Recommendation #1)*

One can develop a reasonably clear understanding of roles, responsibilities, and accountabilities from a review of these documents. However, as the prior fuel audit observed, position descriptions continue to lack guidance with respect to minimum expected qualifications. While it will not always be possible, or even desirable in limited circumstances, to find candidates who meet all such qualifications, defining them remains an accepted and useful element of position descriptions.

4. Written procedures governing gas-supply operations are comprehensive and sufficient.

The written procedures for gas purchasing and management are in the form of Desk Manuals for buying and delivering fuel to each of the gas-fired generating plants. We found them to be complete and helpful to anyone trying to understand the process of providing gas supply to that station.

5. Goals and strategies are clear and appropriate.

The Company's goals for fuel-supply operations, and its strategies for attaining those goals, were extensively revised for its entry into MISO. Personnel have a clear sense of what defines success in that environment, and can function comfortably in it.

6. Management's attention to controls applicable to fuel and energy procurement and management are strong and diligently applied.

Entergy's fuel-supply operations involve large numbers of transactions and enormous amounts of money. The scope of fuel supply involves considerable potential for mistakes. Entergy's controls environment is commensurate with its risks, and controls are well administered. The Company has clearly invested considerable effort in developing adequate control systems, and in administering them. Controls are presented clearly in various policy documents, which are readily accessible to anyone who inquires. Controls are not unduly burdensome.

7. Internal auditing planning and execution gave due attention to fuel and energy procurement during the Audit Period.

The Gas Procurement examination completed in 2019 shows attention to risks inherent in fuel and energy procurement. It also shows attention to operational improvement, a focus on which we consider a strength.

D. Recommendations

1. Include statements of minimum expected qualifications in the position descriptions for fuel and energy procurement and management personnel. *(See Conclusion #3)*

We find such statements essentially universal. They were recommended by the prior auditor.

III. Coal Procurement

A. Background

Entergy's utility companies operate three coal stations, two in Arkansas and one in Louisiana. Entergy Arkansas, LLC (EAL) operates the two in Arkansas, the two-unit 1,678 MW Independence station near Newport and the two-unit 1,636 MW White Bluff station near Pine Bluff. EML owns 25 percent of Independence. The table below provides background information about the units at Independence and White Bluff. Entergy Louisiana LLC (ELL) operates the 615 MW Nelson power plant located at Westlake, LA. Management sources all coal for Independence, White Bluff, and Nelson from Wyoming's Powder River Basin (PRB). The Nelson power plant also takes coal solely from the PRB, but under contracts, agreements, and arrangements separately executed and managed.

Independence and White Bluff Summary
(table is confidential)

Measure	Independence	White Bluff
Capacity		
Units		
Operator		
Annual Burn		
Trains		
Sulfur Limit		
Ownership		

Entergy Services, LLC (ESL) provides fuel and transportation procurement and management functions for the coal-fired plants, under the organization and resources described in Chapter II of this report. The same coal-supply and Union Pacific rail-transportation agreements serve both Independence and White Bluff. A November 2018 settlement calls for White Bluff and Independence, the nation's largest coal units operating without scrubbers, to be retired by 2030. While not imminent, that retirement schedule calls for planning for the units' last phase to begin, including coal contracting and receipt, and management of the railcar fleet that delivers it.

Independence and White Bluff receive coal in common from a number of PRB mines, controlled by three of the country's leading mining operating companies (Cloud Peak, Arch, and Peabody, the latter operating through Coal Sales, LLC, a marketing arm). A fourth supplier, Blackjewel, delivers to White Bluff, but not to Independence.

B. Findings

1. Procurement Strategy Evolution

Our 2010 and 2011 examinations of coal supply at Independence came close to the outset of a fundamental change in direction in supply strategy. Custom had long been to supply Independence predominantly under a single, long-term contract with Peabody Coal Company. With that contract ending in 2011, management began in 2008 to expand its contacts and relationships with other PRB suppliers and coal mines. That expansion has since brought significantly increased supplier and quality diversity, which this Audit Period's contracting extended.

As the end of that Peabody contract approached, management developed a portfolio strategy targeting in-place agreements (placed by the end of each calendar year) for up to [redacted] of the next year's forecast burn, up to [redacted] of the following year's forecast burn, and up to [redacted] of the third year's forecast. Contract durations of between one and five years were set as term guidelines. The balance of requirements would be procured with short-term transactions, with durations of less than one year.

By 2014, the procurement targets had declined to:

[redacted]

Also, the requested contract terms had been shortened to up to three years, rather than up to five. RFPs were reduced to one per year, now occurring in September. Those same targets are in effect today. Management has, however, made a major effort to secure delivery-volume flexibility in its coal-supply and transportation contracts. As noted in the lists of contracts in-place and awarded in late 2018, that flexibility has three components:

- "Pull forward" some proportion of quantities under contract for a future year into a current year
- Deviate within specified proportions from equal monthly quantities for purchases in a single year
- Postpone a proportion of contracted deliveries into a subsequent year, sometimes at the current year's price, and sometimes at the subsequent year's price.

The proportions of the contracted annual quantities subject to these flexibility provisions increased marginally in the 2018 contracts awarded, as compared with those they replaced.

2. Portfolio Components

Entergy pursues a common coal-supply strategy for Independence and White Bluff. Its central element consists of placing fixed percentages of the expected needs of the two stations combined under firm contracts by the start of each year, as follows:

[redacted]

Other elements of the strategy include:

- Maintain an average annual inventory target of [redacted] of supply (described in the next chapter of this report)
- Secure purchases generally under a [redacted]
- [redacted]

Execution of this strategy permits the use of test burns designed to ensure the availability of alternate supplies (*e.g.*, lignite, Columbian, and Indonesian sources) in the event of PRB supply disruptions. This strategy conceptually also leaves room for material levels of short-term purchases (*e.g.*, one-month "spot" purchases) if necessary to meet requirements. Actual rates of coal burn at the Independence and White Bluff units have fallen substantially since we last examined Entergy coal procurement in 2011. The primary reason is the precipitous drop in natural gas prices that had begun shortly before that year, but was to continue. Independence, like other coal-fired units, must compete with very low-priced gas-fired units that form a considerable portion of the generation portfolio in MISO. Even with reductions in Independence dispatch costs over time, such competition has continued to increase the portions of the year that gas units "win" this competition.

The current Audit Period conforms to this pattern, with Independence having burned coal in amounts similar to the several years before the last audit period (October 2017 through September 2018), but the prior one did not. As the 2018 report made clear, its 12 months provided a strong exception. Burn rates jumped considerably and management responded with increased purchases of coal, including from the spot market. The last delivery of spot coal occurred at the very end of that Audit Period, as purchases under firm contracts since then have produced not the targeted [redacted] of burns but somewhat more than 100 percent.

Independence Units 1 and 2 both underwent outages in this Audit Period. Scheduled for [redacted] each, the Unit 1 outage ran about [redacted] days longer, and the second 10 days longer than scheduled, contributing to, but not entirely explaining reduced burns. Fossil Fuel Supply's monthly report for August 2019 states that, "June-August burns were below forecasted and historical averages due to low gas prices."

Other elements of the Solid Fuel Supply Strategy include a Long-Term Transportation Plan, and Railcar Fleet Capacity Requirements. The Transportation Plan focuses on securing appropriate amounts of coal from each mine, scheduling train movements, and working with the railroads to ensure adequate capacity is available.

3. *Rail Transportation*

EAL owns just over [redacted] of the fleet of about [redacted] railcars that deliver coal to Independence and White Bluff. Technically, these railcars were leased until a year or so ago, but in the form of a "synthetic" lease. Such leases are typically with related third parties, created for financial purposes. These railcars reverted to direct Entergy ownership when management determined it to be financially beneficial to do so.

The remainder are leased. For the [redacted] of "outside" leased railcars, management issues requests for proposals every two to three years, as needed. The last RFP was conducted at the end of 2017. It resulted in two leases, covering [redacted] railcars for a year. Since then, those leases have been extended.

Entergy places the railcars into fleets of about [redacted]. Of these, EAL generally keeps [redacted] trainsets in active service, plus one rotating through maintenance. The remaining railcars fill a pool of spares or are out of service pending damage repairs.

4. Coal Consumption

When we last performed the annual fuel audit for EML (in 2011), the Independence Station was consuming over 6,500,000 tons of coal annually. In recent years, consumption has been less, although 2018 usage increased from the previous two years. The following table shows receipts and consumption in the most recent three calendar years.

Independence Station Coal Receipts and Consumption
(table is confidential)

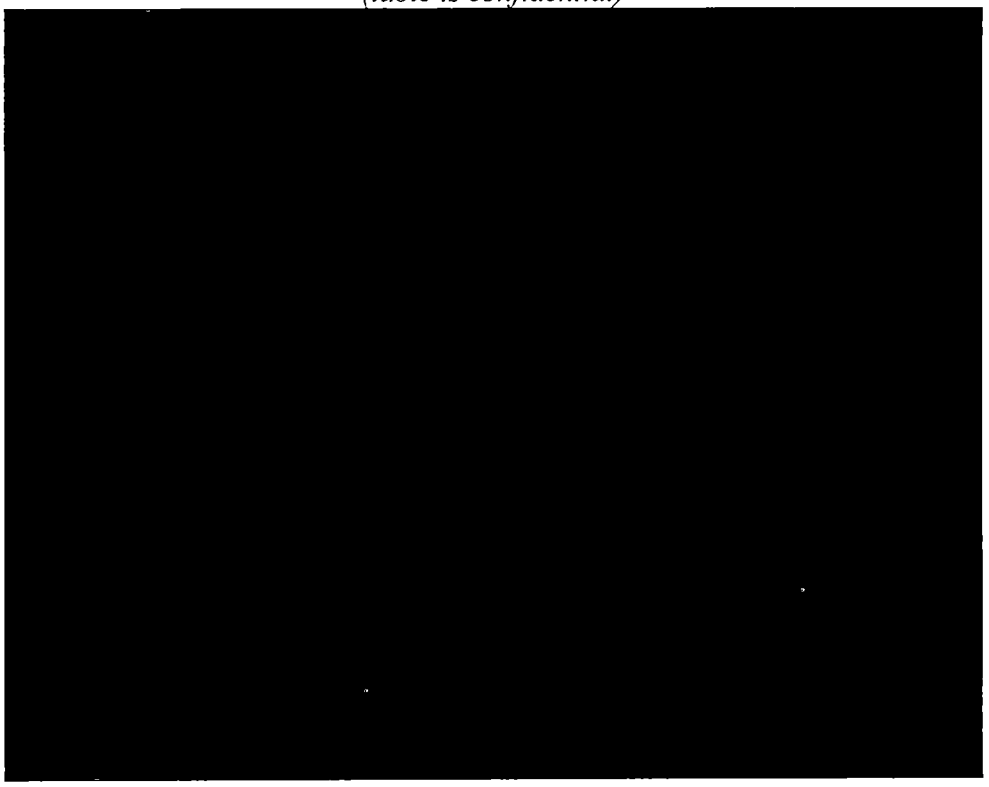
	2016	2017	2018	2019*
Receipts (tons)	[redacted]	[redacted]	[redacted]	[redacted]
Consumed (tons)				
Inventory Change (tons)				

*First nine months

Consumption was only [redacted] tons in the Audit Period, down [redacted] percent versus the previous 12 months, but both units had planned outages during that period. Receipts continued at a more-normal pace. There were no spot deliveries during the Audit Period until the last days, with only a single delivery through the end of September.

The next table summarizes Audit Period deliveries by contract (PO#). The chart separates deliveries in the manner recorded by management, generally because the contracts, particularly multi-year ones, have differing price provisions.

Audit Period Independence Coal Deliveries by Contract
(table is confidential)



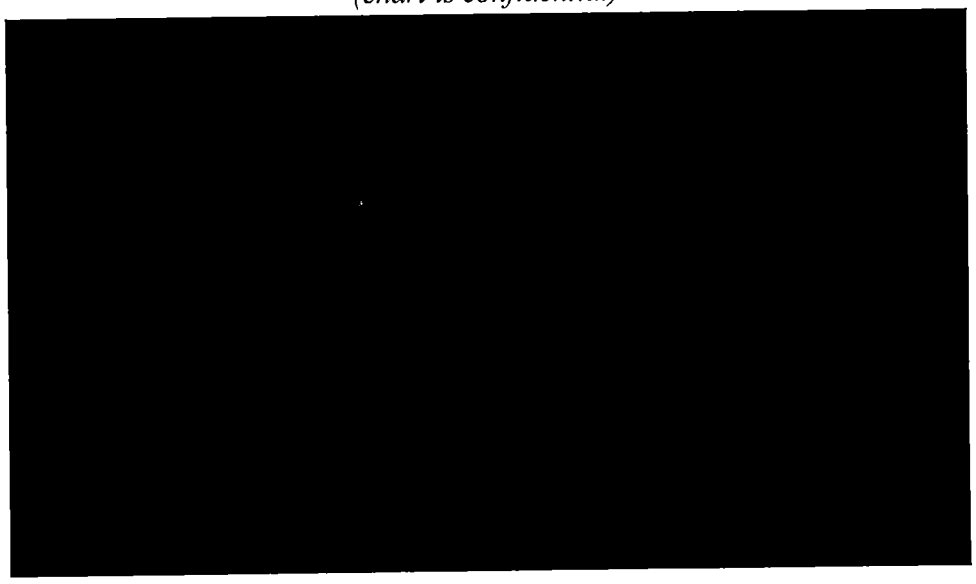
Mine Source:
[1]Black Thunder, [2]Antelope, [3]Cordero, [4]North Antelope, [5]Black Thunder South

5. *Forecast Consumption versus Actual – Current Audit Period*

SPO develops semi-annual outlooks for coal burn each September, as part of its annual Business Plan process. These forecasts are updated in March. SPO also develops month-ahead coal-burn forecasts as part of the Monthly Energy Plan (MEP). The MEP forecasts have been a cause for concern for the last several audit periods, as they have turned out to be considerably above actual consumption.

Liberty reviewed information provided by management on MEP forecast versus actual consumption of coal in the two units at Independence for the current Audit Period. This information is presented below in the same format as in the previous audit, to facilitate comparison. The figure shows that over-forecasting continued through the first seven months of the current Audit Period, but got closer to actuals in the last five months, especially when averaged over those months.

Independence Forecast Versus Actual Coal Consumption (in tons)
(chart is confidential)



The largest differences between forecast and actual occurred in [redacted]. Both generating units at Independence underwent maintenance outages in those months. Maintenance outages are considered in preparing the forecasts, but both outages lasted longer than planned: [redacted] actual versus [redacted] planned in the case of Unit 1, and [redacted] actual versus [redacted] planned for Unit 2.

Planned versus actual coal consumption formed the subject of a recommendation in the 2017 Audit. In September 2018, the Commission required EML to submit a plan of action to address this question (and others). In response, management reported that it was working with a software vendor to improve its simulation of committing these units into MISO, and thus improve the MEP forecasts. We received the forecast-versus-actual data late in this year's audit work, but plan to inquire more deeply into this issue in our next review.

6. Coal Market Conditions

Coal production is in a long-term structural decline, due to:

- Competition with natural gas
- Cost declines in the renewable energy industry
- The aging of the coal-fired power-generation fleet
- Growing utility sector interest in phasing out coal
- Rising corporate interest in greener energy resources and sustainable development; and
- Growing concern about climate risk and carbon dioxide emissions.

U. S. coal production peaked in 2008 at 1,172 million tons, but it has since declined to 754 million tons in 2018, a decline of almost 36 percent. Further declines are expected in 2019. Western coal production, the region where ESL sources coal for its coal-fired generating plants, has also declined about 35 percent, from 634 million tons in 2008 to just over 400 million tons in 2018.

The Powder River Basin, where ESL sources its coal, has considerable excess production capacity. The U. S. Department of Energy's Energy Information Administration (EIA) reports that the utilization rate of the PRB's productive capacity has declined from 97 percent in 2008 to 68 percent in 2018. Mine-mouth prices have shown little volatility over that period. The average annual selling price for PRB coal with a heating value of 8,800 Btu/lb. was $13.31 per short ton in 2008, and had declined to $12.31 in 2018. Transportation costs to deliver PRB coal to power plants, mostly by railroad, now account for nearly two-thirds of the delivered cost of the coal.

Four companies, Peabody, Arch Coal, Cloud Peak and Blackjewel, collectively own 10 PRB mines, and those mines produced 87 percent of PRB coal in 2018. Peabody and Arch filed for bankruptcy in 2016; Cloud Peak and Blackjewel did the same in 2019. As noted below, those four are suppliers to EAL for White Bluff; Independence is supplied by all but Blackjewel. To this point, deliveries have not been impacted.

7. Coal Supply Sources and Costs

a. Current Contracts

The following tables list the current coal supply contracts for Independence, with their key characteristics:

Coal Supply Contracts for Independence and White Bluff
(table is confidential)

Supplier	Term	Base Price			Annual Quantity (tons)		
		2018	2019	2020	2018	2019	2020
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Total Tonnage							
Implied Expected Burns at [redacted], [redacted], and [redacted] of Forecast Requirements							

Peabody sales through marketing arm, Coal Sales LLC

The following table presents some additional characteristics for those contracts:

Independence and White Bluff Coal Contract Details
(table is confidential)

Supplier	Tonnage Flexibility	Btu/lb.	SO_2 lb./ MMBtu	Ash %	Moisture %	Na_2O_3 lb./ MMBtu
[redacted]						

Tonnage flexibility has taken on increased importance in an environment of decreasing coal use. It can enable a buyer to: (a) "pull forward" some proportion of quantities under contract for a future year into a current year, (b) deviate within specified proportions from equal monthly quantities for purchases in a single year, or (c) postpone a proportion of contracted deliveries into a subsequent year, sometimes at the current year's price, and sometimes at the subsequent year's price. The proportions subject to the flexibility term, which of the three potential delivery-schedule adjustments will be allowed, and which price will apply to the schedule-adjusted quantities, are subject to negotiation in reaching a final contract.

The other contract characteristics shown in the chart address coal quality. Suppliers submit lab test results for each of these characteristics as part of their contract offers, and the standards are incorporated into each signed contract. The contracts generally provide that, if a coal shipment does not meet the standards, it can be returned to the Seller at the Seller's expense.

Management reported that [redacted] deliveries failed to meet requirements (although many called for price adjustments, both positive and negative) and [redacted] supplier claimed *force majeure* to excuse any missed shipments. Suppliers [redacted] filed for bankruptcy in [redacted]. Both of those suppliers have continued deliveries to EAL. Data from the U. S. Department of Energy's Energy Information Administration (EIA) indicates that shipments from mines that supply EAL (Arch, Black Thunder; Peabody, North Antelope Rochelle Mine) have not been noticeably impacted. Supplier [redacted] filed for bankruptcy [redacted]. EAL receives supplies from [redacted] mines. To date, shipments from that mine have continued.

On June 19, 2019, Arch and Peabody announced a joint venture of their western operations. This proposal will likely face regulatory scrutiny, as the combined Black Thunder and NARM operations would control 85 percent of the 8,800 MMBtu supply from the PRB.

b. Coal Supply Competitions in 2018

By the end of the third quarter of 2018, coal inventories were near their target levels [redacted] measured on a rolling 12-month average. In view of the anticipated end-of-year inventory and the 2019 Coal Burn Forecast, covering 2019, 2020 and 2021, the Company issued a request for proposals (RFP) for additional supply for those three years.

Acting on behalf of EAL, ESL issued the RFP. It established the following parameters:

- Supply from one to three years
- Up to 3,000,000 tons for each of the three years
- Deliveries commencing in January 2019
- Encouraging offers giving EAL options to:
  - Schedule monthly deliveries non-ratably
  - Carry up to 30 percent of annual quantity into the following year
  - Increase volumes
- Pricing and title transfer at the mine.

The RFP included all the non-price considerations listed in the above table of existing contracts, but increased emphasis on SO_2 content in 2021. The Company anticipated that Arkansas's State Implementation Plan for the Regional Haze rule under the federal Clean Air Act would become effective in 2022. It also anticipated that its compliance plan would involve use of lower-sulfur coal, and that compliance with the rule would be required within three years. Thus, it requested bids with a more-stringent SO_2 requirement for 2021.

The RFP sought supply at two different heat-content levels, 8,400 and 8,800 Btu per pound (Btu/lb). It set rejection limits at <8,200Btu/lb. for the 8,400 coal and <8,600 for the 8,800 coal. The RFP set common SO_2, Sodium Oxide, and Ash rejection limits. The RFP noted current SO_2 emissions limits of 0.93 pounds of SO_2 per MMBtu for Independence and 1.20 pounds for White Bluff. Anticipating a change to 0.60 pounds for both stations, the RFP identified an intent to transition to deliveries with the anticipated lower limits during the 2019-2021 contract period. The RFP therefore solicited supply with sulfur levels at or below the current and anticipated limits. The RFP set the same Sodium Oxide (≥2.5 percent) and Ash (≥6.5 percent) rejection limits, measured as a percentage of weight at receipt, for base and transition supply and for both 8,400 and 8,800 Btu/lb supplies. The RFP provided typical levels of detail and specificity, procedures for evaluating bids and communicating with offerors, and information needed for potential offerors to respond timely and fully.

ESL generally issues a three-year solicitation at about the same time each year. The 2018 RFP went to largely the same group of large Powder River Basin producers as the 2017 one. The next table compares the lists to whom ESL sent the 2017 and 2018 RFPs.

2017 and 2018 Coal RFP Recipients
(table is confidential)

2017 RFP	2018 RFP
[redacted]	[redacted]

[redacted]

The Company issued the RFP on September 17, 2018, setting September 27 for submission. The base evaluation of the responses concluded on October 10. Credit Risk completed its review in mid-October, and the Utility Risk Committee completed its review later in that month.

The Company received [redacted] proposals, from [redacted].

The proposals all met the quality specifications, so SPO staff compared them on the following characteristics:

[redacted]

For Credit Risk Committee and management presentations, cost comparisons were presented on a delivered-cost basis. Components of that cost included not only the coal price at the mine, but transportation costs, including rail costs and the costs of leasing and maintaining the rail cars, coal handling costs at the destination, cost of SO2 allowances, etc.

We reviewed SPO's evaluation, and found that the best offers were selected. We found that the Base Prices in the selected offers were similar to, or marginally lower than, the Base Prices of the existing contracts. Volume flexibility is at least as good as, if not better than, the in-place contracts.

We found documentation of the procurement process reasonably complete. We were able to review all of the offers, SPO's evaluation of the offers, SPO's presentation to EAL's Resource Planning Operating (management) Committee, and signed confirmations for the selected offers. The Company did not provide the Credit Risk analysis.

The one spot transaction delivery at the very end of the current Audit Period came at a price [redacted]

8. The Role of Forecasting in Coal Procurement

As noted above, management develops coal-burn forecasts each September as part of its annual Business Plan Reports. These reports comprise a guide to the coal procurement process in establishing target amounts for purchase in order to meet the targets for the [redacted] as set by the overall strategy.

As also noted, the report of the audit of the previous audit period addressed the accuracy of these forecasts, finding coal-burn forecasts significantly different from actual burns. The report recommended a re-examination of the process that creates these forecasts. Management reported to the Commission that it was working with the software vendor to improve forecasting results. The auditor expressed the same concern in its 2018 report, noting that "The 2016 Business Plan Report [redacted] the coal consumption for the 2017/2018 audit period [redacted], while the 2017 Report underestimated it by [redacted]."

The RFP process for coal supply illustrates the use of Business Plan forecasts deciding how much coal to buy. The Fossil Fuel Supply team uses the forecasts in preparing its RFP. Following offer receipt and evaluation, the team presents the results to EAL's Resource Planning Operating Committee (RPOC). That presentation starts with beginning inventory, adds previously-contracted coal for each year of the forecast, then subtracts estimated burn in each forecast year. The balance, adjusted by the proportions in the Coal Procurement Strategy ([redacted]), yields the amount recommended for purchase for each forecast year.

We reviewed the analysis prepared as part of the 2017 and 2018 RFP processes. The following table shows the Business Plan forecasts used for the 2017 and 2018 RPOC presentations. Note that between forecast BP 2018, prepared in September 2017, and forecast BP 2019, prepared in September 2018, the forecasts for 2019 were revised [redacted]; the forecasts for 2020 were revised [redacted]. The table shows amounts in tons.

Coal Burn Forecasts
(table is confidential)

Delivery Year	BP18	BP19
2018	[redacted]	
2019		
2020		
2021		

9. Cost Competitiveness of Independence Supply

a. Independence versus White Bluff

With coal procurement managed in common for Independence and White Bluff, deliveries to both locations came under the same contracts. Each contract has unique prices, making it important to ensure that shipments of lower- or higher-priced coal do not favor one of the locations. Data collected by EIA allows contract-by-contract comparisons between the two plants.

The table below shows shipments under each contract over the first eleven months of the Audit Period. We found shipments reasonably balanced between the two locations, each of whose units have different utilization and therefore different inventory maintenance needs. The exception was shipments from Blackjewel's Belle Ayre mine, whose lower-sulfur coal went only to White Bluff. Before considering that exception, the shipments to White Bluff for the eleven months examined were about [redacted] percent lower in delivered cost per MMBtu than those to Independence. Even after that exception, the White Bluff costs were only [redacted] percent less than those of Independence.

Independence vs. White Bluff Coal Costs (October 2018 – August 2019)
(table is confidential)

[redacted]

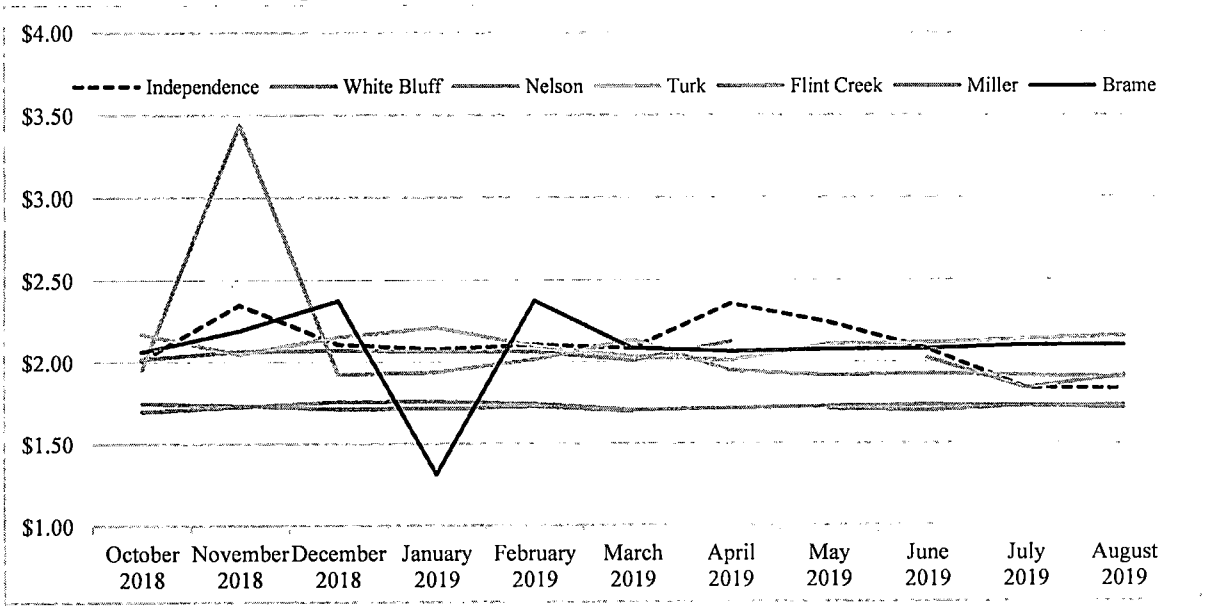
b. Comparisons with Others' Plants

The same EIA data allows comparisons between Entergy's plants and nearby PRB-supplied plants owned by others. We picked out the following plants for comparison with Entergy's:

- Flint Creek Power Plant
  - Owned by American Electric Power subsidiary Southwestern Electric Power Company (50 percent) and Arkansas Electric Cooperative Corp. (50 percent)
  - Location: Benton County, Arkansas
  - Capacity: 528 MW
- John W. Turk, Jr. Coal Plant
  - Owned by American Electric Power subsidiary Southwestern Electric Power Company (73 percent), Arkansas Electric Cooperative Corp. (12 percent). East Texas Electric Cooperative (8 percent), Oklahoma Municipal Power Authority (7 percent)
  - Location: Hempstead County, Arkansas
  - Capacity: 600 MW
- Roy S. Nelson Generating Plant
  - Owned by Entergy
  - Location: Calcasieu Parish, Louisiana
  - Capacity: 614.6 MW
- Brame Energy Center
  - Owned by Cleco, Louisiana Energy and Power Authority, Lafayette Utilities System
  - Location: Rapides Parish, Louisiana
  - Capacity: 523 MW
- James H. Miller, Jr. Electric Generating Plant
  - Owned by Southern Company subsidiary Alabama Power Company
  - Location: near Birmingham, Alabama
  - Capacity: 2,640 MW.

The chart below shows how the delivered costs of coal to those plants compares with those to Independence and White Bluff.

Comparative Prices for Delivered Coal to Independence

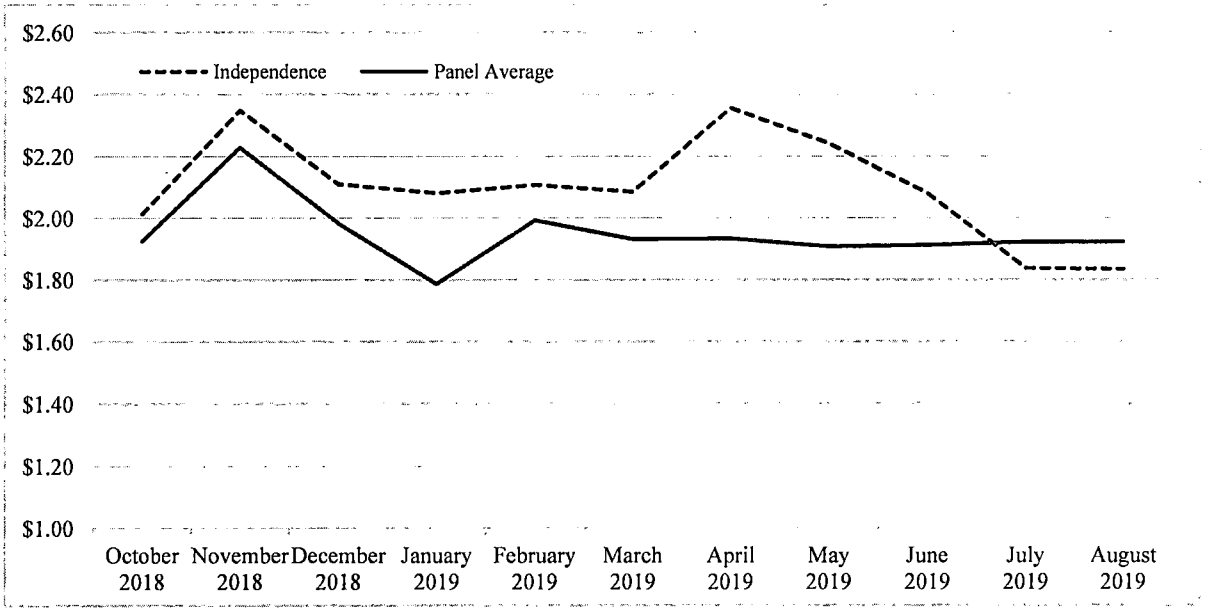


Several important points underlie those comparisons:

- Values out of the trend for each plant reflect one of two things:
  - Reduced operation due to outages
  - A one-month increase usually reflects a transportation issue.
- The variation among the trend lines for each plant is almost entirely due to differences in transportation costs. The EIA data shows that the costs of the coal at the mine is very nearly the same for all of the plants, after adjusting for heat content (MMBtu) and quality (primarily sulfur content).
- The Flint Creek plant is served by the Kansas City Southern Railway. The others are served by Union Pacific.
- The Miller plant is the only one that has access to more than one railroad. It is served by Burlington Northern as well as Union Pacific.

