BEFORE THE NEW MEXICO PUBLIC REGULATION COMMISSION

IN THE MATTER OF SOUTHWESTERN PUBLIC SERVICE COMPANY'S APPLICATION FOR: (1) REVISION OF ITS RETAIL RATES UNDER ADVICE NOTICE NO. 282; (2) AUTHORIZATION AND APPROVAL TO SHORTEN THE SERVICE LIFE OF AND ABANDON ITS TOLK GENERATING STATION UNITS; AND (3) OTHER RELATED RELIEF,	**)**	**CASE NO. 19-00170-UT**
SOUTHWESTERN PUBLIC SERVICE COMPANY,	**)**	
APPLICANT.	**)**	

DIRECT TESTIMONY

of

DAVID A. LOW

on behalf of

SOUTHWESTERN PUBLIC SERVICE COMPANY

TABLE OF CONTENTS

GLOSSARY OF ACRONYMS AND DEFINED TERMS

Acronym/Defined Term	**Meaning**
Base Period	April 1, 2018 through March 31, 2019
Btu	British thermal unit
Commission	New Mexico Public Regulation Commission
EAF	Equivalent Availability Factor
FERC	Federal Energy Regulatory Commission
FOR	Forced Outage Rates
IM	Integrated Marketplace
kWh	kilowatt hour
LP	Low Pressure
M&D	Monitoring and Diagnostic
MW	megawatt
MWh	megawatt hour
NERC	North American Electric Reliability Corporation
GADS	Generating Availability Data System
OEM	Original Equipment Manufacturer
O&M	Operation and maintenance
RFP	Rate Filing Package

Acronym/Defined Term	**Meaning**
SMWA	Service Maintenance and Warranty Agreement
SPP	Southwest Power Pool, Inc.
SPS	Southwestern Public Service Company, a New Mexico corporation
Test Year	Historical Test Year Period consisting of the Base Period and further incorporating all proper adjustments and capital additions
Vestas	Vestas-American Wind Technology, Inc.
Xcel Energy	Xcel Energy Inc.
XES	Xcel Energy Services Inc.

LIST OF ATTACHMENTS

Attachment	Description
DAL-1	Test Year Energy Supply O&M Expenses (*Filename*: DAL-1.xlsx)
DAL-2	Tolk Station Annual Equivalent Availability Factors (*Filename*: DAL-2.xls)
DAL-3	Harrington Station Annual Equivalent Availability Factors (*Filename*: DAL-3.xls)
DAL-4	Gas Units (200-299 MW) Annual Equivalent Availability Factors (*Filename*: DAL-4.xls)
DAL-5	Tolk Station Annual Forced Outage Rates (*Filename*: DAL-5.xls)
DAL-6	Harrington Station Annual Forced Outage Rates (*Filename*: DAL-6.xls)
DAL-7	Gas Units (200-299 MW) Forced Outage Rates (*Filename*: DAL-7.xls)

I. WITNESS IDENTIFICATION AND QUALIFICATIONS

Q. Please state your name and business address.

A. My name is David A. Low. My business address is 790 S. Buchanan Street, Amarillo, Texas 79101.

Q. On whose behalf are you testifying in this proceeding?

A. I am filing testimony on behalf of Southwestern Public Service Company, a New Mexico corporation ("SPS") and wholly-owned electric utility subsidiary of Xcel Energy Inc. ("Xcel Energy").

Q. By whom are you employed and in what position?

A. I am employed by SPS, as General Manager, SPS Generation.

Q. Please briefly outline your responsibilities as General Manager, SPS Generation.

A. I am responsible for providing management for the SPS Generation business area within the Energy Supply organization, which provides leadership, strategic direction, and management of the power generation group within the SPS area of Xcel Energy.

Q. Please describe your educational background.

A. I received a Bachelor of Science in Mechanical Engineering Technology from Texas Tech University in 1983. I also completed course work toward an MBA at West Texas A&M University from 1998 to 2001.