Delivered coal prices during the Audit Period to Independence were 7.7 percent higher than to the five non-Entergy plants shown in the preceding figure.

Independence Delivered Coal Prices vs. Panel Average



C. Conclusions

1. Actual versus forecasted Independence coal burn requires continued attention. *(See Recommendation #1)*

The prior fuel auditor found large variations between Independence coal burns and forecasts. During this Audit Period, over-forecasting continued for the first seven months, but improved in the last five.

Sound requirements forecasting remains important, but has become much more complex and uncertain. It is all the more so for the monthly horizons that formed the principal coal forecasting

concern raised in the report of the last audit. Forecasting issues also complicate longer-term forecasts, like those that did and need to underlie major procurement processes like the ones Entergy conducts each year.

Forecasts of Independence burns depend largely on the competitiveness of its expected dispatch costs compared with those of other units operating in MISO. With natural gas costs so much lower in comparison to coal, Independence operation has become less regular and less certain. Nevertheless, such forecasts are important in planning purchase levels under coming procurements and managing deliveries, using volume flex options available under current supply agreements.

Within a pattern of multi-year decline, increased consumption in 2018 showed the variability that can remain, and the accompanying supply sufficiency risks involved in contracting and contract-management decisions.

Over-forecasting creates inventory and contract-management problems. While those problems could be avoided by buying more conservatively – dropping the next-year procurement target from [redacted] of forecast requirements to [redacted], for example – the weak state of the coal-producing industry creates risk of supply cessation that could reduce volumes enough to make spot-market reliance risky from both price and availability perspectives.

2. The September 2018 solicitation produced agreements corresponding sufficiently with forecasts, used reasonably selected durations, diversified supply sources, and promoted flexibility in dealing with Independence consumption uncertainties.

Supply decisions during this Audit Period followed months of reversal of the decline in generation at Independence from historic levels. Application of the strategy in place to guide procurement decisions was therefore appropriately conservative. The [redacted] million tons of coal actually consumed at Independence in 2018 is reasonably close to a half share of the [redacted] million tons forecasted for it and White Bluff combined. Actual Independence Audit Period burns of [redacted] million tons did fall below a half share of the [redacted] million tons forecasted in BP19 for 2019. Adjusting for the two Independence outages extending beyond schedule during the Audit Period would narrow the gap somewhat.

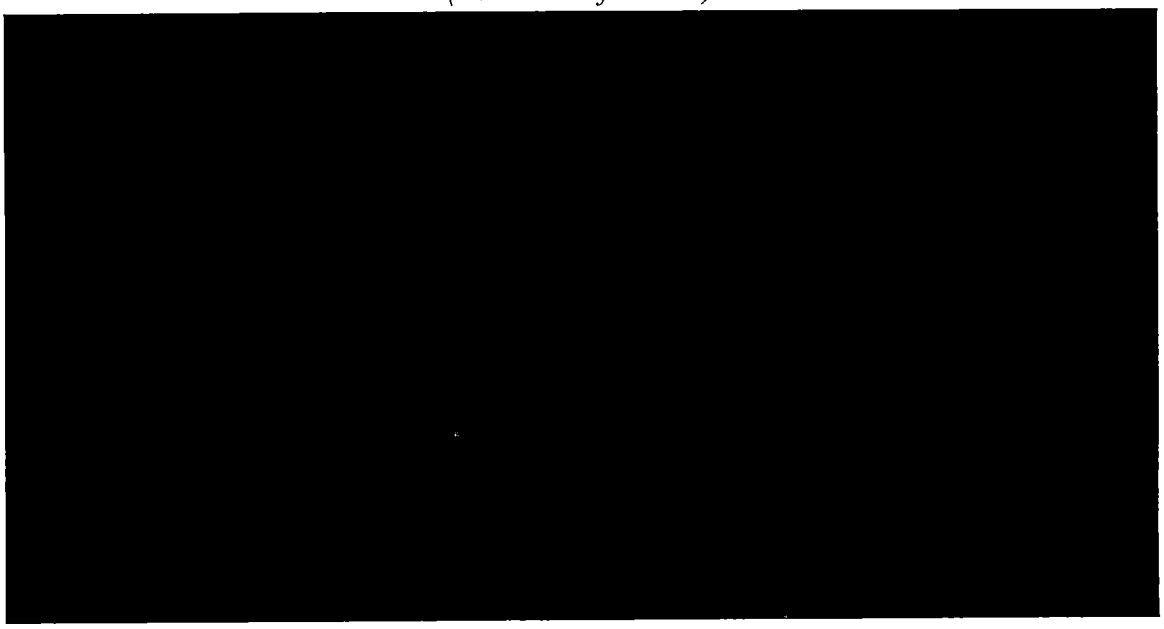
More significant, however, is the effect of the drop in natural gas prices shown below (and in the next chapter as well). The natural gas line does not show dispatch costs for natural gas plants, but rather current prices at Henry Hub, a primary U.S. natural gas industry pricing benchmark. Nevertheless, it directionally shows the increasing pressure on:

- Independence and its stable costs relevant to dispatch

----versus----

- Gas-fired plants benefitting from material reductions in fuel costs.

Comparative Independence Dispatch Costs
(chart is confidential)



With coal plants already in a close competition for some time, patterns like that shown in the next table highlight the difficulties in forecasting coal burns -- they depend heavily on small changes in fuel-market conditions. For this reason, and particularly considering high Independence output in the preceding year, it is sound to take a conservative approach, particularly where what proves to be over-reliance on longer-term purchases in one period can be mitigated by:

- Delays in contract takes
- The significantly greater amount of the next period's expected burn [redacted] that remains uncommitted.

Given the unusually high level of operation at Independence leading up to the contracts, we found it reasonable to adhere to the declining three-year committed supply targets. Increasing the use of volume flex amounts formed a sound means for seeking to avoid overtakes of coal should volumes drop, as they did. As it turned out, the much lower level of coal requirements in 2019 following these new contracts essentially eliminated the need for material spot purchases to supplement base purchases.

With the return in this Audit Period to much lower levels of Independence generation, there is risk that the [redacted] target will become a 100 percent target, or even surpass needs for the coming year. It is for that reason that we consider a review of these targets appropriate as a part of an overall reset of Independence planning for the decade or so it is now expected to remain in operation. We address that need in the next conclusion.

For the 2018 RFP the Company estimated its requirements carefully, and designed the RFP to produce the necessary quantities. The Company modified its proposed terms and conditions in light of its increased need for delivery flexibility, and the impending change to air quality

requirements in Arkansas. The Company also sent the RFP to a broad range of suppliers (more than responded), seeking appropriately to secure the broadest possible response.

3. **Assessing the fuel needs of Independence increasingly becomes a function of planning for units slated for retirement.** *(See Recommendation #1)*

The Independence units would find themselves at a crossroads even without facing retirement in a decade or so. Adding the retirement factor makes it time to plan for scaling capital and operating plans to a different view of remaining life. Management will need to make decisions that are likely to have availability consequences, as unit lives will increasingly give less time to permit payback of costs to keep them running efficiently. Independence is, as the following chapter shows, already the highest-cost Entergy coal unit to dispatch. Changed thinking about investing in its operation will tend to make it less competitive, suggesting a cycle of continuing declines in use, subject to dislocation in the current relationship of natural gas and coal costs.

Capital and operating costs will have the largest consequence in the late stage of the Independence units, but it is important to understand and respond to how decisions about where and how much to spend there will affect fuel needs and the optimum means for meeting them.

4. **Management conducted a structured, comprehensive, and analytically sound evaluation of the offers received in response to the 2018 solicitation that occurred at the beginning of this Audit Period.**

None of the [redacted] supply offers received rejected any of the quality specifications or requirements for delivery flexibility, so the evaluation focused on delivered prices. All components of delivered prices, including rail transportation, railcar leasing and maintenance, SO_2 emissions allowances, etc., were included in the delivered-price estimates. Indeed, the best offers were selected.

The bankrupt state of all [redacted] of the suppliers to Independence was a concern, but all [redacted] were already performing satisfactorily under their existing coal supply contracts with Entergy. To date, deliveries have not been affected. The Company considers credit risk as part of the offer-evaluation process, [redacted].

5. **The delivered coal prices for Independence remained market-competitive during the Audit Period.**

Comparing prices under coal-supply arrangements must recognize that delivered prices depend on unique factors, such as specifications required to meet plant design and operating conditions, coal characteristics required to meet environmental requirements (again affected by plant equipment and systems), and on location-driven transportation requirements. There is one roughly comparable station in Arkansas, but it is about half the size of Independence and White Bluff. EIA data for that station indicate that Independence coal prices are competitive or superior.

EIA data on FOB mine and delivered prices indicate competitive prices at Independence. Finally, management used contemporaneous broker quotes for FOB mine prices to assess the bids it received under the 2018 RFP. [redacted]

Accordingly, we found the accepted offers from the 2018 RFP process comparable with the other offers received through a robust solicitation process, and comparable to published market prices.

6. Documentation of the 2018 RFP process and bid evaluations was complete and it reflected careful and objective evaluation and selection processes.

We reviewed copies of:

- The RFP
- All of the supply offers received in response to the RFP
- Detailed evaluation of the offers by SPO Staff
- Presentation materials for SPO meetings with the Credit Risk Committee, and EAL's RPOC Committee
- Confirmation that the person who signed the contracts for ESL was authorized to do so under the Company's commitment-authority standards
- The signed confirmations.

These materials provided complete and clear records of the results of the solicitation.

D. Recommendations

1. Perform a more robust and risk-based analysis of forecasted coal requirements and required inventory levels. *(See Conclusions #1 and 3)*

Intentions to retire the Independence units in the intermediate term calls for a comprehensive plan addressing how to fund remaining capital and O&M needs with a different perspective. Part of that plan needs to include sound assumptions about projected changes in availability and dispatch costs as plant conditions change over its remaining years. This opportunity to plan for this roughly decade-long phase also provides an opportunity to meet a corresponding need to assess how Independence will fare in continued competition against natural gas, before and after its performance characteristics begin to reflect inherently shorter-term decisions about what capital investments and O&M programs, responses, and costs make economic sense.

Forecasting fuel needs, a significant issue from the report of the prior audit, clearly has significant relevance. However, looking at reasons for past variances without reference to future market conditions and Independence performance characteristics would not be helpful. Nor, to the extent that examining past variances is helpful, is any one period determinative. The last four or so years, for example, include one (2018) that appears anomalous by comparison to the others, but the question is why and primarily what significance does that have for the future?

Focusing on inventory levels, while also material, should not obscure their reason for existence, which is to make sure that unexpected changes in circumstances do not leave an important asset without the ability to operate. The information that management needs to value inventory requires clear and materially quantified analysis of the value of retaining that ability. If buying and holding each incremental block of coal is low relative to the economic loss of unit unavailability, the decision is straightforward. At the other extreme, the value of maintaining that availability may be quite low in a market that offers alternatives very close in cost when MISO might otherwise call on Independence. Where the balance lies between insuring operation through higher inventory

versus risking it through lower levels is material to determining the degree of concern one should have about "excess" inventory. That balance is likely to have even more significance in assessing the degree to which one should have concern about fine-tuning the amount of coal to be procured on a term basis.

Speaking of contract term, reliance on a persistently and systemically weak coal market (under threat not just from economic forces, but subject to environmental issues that seem to split the country about down the middle) is a concern. Consideration of how best to manage existential threats to coal supply through procurement strategy thus also has importance. Even more important is a view of future natural gas price direction and uncertainty. Already having narrowed, and under many conditions overtaken, the competitiveness of Independence, gas prices reached levels some time ago that many thought unsustainable. They have fallen more since. A sound assessment of their future range is important (although in a fundamentally less important but still significant sense) in assessing Independence coal use, which will change during its remaining life. More importantly, it will provide needed context for what value the units have for customers over their remaining lives - - a fundamental determinant of what resources management should commit to them.

Factors like these dictate the need for a holistic examination of all factors that will determine the range of value that Independence may be expected to have in the future, and what capital and operating plans and expenditures (including, but not limited to fuel) should be. More than fuel purchases and costs, a sound assessment of that value will affect fuel plans and resulting costs and risks.

We therefore recommend a broadly-based, quantitative, risk-based approach to assessing the contribution that Independence can make, as a foundation for determining the range of value, qualitative and quantitative, that it can be expected to produce, and what plans and actions are required to produce it. Such a study encompasses issues and factors outside the confines of annual fuel audits. In addition, it would not be surprising to find planning to life-end for the units still developing and evolving next year.

We will certainly be prepared to look at coal forecasting, planning, and procurement in the next Audit Period, but we think it should occur in the context of the units' expected life spans now (and, of course, any uncertainties as to the finality of current expectations, if they exist). It should also employ a robust analysis of the range of natural gas price levels at which sound forecasts of all the costs relevant to Independence dispatch will allow it to compete. This more forward-looking approach appears to us more useful than probing the reasons for prior forecast variances.

The MISO market is a robust one that offers many competitors for capacity and energy. However, we recognize that Independence brings a large block of capacity to that market, and that it meets obligations that EML has with respect to capacity. Other coal units, all facing existential threats of some magnitude, participate in that market as well. Therefore, it is important that analysis of its future value consider changes in capacity markets - - particularly after potential retirements of major units. We discuss energy value issues associated with Grand Gulf in Chapter VI. It is important that the recommendation we make there also consider capacity-market impacts. It has

perhaps greater significance there, as current Independence plans call for its elimination as a source of meeting capacity requirements.

IV. Coal Supply Management

A. Background

We reviewed a range of Independence plant supply-management issues that form important elements of ensuring effective performance. These elements include: measurements of coal quantity and quality, inventory management and coal-combustion wastes.

B. Findings

1. Coal Transportation and Delivery

a. Rail Transportation

The same coal transportation contract, with the Union Pacific Railroad, serves both Independence and White Bluff. Effective July 1, 2017, it covers all of those plants' expected transportation needs through June 30, 2022. The Union Pacific Railroad offers the only long-haul alternative available between the mines and the Independence and White Bluff locations. The annual contracted volume under that contract is [redacted]. All coal deliveries originate at mines in the Powder River Basin region and move to the Independence site by trainsets largely owned by Entergy Arkansas. The Union Pacific delivers all the way to White Bluff; Independence requires an interchange with the Missouri and Northern Arkansas Railway (MNA), which transports the trainsets the final seven miles to the plant site.

A fleet of 2,647 railcars delivers coal to the Independence and White Bluff stations. The same group of Powder River Basin mines supplies both stations generally. A lease with [redacted], with two other entities, [redacted], leasing the remainder. These smaller leases remain, but Entergy Arkansas now owns the 2,353 rail cars previously leased from [redacted]. Each plant's share of total trains determines its share of monthly railcar costs.

Management divides this fleet into trainsets, generally operating [redacted] of them at any one time. These trainsets consist of about [redacted] railcars each, and can carry about [redacted] tons of coal in total. The remaining [redacted] railcars form a pool of spares or are under maintenance. Delivery cycle time has averaged about 243 hours, or 10 days. Entergy's coal plant operations in Louisiana use wholly separate transportation arrangements.

b. Railcar Requirements

Coal burns have decreased at Independence. The station's annual burns amounted to about 6.5 million tons at the time of our 2011 audit. Recent year numbers are:

- 2016: [redacted]
- 2017:
- 2018:
- 2019: (through the September 30 Audit Period end).

The continued decline in delivery requirements, as compared to those for which Entergy has sized its railcar fleet, may support a reduction in the size of the fleet. Recently, delivery issues had

produced side-tracking of trainsets at points along the delivery route, thus necessitating retention of sufficient railcars to accommodate delays. Management has reported resolution of those issues.

c. Rail Transportation Costs

Deliveries under the contract now in place with Union Pacific began shortly before the start of the prior audit period. The current contract calls for a [redacted]

- [redacted]

The new contract produced in the last audit period an average [redacted]. The U. S. Department of Energy's Energy Information Administration (EIA) reports that the average cost of rail transportation from the Powder River Basin to Arkansas was $22.24 per ton in 2017, and $22.60 in 2018. The relevant diesel prices began 2018 at about $3 per gallon, spiked upwards by 10-15 percent by about year-end, and have fallen to roughly $3.00 in 2019.

2. Coal Receipt and Storage

As it has done for many years, Independence plant staff use a rotary car dumper to unload coal from the trainsets, which arrive on a roughly daily basis. The essentially daily deliveries permit dumping to a "live" pile at the foot of the feeders that deliver it to the plant. Nearby, management some time ago began the use of a so-called "Razorback" pile to augment the live one. Accordingly, the plant is generally taking coal from these daily deliveries whenever possible. When those deliveries exceed contemporaneous plant burns, the coal is moved to two "dead" piles (North or South) where it is reserved for use in the event that supply disruptions exhaust the live or the Razorback piles. Coal that remains in dead storage is more subject to quality change, from factors such as local rains and oxidization.

Coal comes to Independence from a number of different mines. However, except for one or two occasions per year, it has not proven necessary to blend coals to produce acceptable heat content or quality.

3. Coal Quality Measurement

Quantity and quality measurement play key roles in ensuring conformity to minimum or maximum content measures for ensuring adherence to supply contracts, to avoid or mitigate adverse consequences for plant operating systems, and for underpinning offers to MISO for determining dispatch of Independence. Minimum heat content (BTUs) and maximum quality measures (*e.g.*, sulfur, moisture, ash, and sodium) comprise key measures in Entergy's supply contracts for Independence. Values for measures like these comprise specifications to which supply agreements hold coal vendors. Performance relative to specifications in areas like these has financial

consequence; *e.g.*, bonus payments for coal with BTUs above a specified level, cost reductions for failure to meet minimum heat-content levels, and contract-liquidated reductions for quality not meeting contract limits. Entergy also may reject deliveries of coal not meeting established limits. Consequently, reliable means for measuring the required attributes is necessary.

Sourcing from the Powder River Basin in the Mountain States region causes coal deliveries to the Arkansas generating stations to traverse great distances. The trip exposes the coal to content-affecting uncertainties (like rainy weather) while in transit. As is typical of the industry, measurement of quantity and quality occurs for each train-load of coal at the mine. Vendors must sample all coal shipments on loading into the railcars, using ASTM standards widely applied in the industry. Separation of the samples into three parts then assures independent verification of measurement integrity and accuracy:

- One part sent to an independent lab hired by the mine undergoes all required measurements
- Entergy's White Bluff coal lab, which receives a second part of the samples, measures a random sample of them periodically to verify consistency
- The third portion goes to the mine's independent lab in the event that measurement discrepancy or variation warrants additional testing.

Delivery manifests accompany the train delivering the coal sampled in this manner. Station personnel enter the vendor-supplied information into Entergy's Railcar and Coal Management System (RCMS). Entergy's White Bluff lab testing of randomly selected samples includes comparison of its test results to the information on the delivery manifests for the shipments selected.

Conditions during transit and while stored at the plant site require that Independence management conduct its own sampling, as conveyors bring the coal from storage piles into the plant. For example, coal piled at the plant remains subject to moisture increase from precipitation, and to oxidation, which can affect heat value (BTU content) over time. Independence management takes a sample during each shift as the coal travels on conveyors that bring it from the coal yard into the plant. The plant's coal conveyors take weight measurements using recently-installed scales subject to twice-yearly calibration thereafter.

After collecting at the site for a week, the samples go to the lab at White Bluff for heat-content and other characteristics testing. These measurements do not bear on contract specification compliance, which follows measurements taken at the mine. White Bluff testing information enters a data base, whose primary use is to keep joint owners informed about plant operating information. It also occasionally serves as a source of information in addressing possible causes of plant operating issues that may arise.

We had a concern about the storage of the samples taken at this point, again in our 2010 audit. A change made the following year produced their placement in lidded buckets, for accumulation for several days pending weekly shipments to White Bluff's coal laboratory for analysis. Our site visit to Independence during this audit confirmed similar treatment. Similar to what we noted in our 2011 audit, the current methods continue to recognize the importance of representative samples, and of maintaining them in a manner that permits accurate moisture readings.

Plant personnel weigh the coal through posimetric (gravimetric) feeders as it is fed to the boilers. These scales are calibrated [redacted] per year. These measurements are the source of the burn quantity information that also goes into RCMS. Plant personnel monitor coal quality for operational purposes with regular sampling from the flowing streams of coal at the feeders. Sampling is done pursuant to established procedures.

a. Heat Rate and Unit Dispatch

Our last (2011) fuel and energy audit of Entergy addressed Independence dispatch as it was occurring before entry into MISO. Management at that time was undertaking mid-year measurements of coal characteristics at the plant, for purposes of performing annual heat rate calculations, which were being used to formulate unit dispatch order. Management now conducts a full-scale heat-rate test at intervals [redacted], supported by outside experts. This testing underlies bids of Independence energy into MISO's Day Ahead Market (explained more fully in Chapter VI, MISO Operations). The values secured during this [redacted] test apply until the next similar test unless specified contingencies occur:

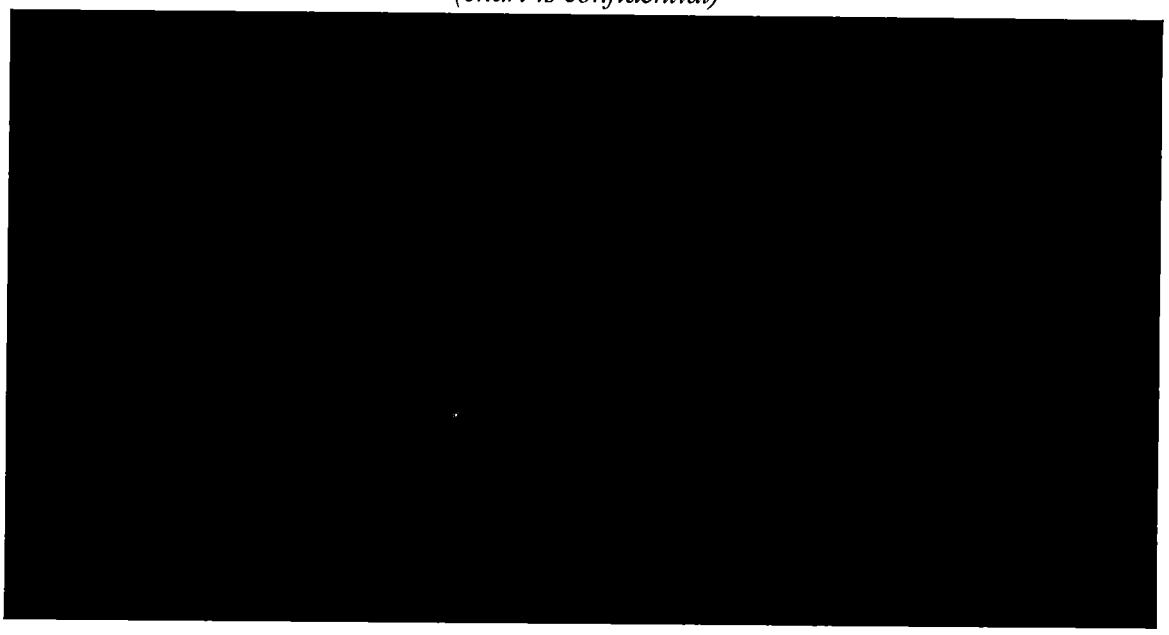
[redacted]

Should such a specially-ordered test identify a material variance from the results of the one currently driving calculation of MISO bids, management would update, as found necessary by the testing, the coefficients used to formulate offers of Independence output into MISO.

Chapter VI of this report addresses the process by which MISO controls the dispatch of member units, including Independence, and the information that Entergy provides to MISO to make dispatch decisions. That information requires sound information about heat rate for management to ensure that it does not offer Independence for dispatch at prices that fail to recover its full costs. The much-lower natural gas prices prevailing and expected to continue have narrowed and frequently reversed the cost advantage that coal plants used to have.

This issue has particular importance for Independence, as the next chart demonstrates. Its costs are frequently at or above those of gas units that often drive MISO prices. The chart comes from a regular monthly report on Entergy fuel supply and management. The narrative accompanying this chart in a monthly internal fuel management report addresses this possibility with the observation that, "June-August burns were below forecasted and historical averages due to low gas prices."

Comparative Independence Dispatch Costs
(chart is confidential)



Operations personnel monitor heat rate at Independence regularly. They, as do The Woodlands personnel, have access to the data produced by White Bluff's regular testing of coal heat content as delivered into the plant, and to other operating data. Such data can provide a means for checking the continued accuracy of the full-scale tests [redacted]. Such checking can identify impacts from differing heat content in coal, or from marginal degradation in the effectiveness of key plant components between instances of cyclical maintenance activities. Should these measures disclose a difference in current heat rate compared to last [redacted] value, management would evaluate the need for new heat rate testing, as described above.

b. Plant Sampling Methods

Our 2010 audit examined the process for sampling coal at the plant. We had a concern about whether the samples taken at that time were representative. The following year, management implemented a new practice that resolved our concern about the approach that preceded it. Our site review of Independence during this audit confirmed that this practice remains in regular use for sampling coal as it nears the end of its movement to the boilers or to in-plant immediate-term storage.

4. Contract Administration

Ensuring effective communications between the plant and Fossil Fuel Supply personnel working from offices at The Woodlands in Texas requires strong communication and reporting. Daily communication, including e-mails, occurs between personnel operating Independence and The Woodlands offices. Station operating personnel, home office personnel in The Woodlands, the railroad and the coal mines facilitate contract administration. Communications keep station personnel abreast of rail shipping plans, schedules and status, and alert The Woodlands personnel to any delivery issues.

SPO receives data that measures quantities delivered to Independence and their quality relative to contract specifications from delivery manifests. The calculation of payments for coal use these measures, as expected. Fuel management personnel input this information into the fuel management system. Actual coal consumption calculations use data taken from the gravimetric feeders to the coal mills.

Contracts for coal supply set parameters for BTU, sulfur, moisture, ash and sodium content. Effective contract administration requires attention to measured qualities and calculation of price offsets or onsets, depending on whether performance falls below or above targeted levels. We examined records for each delivery for the Audit Period, which demonstrated calculations of such pricing adjustments for each.

Contract administration occasionally requires assessment, evaluation, and disposition of issues such as price-change requests, terminations for non-performance, *force majeure* declarations, requests for emissions credits, and renegotiation, amendment, or extension of contracts. Some can be complex, and have significant cost or delivery consequences. We inquired into such events, intending to evaluate the processes and decisions used to address them. Management reported that none occurred during the Audit Period.

5. Coal Inventory

a. Inventory Policy

Management reviews Coal Inventory Policy annually. For some time, the policy has set three principal targets. Those targets remain the same today as they were in 2011, as the next chart summarizes.

Independence Inventory Targets
(table is confidential)

Component	2019 Amounts	
	Tons	Days
[redacted]		

Management calculates the Minimum Base Inventory by adding the quantities required to support: [redacted]. The Base Target Inventory adds a buffer for major transportation disruptions (*e.g.*, major flooding on rail delivery routes). The Annual Average Target reflects inherent variability in burn schedules and inherent deviations from them.

Inventory targets form a significant driver of the Coal Transportation Plan which we found integrated with those requirements. Within the plan, management must make decisions about railcar fleet capacity requirements, trainset sizing, and delivery frequency. Freight rates encourage use of the maximum number of cars per trainset, which management considers in relation to the variable such size affects; *i.e.*, numbers of trainsets per month.

b. Actual Inventory Levels

The next table shows actual inventory level for the month in days of burn on the left, and on the right the last 12-months rolling average including that month.

Independence Inventory Levels
(table is confidential)

Days of Burn available for the month *Days of Burn available, last 12 months*

[redacted]

Independence burns in 2018 went against the direction they have taken since our last audit, which addressed 2011. That year's coal-burn amounted to about [redacted] million tons. Burn then fell to [redacted] million tons in 2016 and further to [redacted] million tons in 2017. A large jump in 2018 brought Independence coal burn to [redacted] million tons. However, burn fell again sharply in this Audit Period, to 3.8 million tons. Thus, the rise of 20 percent from [redacted] million tons to [redacted] million was more than offset by the drop to [redacted] million, which is 83 percent of that [redacted] million tons.

The table shows the dramatic effect of this Audit Period's greatly reduced burns on resulting days of inventory. The period began with the annual average inventory within a reasonable range of target level ([redacted]) and days of burn for the month (October 2018) at the same level as those for October 2017. By the end of the Audit Period (September 2019), the annual average had climbed [redacted].

Despite the large drop in burn in this Audit Period as compared with the preceding one, delivery reductions substantially mitigated inventory build. The next table shows volumes delivered to Independence. Current Audit Period deliveries fell by [redacted] ([redacted] percent) from the prior-period levels. These reductions kept deliveries within about 10 percent of actual burns during the current Audit Period. Two outages at Independence, each extended beyond their original schedules, contributed significantly both to reduced generation at the two units and to the challenges of managing coal deliveries as much as possible to station use and the impacts on inventory growth.

Independence Coal Delivered vs. Burned
(table is confidential)

[redacted]

Thus, despite substantially reduced deliveries, 2019 has seen a new inventory buildup at Independence. The 2019 outages resulted in a loss of [redacted] weeks to the two units combined during this Audit Period, representing [redacted] percent of the 104 total weeks available (52 weeks times 2 units). Adjusting for the [redacted] loss suggests annual burns of [redacted] million tons for the Audit Period -- well below last Audit Period levels, but consistent with those of calendar years 2016 and 2017.

6. Performance Reporting and Auditing

As part of the Independence inventory-tracking process, an independent consultant measures the quantity and quality of the coal in the inventory piles at each coal-fired station [redacted]. Reports of measurement results detail measurement methods and results, as well as quality results provided by the consultant's partnering lab. With access to the consultant reports, management reconciles physical measurement results with the calculated quantities produced by RCMS. The reconciliation parameter is MMBtu, rather than volume or weight. Consequently, the volume

measurements provided by the consultant must be adjusted for weight and Btu content. The consultant reports provide the volume-to-weight conversion, then RCMS converts to MMBtu. Notes to the Monthly Fuels Report for August 2019 report that inventory levels at Independence were increased by 10 days as a result of the most recent one of these reports.

We found that the book inventory is always larger than the physical measurement, requiring that inventory be adjusted down. Management explained that the differences in the inventory values result from different measurement techniques and the methods used to convert those different inventory values to common units (MMBtu versus tons).

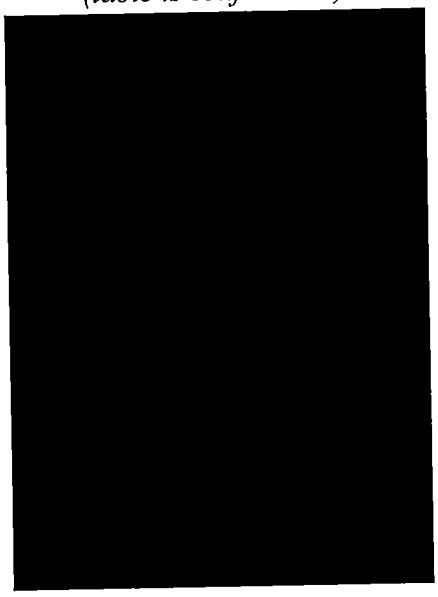
Monthly Fuel Reports contain a coal section, which provides the following data:

- Beginning inventory
- Coal receipts
- Coal burned
- Ending inventory
- Change in inventory
- Monthly inventories for past 12 months
- Receipts by mine.

The reports contain a notes section, but we found it rarely used in the 12 months from May 2018 through May 2019, with no discussion of coal performance.

The reports expanded their treatment of coal issues beginning with the last one produced during the Audit Period. Addressing August 2019, this last report contained an exhibit showing amounts received under each coal-supply contract versus the contract amounts for each. The exhibit also shows year-to-date railroad shipments, compared to contract minimums. The following table, compiled from data in the August report, shows quantities received in the first eight months of 2019, versus quantities contracted for the year. The listed contracts supply both Independence and White Bluff, so deliveries shown in the table are to both plants.

Jan-Aug 2019 Coal Deliveries
(table is confidential)



The following chart, also taken from the August report, shows the high absolute level of inventory at Independence and its comparison with White Bluff levels. White Bluff's inventories have increased steadily through 2019, however, from a low of [redacted] days at the time of the January report to [redacted] days at the end of August. The table indicates a shift in deliveries from Independence to White Bluff to balance inventory growth between the two plants. Expectations, which are typical, are that inventory will fall as plant operation increases along with spring- and summer-season loads. The seasonal inventory changes for White Bluff are typical; the fall-into-winter decline shown for Independence has to be for intentional inventory reduction.

Independence and White Bluff Coal Inventories
(chart is confidential)

The monthly report for August also added a note on coal rail transportation, noting:

- Storage of four trainsets for inventory management regarding Independence and White Bluff
- An observation that June through August burns fell below forecast due to low gas prices.

The only audits addressing coal procurement and management since 2017 have been those, like this one, regularly performed for the Commission.

C. Conclusions

1. Balancing the size of the rail fleet that delivers coal to Independence with forecasts of future delivery requirements is in order. *(See Recommendation #1)*

Entergy has delivered coal with railcars in numbers it has maintained since our last audit in 2011, when Independence was consuming [redacted] million tons of coal per year. With recent burns significantly below those levels, but variable, and with Independence and White Bluff station remaining lives now set at roughly a decade, it is time to form a plan, consistent with expected lives of the Independence and White Bluff units and with railcar needs at other locations thereafter.

2. The Company's processes for receiving, sampling and storing coal are consistent with prevailing industry practices.

Common practice in this industry is for the supplier to weigh, sample and analyze produced coal as it leaves the mine. This information is then provided, along with additional samples, to the receiving power plant with delivery manifests. The power plant then "audits" the sample information in its own laboratory. Entergy conducts these processes in this way. Plant staff conducts coal weighing and sampling under established procedures that ensure that samples are representative of coal as fed into the boilers or stored in plant for essentially immediate use. The

samples are stored in a manner that preserves their characteristics (*e.g.*, moisture content). Weekly deliveries of these samples to the White Bluff lab give its staff a population to use for testing. Procedures call for plant scale calibration every six months.

3. **Regular attention to coal quality measurements produced the price adjustments called for by contracts, and the Audit Period witnessed no material delivery, quality, or contract compliance issues, or requests for contract amendment or relief.**

We reviewed each delivery for shipment dates, amounts, quality measures, and price calculations. Where contracts entitled either Entergy or vendors to price adjustments, their calculations were specified. Our requests for information and discussions with plant management showed a particularly issue-free 12 months with respect to coal deliveries. There were delays in some rail shipments, but sufficient rail cars remained under lease and in operation to support continued coal shipments pending resolution of those delays with the rail carrier.

4. **The heat-rate testing policy for Independence creates the potential for MISO bids not completely aligned with unit costs.** *(See Recommendation #2)*

Timely and accurate measurement of the heat content of coal is necessary to ensure that dispatch of Independence does not fail to recover costs. Determining heat rate accurately requires accurate measurement of both the amounts of coal burned and the BTU content of that coal. Independence uses coal from a significant number of sources, which have different BTU levels. Time spent in storage, even on the live pile, can include precipitation that causes each ton of coal to experience a moisture increase, which reduces the heat content.

Management used to use at least annual measurements of heat rate to determine dispatch of Independence - - before entry into MISO. It now uses [redacted] full-scale tests, which drive MISO bid calculations for the following [redacted] years, absent major plant changes. Continuing declines in natural gas prices have made Independence less frequently economical to dispatch into MISO, making accuracy of its dispatch costs critical in ensuring that dispatch is maximized when economical in MISO markets and avoided when it is not.

5. **Variations between forecasted and actual burns have challenged the management of inventory levels, but a responsive and flexible contracting strategy and delivery tactics have mitigated their consequences; future conditions, however, bring greater uncertainties that warrant analysis and response.** *(See Chapter III Conclusions and Recommendations)*

The forecasts driving coal amounts to be procured have steadily fallen. Not surprisingly, Independence (like all U.S. coal plants, including Entergy's White Bluff and Nelson units) has come under significantly increasing competition from systemically low natural gas prices. Before the last audit period (October 2017 through September 2018) Independence experienced several years of coal-burns well below those of a prior era when natural gas prices, while falling, had yet to reach the levels now prevailing. A jump in burn rates in that last audit period was followed by a drop in this Audit Period to levels much more in line with the two years before that.

The underlying forecasts used to set targeted tonnages to place under firm delivery agreements (*e.g.*, [redacted] of expected burn for the coming year) have fallen. Burn forecasts for

Independence and White Bluff have guided purchase amounts under annual coal solicitations, which cover the combined requirements of the two stations. A roughly 50/50 split approximates the Independence share. The [redacted] levels that drove purchases for those last two years have been:

- Fall 2017 RFP: [redacted]
- Fall 2018 RFP: [redacted].

With the experience of the last audit period in mind, we did not find the burn assumptions underlying the 2018 RFP unreasonable. They were lower. They proved still high, but not greatly consequential, given the following:

- Ability to shift supplies between Independence and White Bluff - - particularly valuable to address unexpected or extended planned outages
- Ability to defer deliveries to avoid extreme inventory conditions.

The lower-than-forecasted usage did preclude access to spot-market sources (contracted amounts proved more than needed), but in a systemically depressed Powder River Basin coal market the spot market did not offer significant price differentials.

The report of the last audit expressed concern about variations from month-ahead forecasts. Attention to their accuracy is warranted, but high levels of variation between them is not surprising. Certainly, plant personnel and Fossil Fuel Supply need to remain closely in touch about outage schedules, significant potential for lengthy outage extensions, and issues imminently threatening unplanned outages. Avenues for such communications exist and they are used. With coal plants like Independence closer to the economic margin in a MISO flush with gas generation sources, it will also often be the case that an expected period of high operation becomes one of low operation, and vice versa. It is much easier to forecast burns for plants that regularly operate at capacity factors in the 80-90 percent range. As plants move toward 50 percent, however, the range of variability around forecasted burns grows greatly.

We therefore consider more useful a process that combines delivery flexibility with sound attention to forecasting natural gas costs over a longer than one-month period - - three to six months. Significant delivery flexibility already exists with the substantial volume flex that Entergy can exercise under its supply contracts. However, there is a limit to how much flex can be had in contracts or that can be exercised where it is authorized. The help that negative "borrowing" against future obligations provides today can prove burdensome when the debt of taking deferred deliveries comes due. Moreover, even healthy suppliers depend on some level of continuity in production. In an unhealthy market, creating uncertainty about the ability to sustain production at predictable levels can have greater risk.

In the short run, therefore, we see burn forecasting and inventory concerns more as a matter of what proportion in the coming year should be left uncommitted (*i.e.*, reliant on the spot market) when setting procurement targets for the annual solicitation. It would appear that a modest reduction in the [redacted] target could help.

However, we believe that more important considerations now need to be applied, given expectations of roughly a decade more of Independence and White Bluff operation. As we explain in Chapter III, which addresses Coal Procurement, it is timely for management to construct a plan

for how it will make capital and O&M expenditure decisions for such a horizon, in consideration of how those decisions will affect plant operations and in turn fuel-supply needs. That planning also needs to consider how to address the uncertainties that continued market weakness and troubled participants should affect supply planning. Contract length and supplier diversity considerations are not necessarily the same when planning for a unit expected to operate for a finite term, rather than indefinitely.

We have not examined (but will in the next audit) the solicitation undertaken for supply in 2020 and beyond. That process is underway now. We believe that an inter-related set of circumstances following this year's solicitation will be important to examine:

- Whether the high level of Independence operation in 2018 anomalous or predictive
- What planning for the next -- and presumably last -- decade of the plant's life may indicate with respect to its operating performance and the consequences for that performance on supply needs (*e.g.*, will availability or heat rate degrade, and if so, over what period)
- How the Powder River Basin market has evolved (*e.g.*, are suppliers more or less resilient; do spot and term prices show divergence).

For now, however, we believe that management has effectively managed the need to balance reasonable assurance of supply with the flexibility to respond to market conditions and to manage inventory levels effectively.

6. **With respect to coal, performance reporting is effective overall, but Audit Period monthly reports contained little narrative and no analysis; Internal Audit examinations of coal supply and transportation have not occurred.** *(See Recommendation #3)*

An outside firm examines inventory quantity and BTU content [redacted]. Monthly fuel reports present a series of charts and graphs showing coal delivery and usage data. Those reports, however, did not contain material narrative to make evident for higher management the drivers of performance shown, nor did they analyze trends that may suggest emergent issues. The last monthly report available for the Audit Period began to chart some additional data, and provided brief narrative about limited aspects of coal supply and rail transportation. Periodic Internal Audit examination of important contract administration issues (*e.g.*, quality verification, heat rate calculation) have not, at least recently, occurred.

D. Recommendations

1. **Perform an analysis of optimum railcar fleet size and evaluate the economics of phased reductions over the remainder of the life of the Independence units.** *(See Conclusion #1)*

Railcar numbers remain at levels commensurate with those of our last audit in 2011. With burn levels down, with continued low natural gas prices against which Independence and White Bluff compete, and with the lives of the four units at the two stations now expected to be a decade or so, it is time to plan for optimizing fleet numbers and planning its disposition. There may be no effective sale opportunities, but retirements and maintenance management changes may produce marginal economies. Fleet planning should occur in the context of master planning for the remaining lives of the stations, and consider how changes in capital and operations spending over that period will affect capacity factors and their influence on coal requirements.

2. **Ensure that timely and accurate heat rate measurements drive MISO offers.** *(See Conclusion #4)*

As many as [redacted] years can elapse between the major tests used to determine heat rate values that underlie bids of Independence output into MISO. A number of years ago, when Independence was generally more competitive economically, annual testing drove dispatch decisions. Now, with Independence more often not economical on given days, extending that cycle can have economic consequences. There are provisions for re-testing, but they allow not only as much as a [redacted] degradation, but one lasting more than [redacted].

Management should undertake an analysis designed to confirm that its [redacted] test cycle and mid-cycle testing triggers ensure effective pricing of MISO bids for Independence output. Plant management takes daily measures of heat rate. Management should conduct and analyze that data relative to:

- Heat Rate Variations: frequency and magnitude of variations from heat rate used for calculating MISO offers
- Would-Have-Been MISO Offers: impact of those variations on MISO bids, had daily plant measures formed bid basis
- Resulting Independence Dispatch: change from actual dispatch of MISO had would-have-been offers been made to MISO.

The analysis should cover at least two years, recognizing that the volume of data makes it logical to employ representative time periods (using statistically-valid sampling techniques). The study should be completed by June 30, 2020, in order to permit a review and analysis of its results as part of the next audit. If appropriate and desired, we can review the study scope and methods prior to their execution.

3. **Establish a list of topics for regularly addressing in monthly reports, and perform periodic internal-audit examination of coal-management performance.** *(See Conclusion #6)*

The last monthly report for the current Audit Period began to add graphical and very brief narrative information about coal supply and delivery. It reflects a good start, but whether it will continue and whether it will grow to encompass all the material measures of effectiveness, analyze trends, and discuss their causes and response measures are uncertain.

A regular list of monthly report subjects meriting narration and analysis should be prepared and regularly addressed, irrespective of whether exceptions or adverse trends exist. Those subjects should in particular address expected-versus-actual coal burns, the sources for variances, the consequences for over/under deliveries under supply contracts, and plans to address them. They should also address railcar utilization, particularly given a fleet designed for higher coal use and slated for an end to its usefulness in a decade or so.

The report should use available and expected developments to trend performance through the remainder of the year, in order to highlight needs for considering alternatives (*e.g.*, using contract delivery flex options) and for making clear implications for coming decisions (*e.g.*, new purchase commitments to replace expiring ones).

Fuel management personnel showed awareness of status, trends, and potential needs for adjustment in our interviews with them. It would be useful to present information about these developments in the monthly reports, even if the increase in visibility to them is small, because it will provide higher management with a clearer basis, supported by documented data and analysis, to remain currently informed of emergent issues for use in overseeing fuels actions and decisions that may come to require immediate adjustment to plans and expectations, or longer-term ones associated with: (a) the need for and entry of new agreements, and (b) as will become more significant now, planning for an ever-shortening remaining life of Independence.

We also consider it important for Internal Audit to ensure that it gives due consideration to coal-related issues in its planning. As it was when we last audited Entergy fuel and energy management, the focus and attention of Internal Audit on operational issues was a source of strength. Issues like ensuring sound calculations underlying MISO bids (which include, for example, heat rate) bear outside attention in ensuring that the decisions made consider both timely and accurately all factors bearing on the costs underlying them.

V. Natural Gas and Fuel Oils

A. Background

Natural gas is the primary fuel source for EML, and for the Entergy operating companies generally. Fuel oils have served as alternate fuels, but that role has diminished as gas has become more readily available. Gas purchasing and delivery to the generating plants involve several processes, requiring the services of an experienced and capable staff. Sufficient documentation is essential for internal control and regulatory review.

B. Findings

Natural gas is Entergy's most-used generation fuel. EML uses natural gas in its five generating plants. The following table shows the plants, their gas-fired generating capacities, their peak gas requirements and Audit Period gas consumption. Purchases for all of its generating stations and its gas-distribution operations can reach almost 40 million MMBtu per month, at a cost of over $100 million.

EML Natural Gas Plants
(table is confidential)

Plant	Type	Unit	Capacity (MW)		Peak Gas Requirements	Audit Period Consumption
			Min.	Max.	(MMBtu/day)	(MMBtu)
Attala Plant	CCGT	1	[redacted]	[redacted]	[redacted]	[redacted]
Baxter Wilson	Steam	1	[redacted]	[redacted]	[redacted]	[redacted]
Gerald Andrus Plant	Steam	1	[redacted]	[redacted]	[redacted]	[redacted]
Hinds Energy Facility	CCGT	1	[redacted]	[redacted]	[redacted]	[redacted]
Hinds 2	CT	2	[redacted]	[redacted]	[redacted]	[redacted]
Rex Brown	Steam	4	[redacted]	[redacted]	[redacted]	[redacted]

The Baxter Wilson and Gerald Andrus units have had fuel-oil burning capability, but only used this fuel rarely. Management completed sale and removal of the fuel oil inventory in 2018. Removal of the storage tanks is ongoing. The Independence Station uses diesel fuel (No. 2 distillate fuel oil) for start-up and flame stabilization, but primarily employs coal. Rex Brown Unit 5 had served as a 9 MW diesel-powered black-start unit, until retirement in June 2019 upon replacement by the new Hinds 2 gas-fired combustion turbine. Rex Brown Unit 4 was also retired in June 2019.

1. Natural Gas and Fuel Oils Procurement Process

Entry into MISO has changed the focus of gas purchasing to the very near term. Entergy's utility operating companies may make monthly purchases covering a portion of anticipated gas requirements for plants reasonably expected to operate at high load factors. Excepting such monthly purchases, the gas procurement strategy [redacted]

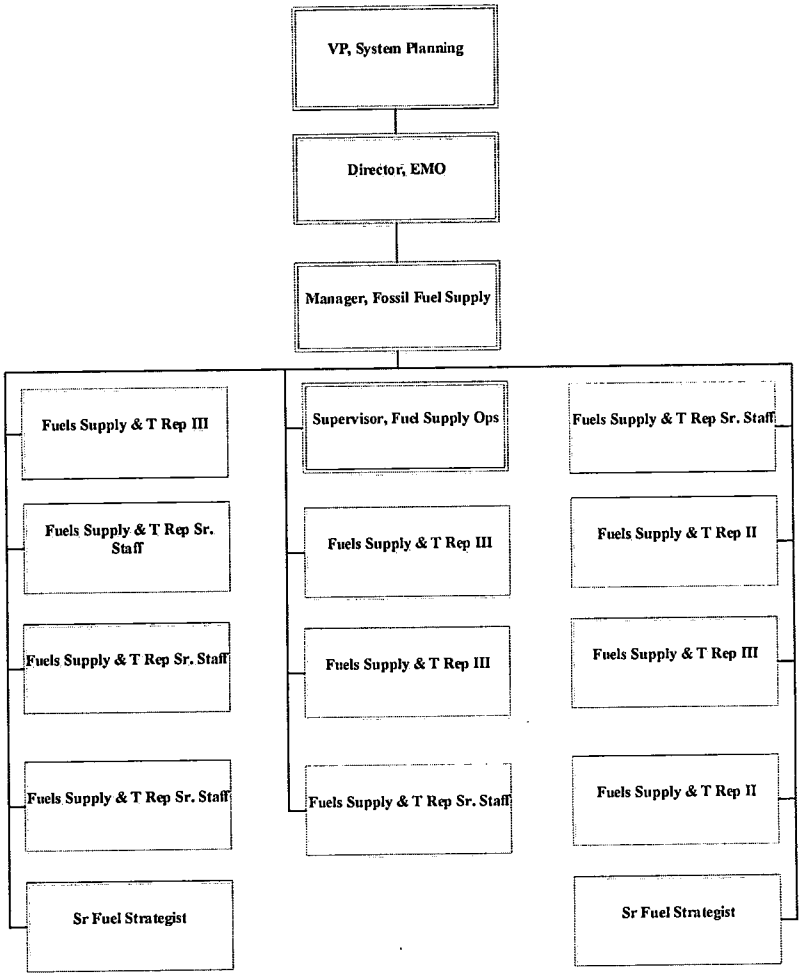
[redacted]

The operating companies may also purchase and sell gas in the intra-day gas markets as needed to address changes in forecasted or actual system operations, subsequent to the gas-purchase decision and transaction, including changes in unit commitment or dispatch resulting from MISO's Reliability Assessment Commitment process. Gas sales are incidental to the gas procurement strategy.

The general strategy for fuel oils is to maintain [redacted]. The plants are authorized to procure fuel oils as necessary to maintain those levels. With the removal of fuel-oil inventories and storage capability from the Baxter Wilson and Gerald Andrus plants, EML's only fuel-oil requirement is for start-up and flame stabilization at Independence Station. In accordance with the general strategy, the plant notifies Fossil Fuel Supply when additional supplies are needed, and Fossil Fuel Supply issues a request for proposals to approved vendors.

a. Organization

EMO's Fossil Fuel Supply group executes this strategy, using a staff consisting mostly of gas traders. See the organization chart below.



b. Approach

The Company's approach to fuel procurement begins with an offer strategy for each generating unit [redacted]

Offers are submitted into MISO's Day-Ahead process. [redacted] When management receives supply and demand schedules from MISO (mid-day before the day of operation), Fossil Fuel Supply adjusts its purchases as necessary. A second adjustment later in the day takes place, should MISO's Reliability Assessment analysis result in changes in requested unit operations.

Pipeline-capacity contracting and commodity purchasing strategies and practices have also changed to support the MISO-oriented modes of operation. The next sections describe those strategies and practices.

2. Gas Pipeline Capacity Contracting

Proximity to a pipeline comprises the biggest factor in deciding with which pipeline to connect each generating plant. The Baxter Wilson plant presents an exception to this rule among EML's plants. It sits close to and connects with a lateral on the Gulf South Pipeline system. The Gulf South connection is inactive, however, with Baxter Wilson served primarily by the Columbia Gulf pipeline. EML entered a 10-year contract with Columbia Gulf some years ago, in order to induce the pipeline to build a lateral to the plant. The table below shows each plant's active pipeline connections, with the physical capacity of each one.

Pipeline Connections and Capacity
(table is confidential)

Station	Pipeline	Connection Capacity *(MMBtu/day)*
[redacted]	[redacted]	[redacted]

ESL uses both firm and interruptible pipeline capacity to serve EML's needs, and buys some supply on a delivered-to-the-plant basis. The mode selected for each plant depends on several factors:

[redacted]

The table below shows the existing contracts for firm capacity. Firm capacity covers about [redacted] the full-power requirements of the two CCGT plants, assuring their ability to run at a base output level. The bid strategy for those two plants would incorporate the [redacted] in the structure of the offer into MISO. The Company has contracted for [redacted] of Hinds 2's requirements: as a black-start unit; it must have fuel if called upon to operate. Baxter Wilson's contract encompasses a large quantity over a long time, given the need for a contract to support Columbia Gulf's willingness to extend a lateral to the plant.

Firm Capacity Contracts
(table is confidential)

Plant	Pipeline	Start Date	End Date	Contracted Capacity (MMBtu/day)	Proportion Contracted (%)
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted][1]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

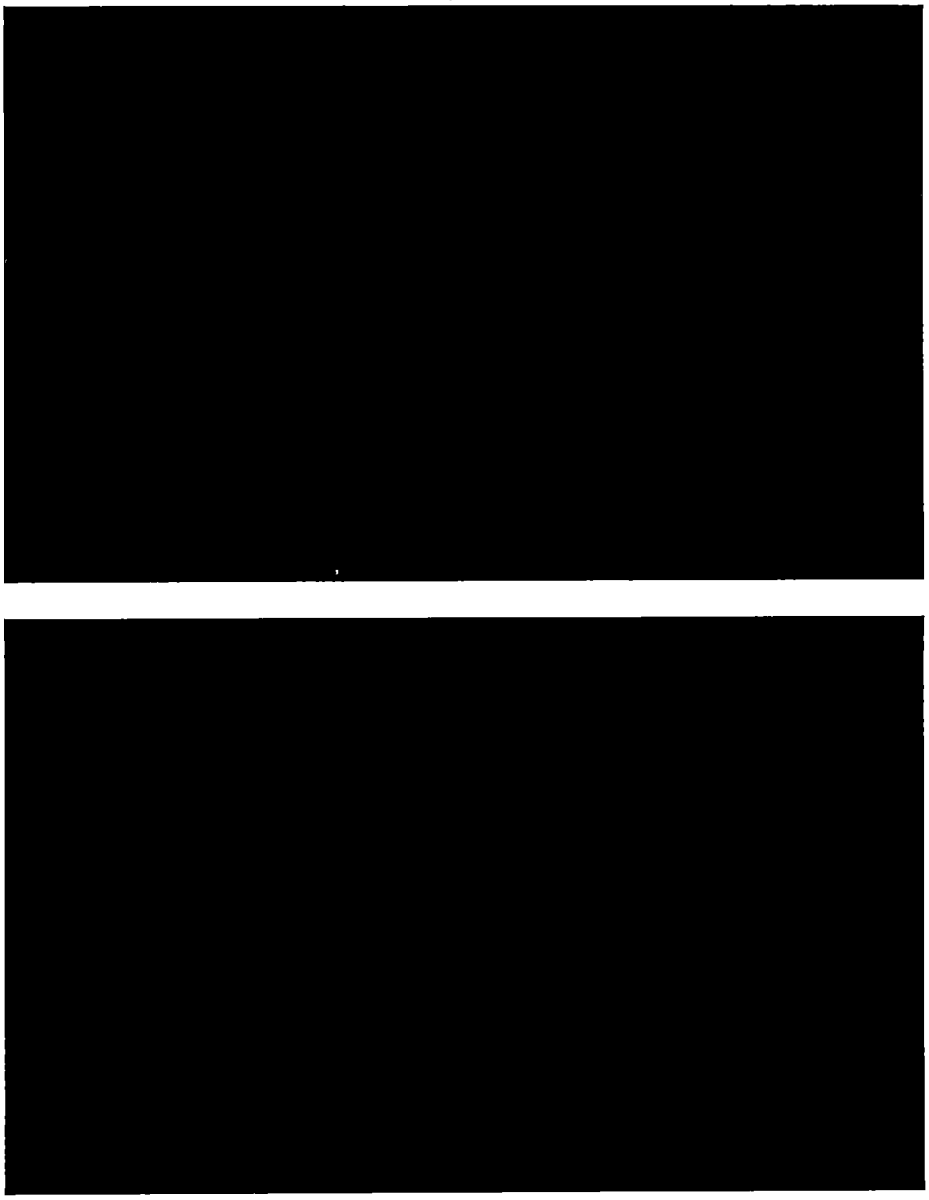
[1] *This figure is 100 percent of the capacity of the plant's connection to* [redacted]. *The others in this column are proportions of the generating station's peak gas requirements.*

No firm capacity contract exists for the [redacted]. That plant has high-capacity connections to Tennessee Gas Pipeline and Texas Gas Transmission, in a location essentially on the main north-south corridor for both pipelines. For that location, ESL buys all gas [redacted].

The charts below show monthly average use of the firm capacity contracts during the Audit Period.

[redacted]

Firm Capacity Utilization
(charts are confidential)
(monthly average)



The following table shows EML's contracts for interruptible pipeline capacity, with the generating plants served.

Interruptible Capacity Contracts
(table is confidential)

Plant	Pipeline	Contracted Capacity (MMBtu/day)
[redacted]	[redacted]	[redacted]

3. Commodity Purchasing

ESL looks for suppliers of natural gas who can: (a) provide supply at the receipt points in the Company's pipeline-capacity contracts, and/or (b) deliver to the Company's plants. ESL is one of the largest buyers of gas in North America; many suppliers seek to sell to the Entergy system. Identification of prospective suppliers initiates a credit review by Entergy's Credit department. If the supplier's credit is satisfactory, management will try to negotiate a master enabling agreement covering transactions with the supplier. The industry-standard North American Energy Standards Board (NAESB) agreement serves as Entergy's primary enabling agreement.

Parent-company practice calls for each operating company to enter contracts with gas suppliers with whom it might do business. This practice applies to both pipeline-capacity contracts and commodity-supply contracts. The service company performs credit analysis and contract administration, but does not serve as the contracting party for the operating companies.

EML reports that it has master enabling agreements with [redacted], having added one new one during the Audit Period. Management updates credit ratings quarterly under a policy that places firms whose credit declines on a "watch list" until improvement. EML had a robust range of authorized suppliers during the Audit Period. The table below shows EML's top 10 Audit Period suppliers and volumes bought. EML bought smaller quantities from another 12 suppliers.

EML Top 10 Suppliers of Natural Gas
(table is confidential)

Supplier Name	Quantity Bought (MMBtu)
[redacted]	[redacted]

4. Commodity and Capacity Management

A central principle guides fuel procurement for Entergy's gas-fired generating facilities: [redacted]. Each day, MISO determines which plants will run, and at what levels. Thus, Entergy organizes its day-to-day gas-supply processes around forecasting which plants MISO will select, and [redacted].

Management develops and uses offer strategies that give each unit its best opportunity to be selected for operation. Those offer strategies [redacted].

These processes start with annual forecasts of each unit's operation. Those forecasts roll into monthly ones as the year proceeds. Monthly forecasts are succeeded by rolling seven-day forecasts. ESL performs "shadow dispatch" for all units in MISO as part of its effort to forecast each day's operation of its own units. [redacted].

Entergy's generating plants are located in an area of abundant flowing gas supplies. Gas price information is readily available from published sources. Those sources aggregate data from individual transactions into index prices for most of the locations where Entergy buys gas. Thus, most of Entergy's purchases are priced with reference to an index, either the index for a receipt point on one of Entergy's gas transportation contracts when Entergy is delivering the gas, or the index for a location near the destination generating plant when the seller is delivering.

[redacted]

Entergy's gas-purchase strategy is driven [redacted]

[redacted]

If an expectation about a unit turns out to be wrong – if, for example, a unit expected to run is not dispatched, or a unit not expected to run is dispatched – then necessary adjustments to gas purchases are made in the intra-day markets.

Each of ESL's gas buyers works with a particular group of generating stations. Each buyer therefore knows which suppliers can deliver to his or her receipt points if Entergy's pipeline capacity is to be used, or to his or her stations if the seller is delivering the gas. The buyers solicit bids for each plant via phone or instant message. Accepted offers are confirmed, and then recorded in the Company's Gas Transactions Database. The Gas Transactions Database has been developed over a number of years. It includes a series of screens that allow the buyer to enter all components of an agreed-upon transaction. Each buyer nominates the necessary pipeline capacity when he or she buys gas for delivery into a receipt point for one of EML's transportation contracts. Each buyer's log saves all offers, accepted and rejected. Rejected offers are retained in a different database.

The following table shows the results of applying these processes through the Audit Period.

Audit Period Natural Gas Purchases
(table is confidential)

	[redacted]		[redacted]		[redacted]	
Month	**# of Trans.**	**Total Volume (MMBtu)**	**# of Trans.**	**Total Volume (MMBtu)**	**# of Trans.**	**Total Volume (MMBtu)**
October 2018	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
November 2018	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
December 2018	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
January 2019	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
February 2019	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
March 2019	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
April 2019	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
May 2019	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
June 2019	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
July 2019	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Audit Period Natural Gas Sales
(table is confidential)

Month	[redacted]		[redacted]		[redacted]	
	# of Trans	Total Volume (MMBtu)	# of Trans	Total Volume (MMBtu)	# of Trans	Total Volume (MMBtu)
October 2018	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
November 2018	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
December 2018	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
January 2019	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
February 2019	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
March 2019	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
April 2019	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
May 2019	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
June 2019	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
July 2019	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

a. Secondary Market Activities

As a general rule, Entergy [redacted]. The report of the most recent auditor recommended use of a capacity-release program or asset manager in an effort to recover at least some of the costs of the capacity. Management reports development of a process to post 101,000 MMBtu/day of its Columbia Gulf capacity on the pipeline's electronic bulletin board (EBB) for sale and release to any interested shippers. The process occurs every month, and will continue for the duration of the contract, in order to maintain a frequent posting for any parties that may develop an interest. Thus far, however, there have been no interested parties.