Q. Please describe your professional experience.

A. I began my career with SPS in 1983 as a Plant Engineer at Tolk Station. I was promoted to Supervisory Plant/Project Engineer at Tolk Station in 1987. In 1992, I was promoted to Senior Project Engineer at Tolk Station. Then in 1995, I became the Maintenance Manager for SPS's Harrington Station. In 2003, I was promoted to Plant Director for Public Service Company of Colorado's Pawnee Station. In 2007, I was promoted to Plant Director of SPS's Tolk and Plant X Complex. Finally, in 2011, I was promoted to my current position as General Manager, SPS Generation.

Q. Have you attended or taken any special courses or seminars relating to public utilities?

A. Yes. Over my career, I have taken various courses and seminars related specifically to the public utility industry.

Q. Have you testified before any regulatory authorities?

A. Yes. I have filed testimony and testified before the New Mexico Public Regulation Commission ("Commission"). I have also filed testimony at the Public Utility Commission of Texas. My testimony has addressed the topics of SPS's generation and its power plant operation, maintenance, expenses, and cost control practices.

II. ASSIGNMENT AND SUMMARY OF TESTIMONY AND RECOMMENDATIONS

Q. What is your assignment in this proceeding?

A. My testimony supports the Test Year[1] Operation and Maintenance ("O&M") expenses for the Energy Supply business area and demonstrates how those expenses are reasonable and necessary to support the electric service SPS provides to its New Mexico retail customers and representative of future costs. I also discuss SPS's generation by operating plant and unit, and its power plant operation, maintenance, and cost control practices during the Test Year. In addition, I sponsor Schedule P-7 in SPS's Rate Filing Package ("RFP").

Q. Please summarize the recommendations and conclusions in your testimony.

A. I recommend that the Commission approve SPS's requested Energy Supply business area O&M expenses. SPS's Test Year Energy Supply business area O&M expenses are reasonable and necessary to support the electric service SPS provides to its New Mexico retail customers and are representative of SPS's future costs. SPS operates its units in a prudent and efficient manner that ensures

1 The Test Year consists of the Base Period, which is the period from April 1, 2018 through March 31, 2019, plus all proper adjustments to Base Period costs.

the safe and reliable operations of its units, with continued environmental compliance:

- SPS's approach to O&M for the Hale Wind Project leverages Xcel Energy's experience with other wind projects and efficiently uses experienced contractors and internal personnel.
- SPS uses tools such as PLEXOS software to schedule maintenance or overhauls on a component basis (instead of complete or major unit overhauls), which helps stabilize maintenance costs from year to year and ensures the efficient and reliable operation of SPS's units.
- SPS uses a proactive predictive maintenance program that helps minimize costs, while maintaining unit reliability.
- SPS maintains a robust performance assurance program, which includes ongoing monitoring of power plant performance, to improve unit efficiency and find cost-effective ways to reduce fuel costs:
    - SPS's coal units performed well during the Base Period, with most operating within 3% of their Adjusted Design Net Heat Rate; and
    - During the Base Period, SPS conducted a Steam Path Analysis on Tolk Unit 1, Jones Unit 2, and Harrington Unit 1 turbines, which resulted in greater fuel savings and improvements in heat rates for those units.
- SPS requires and provides training of plant operators and maintenance personnel to ensure the safe and reliable operation of its units.
- Although SPS continues operating in an efficient manner, the changes to the Southwest Power Pool, Inc.'s ("SPP") market has increased unit starts and shortened unit service hours, which has increased O&M expense and will likely do so in the future.

In comparison to other utilities, SPS's O&M programs for generation facilities are highly effective:

- The overall Equivalent Availability Factor ("EAF") for SPS's coal and gas units compare favorably with the national average for 2017, the most recent North American Electric Reliability Corporation ("NERC") publication of these metrics.

- The overall Forced Outage Rates ("FOR") of SPS's coal and gas units also compare favorably to the national average in 2017.

- Although SPS had several unplanned outages during the Base Period, SPS took all reasonable steps to avoid unplanned outages and to quickly make repairs and bring plants back on line when needed.

SPS's practices also include efforts to minimize related O&M expenses.

Q. Was Attachment DAL-1 prepared by you or under your direct supervision and control?

A. Attachment DAL-1 was prepared under the supervision of SPS witness Arthur P. Freitas and represents a portion of the jurisdictional cost of service provided in Mr. Freitas's direct testimony (Attachment APF-6). I have reviewed Attachment DAL-1 and believe it to be accurate.