5. Price Risk Management

In 2003, the Company agreed with the Mississippi Public Utilities Staff that, due to the volatility in the price of natural gas, EML should implement a hedging program. The agreement limited the use of fixed-price financial hedging instruments for fuel for the Company's retail jurisdictional customers to 75 percent of fuel requirements for providing power to those customers. Transaction costs, along with program gains and losses, flow through a rider to EML's rates and charges. The rider is separate from the one that covers fuel and purchased-power costs. The Commission approved a stipulation between the Company and the Staff to these effects in December 2003.

Entergy's Utility Risk Management Policy provides that the operating companies may enter into financially-settled natural gas swaps consistent with jurisdictional commission orders. The most-recent update of the Utility Risk Manual provides hedging of [redacted] of EML's natural gas requirements for generation fuel.

EML's hedging program operates in a simple, straightforward manner. Reducing gas price volatility comprises the single objective of the program. ESL buys hedges for about [redacted] of

the gas it expects EML to use in each season. Gas for the winter gets hedged during the preceding summer, and gas for the summer gets hedged during the preceding winter. ESL hedges [redacted] of the desired quantity in each of the five months prior to the beginning of the season being hedged.

[redacted] serve as the preferred hedging instrument. The [redacted].

At the beginning of each month in which hedging will occur, ESL issues a request for proposals (RFP) to approved counterparties, requesting quotes [redacted]. Prospective counterparties undergo review by the Credit Department. If approved, they must enter into a master swap agreement with the Company. Only then can they submit an offer [redacted].

ESL awards the business to the counterparty [redacted]. That counterparty then buys hedges for Entergy's volumes each week during the first three weeks of the month. The entire process repeats at the beginning of each of the following four months.

EMO's Fossil Fuel Supply group conducts this activity. Accepted transactions are entered into the Gas Database. The Company holds selected hedge contracts to maturity; *i.e.*, it does not trade them.

The Company uses the International Swaps and Derivatives Association (ISDA) standard form contract as the master agreement with approved counterparties. EML has ISDAs with [redacted] counterparties; RFPs are sent to all of them. The Company reports that it receives [redacted] responses to each RFP.

The *Corporate Risk Control Standards – Regulated* guide energy price risk-management activity. Risk metrics are computed for financial reporting purposes, but Entergy does not use them for financial risk management. The nature of the program makes failure of a counterparty the principal risk. Losses would be restricted to the difference between the market price and the hedged price. Nevertheless, Entergy's Credit department monitors counterparty credit carefully. It updates credit evaluations for all counterparties quarterly, and communicates "watch" lists and trading suspensions via e-mail to Company staff as they occur.

The following chart shows the results of the Company's gas-price hedging program for the Audit Period.

Hedging Program Results
(table is confidential)

Month	Quantity Hedged (MMBtu)	Cost of Hedges	Proceeds of Hedge Settlement	Benefit/Cost to EML's Fuel Costs (minus is benefit)
10/2018	[redacted]	[redacted]	[redacted]	[redacted]
11/2018	[redacted]	[redacted]	[redacted]	[redacted]
12/2018	[redacted]	[redacted]	[redacted]	[redacted]
1/2019	[redacted]	[redacted]	[redacted]	[redacted]
2/2019	[redacted]	[redacted]	[redacted]	[redacted]
3/2019	[redacted]	[redacted]	[redacted]	[redacted]
4/2019	[redacted]	[redacted]	[redacted]	[redacted]
5/2019	[redacted]	[redacted]	[redacted]	[redacted]
6/2019	[redacted]	[redacted]	[redacted]	[redacted]
7/2019	[redacted]	[redacted]	[redacted]	[redacted]
8/2019	[redacted]	[redacted]	[redacted]	[redacted]
9/2019	[redacted]	[redacted]	[redacted]	[redacted]
Total	[redacted]	[redacted]	[redacted]	[redacted]

6. Fuel Oil Commodity Contracting and Management

EML's steam plants all had alternate-fuel capability, enabling them to use fuel oils instead of natural gas. The Baxter Wilson and Gerald Andrus plants used No. 6 oil, and Rex Brown used No. 2. EML did not use fuel oils much, as they were higher in cost, and because using them often resulted in ancillary costs, such as higher operation and maintenance costs, and exposure to environmental penalties. In 2018, the Mississippi Public Service Commission found prudent management's elimination of oil-burning capability at Baxter Wilson and Gerald Andrus; the remaining units at Rex Brown were retired earlier this year. The only remaining fuel-oil use is for start-up and flame stabilization at Independence. The following table shows Audit Period fuel oil use (in barrels) at the steam plants.

Audit Period Fuel Oil Burn
(table is confidential)

Year	Month	Baxter Wilson	Gerald Andrus	Rex Brown
2018	October	[redacted]	[redacted]	[redacted]
	November			
	December			
2019	January			
	February			
	March			
	April			
	May			
	June			
	July			
	August			
	September			

Sale of most remaining inventory at Baxter Wilson and Gerald Andrus occurred in the third quarter of 2018. The oil tanks and other infrastructure associated with fuel-oil use are currently being demolished.

Independence regularly requires additional supplies of No. 2 fuel oil. When its inventory is low, the plant notifies the Fossil Fuel Supply group in The Woodlands. Fossil Fuel Supply then sends an RFP to approved suppliers. There are currently [redacted] approved suppliers for No. 2 fuel oil to Independence. The RFP includes product specifications and delivery terms. Fossil Fuel Supply sends a purchase order to the winning bidder.

The following table shows the Audit Period purchases for Independence.

Audit Period No. 2 Oil Purchases for Independence
(table is confidential)

Year	Month	RFPs Sent	Bids Received	Number of Transactions	Quantity (barrels)
2018	October	[redacted]	[redacted]	[redacted]	[redacted]
	November				
	December				
2019	January				
	February				
	March				
	April				
	May				
	June				
	July				
	August				
	September				

Plant personnel measure and report on inventory at the end of the month. A third-party independent inspector measures inventory at the end of the year.

7. *Transaction Analysis*

a. Internal Audit Review

We noted earlier that each of ESL's gas buyers works a particular group of generating stations. The buyers solicit bids for each plant via phone or instant message. Accepted offers are confirmed, and then recorded in the Gas Transactions Database. The buyers keep a log of all offers, accepted and rejected. Rejected offers are retained in a different database.

The Internal Audit Services group (IAS) reviewed this process at the request of SPO's Vice President. The scope of the audit included gas-purchase transactions during January 1, 2018,

through February 28, 2019. The audit focused on the gas-buying process; pipeline, transportation and supplier-invoice reconciliation were excluded, as were: (a) the recording of gas purchases in the general ledgers of the various operating companies, (b) long-term gas purchase and transportation contracts, (c) gas hedges, and (d) Gas Transactions Database controls.

Conduct of the audit involved the following procedures:

- Perform "walk-throughs" of processes related to gas procurement, including short-term gas purchasing, gas scheduling, daily generating-unit pricing and distribution, the counterparty approval process, and back-office duties, in order to obtain an understanding of the distribution of responsibilities among various involved personnel
- Determine whether strategy, policies and procedures surrounding short-term gas procurement exist, and are adequate to perform duties efficiently and effectively
- Perform data analytics on the Gas Database information for scenarios which could indicate behaviors or transactions that may not be in the best interest of the Company.

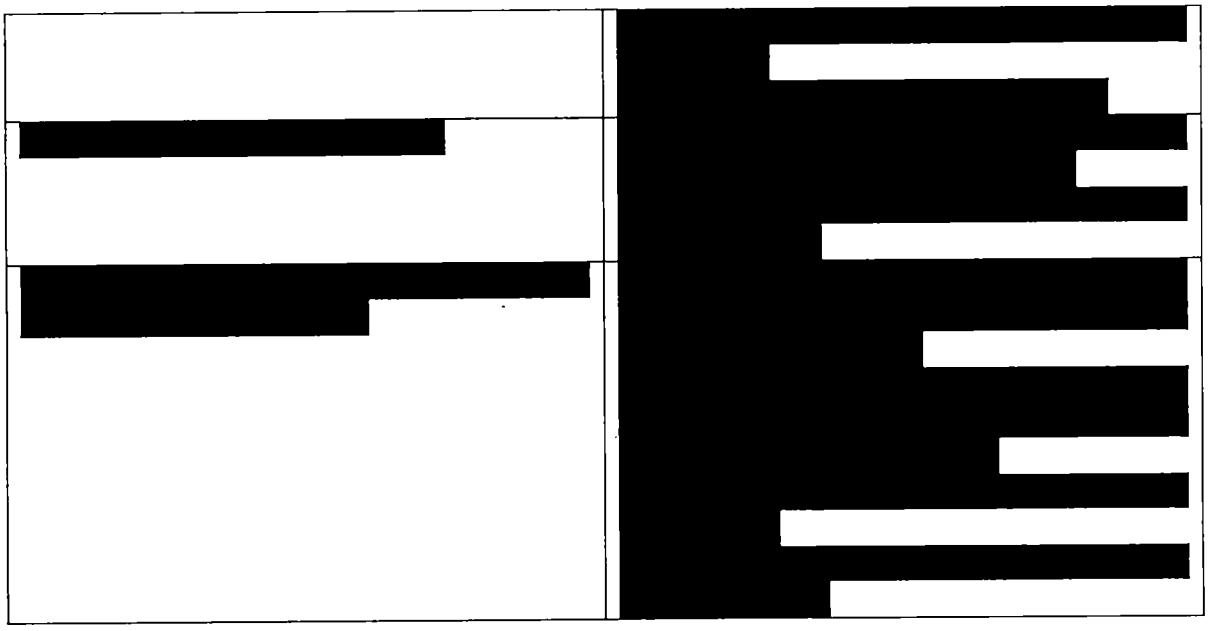
The principal findings of the audit were as follows:

[redacted]

EMO addressed these findings. The following table summarizes its principal undertakings for each finding:

Management Responses to Audit Findings
(table is confidential)

[redacted]



Efforts to address all of Management's commitments are ongoing. IAS's practice is to assist Management's efforts if asked. IAS also tracks Management's progress in meeting its commitments with a special on-line compliance and risk application tool. IAS also reports to the Audit Committee of the Company's Board of Directors on all of its audits, and on all of Management's efforts to address identified deficiencies.

b. Transactions since July 1

We undertook procedures to test natural gas transactions. Our previous audits of both EML and Mississippi Power Company employed a random-sampling process, designed to test various types and categories of transactions to levels of statistical significance. As with our previous Mississippi fuel audits, our testing focused on two comparisons:

- Comparing transaction prices with EML's log of competing offers - - to ensure that natural gas traders selected the offer with the most economic benefit (the lowest purchase price, the highest sales price)
- Comparing prices in relation to relevant, third-party index prices.

As described previously in this chapter, based on the results of an internal audit, and the development of action plans by both Fuel Supply and Internal Audit personnel, internal company resources devoted significant time and effort to these types of activities during our Audit Period. As a result, we were able to review all Audit Period natural gas transactions after the initiation of the pilot program and adoption of revised, and enhanced, transaction record-keeping. Our review included analysis of all transactions from July 1, 2019 through September 30, 2019. For comparison purposes, this resulted in testing over 750 transactions, while our previous audit of EML tested 182.

We reviewed transaction details which included, where available, both comparison points for all Audit Period transactions after July 1. Not all transactions included recording of competing offers. Not all transactions had relevant index points for price comparisons; some transactions occurred

on days where no relevant index price was published. In performing our review, we undertook efforts to perform as closely as possible "apples to apples" comparisons. We looked for transactions and competing offers with the same transaction date, same delivery date, same location (whether delivered to a plant, or to a receipt point on one of EML's pipeline-capacity contracts).

Summary observations from our review follow:

- We were not able to verify with certainty that in all instances EML selected the offer providing the most economic benefit
- We observed transactions occurring at a range of margin to published index prices.

With respect to competing offers, we observed nine transactions that potentially represented either a lower purchase price or a higher sales price opportunity that management did not elect to accept. As with our previous reviews of EML natural gas purchases and sales, we again observed transactions at a range of prices both above and below published index values. Both of these observations we understand to be part of the enhanced tracking, analysis, and reviews which management will undertake after implementation changes post the internal audit.

C. Conclusions

1. Organization and staffing for gas procurement appear stretched in light of new oversight responsibilities. *(See Recommendation #1)*

Entergy's Internal Audit Services (IAS) made important findings and recommendations regarding the conduct of gas procurement. Management has agreed with those findings and recommendations, and has undertaken to implement recommended changes expeditiously. It is not clear that current staffing will remain sufficient to support the continuing duties and responsibilities associated with those changes.

Addressing this question is not as simple as adding staff to Fossil Fuel Supply. Other organizational units will likely have assigned tasks in the continuing oversight of the gas-procurement function. Organization and staffing for the function should be addressed holistically, centering on analysis of what units need to perform what tasks in order for the function to proceed efficiently, but with adequate oversight.

2. Gas purchasing strategy is well suited to the role of gas-fired capacity.

Within MISO, management does not know well ahead of time which plants will run, or at what level, until MISO dispatches them. Dispatch instructions come preliminarily the day before operation, with adjustment later in the day, after MISO's Reliability Assessment run. They may require yet another adjustment on the day of operation. In that environment, [redacted]. This strategy is well suited to the role of Entergy's gas-fired generation.

3. **Pipeline capacity contracting is well coordinated with the role of Entergy's gas-fired capacity in power production, but current contracts should be reviewed when they expire.** *(See Recommendation #2)*

[redacted]

4. **The approach to gas commodity purchasing is sound.**

As one of the largest consumers of gas in North America, located in a region with abundant supplies and suppliers, Entergy has the benefit of access to numerous sources of gas supplies. Management generally welcomes new suppliers, entering a base supply agreement with most any supplier that passes their credit analysis. EML can buy from any of [redacted] suppliers.

As a practical matter, ESL's buyers make it their business to know which suppliers can provide supply to the Company's principal supply points. Each buyer focuses on particular plants; the Desk Manual for each plant has the name and contact information for suppliers who are known to have supply available at the principal points for that plant. The Desk Manuals are updated periodically, particularly with current information about suppliers that can be relied on for each plant.

5. **The Company's secondary-market activities are sufficient for its circumstances.**

ESL's principal secondary-market activity is selling back into its markets supplies that turn out to be excess due to changed dispatch by MISO, or due to a reduced operating level. ESL's gas buyers handle that task effectively, as they do supply acquisition.

At the recommendation of last year's auditor, ESL tried to place some of EML's surplus capacity on the Columbia Gulf system by posting it on the pipeline's electronic bulletin board. To date, there have been no offers for the capacity, but ESL continues to post it.

6. **ESL's fuel-oil supply management, small in scope, has been performed effectively.**

The role of fuel oils in EML's power generation has diminished to the point that inventory has been removed from the dual-fuel plants in Mississippi and the storage tanks are being removed. The only remaining fuel-oil use is start-up and flame stabilization at Independence.

Long-established processes and procedures for procuring and maintaining that supply are in place, and are being followed. Supply management is satisfactory.

7. EML's hedging program operates effectively in serving its established objectives.

EML began the hedging activity some years ago at the behest of the Mississippi Public Utilities Commission. The objective of the activity has always been gas-price stabilization, and the program has been designed and implemented to that effect. Gas prices have otherwise stabilized considerably over the period since the program was initiated, so the proportion of supply that is hedged has been reduced. The program continues to do what it is supposed to do.

8. The transaction records maintained by EML as a result of the internal audit are reasonably complete. *(See Recommendations #1 and #2)*

Our testing observed a number of transactions and associated information regarding pricing, volume, counterparts, and other information. We also reviewed similar information for competing offers, where available. Some data points were, however, either omitted from these records or not clear.

9. Some observations from our natural gas transaction review warrant follow-up attention by management. *(Recommendations #1 and #2)*

We found the types of information management has undertaken to record reasonably comprehensive. It provides a valuable tool in providing oversight over natural gas transactions, particularly when coupled with management's intention (as expressed to us during interviews) that it will follow up on issues which present themselves in the data. Our understanding is that includes some of the larger variances or margins to index in transactions. For those that indicate the higher margins, these indicate areas where management review would indicate an area of improved controls. Also included should be the instances of transactions where we were not able to verify that the most economic transaction was selected amongst available offers. Those include:

- Gerald Andrus
  - A September 12 multi-day purchase
- Attala
  - An August 26 Intraday sale
  - An August 28 Intraday sale
  - A September 2 Intraday sale
  - An August 1 Intraday purchase
  - An August 12 Intraday purchase
  - Two September 19 Next Day purchases
  - Two September 20 Next Day purchases
- Hinds
  - Two June 26 Monthly purchases.

D. Recommendations

1. Review organization and staffing for the gas procurement function. *(See Conclusion #1)*

Gas procurement has always proceeded efficiently at Entergy, thanks to a capable and experienced staff. The recent internal audit found, however, that the function needs additional oversight. IAS recommended improvements in other aspects of controls, including documentation and process and procedures improvements.

SPO's Fossil Fuel Supply group and the Back Office group have undertaken to address IAS's recommendations. Participation by both groups indicates the scope of the required improvements. We recommend that part of this effort be a careful assessment of the distribution of responsibilities involved in implementing the improvements. If these duties are not properly organized and staffed, they are unlikely to be discharged effectively.

Fossil Fuel Supply and Back Office should report to IAS on the organization and staffing aspects of their improvement actions, as well as the substantive aspects. IAS should insist that organization and staffing be sufficient to ensure that their recommended improvements be implemented effectively.

2. Review alternatives as pipeline capacity contracts expire. *(See Conclusion #3)*

Last year's auditor found that EML's firm-capacity contracts on Texas Eastern were well utilized, but that the Columbia Gulf contract for Baxter Wilson was under-utilized. That firm recommended performing a cost-versus-reliability benefit analysis of continuing to contract for firm transportation before renewing those contracts, noting that the annual reservation fees for the two contracts on Texas Eastern amount to more than $2 million. The Commission took note of this recommendation, but deferred action on it pending the results of this (2019) audit.

We share the view that the need for the firm capacity contracts should be examined before renewal, but we recommend a broader inquiry. Demand for capacity on particular segments of pipeline systems can be ascertained from publicly-available data. Such data should provide a good indication regarding the necessity of contracting for firm capacity. Moreover, the Attala plant is connected to two pipelines. Each of those connections has physical capacity well in excess of the maximum requirements of that plant. Perhaps Attala should switch to delivered supply, as well.

Another factor is the changing flow patterns among gas pipelines. With increasing amounts of supply available in the Marcellus-Utica producing region of Pennsylvania, West Virginia and Ohio, many of the pipelines emanating from the U. S. Gulf Coast are reversing their direction of flow. The changed flow patterns are affecting basis differentials; thus, the availability and price of supply on pipelines in the region are changing in ways that might make switching pipelines desirable.

The required analysis is not necessarily simple. There may be advantages in terms of delivery flexibility to having two generating plants with firm capacity contracts on the same pipeline, for example. Our recommendation is simply that the analysis should be done, and decisions regarding

whether to renew the expiring contracts for firm capacity should be made on the basis of the analysis.

3. **Ensure follow-up on plans to continue tracking, recording, and follow-up investigations of transaction matters.** *(See Conclusions #8 and 9)*

The current process lays a strong foundation for enhanced and thorough controls and transaction reviews. If management indeed continues these actions, and moves forward with plans expressed to us, it will follow up on items such as index-price deviations and instances of questions regarding the selection of offers, and EMO will have in place extra layers of controls that will permit enhanced oversight of transactions and confidence in actions undertaken.

4. **Investigate potential occurrences of the selection of transactions that may not have been the most economical; proceed with plans to examine instances of high margins to index prices.** *(See Conclusions #8 and 9)*

We observed nine transactions where it appears that the most economic offer was not chosen. Management should explore these instances and, if appropriate, quantify the value difference and credit that difference to customers. We believe that our analysis takes a form consistent with the Company's IAS envisioned in its recommendations for gas-purchasing process improvements. We plan to review management's analysis of these transactions in the next audit.

VI. MISO Operations

A. Background

System Planning & Operations (SPO), as part of the Entergy Services, LLC (ESL) organization, provides centralized planning and operational services to the Entergy operating companies, including EML. SPO's many functions include those performed by its Energy Management Organization (EMO), which has direct responsibility and accountability for managing participation in the Midcontinent Independent System Operator (MISO). MISO has a large footprint, covering all or part of Arkansas, Illinois, Indiana, Iowa, Kentucky, Louisiana, Michigan, Minnesota, Mississippi, Missouri, Montana, North Dakota, South Dakota, Texas, Wisconsin, and the Province of Manitoba. EMO provides market operations and planning services.

The Director of EMO manages the work of three primary groups that handle daily operations, organized under separate managers:

- Manager of Market Operations (primarily day-ahead market operation)
- Manager of Real-Time EMO (engaging in MISO's real-time market)
- Manager, Fossil Fuel Supply (interacting with both real-time and day-ahead operations).

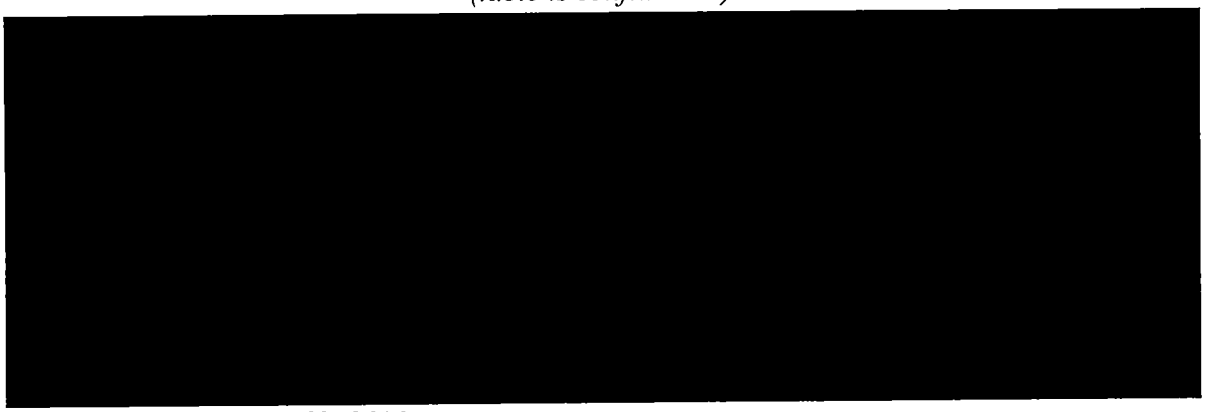
Like other ISOs, MISO focuses on providing a secure, reliable energy grid, and overseeing an efficiently-operated energy market. An Independent Market Monitor (IMM) ensures efficiency, and monitors participant conduct across MISO, which consists of three sub-regions: North, Central, and South. The Entergy operating companies, including EML, operate in the South sub-region.

Prior to joining MISO, EML and the other Entergy operating companies operated under an Entergy System Agreement (ESA), which sought to minimize total system supply cost, while ensuring supply adequacy. The ESA governed central dispatch, cost-saving, and revenue-sharing among the operating companies. The SPO performed generation dispatch centrally on behalf of the operating companies. Following the Mississippi operating company's ESA exit in November 2015, SPO has continued to provide central services for the operating companies through the present. Its role has changed from control of dispatch to management of Entergy operating company participation MISO, whose operators have responsibility for matching electricity supply and demand.

1. EML's Fossil Generation Portfolio

EML's supply resources include its share of output and costs from the Grand Gulf nuclear station, and the five fossil fuel-fired power plants (10 units) displayed in the next table. The table lists the basic operational and economic parameters of each unit.

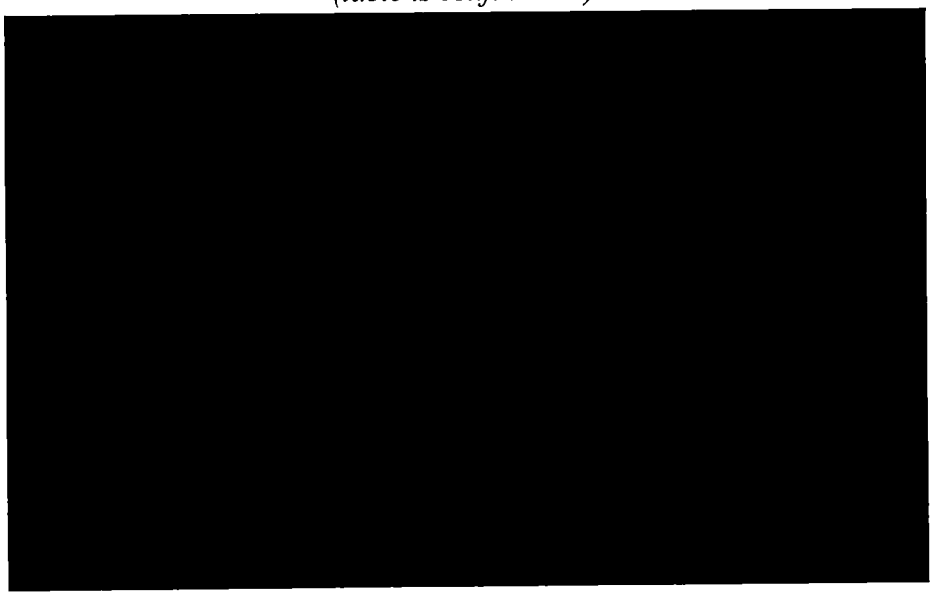
EML Fossil Generation Resources (2018 Data)
(table is confidential)



VO&M means variable O&M.

EML's supply portfolio also included until recently the Rex Brown plant, the last two units of which were retired in 2019. It played only a minor role in providing energy to EML, dispatching at an average of just six percent of its capacity over the five-year period from 2013-18. The next figure plots the dispatch cost of these units on an "adjusted" MISO supply curve, showing generally where they rank in economic order within MISO.

MISO Fossil Supply Curve (Adjusted)
(table is confidential)



This supply curve shows just plants within MISO that burn gas and coal, inclusive of coal-fired steam generators, gas-fired steam generators, and gas-fired CTs and combined cycle units. It is designed to show the relative competitive position of EML's assets within the larger MISO arena. The results vary widely with the Independence units being highly competitive, while Baxter

Wilson and Gerald Andrus are far less competitive. This display of costs leads to the discussion of the dispatch that is derived from it.

2. Dispatch Operations

EMO's dispatch-related functions include bidding generation into MISO's day-ahead (DA) and real-time (RT) market. The majority of MISO-dispatched energy takes place in the DA market. EMO has moved only a percent or two of its production in into MISO is in the RT market. Nonetheless, the RT market remains critical in balancing supply and demand based on actual market conditions in real time as market conditions fluctuate. The RT market therefore exhibits significantly more price volatility than the DA market does. The RT market therefore affords market participants opportunities to generate profits at potentially higher margins per MWh than those that can be achieved in the DA market, although with far less volume. MISO also operates reserve markets in addition to the DA and RT energy markets. These three operating reserve markets ensure reliability and power quality. The three reserve markets consist of regulation/automatic generation control (AGC), spinning reserve, and supplemental contingency reserves.

MISO offers two options for generators to make bids, known as "resource offers," into the DA market: self-scheduling and economic offer. The first, made for a self-scheduled period, obliges the maker of an accepted offer to run at a particular load level, taking whatever prices market conditions dictate during that period. The resource offers consist of key operational and economic parameters that MISO collects from all Market Participants. The second type, economic offers, include bid prices that include startup cost, no-load cost, and incremental energy cost.

SPO uses the strategy matrix shown in the next table to guide its efforts in producing resource offers for its various asset types for all its operating companies. We focused particularly on the fossil fuel units, shaded in the table, reflecting the coal and gas-fired units that comprise EML's fossil resources. In addition to the fact that all of EML's owned generating assets are fossil units, the hydro and nuclear assets are not subject to economic dispatch but are must-run resources that generated whenever online.

Day-Ahead Offer Strategy
(table is confidential)

[redacted]

The strategy table guides how SPO presents its units to the market, in what are called "resource offers" within MISO. A resource offer essentially comprises a bid of the unit's cost to provide generation into MISO at specific levels and prices. The strategy [redacted]

[redacted]. It also means that the units will produce more power whenever market prices exceed the unit dispatch cost. Because the coal plants are [redacted] All of Entergy's fossil units are dispatched on the basis of comparing the units marginal dispatch cost with MISO market prices.

EMO conducts DA market bidding and offer submission under a complex series of processes that begins at 5 am daily, and concludes after 5 pm. The series of established processes and protocols begins with an update of plant status, gathers fuel prices, performs a load forecast, submits resource offers to MISO, and sends operating instructions to plant operators. Each day, a morning meeting covers expected load, generating unit status, the gas market, and coal issues (inventory and prices). An appendix to this chapter provides a flow chart and schedule of the processes that together address the flow of the day-ahead processes.

3. *Load Forecasting*

Two independent models support load forecasting: PRT and Tesla. The models are fed actual load data and temperatures from the previous day, along with forecasted temperatures for the next six days. Model updates at least hourly keep EMO personnel apprised of load conditions. Modeling produces two independent six-day load forecasts used for determining submit load bids to MISO.

EMO tracks the accuracy of each of the two load forecasting models, to gauge which currently provides more accurate load projections. The models utilize artificial intelligence algorithms to "train" themselves to maintain accuracy and both models are generally accurate. A third model developed with SAS is under review for consideration to augment the current two.

As a load-serving entity, EML's load is bid into MISO's day-ahead and real-time markets based on the forecasting tools and processes previously described. These hourly loads become part of MISO's commitment and dispatch modeling process that ultimate determine locational marginal prices as a function of the cost marginal cost to serve system load.

B. Findings

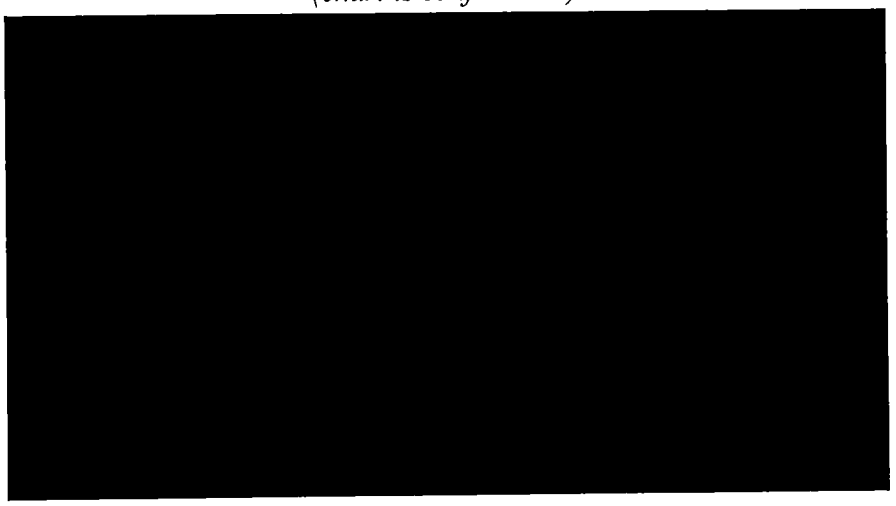
1. *Fossil Generating Resources*

Generating unit dispatch follows an extremely sophisticated set of processes that must take into consideration market conditions, supply curve characteristics, individual generating unit parameters and constraints, and system reliability. Economic dispatch supports matching supply and demand at the lowest possible cost. The process seeks to dispatch the lowest cost units first, supplementing them with higher-cost units as needed.

There should, overall, exist a negative correlation between a generator's dispatch cost (as defined by its fuel cost and non-fuel variable O&M cost, in $/MWh) and its capacity factor. The more

expensive a plant is to run, the less it should operate, and vice versa. We examined the dispatch of EML's fossil units by plotting dispatch cost and capacity factor for each unit (2018 data), which the next figure depicts.

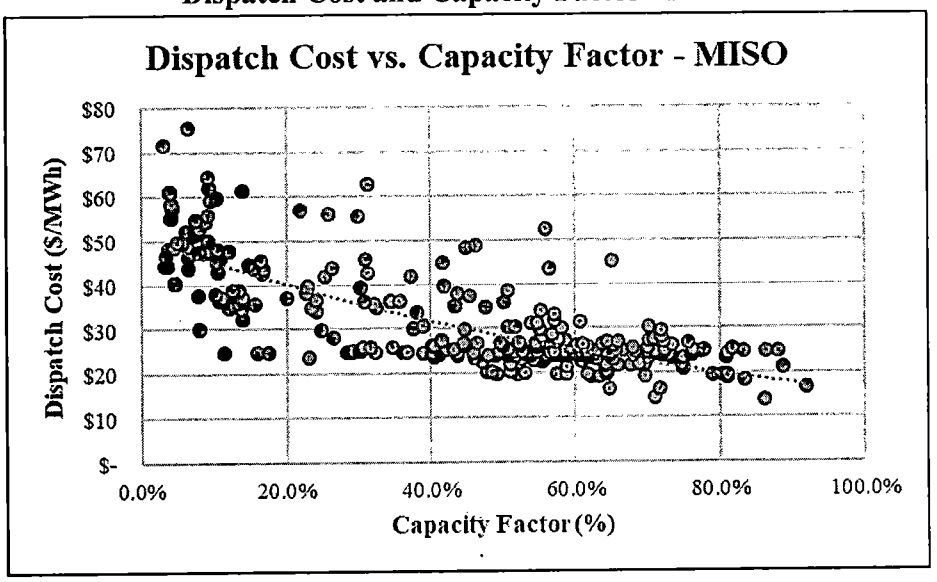
Dispatch Cost and Capacity Factor
(chart is confidential)



EML's units follow this basic principle. The Hinds CC was dispatched at a [redacted] capacity factor then both Independence units, [redacted]. Overall, though, the fossil fleet shows the expected relationship between dispatch cost and capacity factor.

We extended this baseline analysis to view the relationship between dispatch cost and capacity factor for MISO fossil generators as a whole. The next figure displays this relationship. Specifically, the blue dashed line represents the exponential curve that most closely defines the relationship between cost and output.

Dispatch Cost and Capacity Factor - MISO

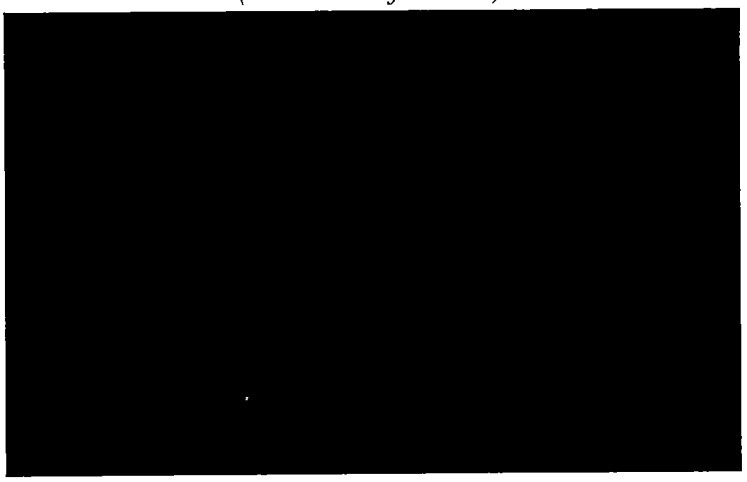


The interesting element of this analysis is the relationship between the two charts, as indicated by the blue dotted exponential curve in each. The curves are similar, based on viewing some data point intersections. On each chart, a dispatch cost of $30 per MWh reflects a capacity factor of approximately 40 percent. Also, on each chart, a dispatch cost of $22.50 reflects a capacity factor of approximately 70 percent. This has two important takeaways.

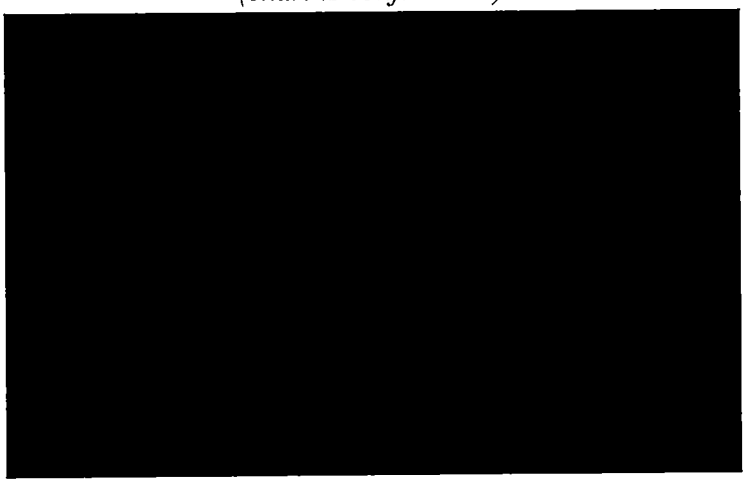
First, the units exhibit the expected negative correlation of cost to capacity factor. Second, and more importantly, this analysis indicates that EML's units are dispatched in the same manner as the much large sample inclusive of all of MISO. While on the surface this may only seem to be a credit to MISO itself for fairness and consistency in its commitment and dispatch logic, it also has a positive implication for EML. While dispatch cost is an economic signal that leads to dispatch, the units must be available to operate in order to achieve dispatch and revenue. The fact that these curves are so similar indicates that EML units are on par with MISO's units as a whole in terms of availability for dispatch.

Another way to look at dispatch is to look at each plan over time, plotting the dispatch cost and capacity factors on the same chart, but with different axes. The next six charts display the five EML fossil plants, with each unit of Independence displayed separately (the Attala and Hinds combined cycle plants were each represented by one unit, since they are of nearly identical dispatch cost and capacity factor).

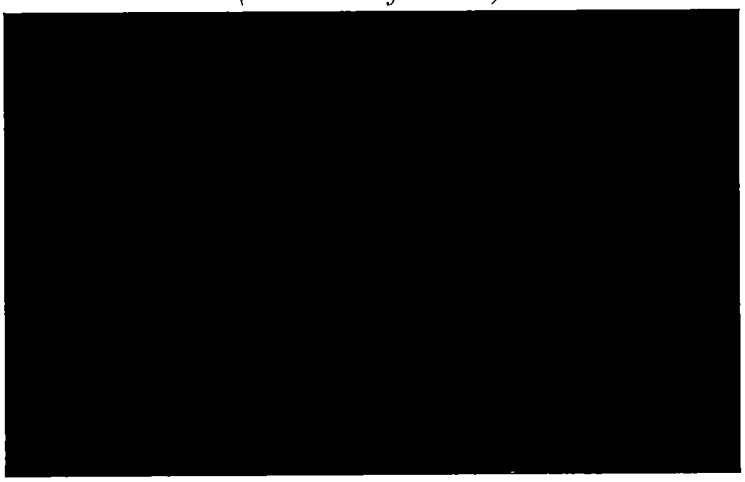
Dispatch Cost and Capacity Factor - - Attala
(chart is confidential)



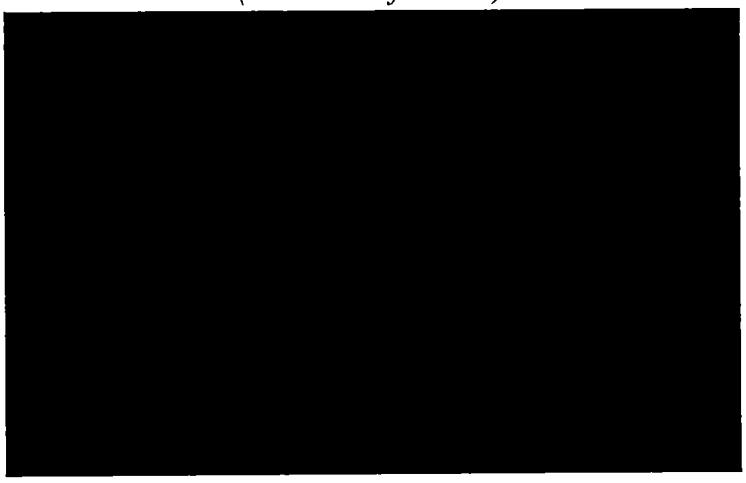
Dispatch Cost and Capacity Factor - - Baxter Wilson
(chart is confidential)



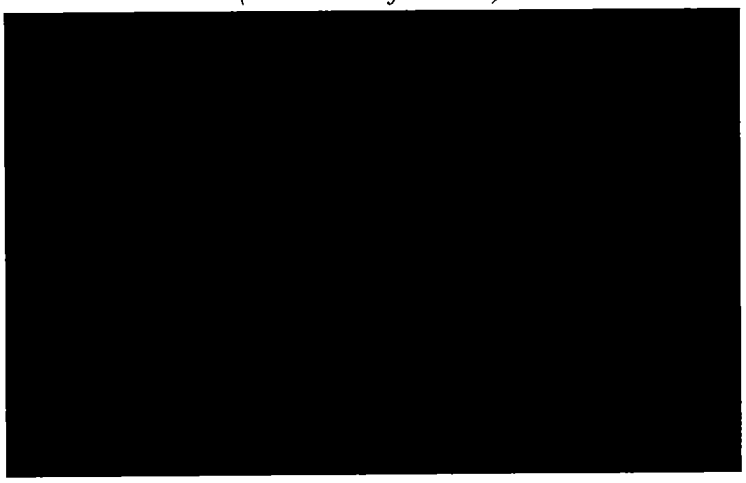
Dispatch Cost and Capacity Factor - - Gerald Andrus
(chart is confidential)



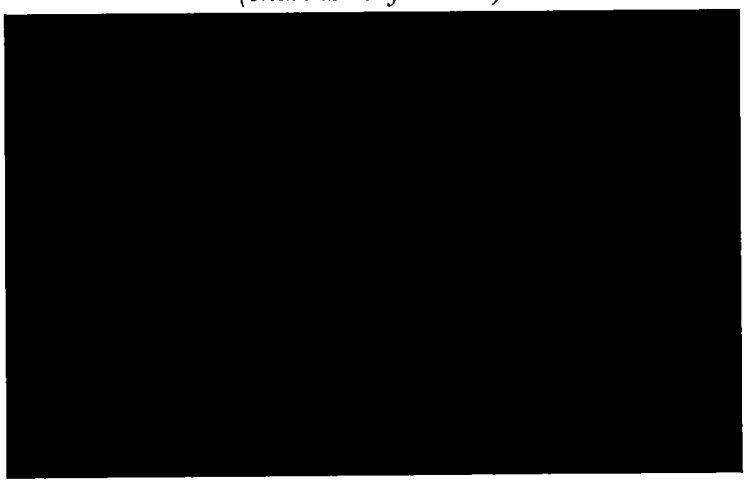
Dispatch Cost and Capacity Factor - - Hinds
(chart is confidential)



Dispatch Cost and Capacity Factor - - Independence 1
(chart is confidential)



Dispatch Cost and Capacity Factor - - Independence 2
(chart is confidential)



The capacity factors for Independence 1 and 2 merit further discussion. There has been some concern in previous audits related to the coal inventory at Independence. Specifically, there was concern that the units were being dispatched in an uneconomic manner in an effort to reduce coal inventory.

Based on the capacity factors and dispatch costs displayed in the two time series charts for Independence 1 and 2, energy production (and therefore, fuel consumption) have risen dramatically since 2015. However, it is equally, or even more, notable that the dispatch costs at both units have also fallen dramatically. That is, the increase in energy production and coal consumption at Independence appears to be completely appropriate given the change in dispatch cost.

Moreover, the scatter plot showing the relationship between dispatch cost and capacity factor for the EML units indicates that Independence is almost exactly on the exponential curve that defines the best fit for the data. Since the curve is very similar to that of MISO as a whole, this indicates that Independence is being dispatched at a capacity factor commensurate with its assigned dispatch cost.

2. *Grand Gulf*

EML's resource portfolio includes an allocation of the output and costs of Entergy's 1,443 MW Grand Gulf nuclear station, jointly owned by Entergy's System Energy Resources, Inc. (SERI) which owns 90 percent and Cooperative Energy which owns the other 10 percent. Through the Unit Power Sales Agreement ("UPSA"), EML receives 33 percent of SERI's portion of Grand Gulf energy and capacity.

According to the LEI report, using May 2017 as a cost and quantity reference point results in costs to EML of [redacted] for its share of Grand Gulf's output. This period was chosen by LEI, and referenced by Liberty, due to the high capacity factor achieved in that month. Cost per MWh is a function of capacity factor, with higher capacity factors reflecting lower per-unit ($ per MWh) cost. As such, using this month presents a conservative comparison. Unfortunately, these costs are still very high when compared to the average market price in MISO's MS hub (*e.g.,* $33.46 per MWh in 2018). EML is paying [redacted] than it would pay to buy the same quantity of power from MISO's day-ahead market.

When production at Grand Gulf is curtailed for any reason, the costs continue and the energy must be replaced by other sources, exacerbating the above-market costs of Grand Gulf. This is due to the fact that most nuclear plant O&M expenses are fixed, not variable. Loss of production from Grand Gulf costs EML an additional [redacted] for replacement power from MISO.

While energy from Grand Gulf is economically uncompetitive, however, its presence in the MISO energy and capacity markets needs to be considered as well. For example, if Grand Gulf ceased to provide energy and capacity within MISO, the energy and capacity markets could be changed (in the form of higher commodity prices). This economic theory is sound in that all other things equal, a decrease in supply leads to increases in price. Grand Gulf's 1,443 MW amounts to three-quarters of a percent of MISO's approximately 180,000 MW of capacity.

MISO currently has a large supply of capacity, 180 GW, relative to its system peak of about 130 GW. This ratio of supply to demand has produced very low capacity prices within MISO, which are currently at $3 per MW-day. By comparison, PJM capacity are prices typically in the $100-200 per MW-day range. To put the low MISO capacity prices into perspective, at $3 per MW-day, Entergy could replace its portion of the capacity from Grand Gulf for just $1.4 million per year. Liberty understands that the absence of Grand Gulf could impact market prices, and that would require a substantial analytical initiative to ascertain.

3. *Organization & Staffing*

The organization has changed little in recent years, reaching a steady-state post-ESA and since joining MISO. The organization appears to be well-run, well-managed, and staffed by experienced

staff. The processes involved in the DA market participation, in particular, are sophisticated and require a well-choreographed sequence of tasks in order to be performed. It is based on a variety of data inputs, models, and groups within SPO.

Key to consistency in the processes is staff. Acquiring talent from within and without, limiting turnover, avoiding vacancies, and providing training are all part of establishing a competent team. Management of the planning and operations processes appears to be competent and supportive of the needs of the organization. The models used in all aspects of planning and MISO operations are state of the art and are in a mode of continuous improvement. For example, with two effective load forecasting tools, a third is under development to augment the portfolio of tools for this function. Established, high-end models such as PCI's GenTrader and AURORA are examples of the excellent tools available to support the functions of the group. Moreover, the staff is experienced in the industry and well trained.

4. *Status of 2018 Audit Recommendations*

The report of the most recent fuel and energy audit included three recommendations related to MISO operations. They concerned cybersecurity at its third-party vendors/contractors, monitoring the accuracy of DA market projections for fossil units, and SPO's ARR/FTR strategy. We requested updates from the Company on the status of each issue and reviewed each. Our findings are as follows:

a. Cybersecurity Recommendation

This recommendation stated:

> *Given that one of SPO's load forecast providers was impacted by a cyber-attack, and that cyber-attack has become an increasingly major safety issue in the U.S., SPO should follow up with the affected provider to ensure measures are put in place to reduce the risk of future attacks that could disrupt service. SPO should also consider requesting security audits of other providers, and consider cyber security measures is put in place by potential providers as a criterion when selecting service providers.*

SPO has addressed cybersecurity concerns at its vendors in two ways. First, it states that it has "followed up with the load forecasting provider and confirmed the additional security measures that the provider put into place following the cyberattack." Second, it was requested that EML request audits of its other providers as well. Entergy has responded that several of its cybersecurity policies and procedures are already in place for ensuring third party vendor cybersecurity. However, no detail was provided on how this is performed, leading to a key conclusion and recommendation on this subject.

b. Back-casting Daily Unit Forecasts

This recommendation stated:

> *LEI recommends that, in addition to monitoring its daily DA market activities, SPO should also establish a mechanism to back-cast and review the accuracy and reasonableness of the unit forecast for its gas and coal units to understand the actual costs, revenues, or missed revenues, associated with the daily decision-making. Without such a reporting system, it is impossible for the Market Operations group to assess effectively whether the*

accuracy of the daily decisions to commit, or not, the coal plant, or to purchase, or not, day-ahead natural gas. Such reports, over time, would provide valuable insight into the performance of the daily decision-making process.

Continuous monitoring and approval of daily forecasts and ultimately overall operations is important. Back-casting to test the efficacy of forecasting to capture opportunities and avoid risks in the DA and RT markets forms part of doing so. SPO has agreed to develop and implement a back-casting program, which is in the implementation phase.

c. ARR/FTR Strategy

This recommendation stated:

LEI generally agrees with EMI's nomination strategy for ARRs, although LEI would suggest [redacted]

We find SPO's strategy for nominating ARRs generally appropriate, but share the prior auditor's concerns about adjusting the strategy as market conditions change. There has been no change in SPO's strategy since the prior 2018 audit. We find that result expected, given the relative stability of pricing and market conditions that enable the current strategy to remain effective as a hedge against congestion costs.

C. Conclusions

1. **EML's planning functions, provided by ESL, are well run by experienced personnel and management and feature state-of-the art models and processes.**

The planning organization of SPO (System Planning & Operations) provides centralized services in support of EML as well as the other state-level utility operating companies within Entergy. The models used by the organization are well established within the industry and are under continuous review for improvement opportunities.

2. **EML's market operation functions, provided by SPO and based on MISO participation, are run well by experienced personnel and management, with only minor issues related to certain dispatch characteristics described below. Actual dispatch is out of SPO's hands as it is dictated by MISO.**

As a MISO member, Entergy generating units are dispatched economically (and centrally) by MISO. Most of the energy dispatched is in MISO's day-ahead market, based on a well-established and effective team and processes that submits bids for supply at specific price and quantity (MW)

levels. A balancing real-time market is monitored effectively for opportunities to sell additional generation into MISO as needed based on market conditions.

3. EML's dispatch appears appropriate, with only minor concern for the relative dispatch levels between Independence and Attala.

In general, over the audit period, dispatch, as defined by capacity factor, shows an appropriate negative correlation with dispatch cost (i.e., units with lower dispatch costs have higher capacity factors). Dispatch cost is the plant's variable cost, mostly fuel, that is bid into MISO for economic dispatch in both the day-ahead and real-time markets. From 2013-18, in general, EML's lower-cost units have higher capacity factors than higher-cost units. The exception is Independence which at times has lower dispatch cost than both Attala and Hinds CCs, yet lower capacity factor.

4. Dispatch at Independence may actually be lower than it should be.

As discussed in Conclusion #3, lower-cost units should dispatch more than higher-cost units. However, in two of the past five years, this was not exactly the case for Independence. In 2014, Independence Unit #1 had substantially [redacted] dispatch costs than Attala, but dispatched slightly [redacted] than Attala. In 2018, both of the Independence units had [redacted] dispatch costs than Hinds, but dispatched [redacted]. On the surface, this indicates a potential problem with dispatch. However, this may be able to be explained by reliability needs, flexibility of CCs vs. coal plants, or outages/availability.

5. Independence does not appear to be dispatched in a manner that is uneconomic in an attempt to reduce coal inventory.

We examined concerns about high coal inventories, and considered whether the company was attempting to lower its inventory by running Independence more than it should otherwise run from an economic standpoint. Over the last several years, 2013-18, capacity factors at the Independence units have varied from as high as [redacted] at Unit #2 in 2015. Dispatch at both units has increased noticeably since 2015, but the level of output is commensurate with decreases in reported dispatch cost at the plant. The increased level of dispatch is appropriate based on the reduction in costs. While EMO could self-schedule Independence (to run at a set output level as a price taker) there is no benefit to Entergy to operate the plants at a loss.

6. Grand Gulf is an economic burden to EML when running at high capacity factor and is even worse when production drops. *(See Recommendation #1)*

According to the LEI report, using May 2017 as a cost and quantity reference point results in costs to EML of [redacted] for its share of Grand Gulf's output. This period reflects relatively favorable conditions given the high capacity factor observed. Unfortunately, these costs are very high when compared to the average market price in MISO's MS hub ($33.46 per MWh in 2018). EML is paying [redacted] than it would pay buying power from MISO's day-ahead market.

When production at Grand Gulf is curtailed for any reason, the costs continue and the energy must be replaced by other sources. This is due to the fact that most nuclear plant O&M expenses are fixed, not variable. As such, loss of production from Grand Gulf costs EML an additional [redacted] for replacement power.

7. SPO should complete the implementation and evaluation of its back-casting program. *(See Recommendation #2)*

According to SPO, it agreed with LEI's recommendation for back-casting, and is in the process of implementing the program. SPO should make back-casting a priority and complete implementation and evaluate performance of the process. Only through the implementation of an effective back-casting/monitoring program can the organization be assured that its tools and processes are adequate in identifying opportunities and risks in the market.

8. SPO's cybersecurity programs present a large unknown.

SPO acknowledges the importance of ensuring that third party vendors do not cause cybersecurity breaches, but the exact measures it takes remain unclear. SPO provides mission-critical processes for EML and also houses highly sensitive competitive information.

SPO is not alone in these regards among the many functions required to deliver or support the delivery of electricity. Cybersecurity is of utmost importance in an environment facing increasing numbers and sophistication of cyber threats. Addressing them takes a structured, coordinated set of measures designed and applied by a large and sophisticated organization, and supported by training in behaviors to be applied by all employees and contract resources.

We have familiarity with examining the effectiveness of cyber security in the large electric utility holding company context. We find it difficult to address the needs in the narrow context of this fuel and energy audit. However, the recent existence of a vendor event and the generalized information Entergy has provided about corrective measures, we believe that the Commission would be correct in asking more broadly how Entergy manages cyber security overall, not just with respect to fuel and energy management. Such an inquiry has implications well beyond fuel and energy management, and should be considered and, if undertaken, take a broad view of the subject.

D. Recommendations

1. Investigate options for relief from Grand Gulf expenses. *(See Conclusion #6)*

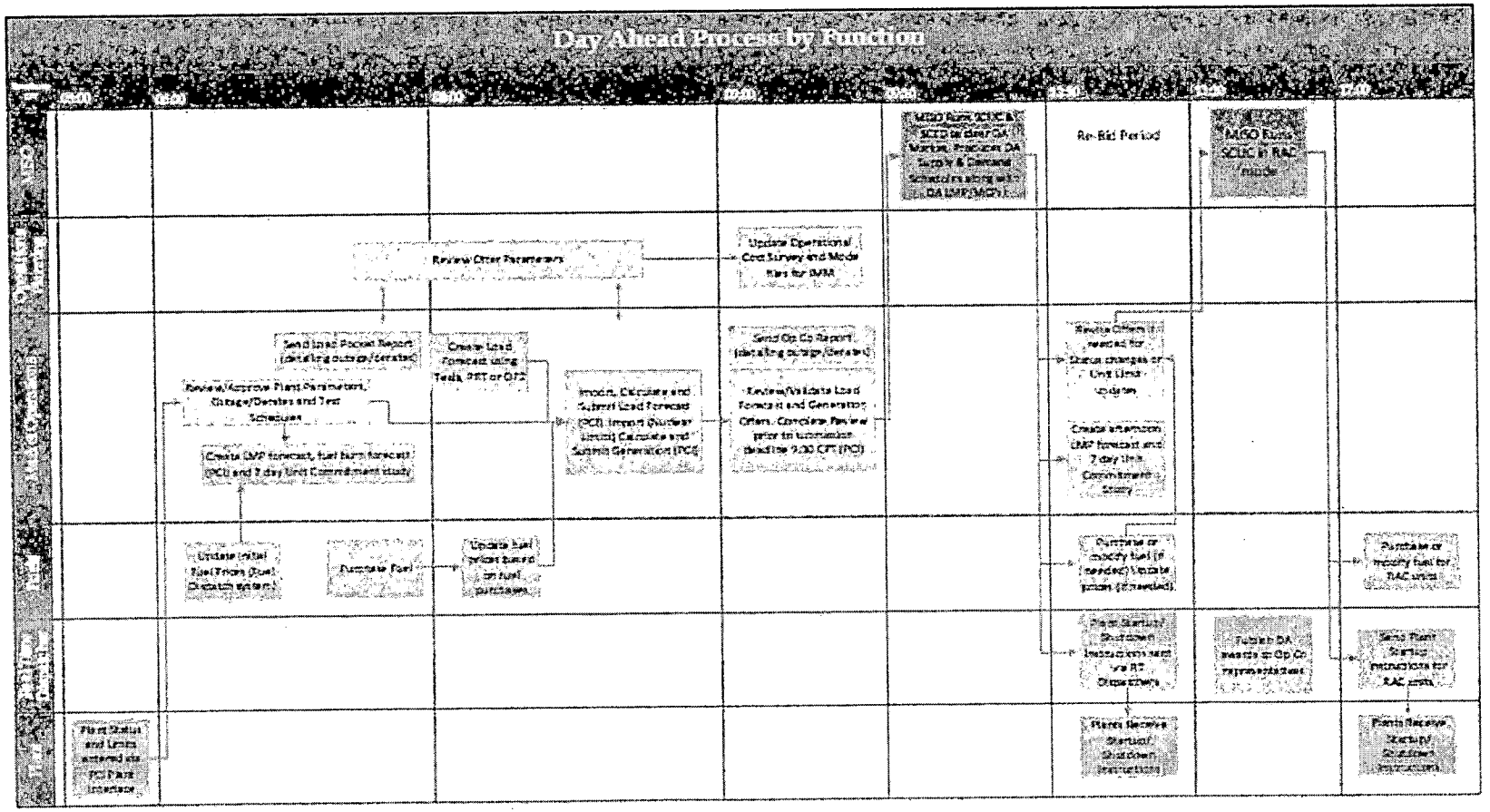
A key benefit of joining MISO is access to a larger, robust energy market as a buyer and a seller. Grand Gulf's costs to EML are above market and are a burden to EML, which is exacerbated by any reduction in capacity factor. EML should consider all options for mitigating Grand Gulf costs.

This initiative should be based on a market modeling effort that captures the before and after effects of retiring Grand Gulf. The result would be an understanding of the impact on MISO's energy and capacity market prices and the subsequent impact on Entergy and EML's energy and capacity costs.

2. Finalize and implement a back-casting process. *(See Conclusion #7)*

EML must make strides to develop an effective back-casting process and implement it as soon as reasonably possible. This should be a priority.

Chapter VI Appendix: Day-Ahead Process Timeline



VII. Power Plant Operations

A. Background

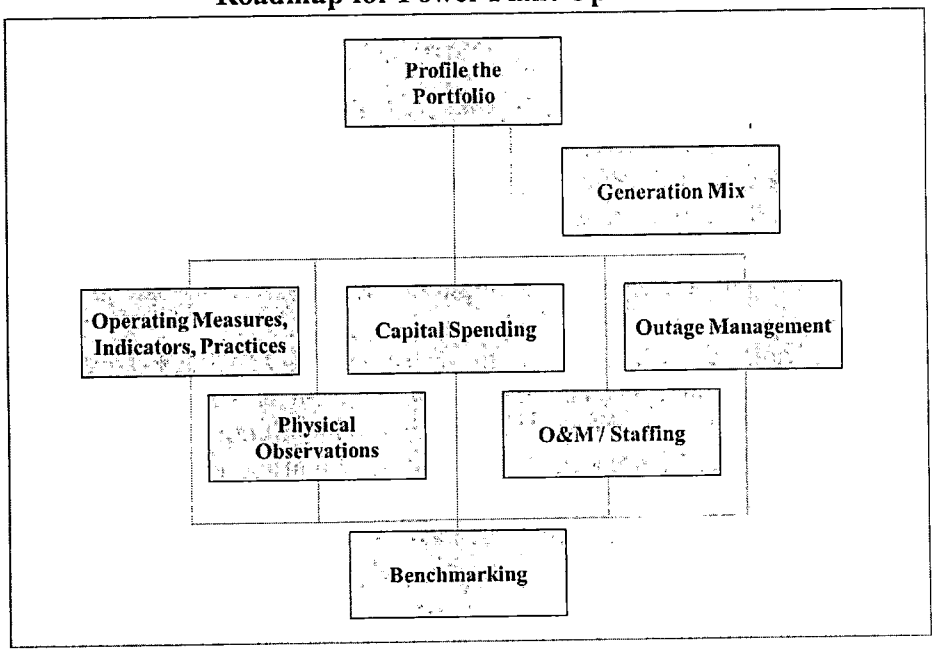
Fossil generation continues to face challenges not present many years ago. Drastic reductions in natural gas prices, a rise in the number of units fired by natural gas, continuing environmental concerns, and support for renewable energy technologies have created existential threats to coal units, as plans for retiring Entergy's Independence and White Bluff units underscore. Even natural gas and nuclear plants face significant challenges.