Q. Were Attachments DAL-2 through DAL-7 prepared by you or under your direct supervision and control?

A. Yes.

Q. Was RFP Schedule P-7, which you sponsor, prepared by you or under your direct supervision and control?

A. Yes.

Q. Do you incorporate RFP Schedule P-7 that you sponsor into your testimony?

A. Yes.

Q. How were New Mexico retail jurisdictional amounts in your testimony and attachments calculated?

A. Throughout my testimony, I quantify the expense and asset amounts on a New Mexico retail basis based upon the jurisdictional allocation percentages Mr. Freitas uses to develop the New Mexico retail revenue requirement in his Attachment APF-6. Mr. Freitas is responsible for calculating jurisdictional allocation percentages that apply to the various costs components in the cost of service. My staff and I conferred with Mr. Freitas and his staff to determine these New Mexico retail jurisdictional amounts presented in my testimony and attachments. If the percentages used to allocate amounts to the New Mexico retail jurisdiction change, those new allocation percentages will need to be applied to the total SPS numbers to derive updated New Mexico retail amounts.

III. GENERATING FACILITIES

Q. Please describe SPS's generating facilities.

A. SPS had the following generating facilities in service during the Base Period:

Steam Production – Gas/Oil

- Jones Unit 1
- Jones Unit 2
- Plant X Unit 1
- Plant X Unit 2
- Plant X Unit 3
- Plant X Unit 4

Steam Production – Gas

- Cunningham Unit 1
- Cunningham Unit 2
- Maddox Unit 1
- Nichols Unit 1
- Nichols Unit 2
- Nichols Unit 3

Steam Production – Coal

- Harrington Unit 1
- Harrington Unit 2
- Harrington Unit 3
- Tolk Unit 1
- Tolk Unit 2

Other Production – Combustion Turbine

- Cunningham Unit 3
- Cunningham Unit 4
- Jones Unit 3
- Jones Unit 4
- Maddox Unit 2

- Maddox Unit 3
- Quay County Unit 1

SPS's natural gas-fueled plants consist of 12 steam turbine units and 7 combustion turbines. SPS's coal-fueled power plants consist of 5 steam units. SPS's Carlsbad Generating Station was retired on December 31, 2017, and it has been dismantled. A major addition in the SPS generation fleet is the Hale Wind Project. The Hale Wind Project began commercial operation in June 2019. In addition to these SPS-owned facilities, SPS also makes use of four solar generation facilities located in New Mexico.

Q. Are any units dedicated for peaking service?

A. Yes. The combustion turbines at Jones Units 3 and 4, Cunningham Units 3 and 4, and Maddox Unit 2 are considered peaking units.

Q. Are any units used primarily for emergency situations?

A. Yes. Quay County and Maddox Unit 3 are designated primarily for emergency use.

IV. ENERGY SUPPLY O&M EXPENDITURES

Q. What are the types of O&M services associated with SPS's Energy Supply business area?

A. SPS's Energy Supply business area is responsible for the oversight, planning, siting, design, construction, operation, and maintenance of SPS's generation facilities. The services Energy Supply provides include activities such as capital project oversight and management, plant engineering and technical support, performance testing and analysis, reliability maintenance services, safety programs, NERC reliability standards compliance, and environmental compliance (e.g., continued compliance with environmental rules and regulations, obtaining permits for new and existing facilities).

Q. Are the services and associated costs related to the Energy Supply business area necessary for SPS's operations?

A. Yes. The services and associated costs are necessary to ensure that SPS's generation fleet, which is essential to providing electric service to SPS's customers, is safely and reliably operated and maintained. For example, these services are necessary to ensure that SPS's generation facilities remain in compliance with environmental regulations and receive sufficient technical support. The Energy Supply business area provides services that are required by all utilities and without which SPS would not be able to provide electric service to its customers.

Q. Do SPS's New Mexico retail customers benefit from the services that are provided by the Energy Supply business area?

A. Yes. The services of the Energy Supply business area benefit SPS's New Mexico retail customers by supporting the safe and reliable production of generation capacity needed to serve the electric needs of those customers.

Q. Please describe the costs associated with the O&M services provided by Energy Supply business area.

A. The costs for these services are made up of both native costs and affiliate charges. Native SPS costs are those costs incurred directly by SPS to provide electric service to customers. For example, the salaries and benefits of SPS employees are native costs. Affiliate costs are those associated with services provided by Xcel Energy Services Inc. ("XES")[2] or other affiliates to SPS. These services are in addition to, and not duplicative of, the services that SPS employees provide. Charges for affiliate services are provided "at cost," or without profit.

[2] XES is a centralized service company.

The costs for these services are related to labor, overheads, pension and benefits costs, materials, and supplies. SPS witness Michael T. Knoll provides testimony explaining that SPS's labor costs are reasonable. SPS witness Richard R. Schrubbe provides testimony explaining that SPS's pension and related benefits costs are reasonable. SPS witness Melissa L. Schmidt provides testimony explaining that the methodology of billings for labor and labor-related overheads and affiliate costs is reasonable.

Q. Do you provide an attachment that lists the total Energy Supply business area O&M expense by Federal Energy Regulatory Commission ("FERC") account?

A. Yes. Attachment DAL-1 provides the total Test Year Energy Supply-related O&M expenses broken down by FERC account.

Q. During the fiscal year, does the Energy Supply business area monitor its actual expenditures versus its budget?

A. Yes. Actual versus expected expenditures are monitored on a monthly basis by management within each department of the Energy Supply business area. Deviations are evaluated each month to ensure that costs are appropriate. In addition, action plans are developed to mitigate variations in actual to budgeted expenditures. These mitigation plans may either reduce or delay other expenditures so that overall spending complies with the authorized budget.

Q. Are employees within the Energy Supply business area held accountable for deviations from the budget?

A. Yes. All management employees in the Energy Supply business area have specific budgetary targets that are measured on a monthly basis to ensure adherence to the targets and provide for action plan development to address variances.

Q. Is the Test Year level of O&M costs associated with the Energy Supply business area reasonable and representative of the costs apt to prevail in the future?

A. Yes. The Test Year level of Energy Supply business area O&M expenses are reasonable and representative of the costs SPS will experience in the future. As I discussed earlier, SPS provides Energy Supply business area services as efficiently as possible, making all reasonable efforts to manage costs and stay within an O&M budget.

V. HALE WIND PROJECT O&M EXPENDITURES

Q. Is SPS proposing any adjustments to its Base Period O&M?

A. Yes. The Base Period O&M does not reflect the operation and maintenance expenses for the Hale Wind Project, which began commercial operation in June 2019. The adjustment requested for O&M expenditures for the Hale Wind Project is $7,686,240 ($2,205,028 New Mexico Retail). The O&M expense is shown in Attachment APF-6 presented by Mr. Freitas. For the reasons explained below, that amount is reasonable, necessary, and representative of the ongoing costs to support the O&M of the Hale Wind Project.

Q. How was the amount included in the cost of service for the Hale Wind Project O&M developed?

A. The Hale O&M costs in the cost of service reflect the cost of the Service, Maintenance and Warranty Agreement ("SMWA") with Vestas-American Wind Technology, Inc. ("Vestas") for the year during the period that rates will be in effect. Based on the terms of the contract, that amount is known with certainty.

Q. Will there be O&M costs for Hale that are not reflected in the cost of service?

A. Yes. There will likely be additional O&M costs outside of the SMWA that SPS intends to request in future cases.

Q. Please provide a description of the Hale Wind Project.

A. The Hale Wind Project is a 478 megawatt ("MW") facility located in Hale County, Texas. To develop the Hale Wind Project, SPS has installed 239 turbines through a combination of Vestas model 2.0 MW V110 and 2.0 MW V116 wind turbines. Site infrastructure includes access roads, foundations, electrical cable collection systems, and collection system substations. The generation output ties into the SPP transmission system through a generation tie line from the Hale Wind Project collector station to the interconnection tie breaker at the TUCO substation (i.e., the SPP transmission grid point).

Q. What is involved in the O&M of a wind project?

A. O&M activities associated with a wind project generally involve two categories of maintenance: (1) scheduled; and (2) unscheduled. Scheduled maintenance includes general preventative maintenance. Unscheduled maintenance stems from the identification of operational issues from monitoring the wind turbines and the subsequent repair of identified issues.