Coal and nuclear plants increasingly operate out of the baseload mode for which they were designed. Capacity factors for coal plants have been particularly hard hit, particularly in markets like MISO, rich in capacity, much of it natural gas fired. Such changes do not obviate use of traditional measures like heat rate and capacity factor as indicators of generating organization effectiveness. They do, however, invite the use of additional indicators and programmatic issues to determine how well a particular generating organization is performing.

The term "operational excellence" has gained common use in the generation business. The concept seeks a more wholistic look at plant operations than what plant indicators alone offer, although plant indicators remain an important part in examining operations effectiveness. For example, heat rate clearly remains an important indicator, however, heat rate will vary depending upon the plant operations such as cycling the plant due to economic dispatch. Therefore, other aspects of plant operations such as maintenance, outage management, root cause analysis, safety, and other programs require examination.

Liberty focused our review in this portion of the audit on the roadmap depicted below.

Roadmap for Power Plant Operations



Our analysis focused on the following operations topics:

- Mission
- Organizational Structure
- Training and qualifications of plant personnel
- Unit performance as measured by traditional indicators/operating measures for power plants such as: capacity factor, forced outage rates, availability, and heat rates
- Outage Management including a look at the program, the outages, the indicators, and the outage reports.
- Operations and maintenance costs (O&M) and staffing
- Capital Spending
- Maintenance indicators
- Benchmarking.

B. Findings

1. EML Power's Thermal Fleet

EML operates a diverse fleet of thermal generation units, ranging in age from 18 to 52 years measured from their commercial operation dates (COD). The large coal units are 35-36 years old – comparatively new compared to the large number of units over 50 years old, located primarily in the U.S. Northeast region.

EML Thermal Fleet

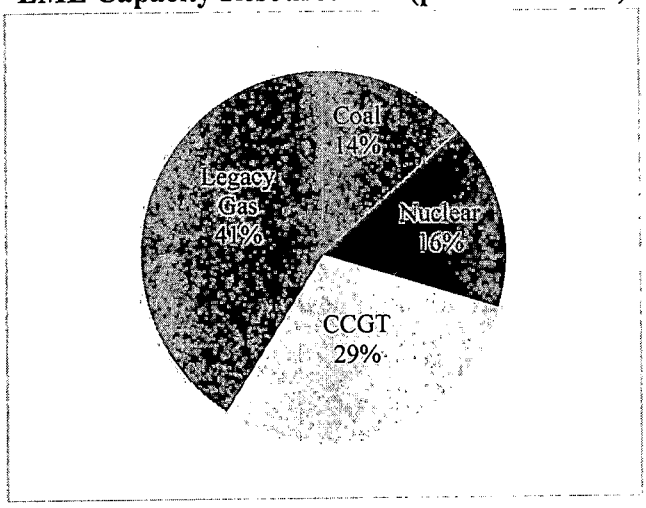
Plant	Capacity (MW)	COD	Fuel Type	Technology
Baxter Wilson U-1	546	1967	Natural Gas	Steam
Gerald Andrus	731	1975	Natural Gas	Steam
Independence 1	209	1983	Coal	Steam
Independence 2	210	1984	Coal	Steam
Attala	457	2001	Natural Gas	2X1 CCGT
Hinds	454	2001	Natural Gas	2X1 CCGT
Totals	2,607			

The chart shows EML's 25 percent share of the Independence units. EML also purchases power from the Grand Gulf nuclear station but does not own or operate the plant. Total EML capacity with Grand Gulf considered amounts to about 3,117 MW, with solar capacity at about 2MW. Table 2 depicts the EML portfolio mix.

EML Capacity Portfolio Mix

Resource	MW	Percent
Coal	419	13%
Nuclear	508	16%
CCGT	911	29%
Legacy Gas	1,277	41%
Solar	2	<1%

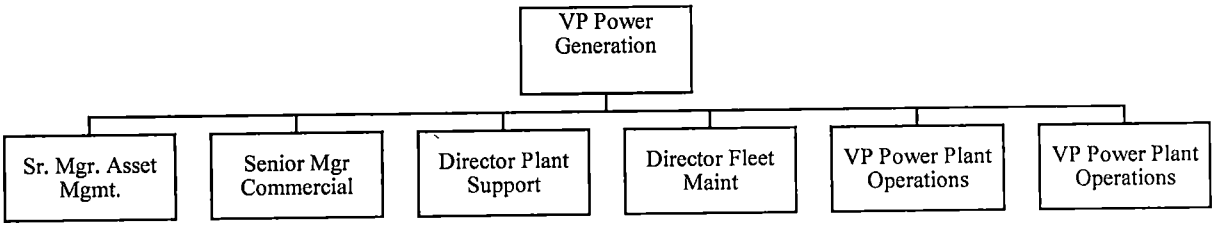
EML Capacity Resource Mix (percent of MW)



2. Organization

EML generation personnel operate as part of Entergy's Power Generation Organization. The following figure depicts this group.

Power Generation Organization



The organizations at Attala, Hinds, Baxter Wilson 1, Gerald Andrus, Rex Brown, and Independence divide among two the vice presidents who report to the head of Power Generation, to whom a Director Environmental and a Sr. Manager Safety also report. The Vice President, Power Generation oversees management and operations of Entergy's fleet of about 28 natural gas,

oil, coal, hydro-electric, and solar generating facilities. These units spread across Texas, Louisiana, Arkansas, and Mississippi. Their combined capacity totals approximately 18,000 MW. The two Vice Presidents of Plant Operations direct the operations and maintenance for the fleet of units under them. Each site has a plant manager who heads operations staff at each plant.

The Director Fleet Maintenance partners with the generation operations vice presidents to provide overall maintenance and outage strategies. The director also provides long range critical outage planning, risk assessments, and financial planning to the divisions, and develops long term inspection plans for critical systems and provides maintenance strategies for the CCGT assets.

The Director Plant Support provides in-house technical functions required to support the design, operations, and maintenance of the fossil fleet. This director plans, directs, and manages the services related to project management and design engineering. The Director Plant Support also provides services in water chemistry, training, NERC compliance, and risk management.

The Senior Manager Commercial Excellence provides services to develop and execute a commercial strategy to optimize each unit's financial/operations value in the MISO market. The Senior Manager Commercial Excellence also provides performance testing services.

The Director Environmental Support provides oversight and manages the power generation fleet environmental compliance programs.

The Sr. Manager Safety provides leadership and management for the safety of all capital projects. This could include safety direction for a capital spend of about $8.7B dollars with over 100 employees and thousands of contractors over the project portfolio.

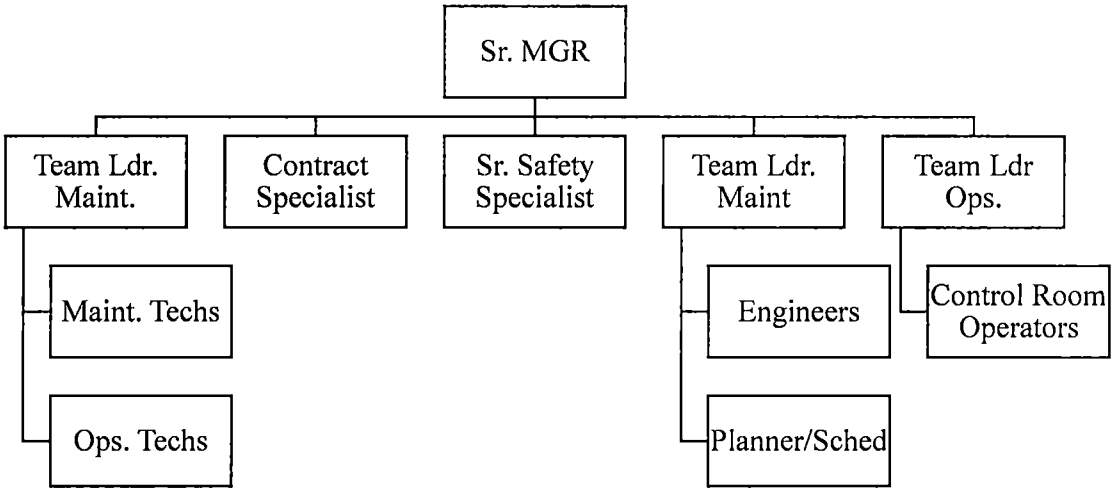
Most EML employees engaged in generation operations report through the plant organizations assigned to the vice presidents to which plants are assigned. The remainder of the organization under the head of Power Generation supports all the sites through a matrix approach. The next table shows the site organization complements for plants of concern to EML.

Power Generation Group

Site	# of Employees
VP Plant Operations	2
Attala	31
Baxter Wilson	34
Gerald Andrus	32
Hinds	29
Independence	108
Rex Brown	7

Entergy uses its standard Power Generation model to address staffing at the combined cycle plants.

Standard CCGT Organization



It is common to use a standard organization for such plants, which employ advanced technology and tend to be standard in operation, lending themselves common organizations and resource levels. The Entergy model does permit modifications to suite any site-unique needs.

3. Performance Management Process

The performance management process focuses on goals and objectives for an individual or group. Goals set early in the year cascade down through the organization to promote consistency and focus on common objectives and results. Supervisors may tailor goals to their employees' specific roles and responsibilities. Overall performance ratings use accomplishment of goals and satisfaction of identified competencies in achieving them. The ratings include:

- Exceptional
- Exceeds expectations
- Meets expectations
- Meets some expectations
- Improvement required
- New in position.

Compensation consists of base pay, annual incentives, and long-term incentives. The goals that drive incentives typically focus on safety, operations, customer service, and cost management.

Entergy's generation business plan, a high-level document, consists of four measured pillars of performance:

- Safety over production: improve the OSHA recordable rate from second quartile to top quartile (< 0.42)
- Shared understanding of excellence: improve operational excellence index from 111 percent to 120 percent or higher
- Focus on fundamentals: improve fleet equivalent forced outage rate (EFOR) from 14 percent to 9.9 percent or better (a weighted average EFOR for the fleet)
- Engagement and accountability: improve the health index to 80 percent or higher.

4. Analysis of Performance

a. Availability Factor

Availability factor (AF) represents the percentage of time a unit is available for service over the period of hours.

$$AF = \frac{\text{Hours a unit is capable of operating}}{\text{Total period hours}}$$

Availability factor comprises a core performance evaluation measure; for a unit to serve the customer, it must be available to generate electricity. Raw AF does not tell the whole story, however. Units typically must perform maintenance outages on a periodic basis to ensure that equipment is maintained, and that the unit remains reliable. Therefore, an AF of 100 percent is not always achievable. Typically, an AF for large coal units of 80 percent plus is achievable.

EML reports equivalent availability factor (EAF). This measure is similar to AF but considers loss of available hours due to equivalent planned derate hours, equivalent unplanned derate hours and equivalent seasonal derate hours. That is, the derates are changed to equivalent lost hours of availability and applied to the equation. This is a better measure.

b. Equivalent Forced Outage Rate (EFOR)

This indicator measures the forced outage hours plus the equivalent forced derate hours as a percentage of the hours/equivalent hours the unit otherwise should have been expected to run.

EFOR = (FOH + EFDH)/(FOH+SH+EFDHRS)

Where, FOH = forced outage hours
EFDH = equivalent forced derate hours
SH = service hours

c. Net capacity factor (NCF)

NCF= ((MWh of net generation)/(PH * NMC))X 100

Where, PH = period hours
NMC = net maximum capacity

This indicator measures the plant usage or generation over time. Plants with lower heat rates and lower costs will tend to be dispatched more often and consequentially display higher capacity factors. Large base load units should have capacity factors in the 80 percent plus range to help justify the investment. Lower capacity factors imply that the particular unit is not as economically competitive with another unit (all other factors being equal).

5. EML Equivalent Forced Outage Rate (EFOR)

The following table summarizes EML's EFOR for the audit period.

EML EFOR
(table is confidential)

Unit	EFOR Oct 18- Sep 19	EFOR Oct 17- Aug 18
Independence 1	[redacted]	[redacted]
Independence 2	[redacted]	[redacted]
Baxter Wilson 1	[redacted]	[redacted]
Gerald Andrus	[redacted]	[redacted]
Attala	[redacted]	[redacted]
Hinds	[redacted]	[redacted]

a. Coal Units

Independence 1 performed well throughout the year, with a relatively low EFOR of [redacted], significantly below the business plan fleet-average goal of 9.9 percent. Independence 2 also performed well with an average EFOR for the period of about [redacted]. This compares favorably with industry averages for coal units which typically approximate 8 to 9 percent. EFOR for the units last period was Independence 1 at [redacted] and Independence 2 at [redacted].

b. Combined Cycle Units

Attala had an EFOR average for the period of [redacted] for a combined cycle plant, but more than satisfying the business plan fleet-average goal of 9.9 percent. Attala's December 2018 EFOR was [redacted] because the unit was dispatched for only 14 days, with [redacted]

Hinds had an average EFOR for the period of about [redacted], indicating very good performance for the period.

c. Legacy Steam Units

Baxter Wilson 1 had an average EFOR of about [redacted] for the period. This is [redacted]

Gerald Andrus experienced an average EFOR for the period of about [redacted]

6. Net Capacity Factor

The following table summarizes EML's Net Capacity Factor (NCF) for the audit period.

EML Net Capacity Factor
(table is confidential)

Unit	NCF Oct 18- Sep 19	NCF Oct 17- Aug 18
Independence 1	[redacted]	[redacted]
Independence 2	[redacted]	[redacted]
Baxter Wilson 1	[redacted]	[redacted]
Gerald Andrus	[redacted]	[redacted]
Hinds	[redacted]	[redacted]
Attala	[redacted]	[redacted]

a. Coal Units

The period of [redacted]

b. Combined Cycle Units

Attala underwent a planned outage that lasted [redacted]. The Hinds unit capacity factor was relatively high throughout the period.

c. Legacy Steam Units

Net capacity factor for Gerald Andrus was [redacted] the period. Baxter Wilson 1 had a relatively higher NCF [redacted]

[redacted]

7. Equivalent Availability

The following table summarizes EML's Equivalent Availability (EAF) for the audit period.

EML Equivalent Availability Factor
(table is confidential)

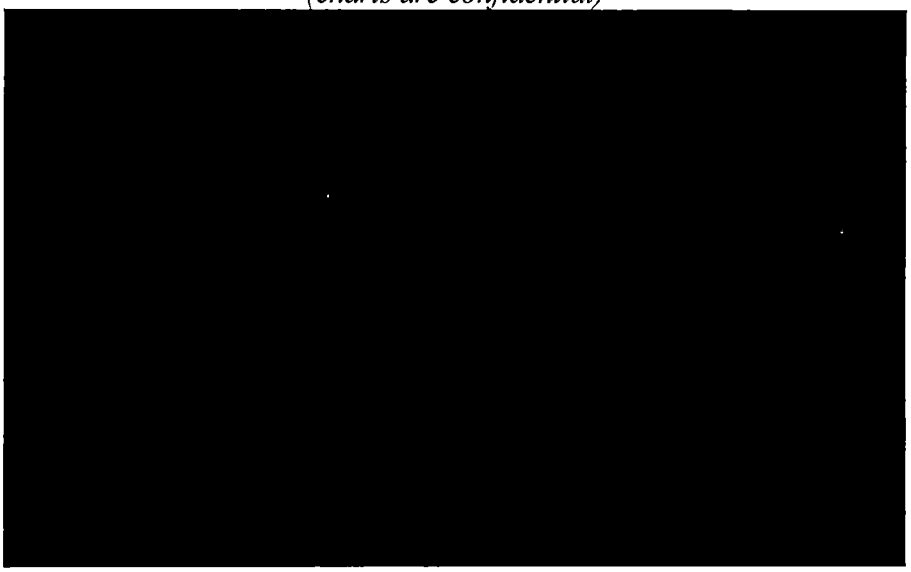
Unit	Equivalent Availability Oct 18- Sep19	Equivalent Availability Oct 17- Aug 18
Independence 1	[redacted]	[redacted]
Independence 2	[redacted]	[redacted]
Baxter Wilson1	[redacted]	[redacted]
Gerald Andrus	[redacted]	[redacted]
Hinds	[redacted]	[redacted]
Attala	[redacted]	[redacted]

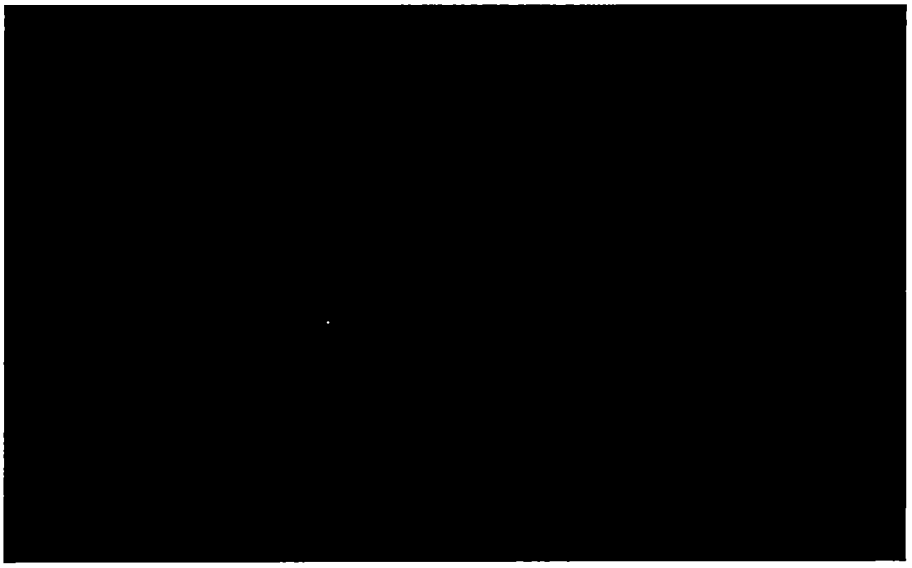
In summary, the units remained reasonably available with the exceptions of [redacted]. The EAF for the coal units and the CCGTS were [redacted]. Baxter Wilson 1 [redacted].

8. Mixed Generation Indicators

Both Independence units 1 and 2 experienced [redacted]. These results indicate good plant reliability. The average capacity factors were [redacted] for unit 1 and [redacted] for unit 2, significantly [redacted] than the last period average of [redacted] and [redacted] respectively.

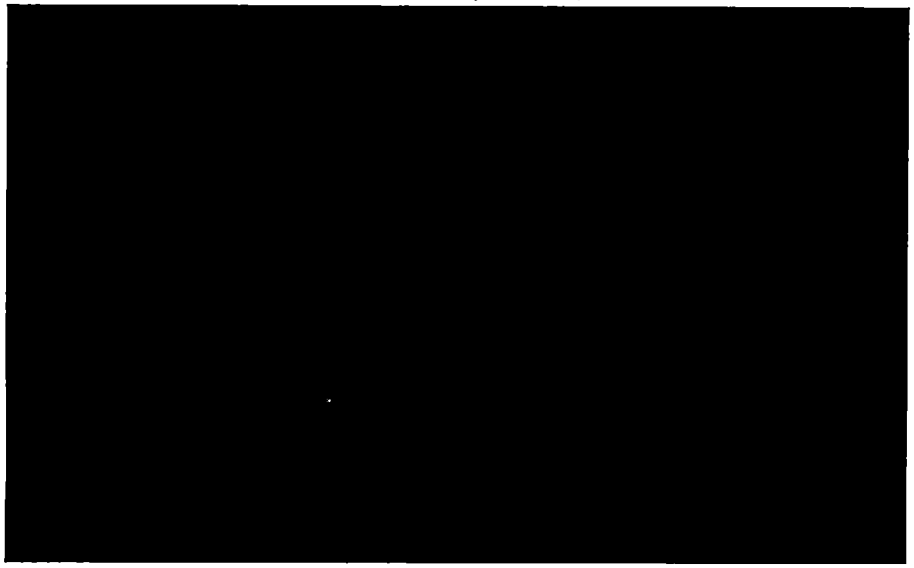
Independence Units 1 and 2 Generation Indicators
(charts are confidential)



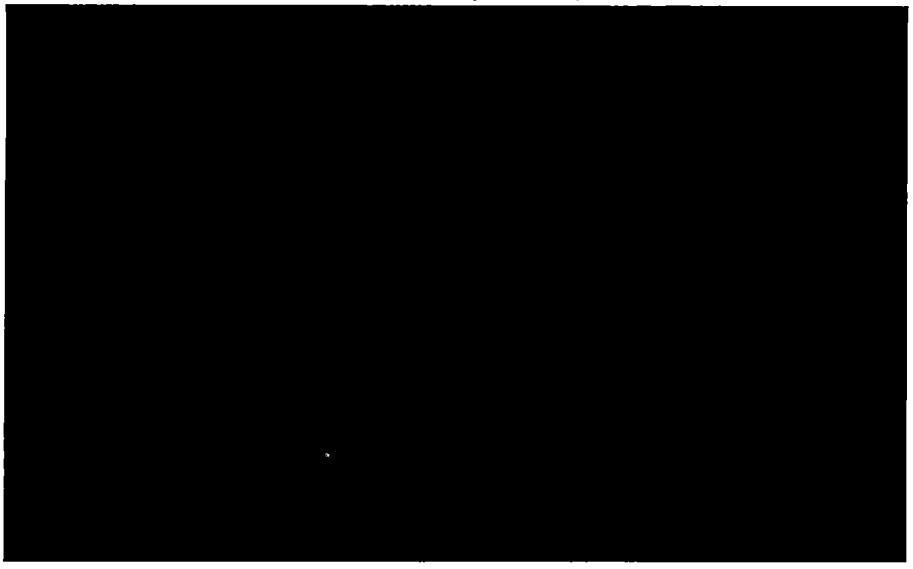


Attala was available with a low EFOR except for [redacted]. The NCF for Attala was [redacted] versus an NCF of [redacted] for the same period last year. Hinds had a very low EFOR and fairly high EA the entire period. Hinds had a capacity factor of [redacted] versus that of [redacted] last period. Hinds was in an outage [redacted].

Attala Generation Indicators
(chart is confidential)

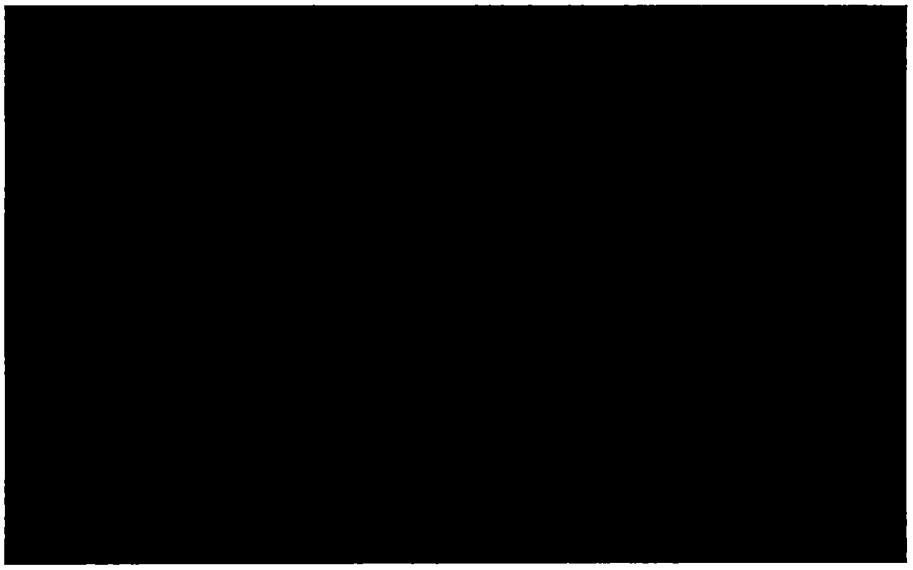


Hinds Generation Indicators
(chart is confidential)

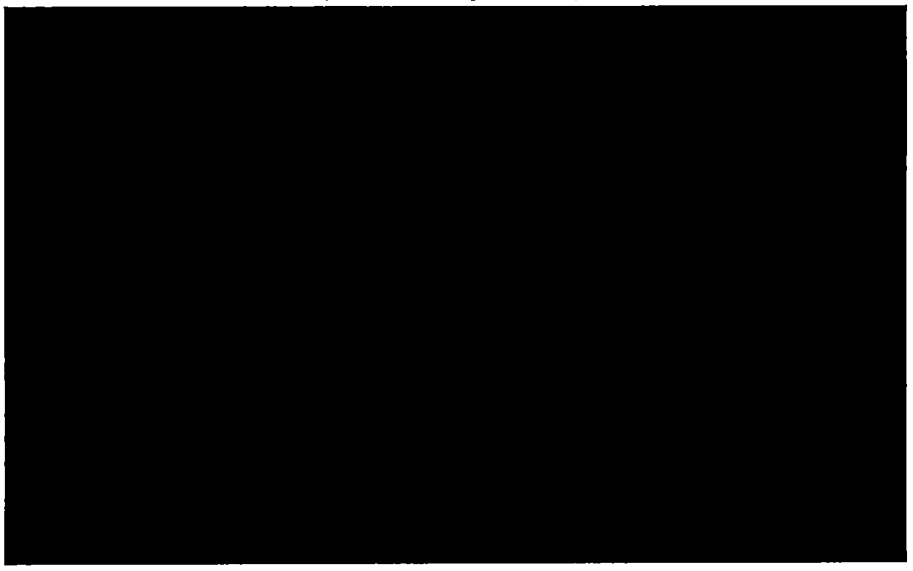


The Legacy steam units suffered from [redacted] EFORs of [redacted] for Baxter Wilson 1 and [redacted] for Gerald Andrus. This compares to EFOR rates of [redacted] and [redacted] respectively for the previous audit period. The NCF was [redacted] for Baxter Wilson 1 and [redacted] for Gerald Andrus. This compares to an NCF of [redacted] and [redacted] respectively from last period. EA has also [redacted] since last period from [redacted] for Baxter Wilson 1 to [redacted] and from [redacted] to [redacted] for Gerald Andrus. These units are [redacted] available and have [redacted] EFORs from last period indicating they have [redacted] in reliability from last period.

Baxter Wilson Generation Indicators
(chart is confidential)



Gerald Andrus Generation Indicators
(chart is confidential)



9. Heat Rate

A plant's heat rate reflects its thermal efficiency. The plant's heat rate measures the amount of energy input into the thermal cycle in BTUs needed to produce a kWh of energy output. Therefore, a lower heat rate is better as it reflects less energy is needed to produce an equivalent amount of energy output as compared to another unit. A lower heat rate translates directly into fuel savings.

Heat Rate = (BTUs Energy Input)/(kWh Energy Output)

Many factors can affect heat rate; they include the original plant design, maintenance of the plant, age of the plant, or the operating profile of the plant. Heat rates vary as shown below

Improved design implies better heat rate
Improve maintenance implies better heat rate
Age degradation implies worse heat rate
Cycling units implies worse heat rate

EML Unit Heat Rate
(table is confidential)

Unit	Heat Rate (BTU/kWh)	
	2019	2018
Independence 1	[redacted]	[redacted]
Independence 2	[redacted]	[redacted]
Baxter Wilson1	[redacted]	[redacted]
Gerald Andrus	[redacted]	[redacted]
Hinds	[redacted]	[redacted]
Attala	[redacted]	[redacted]

The unit heat rates have not materially changed from those of last period.

During our plant visit to Independence, we discussed heat rate and the process procedures used to manage the heat rate on a day-to-day basis. We learned that plant management does not have a formal process procedure to track heat rate losses, or designate a person in charge of the program, or designate specific reports to upper management regarding the losses and the actions to correct these losses. However, they do provide these important actions as site practices. Each day, the staff receives a controllable loss report on each unit. The reports provide daily heat rate and controllable losses to make operational and maintenance decisions to optimize heat rate. The Plant Engineer is designated as the Heat Rate Champion. In addition, upper management has dashboards that show real time heat rate and are provided key performance indicators and heat rate indicators in quarterly meetings.

10. Maintenance

Maintenance of plant systems is important to maintain equipment in good working condition and helps to ensure the plant can run in a reliable and safe manner. EML has a long-term service agreement (LTSA) with General Electric (GE) for the maintenance of the key components of the Hinds and Attala units, the CCGTs. These maintenance agreements are typical for CCGTs plants, whose relatively new and complex technologies generally make maintenance by the original equipment manufacturers (OEMs) a sound approach.

The LTSA for the CCGTs consists of the following maintenance items:
[redacted]

[redacted]

In addition to the agreed upon maintenance of the units, the LTSA calls for [redacted]

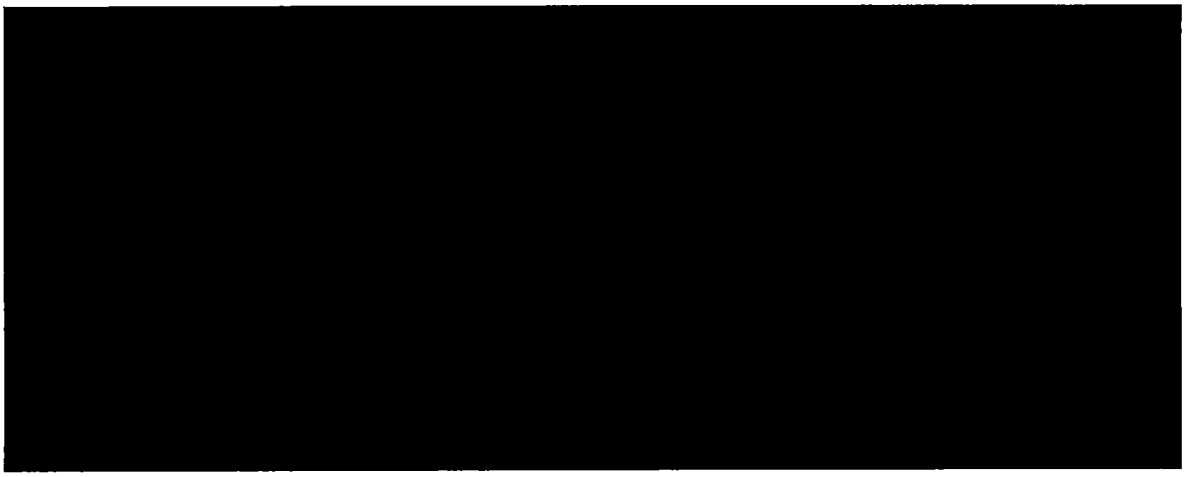
All units are subject to EML routine maintenance programs that consist of corrective maintenance and preventive maintenance. Backlogs of corrective maintenance orders (CM) and predictive maintenance tasks (PM) offer a good indicator of plant health. In addition, measuring schedule adherence in completing maintenance as scheduled is a good indicator of the maintenance process. In general, a low maintenance backlog and high schedule adherence indicates a well-run maintenance program.

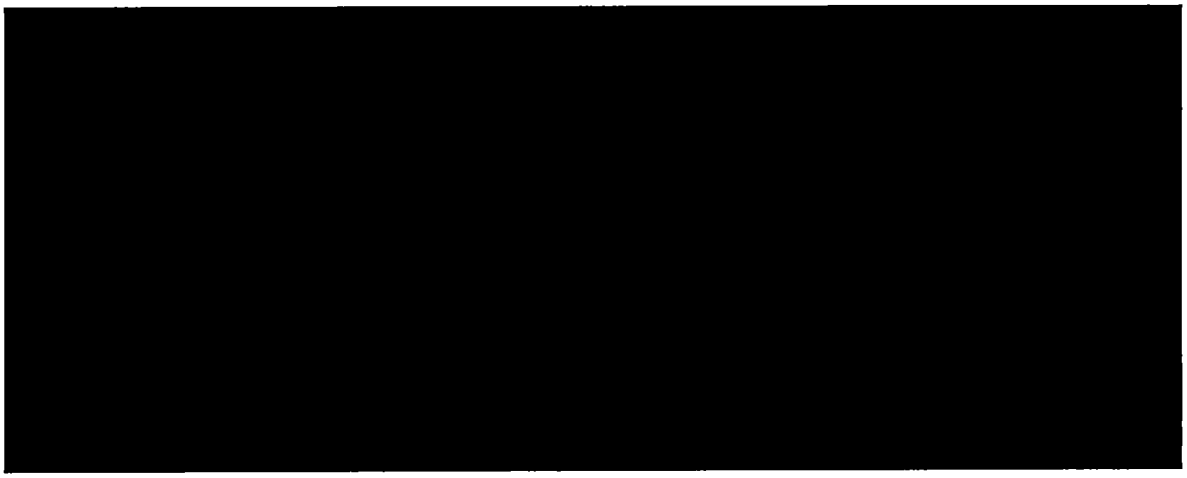
Unit Schedule Adherence (through July 15, 2019)
(table is confidential)

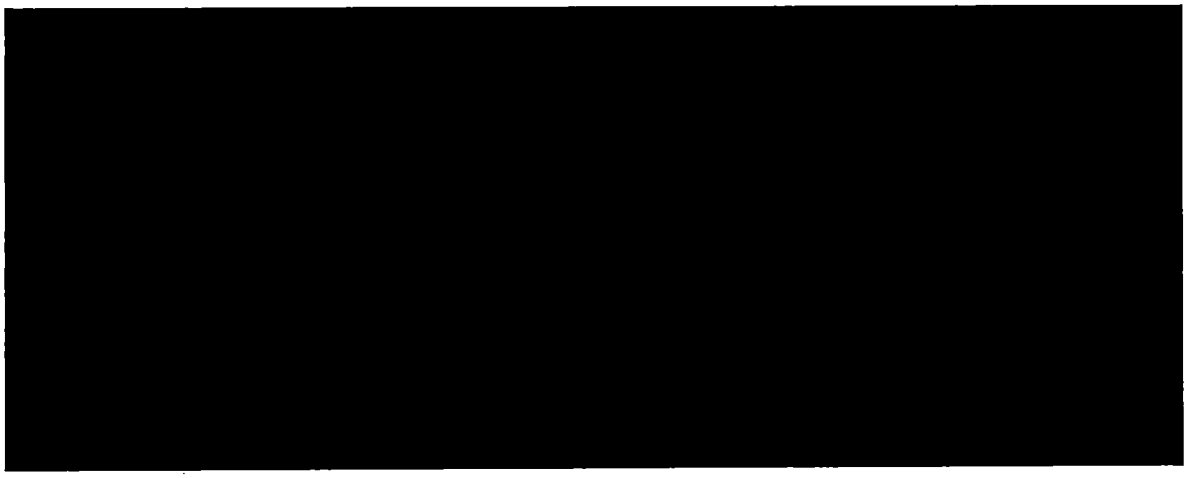
Plant Name	All Maintenance Activities	CM Activities	PM Activities
Attala	[redacted]	[redacted]	[redacted]
Baxter Wilson	[redacted]	[redacted]	[redacted]
Gerald Andrus	[redacted]	[redacted]	[redacted]
Hinds	[redacted]	[redacted]	[redacted]
Rex Brown	[redacted]	[redacted]	[redacted]
Independence 1	[redacted]	[redacted]	[redacted]
Independence 2	[redacted]	[redacted]	[redacted]

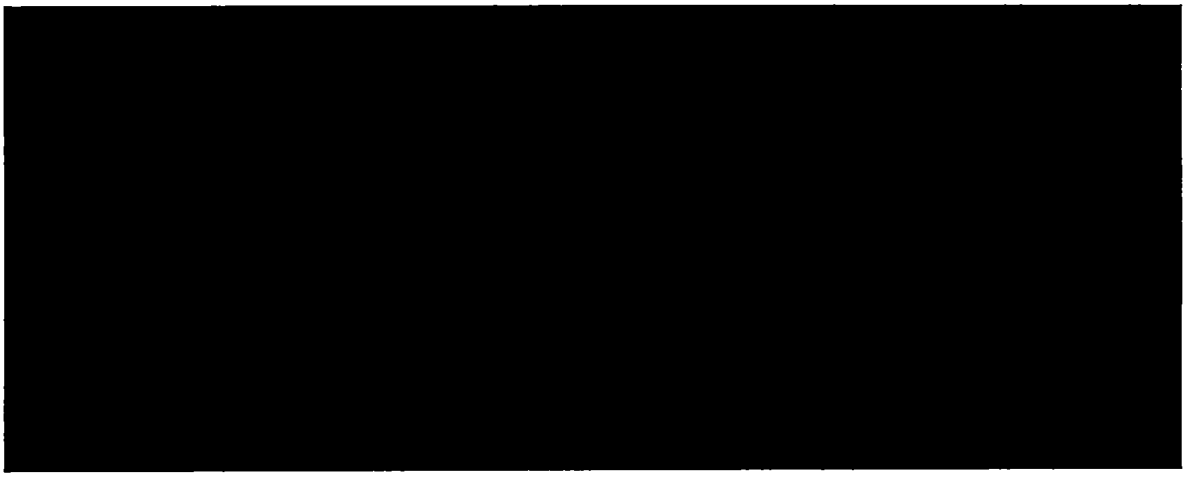
CM/PM Backlog

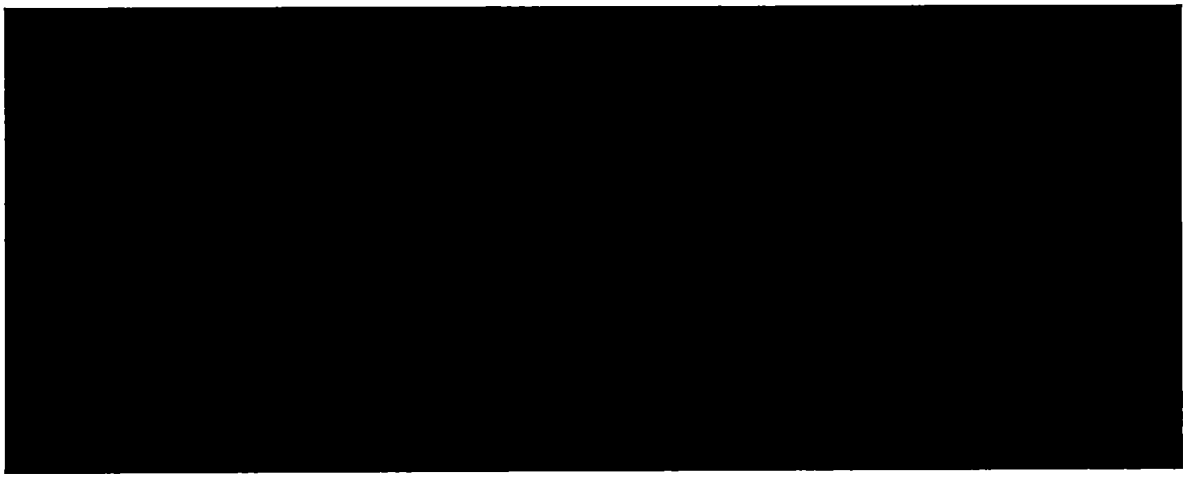
(charts are confidential)











The table and graphs above depict schedule adherence for the various plant maintenance activities and the backlogs for the PM tasks and the CM tasks for each plant. The schedule adherence for all units except for [redacted] and [redacted]drus are reasonable, using as a benchmark 90 percent of scheduled tasks are performed as scheduled. Gerald Andrus is [redacted].

The graphs also indicate that virtually all PM and CM task backlogs have risen over the last several years except for Attala, which decreased in the number of corrective maintenance orders open. However, virually all units have relatively low backlogs [redacted].

Generation Maintenance Capital
(table is confidential)

Unit	Budget	Actual	Difference
Attala	[redacted]	[redacted]	[redacted]
Baxter Wilson 1	[redacted]	[redacted]	[redacted]
Baxter Wilson 2	[redacted]	[redacted]	[redacted]
Baxter Wilson Common	[redacted]	[redacted]	[redacted]
Gerald Andrus	[redacted]	[redacted]	[redacted]
Gerald Andrus Common	[redacted]	[redacted]	[redacted]
Hinds	[redacted]	[redacted]	[redacted]
Hinds Black Start	[redacted]	[redacted]	[redacted]
Independence 1	[redacted]	[redacted]	[redacted]
Independence 2	[redacted]	[redacted]	[redacted]
Independence Common	[redacted]	[redacted]	[redacted]
Total	[redacted]	[redacted]	[redacted]

The capital costs for all units were within a 10 percent band except for [redacted]

Unit O&M Costs
(table is confidential)

Unit	2018		Difference
	Actual	Budget	
Attala	[redacted]	[redacted]	[redacted]
Baxter Wilson 1	[redacted]	[redacted]	[redacted]
Gerald Andrus	[redacted]	[redacted]	[redacted]
Hinds	[redacted]	[redacted]	[redacted]
Independence 1	[redacted]	[redacted]	[redacted]
Independence 2	[redacted]	[redacted]	[redacted]

Actual O&M generally conformed to budgets except for [redacted].

11. Outages

Another important aspect of maintaining plant operations at low cost and reliable, and safe operation is outage performance. This includes a good outage process and good execution of the process.

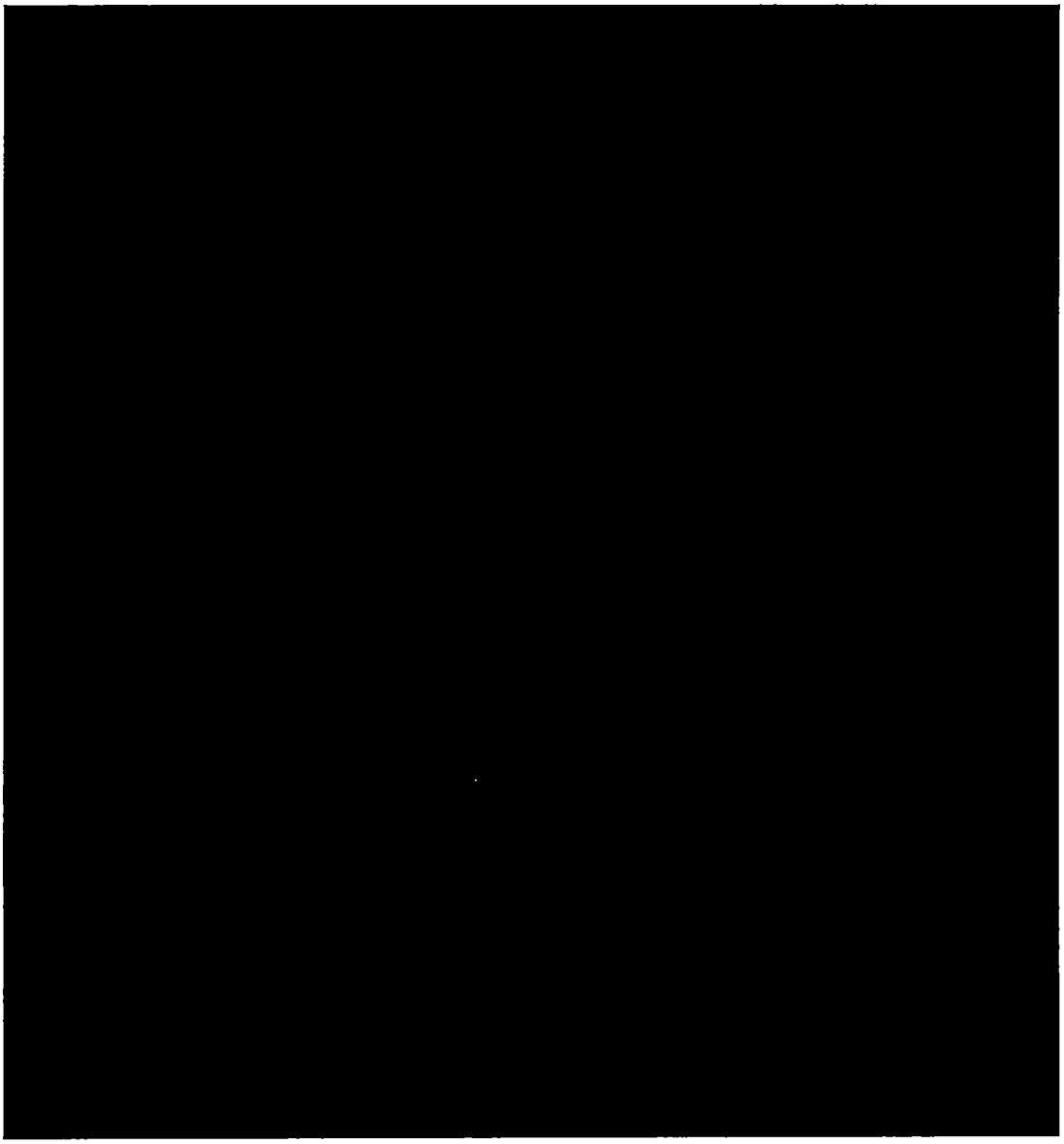
EML follows the Entergy Project Delivery System for their outages. The process has four tenets; predictable and certainty of project outcomes, accountability, application of management fundamentals and tools, and leadership. The program procedure has extensive detail, essentially comprising an outage stage gate procedure. ESL establishes gates with detailed deliverables for each gate along with dates prior to outage start for the completion of the gate deliverables.

EML produces a weekly outage report for each unit that conveys the following important information in the various sections of the report:

- The plant name, the week of the report, outage type, and cost data
- Schedule information is also provided which covers start date, actual start date, original end date, actual end date, scheduled duration and variance until outage end date.
- Major work scope items and scope changes.
- Outage safety and human performance including, safety catches, first aids, tagging errors, and OSHA recordables.
- The report also has a financial section to include O&M costs capital costs and variances of these costs from original budget to actual costs
- The last section of the report is a narrative section that covers the critical path progress, critical path activities for the next seven days, and upcoming significant milestone status.

Unit Outage Durations

(chart is confidential)



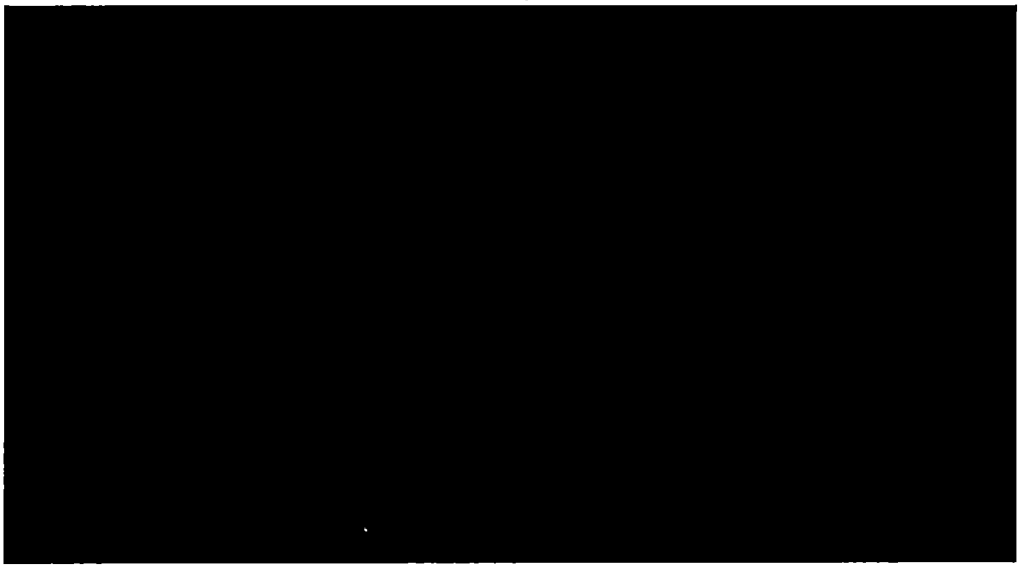
12. Technician Training

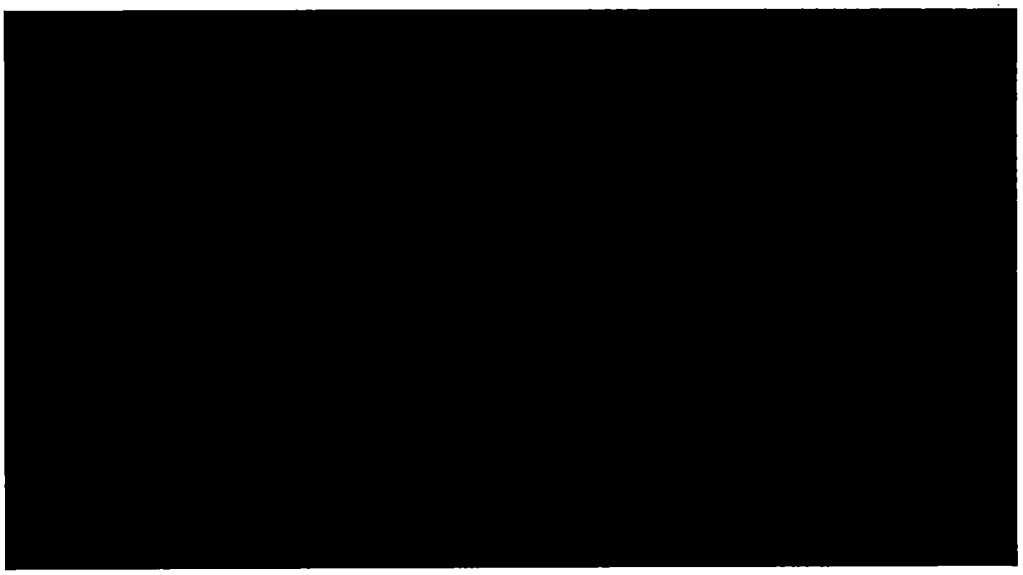
A highly detailed EML training program consists of an overall technician progression plan or a Board type qualification requirement check off list depending on the specific site requirements. The program requires several different demonstrations of knowledge and skill. The qualification requirements consist of general knowledge of plant operations such as describing the basic steam cycle to describing the sequence of events for a plant shut down or startup of the plant. Other requirements include providing examples of detailed knowledge of various plant systems and placing various equipment in service. This knowledge is not only orally examined but also tasks must be performed in the field. Other parts of the training are Computer Based Training modules (CBT) that cover fundamentals of power plant operations and basic plant operations theory. The progress of each individual is tracked throughout the training process.

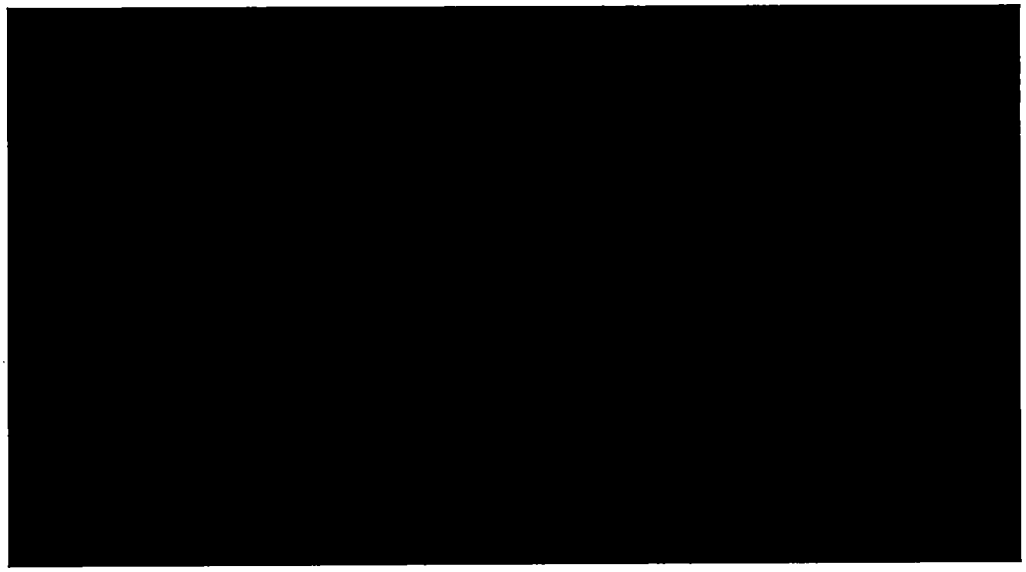
13. Benchmarking

We benchmarked EML O&M plant costs, recognizing O&M as the controllable cost area and one critical to dispatch. The following graphs show the results.

Total Non-Fuel O&M Costs
(charts are confidential)







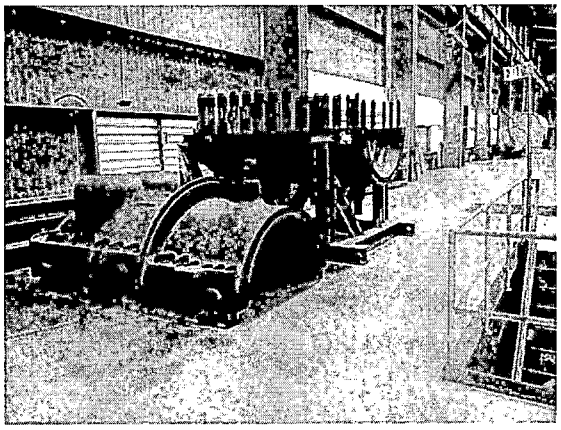
We divided the benchmark data into technology groups, to support comparisons of costs with those of other, like SERC plants. The groups consist of the legacy steam units, the coal plants, and the combined cycle gas turbine units. The Hinds unit proved [redacted] compared to an average of $4.56/MWh for the group. Attala costs [redacted]. The Independence units compared well to other SERC plants with regard to non-fuel O&M costs per MWh at a cost of about [redacted] compared to the average for the group of $10.78/MWh. The Legacy steam units, Gerald Andrus and Baxter Wilson 1 were [redacted] the average costs for the SERC comparison group at [redacted] and [redacted] respectively. All EML units except for [redacted] fell below the average total non-fuel O&M cots for the benchmark SERC units.

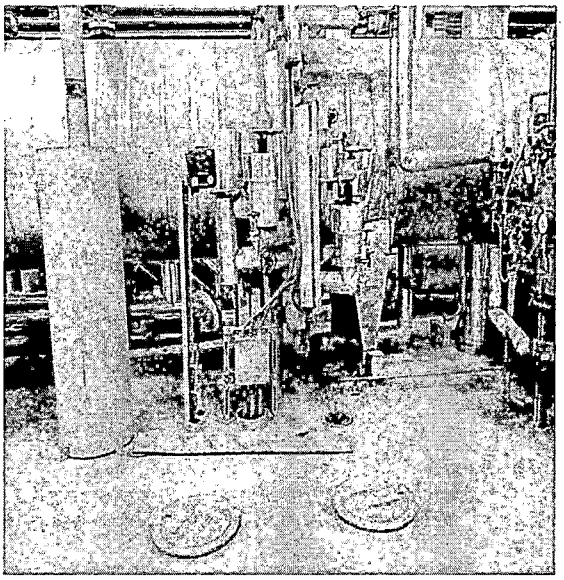
14. Site Visit

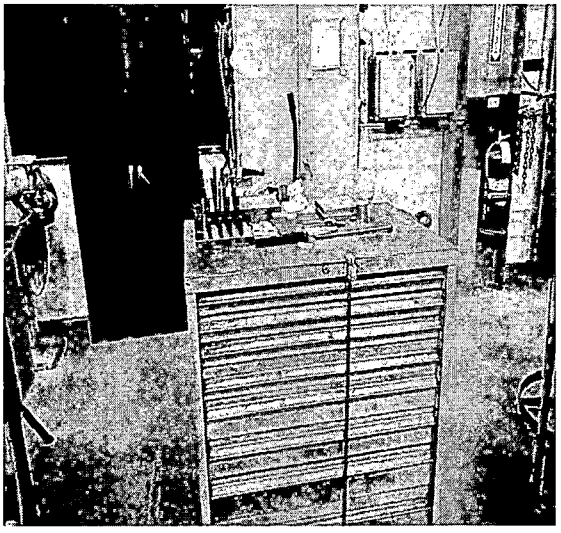
On October 28, 2019, Liberty team members performed a plant visit to the Independence coal plant. The visit consisted primarily of a plant walk-down and interviews with several plant members, including the plant manager. That visit produced the following observations:

- All staff members interviewed proved knowledgeable with regard to plant operations, the history of issues, and the overall performance of the units.
- Examination of a broad range of plant areas (including coal handling equipment, turbine deck, machine shop, turbine tool room, and feed pumps) found all equipment was in good working order and clean. Tools were stored in good order and all equipment in the machine shop were clean.
- The safety record for the site was discussed. As of this date, the date of the visit, the plant manager indicated that they have a zero OSHA recordable rate. This is a significant accomplishment.
- Plant personnel on the tour were conscious of wearing the proper plant protective equipment.
- We saw no evidence of combustible coal fines, an area of concern in our audits some years ago.

Overall, our observations indicated a site well run by knowledgeable individuals. The following pictures show various plant areas. The pictures indicate the cleanliness of the plant and the orderliness of the tools and the machine shop.







15. Grand Gulf

The Grand Gulf nuclear unit is located at Port Gibson, Mississippi. The unit is a General Electric boiling water reactor and has a capacity rating of 1485 MW. The unit began commercial operation in 1985. Liberty focused on reviewing the unit capacity factor performance for this audit. Capacity factor is a relevant and important indicator for a base load plant such as Grand Gulf. Recall that net capacity factor or NCF measures net generation divided by the product of period hours (PH) multiplied by net maximum capacity (NMC) and then all multiplied by 100 percent.

$$NCF = (\text{Net generation}/(PH^* NMC)) * 100 \text{ percent}$$

EML also calculates and tracks an indicator called unit capability factor (UCF). The unit capability factor equals the percentage of maximum energy generation that a unit is capable of supplying to the grid, limited only by factors within the control of plant management. A high UCF indicates

effective plant maintenance programs and practices to minimize unplanned energy losses and to optimize plant outages. Barring any unusual events, both indicators are relatively equal for a base load unit.

Capability Factor = ((REG-PEL-UEL-OEL)/REG) * 100 percent

Where, REG = reference unit power * hours in the period
PEL= planned energy losses (MWhs.)
UEL = unplanned energy losses (MWhs.)
OEL = outage extension losses (MWhs.)

Grand Gulf UCF and NCF
(table is confidential)

Date	Capability	Capacity
Oct. 2018	[redacted]	[redacted]
Nov. 2018	[redacted]	[redacted]
Dec. 2018	[redacted]	[redacted]
Jan. 2019	[redacted]	[redacted]
Feb. 2019	[redacted]	[redacted]
Mar. 2019	[redacted]	[redacted]
Apr. 2019	[redacted]	[redacted]
May 2019	[redacted]	[redacted]
Jun. 2019	[redacted]	[redacted]
July 2019	[redacted]	[redacted]
Aug. 2019	[redacted]	[redacted]
Sept. 2019	[redacted]	[redacted]
Average	[redacted]	[redacted]

The table shows that Grand Gulf's UCF and NCF comfortably exceeded [redacted].

C. Conclusions

1. The generation operations organization is well designed and sufficiently staffed to support safe, reliable plant operations, but some concern exists regarding the Independence units.

The organization operates as part of a larger, Entergy organization that we found large and well-staffed to support the EML plants across the required ranges of expertise such as engineering, outage management, project management, commercial management, and asset management. The CCGT plants employ a standard organization, typical of U.S. operation of these units. Interviews with the plant manager Independence indicated that the backlog of maintenance items is growing due to possible shortages in staff. Liberty understands that the site is hiring individuals but is having a difficult time getting to full complement.

2. The performance management process is well defined performance oriented.

The performance management process is a goal focused process. The goals are set early in the year and are cascaded throughout the organization. Overall individual performance is rated on accomplishment of the goals

3. **The equivalent forced outage rate (EFOR) for the legacy steam units was [redacted] this period.** *(See Recommendation #1)*

The EFOR for the coal and CCGT plants was in an acceptable range, [redacted]

4. **The net capacity factor for Gerald Andrus was relatively [redacted] for the Audit Period; Attala and Independence 2 values were also relatively [redacted].** *(See Recommendation #1)*

The NCF for Baxter Wilson 1 and Gerald Andrus were [redacted] and [redacted] respectively versus an NCF of [redacted] and [redacted] respectively for last period. Attala NCF was [redacted] versus an NCF of [redacted] for last period. Independence 1 NCF was [redacted] versus about [redacted] last period.

5. **Several maintenance program indicators were relatively [redacted] this period.** *(See Recommendation #2)*

Schedule adherence of maintenance activities was particularly [redacted]. All other units were about [redacted] plus for the period. All units' corrective maintenance (CM) and preventive maintenance (PM) backlogs have [redacted], all backlogs are relatively low except for the [redacted] units.

6. **Capital and O&M maintenance costs were well controlled for the period except for [redacted] O&M expenses.**

The O&M expenses for [redacted]

7. **Several outages were extended beyond [redacted] of their original duration.** *(See Recommendation #3)*

Gerald Andrus, Hinds , and Independence 1 all had outages that were greater than 30 percent of their original schedule. Both Independence 1 and Gerald Andrus were extended [redacted]. The site visit to Independence revealed that this site has hired a third-party expert to re-baseline the areas susceptible to FAC corrosion as a result of the different operating profiles of the plant. However, a sustained period of time is necessary to determine if these plans are sufficient to prevent performance issues from FAC.

8. **Grand Gulf Nuclear Unit performed well for this period.**

The Grand Gulf nuclear unit performed well during this period with an average capacity factor of greater than [redacted] or an actual NCF of [redacted].

9. Actions taken from previous audits with regard to [redacted] and [redacted] seem to be not effective.

Recommendation 2018-4 from London Economics International LLC (LEI) suggested "continued monitoring of the performance indicators for [redacted] and [redacted] to ensure that steps taken by EML during the audit period result in meaningful improvement". The performance of these units did not improve, rather the performance degraded over the period.

Management provided a high-level summary of a [redacted] plant equipment assessment performed by an outside engineering firm. This summary listing identified a significant amount of work for performance over the next ten years. This work spans [redacted]. The span of system work recommendations indicates a deteriorating plant asset; maintaining its reliability will require very significant work. We would expect that these systems will continue to degrade and most likely the reliability will degrade as well.

10. Benchmarking indicated generally competitive performance for the generating fleet.

Liberty recognizes that the EML units are relatively low-cost units when compared with their peer group in SERC. The units that reflect performance below internal goals and industry averages are [redacted] and [redacted]. Initiatives to improve these unit performances should be implemented before any further benchmarking would prove valuable at this point in time.

11. The Liberty site visit revealed the fact that Independence does not have a [redacted]. *(See Recommendation #4)*

Plant management at the site does monitor heat rate losses on a day-to-day basis, [redacted]

D. Recommendations

1. Analyze the deteriorating performance of [redacted]. *(See Conclusions #3 and 4)*

The [redacted] performance has declined for several key indicators this period. These areas of decline include equivalent forced outage rate (EFOR), equivalent availability (EA), and net capacity factor (NCF) for [redacted], and EFOR and EA for [redacted]. O&M costs for these units also exceeded 2018 budgeted amounts for these non-baseload units. [redacted] performed less reliably than [redacted], but the data provided by management does not

indicate that its condition and causes have undergone formal assessment. Management should conduct an assessment similar to that performed for [redacted].

Management should seek to identify the root causes of performance declines, identify any common, systemic contributors, and identify the solutions required, and determine whether their costs and results are proportionate to the value that the units provide. The high-level summary provided by management did not show substantial work completion at [redacted] by the end of the Audit Period. Management should prepare a comprehensive plan and schedule for work identified at both plants.

2. **Analyze the maintenance** [redacted]. *(See Conclusion #5)*

Liberty recognizes that the absolute number of maintenance tasks in the backlogs except, for [redacted] are not of concern at this point, however, the trend for all units over the last several years is [redacted] backlogs of corrective and preventive maintenance are a direct indication of material condition. In addition, large backlogs, if allowed to occur, will cost disproportionately more to address.

3. **Analyze the status and health of the fleet's flow accelerated corrosion (FAC) program.** *(See Conclusion #7)*

Based upon the fact that two units' outages were negatively affected by FAC program piping repairs and inspections, it is logical to analyze the health of the program. FAC is a well-known phenomenon. This program should be well defined, and inspections scheduled and controlled so as not to contribute to outage extensions. This is an important program that affects reliability but also can significantly affect personnel safety. Liberty recommends that the FAC programs at the appropriate sites be reviewed to ensure they are being updated and implemented so as not to cause piping failures, safety issues, unplanned outages, or extensions to planned outages.

4. **Review the status of the heat rate programs at each site.** *(See Conclusion #11)*

Liberty recommends that EML develop a heat rate improvement process procedure to manage the heat rate of the units in a formal fashion. Heat rate is an important parameter that should be formally monitored and controlled as it directly impacts fuel costs. The fuel cost impacts can be rather significant depending on the magnitude of heat rate losses and the capacity factors of the particular units.

VIII. Nuclear Fuel

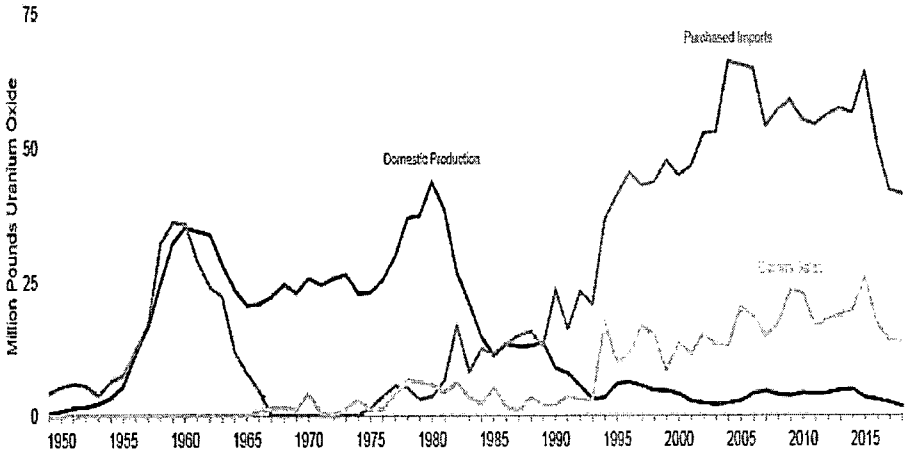
A. Background

This chapter describes the organization and resources dedicated to acquiring fuel for the Grand Gulf Nuclear Station, a 1,433 MW boiling water reactor, authorized by the U.S. Nuclear Regulatory Commission to operate into 2044. Grand Gulf operates under an organization having that same responsibility for the remainder of Entergy's nuclear fleet. This chapter discusses the contracting portfolio strategy that management applies across this fleet, and addresses competitiveness of nuclear fuel-supply costs.

Grand Gulf, located near Port Gibson, Mississippi, entered commercial operation in 1985. General Electric manufactured the station's boiling water reactor. A 2012 upgrade increased the station's 1,266 MW capacity to a maximum dependable output of 1,433 MW. System Energy Resources, Inc. (SERI) holds ninety percent of Grand Gulf's ownership and Cooperative Energy (formerly South Mississippi Electric Power Association) the other 10 percent. A Unit Power Sales Agreement (UPSA) addresses EML's entitlements regarding Grand Gulf. EML has an entitlement of 33 percent of the plant's capacity and energy, and responsibility for a corresponding share of Grand Gulf costs, including those related to fuel.

As observed in the report of last year's audit of Entergy fuel and energy management, the nuclear fuel market remained soft as our Audit Period began, and remained so through most of 2018. The report for last year's audit noted on the pendency of a Section 232 Petition to the U.S. Department of Commerce seeking to require that U.S. utilities procure at least 25 percent of their uranium from U.S. mines. On July 12, 2019, a decision by the U.S. Administration to take no trade action rejected such a quota. The next chart shows low levels of U.S. production and high levels of purchases of imports that now characterize the industry.

Uranium Oxide Production and Trade in the U.S.



The remainder of the Entergy fleet of operating nuclear units spans a large portion of the country:

- Arkansas Nuclear One Units 1 and 2 near Russellville, Arkansas
- River Bend Station in St. Francisville, Louisiana

- Waterford 3 in Taft, Louisiana
- Indian Point Energy Center Units 2 & 3 in Westchester County, New York, planned for shutdown in 2020 and 2021
- Palisades in Covert, Michigan, planned for shutdown in 2022
- Entergy also provides management services to Cooper in Brownville, Nebraska (owned by Nebraska Public Power District and operated by Entergy Nuclear).

Including plants retired and sold, Entergy nuclear units also span the gamut of commercial types:

- Six General Electric boiling water reactors
- Three Combustion Engineering pressurized water reactors
- One Babcock and Wilcox pressurized water reactor
- Two Westinghouse pressurized water reactors.

B. Findings

1. Nuclear Fuel Costs

a. Historical and Current Costs

The following graph shows Grand Gulf nuclear fuel costs since February 2017. The dotted line indicates the start of the current Audit Period. [redacted]. Note that the chart omits the January 2017 value, which was [redacted]; the unit operated on only one day that month.

Grand Gulf Nuclear Fuel Costs
(chart is confidential)

[redacted]

b. Rate Treatment of Nuclear Fuel Costs

As was true at the time of our 2011 audit, EML continues to accumulate and capitalize uranium, conversion, enrichment, and fabrication costs, for each batch of nuclear fuel loaded. EML also capitalizes the associated financing and tax costs of each batch under the nuclear fuel lease, prior to insertion into the reactor core. EML then amortizes these capitalized costs for each batch across its life in producing energy, using energy produced as the basis for the amortization. EML includes the financing costs as fuel expense (as opposed to recovering them in base rates), because it finances fuel under a fuel lease. EML and the other Entergy operating companies employ a unique fuel lease with a nuclear fuel trust company. Nuclear unit operators have entered into such agreements frequently to provide for the financing of fuel in a way that is commensurate with the life of the fuel, and supports amortization of fuel as it is burned, by tying payments to actual fuel burn.

EML also recovers other fuel-related costs as fuel expenses:

- Costs related to dry casks required to supplement onsite spent fuel storage
- Ad valorem/property taxes on nuclear fuel that are not capitalized to batches.

Some years ago EML also incurred other fuel-related costs it recovered as fuel expenses. These costs, which it no longer incurs, due to unresolved federal policy issues, include:

- Spent fuel disposal (the last fuel-cycle element) payments to the U.S. Department of Energy (DOE)
- Annual fees to DOE for facility decontamination and decommissioning under the Energy Policy Act of 1992.

2. The Nuclear Fuel Cycle

The nuclear unit fuel cycle consists of the integrated set of activities necessary to take uranium ore from production to disposal. The key procurement elements in that cycle include:

- Uranium: Securing uranium in the form of ore or concentrates, referred to as U_3O_8
- Conversion: Converting the material to uranium hexafluoride gas (UF_6) to make it suitable for enrichment
- Enrichment: Enriching UF_6
- Fabrication: Reconverting UF_6 to produce enriched uranium, oxide (UO^2) and fabricating it into fuel rods that comprise the fuel assemblies loaded into the reactor core for use in electricity generation.

Different contracts with multiple providers cover these elements, with transportation of the products produced under each covered by those contracts.

Following reactor operation for the period between refueling, the assemblies must be removed from the reactor and then placed into storage or removed from the plant for disposal.

A reactor can require between 600,000 and 1,600,000 pounds of U_3O_8 for a single cycle (between refueling), depending on the time length involved. Uranium mining begins the process of producing U_3O_8. Uranium, a slightly radioactive metal, exists in most rocks and soils, in many rivers, and in seawater. A number of the earth's regions have ground concentrations of uranium at levels sufficient to make extraction of it for use as nuclear fuel economical. Extraction of these

concentrations of ore takes place through underground or open pit mining, or through a leaching process undertaken in situ. Natural uranium consists, primarily, of a mixture of two isotopes (atomic forms) of uranium. Only 0.7 percent of natural uranium is "fissile," or readily capable of undergoing fission, the process by which energy is produced in a nuclear reactor. The fissile isotope of uranium is uranium 235 (U-235). The remainder is uranium 238 (U-238).

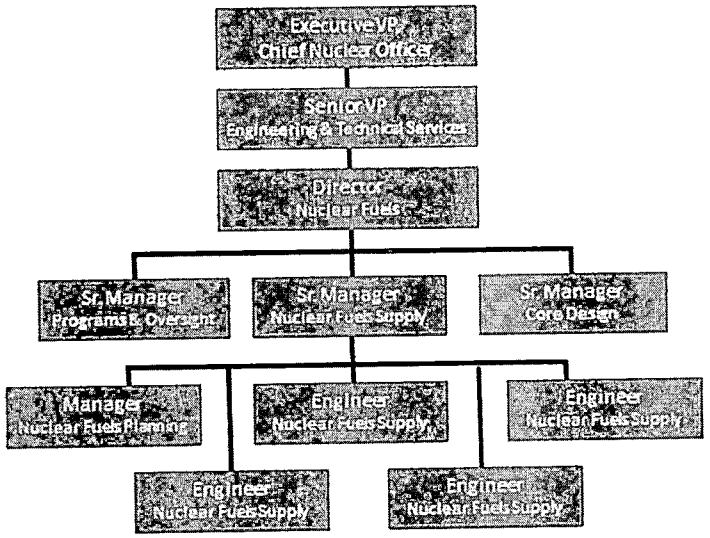
Uranium milling extracts the uranium from the ore. Milling produces the uranium oxide concentrate; *i.e.*, yellowcake, which contains more than 80 percent uranium. Additional processing through conversion and enrichment prepares the uranium for use as fuel. This process requires uranium to be in gaseous form (UF_6), so the U_3O_8 to UF_6 conversion process is performed first. Enrichment strips away the U-238 isotope, and increases the concentration of the fissile isotope, U-235, from about 0.7 percent in natural uranium to between three and five percent.

Following enrichment, fabrication takes place. This process involves converting the enriched UF_6 to UO_2 powder, forming the powder into ceramic pellets, loading the pellets into metal tubes ("fuel rods") and assembling the rods into fuel bundles. These bundles are designed for loading into the core. The fabrication process must be performed on a basis customized for each reactor type and core design.

3. *Entergy's Nuclear Fuels Organization*

An Entergy Executive Vice President and Chief Nuclear Officer has responsibility for the Entergy nuclear fleet, including Grand Gulf. The responsibilities of a Senior Vice President, Engineering & Technical Services under the Chief Nuclear Officer include nuclear fuels, which a Director, Nuclear Fuels heads. The next chart shows the details and reporting of the Nuclear Fuels Group at the beginning of our Audit Period. Nuclear Fuels Supply manages procurement and Core Design has responsibility for, among other things, fuel fabrication, which forms an important element of the nuclear fuel cycle.

Entergy Nuclear Fuels Organization



The organization has changed somewhat since the Audit Period began. The Director, Nuclear Fuels title has changed to General Manager, Nuclear Fuels & Analysis. The Programs & Oversight group has become Safety Analysis and Probabilistic Risk Assessment. At the time of the audit, the acting Director, Nuclear Fuels, a reactor engineer, has 30 years of experience at Entergy. The primary roles in nuclear fuel procurement and contract management reside under the Senior Manager, Nuclear Fuels Supply, who has 30 years of experience at Entergy, starting with nuclear plant start-up, and continuing in reactor engineering. He has been in nuclear fuels for 10 years, beginning in an accounting role.

The five-person team operating under the Senior Manager, Nuclear Fuels Supply has responsibility for procurement, management, planning, forecasting, accounting, and support related to nuclear fuel. The group prepares requests for proposals, evaluates bids, negotiates terms, and ensures effective execution of nuclear fuel contracts. Agreements covering individual fuel cycle elements are assigned to the engineers for administration (*e.g.*, invoicing and delivery scheduling). Procurement decisions, such as those under the RFPs issued and completed during our Audit Period, are addressed by Nuclear Fuels Supply group acting as a team. The manager and four engineers in this group have a range of from 5 to 30 years of experience with various Entergy nuclear operations functions.

The Manager, Nuclear Fuels Planning forecasts fuel needs, manages the approval process for large contract commitments, and provides a source of oversight of contracting, outside the Nuclear Fuels Supply team directly responsible for managing procurements. She has 20 years of experience with Entergy in a variety of planning, forecasting, procurement, and fuel accounting positions. She has been in the Entergy nuclear fuels organization for two years.

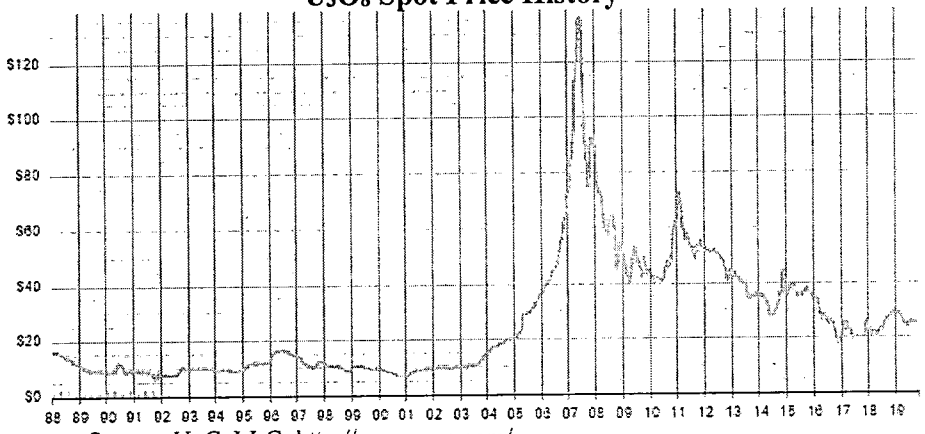
The Senior Manager Core Design, manages a group of engineering resources whose duties include the identification of plant requirements that drive procurement needs.

4. *Nuclear Fuel Markets*

As we will describe below, [redacted]

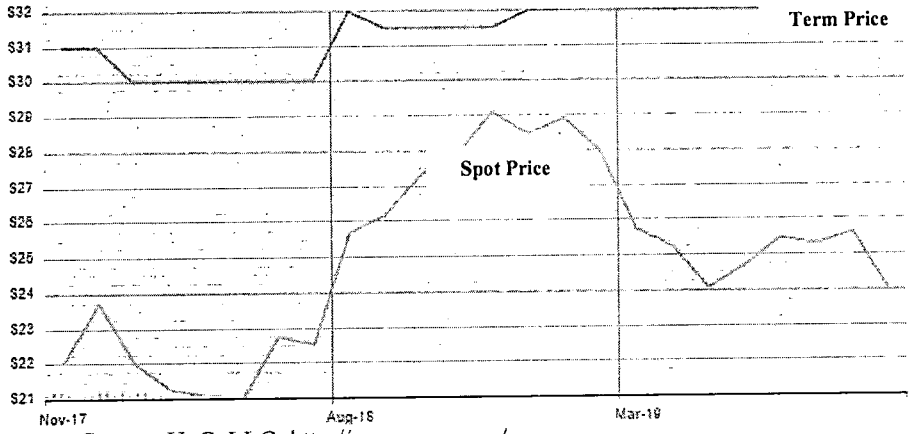
The next series of charts show the histories of U_3O_8 and conversion prices and of U_3O_8 taken as UF_6 (*i.e.*, converted U_3O_8), as Entergy began to do under the contracts it entered in November 2018. A spike occurred following 15 years of stability in U_3O_8 prices. Following a sharp drop, prices have for a long period fallen, reaching stability in early 2018. Long-term U_3O_8 prices have since remained stable, but, as the two-year U_3O_8 chart below shows, spot prices began in mid-2018 a rise through the end of the year, falling thereafter, as term prices remained stable. Exhibiting a different pattern, conversion prices (shown in the following Conversion Prices chart) fell off sharply from 2013 through 2018, rising thereafter. The last chart (Spot U_x UF_6 Prices) [redacted]

U_3O_8 Spot Price History



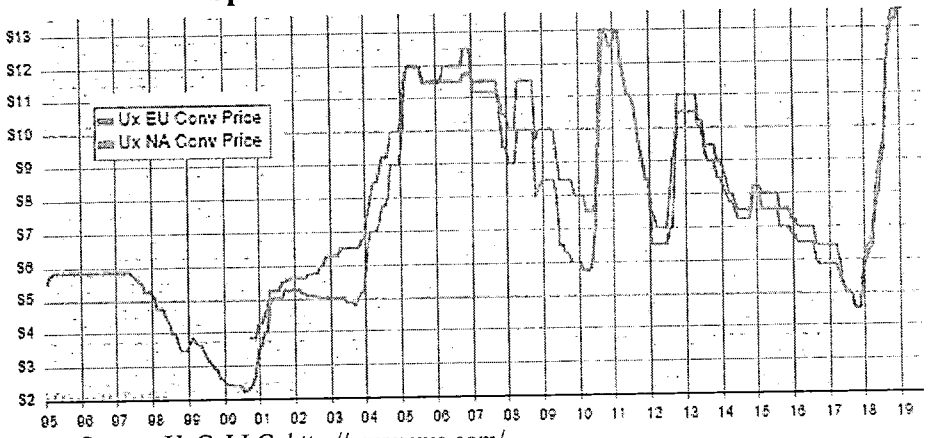
Source: UxC, LLC; http://www.uxc.com/

Two-Year U_3O_8 Spot and Long-Term Prices



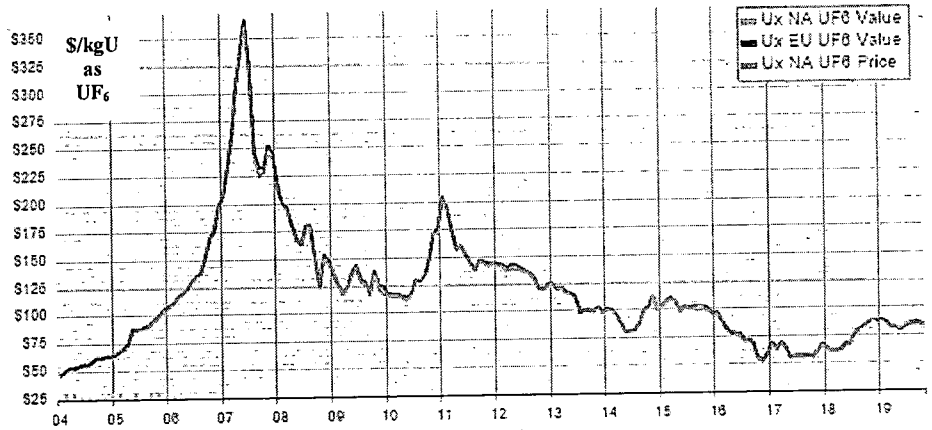
Source: UxC, LLC; http://www.uxc.com/

Spot Ux NA & EU Conversion Prices



Source: UxC, LLC; http://www.uxc.com/

Spot Ux UF_6 Prices



Source: UxC, LLC; http://www.uxc.com/

Across 2018, the relationship between spot and term contract prices for U_3O_8 and conversion changed significantly. The next chart shows that, on average, the gap between them narrowed, as spot prices increased much more significantly than did contract prices for both. The data comes from annual and quarterly reports of a large international uranium supplier, Cameco, a publicly traded company that regularly reports such data, averaging values from two leading firms that report industry data (*TradeTech* and *UxC*).

2018 U_3O_8 and Conversion (UF_6) Price Changes

	2018	2017	CHANGE
Uranium ($US/lb U_3O_8)[1]			
Average annual spot market price	24.59	21.78	13%
Average annual long-term price	30.38	31.92	(5)%
Fuel services ($US/kgU as UF_6)[1]			
Average annual spot market price			
North America	9.98	5.26	90%
Europe	10.32	5.69	81%
Average annual long-term price			
North America	14.33	14.00	2%
Europe	14.44	14.04	3%

Thus, Entergy faced the need to secure these services in a period where continuation of such differences could well erase any perceived economy in reliance on spot prices. The trend over the last six months in fact showed, as the next chart highlights a continued narrowing of the gap.

June-December 2018 U_3O_8 and Conversion Price Changes

Period	31-Dec-18		30-Jun-18	
Type	Spot	Contract	Spot	Contract
U_3O_8/lb	$27.75	$32.00	$22.65	$29.00
kg/lb	**2.204623**	**2.204623**	**2.204623**	**2.204623**
U_3O_8/kg	$61.18	$70.55	$49.93	$63.93
UF_6/kg	$13.50	$16.00	$9.03	$14.25
Total/kg	$74.68	$86.55	$58.96	$78.18
June- December Spot Change ($)				$15.71
June- December Spot Change (%)				26.6%
June- December Contract Change ($)				$8.36
June- December Contract Change ($)				10.7%
Spot Discount from Contract				
	$11.87	**13.7%**	**$19.22**	**24.6%**

UxC, a leading firm in reporting on and analyzing uranium markets has recently offered a number of observations about conditions in the second half of 2018, [redacted] The recent *UxC* observations noted that spot prices were rising in the last half of 2018, as suppliers cut production in a glutted market. *UxC* also observed factors that will have significant impact on markets through the [redacted]. A slip that occurred in 2019 spot prices did not necessarily serve as an indicator of future price direction, with a market lull produced by the pendency of the Section 232 decision, not made until July of 2019. That decision permitted U.S. utilities to proceed with long-term fuel cycle element procurement commitments without fear of imposition of a U.S. origin requirement. Similarly, non-U.S. utility competitors for supply had also deferred commitments, until learning whether global market prices would fall, should the U.S. impose a domestic content requirement.

UxC also observed that the production cuts proceeding over the past several years had positioned the market to generate higher prices, approaching more closely marginal production costs. The observations also included a caution about hikes in spot market prices caused by trader speculation in advance of coming rounds of contract extensions by utilities. *UxC* also cited volatility concerns arising from the large portion of production from world regions with high geopolitical risk. Finally, *UxC* noted a window of flat reactor requirements through 2025, at risk of closing thereafter due to: (a) significant world-wide growth in the ensuing decade, and (b) resource exhaustion at a number of uranium projects by 2025.

These factors underscore the importance of seeking in the second half of 2018 a future supply balance that would:

- Protect against price increases from a supply/demand rebalancing
- Retaining some ability to take advantage should such balancing proceed more slowly and spot prices prove soft (as they did early in 2019)
- Hedged the consequences of an as yet unknown resolution of the domestic content issue
- Recognize through contract term length the potential for significant market shifts related to long term entry of new sources of demand and losses of large sources of existing supply.

This chapter addresses below how management considered such factors in its 2018 supply decisions for UF_6 and enrichment services.

5. *Nuclear Fuel Agreements*

a. Contracting Strategy

[redacted] As we describe below, depressed prices, increased concentration of supply sources in less reliable world regions, and a pending risk of U.S. adoption of a minimum domestic content played significant market roles in the second half of 2018, [redacted]

Entergy's Nuclear Fuels Group does undertake substantial analysis of existing, likely, and possible future market circumstances in making strategic and tactical decisions about the key factors in securing future supply. For example, a changing relationship between term and spot prices, expected changes in supply/demand fundamentals expected in the future, and uncertainties about foreign content and resource location and control, had clear impacts on contract durations, optimizing the mix of pricing types, and supplier risk clearly influenced the structure of the solicitations to replace expiring contracts and the decisions made about how to replace them and for how long.

b. Contracts Expiring During the Audit Period

Entergy's comparatively large nuclear fleet provides leverage in combining agreements for uranium, conversion, and enrichment. Fabrication, however, is unit specific, driven by station-specific manufacturer specifications. [redacted]

For Grand Gulf, Entergy currently contracts with [redacted]

Nuclear Fuel Cycle Contracts Expiring in 2019
(table is confidential)

Counterparty	Execution	Element	Term
[redacted]			

[redacted]

c. Replacement of the Expiring Contracts

[redacted]

2019 Nuclear Fuel Agreements
(table is confidential)

Counterparty	Execution	Element	Term
[redacted]			

[redacted]

d. Management's Analysis of the Offers Made

[redacted]

Each cycle element comprised the following percentages of total fuel-cycle costs at the time of our 2011 audit and for the current Grand Gulf fuel load: A separately calculated "Fuel-Related Taxes & Fees" category existing now accounts for two percent of the total.

Nuclear Fuel Cycle Costs
(table is confidential)

Element	Uranium	Enrichment	Fabrication	Conversion
2011 Share	[redacted]	[redacted]	[redacted]	[redacted]
Current Share	[redacted]	[redacted]	[redacted]	[redacted]

6. Prior Audit Recommendations

We consider the nuclear-fuel recommendations of the prior audit effectively implemented insofar as we consider them to be applicable to current and expected management responsibilities and actions.

The last audit recommended consideration of a "forward coverage policy." Management appears to have expressed reluctance to do so lest it lose opportunities to take advantage of opportunities in changing markets. [redacted] did lead management to what we viewed as an informed analysis of how much "forward coverage" to secure and how to secure it. That it was not driven by pre-established, quantified benchmarks or targets did not, in any way apparent to us, diminish or misdirect the

information gathering and analysis that led to securing the coverage represented by [redacted].

We agree entirely with the prior auditor's underlying premise that sound, comprehensive analysis and judgment should guide procurement commitments. We believe that Entergy did that in 2018 [redacted]. We would not extend that agreement, however, to finding quantified targets especially useful. For whatever benefit they might bring, they also burden future thinking by the need to justify variation from plans based on conditions no longer in the same balance with each other.

With respect to the "backcasting" addressed in the last audit report, we do consider it necessary to analyze the foundations and results of prior assumptions against results, in order to ensure a fully robust understanding of the kinds of risks that a dynamic, world-wide market poses even for good forecasting. However, the variables underlying performance of that market would not appear to us to justify very complex and time consuming efforts to isolate and measure the impacts that all known factor changes (relative to expectations) may have had on the range of future results on which planning was performed. As to the former, more qualitative assessment of past assumptions, we believe that management already does it. If creation and use of the complex modeling it would take to test all of those assumptions mathematically against actual outcomes was intended, we do not consider it economically justifiable.

The last audit addressed the loss of access to the Nuclear Energy Institute's personnel database and benchmarking data following withdrawal from the Institute. The personnel database, which assists in background screening did not appear to us to be within the scope of this fuel and energy audit. We agree that such screening is vital and should be made as efficient as possible, but considered impracticable the extensive examination it would take into what access Entergy has lost, how it has replaced it, and what risks may remain arising from hiring threats. With respect to nuclear fuel related data, we found Entergy's benchmarking sources strong and comprehensive, supported by the knowledge, experience and contacts of a large population of nuclear industry personnel.

With respect to RFP design and use, we agree that solicitations should be clear, comprehensive, and fully actionable when it comes to vendor response. Our examination of the [redacted] With needs and market circumstances so variable, however, we do not see investment in standardized forms for all possibilities a worthwhile exercise, as opposed to using prior solicitation documentation as a starting point, where appropriate, for future procurements.

C. Conclusions

1. **Nuclear fuel costs for the Audit Period averaged about [redacted] and remained steady during the Audit Period; the substantial improvement over the prior audit period was driven by the higher capacity factor attained in this Audit Period.**

Refueling cycles drive the calculation of nuclear fuel costs. Management capitalizes the uranium, conversion, enrichment, and fabrication costs for each batch of nuclear fuel, which carries the unit between refueling outages, and then amortizes them over the 24 months between those outages.

Therefore, measuring on a ¢/mmBTU basis says more about unit capacity factor than it does the raw costs of providing for each element of the fuel cycle. Chapter VII describes the comparatively high Grand Gulf capacity factor (compared its recent historical performance) during this Audit Period. Thus, from that perspective, costs looked sound.

2. [redacted]

Another way to look at nuclear fuel cost performance is to compare contract prices to markets at the time of entry of those prices. During the last audit period, continuing soft market conditions, characterized by significant oversupply relative to demand, produced low spot prices. However, as 2018 progressed and as the prior audit period ended (on September 30, 2018), spot prices firmed significantly, with spot U_3O_8 prices rising throughout the second half of 2018. While they fell back in 2019, they did not return to levels seen during the last audit period.

[redacted]

3. [redacted]

[redacted] Management analyzed their price and other terms, and considered important risk factors, like possible impacts from the pending Section 232 risk of imposition of a minimum domestic content requirement for uranium. [redacted]

[redacted]

[redacted]. Potential future vendor diversity concerns moderated with the

decision not to impose a domestic content requirement, but incorporation of [redacted]

4. Entergy employs a well-organized, experienced, and effective organization to manage nuclear fuels.

The Nuclear Fuels group operates as part of an integrated Nuclear organization, operating under a Chief Nuclear Officer, which has become the standard utility model, particularly for those, like Entergy, who have sizeable nuclear fleets. Management has taken advantage of the size of that fleet to establish and maintain a highly experienced Nuclear Fuels Supply organization with a sufficiently large size to ensure sound procurement and to allow assignment of specific individuals to administration of contracts by fuel cycle element. A parallel group addressing planning also adds accounting expertise and provides an independent source of oversight over major procurements and payments. The supply organization is also tightly integrated with nuclear engineering and design resources, particularly core design, which facilitates the process of ensuring the accuracy and precision needed to meet the special requirements of fueling nuclear reactors.

D. Recommendations

We have no nuclear fuel recommendations