Q. Please provide an overview of SPS's plan for operating and maintaining the Hale Wind Project.

A. SPS is using a combination of services provided by the Original Equipment Manufacturer ("OEM") and internal personnel assigned to the Hale Wind Project site. SPS has executed a SMWA with Vestas, the OEM.

Q. Why did SPS enter into an SMWA with Vestas?

A. Vestas is the OEM of the turbines used in building the Hale Wind Project. Xcel Energy has found that using the OEM to perform O&M services offers several benefits, including: (i) lowering the risk of claims of inadequate maintenance during the warranty period; (ii) allowing Xcel Energy to readily obtain controls and software updates that help maintain reliability; and (iii) allowing Xcel Energy's teams to gain greater knowledge of technological advances by working closely with the OEM, which leads to improved O&M on the turbines over their useful lives. Vestas often provides O&M services to other wind projects, providing SPS additional assurance that Vestas is highly qualified to do the O&M work.

Q. What types of services will Vestas provide under the SMWA?

A. The SMWA obligates Vestas to perform warranty work as well as scheduled and unscheduled maintenance. The SMWA will cover warranty work for equipment including wind turbines, towers, and climb assists. Examples of warranty work include replacement of failed parts such as bearings, electronic components, and the labor associated with the replacement.

Vestas will also perform all maintenance, diagnostics, repair and replacement services on the serviced equipment, including among other things, performing gearbox borescopes, inspecting wind turbine blades, sampling gearbox and hydraulic unit oil, checking tensioning of tower base section anchor bolts and performing re-tensioning, monitoring and reporting any FAA lighting outages, and repairing and maintaining climb assists at scheduled intervals. Vestas is also required to maintain a suitable inventory of replacement and spare parts for the wind turbines.

Q. Could SPS have provided internally the same services as Vestas is providing through the SMWA?

A. No. SPS does not have any employees trained in wind generation O&M, and SPS does not currently have training programs to support such activities.

Q. How many internal staff will be assigned to work on Hale O&M?

A. There will be four internal staff that will provide plant management, engineering, and administrative services to the Hale Wind Project, in addition to overseeing the SMWA contractors. In addition, XES personnel will provide various support services including providing technical service groups for assistance with engineering issues, material and chemical analysis, grid reliability, equipment analysis, environmental services, safety services, and site security.

Q. How does SPS and Xcel Energy work with the OEM to provide O&M activities for a wind generation project?

A. Xcel Energy works with the OEM during all phases of the project construction process and thereafter in the operation of the project. Xcel Energy staff monitors and coordinates with those contractors to perform the O&M needed for the facility. SPS staff coordinates on scheduled maintenance as well as on responding to issues at the site. The contractor bears the responsibility for reporting conditions at the site and any issues, and contractor will inform the internal employees when an operations issue is identified.

In an instance where monitoring of SCADA data or other O&M-related monitoring has revealed a potential operations issue, internal staff will direct the external contractors to schedule a technician to go out to the turbine in question.

Depending upon the nature of the potential problem, the team that goes out to the turbine may include both internal and external personnel. SPS works hand in hand with the contractor to address the cause of the issue and fix it as timely as possible.

Q. What type of plant management technology will the Hale Wind Project use?

A. The Hale Wind Project will use Energy Supply's Monitoring and Diagnostic ("M&D") Center as described in Section VI of my testimony.

Q. How will the Hale Wind Project be monitored?

A. Xcel Energy has staff on site Monday through Friday during normal business hours, so if an issue arises during this time the staff can respond quickly. After normal business hours, the SCADA system continues to be monitored remotely by Vestas and personnel can be dispatched if an issue arises that requires an immediate response. Turbines can also be turned off and restarted remotely if a problem is observed and the turbine needs to be taken offline. Under both emergency and non-emergency situations, however, the O&M response is just like any other power plant: when you get an alarm, you go to the site and address it as soon as practicable given the issue.

Q. Does Xcel Energy have experience with other wind project O&M?

A. Yes. Xcel Energy has wind farm O&M experience through multiple, successful company-owned wind projects at its other Operating Companies.[3] In total, by the end of 2019 Xcel Energy expects to be operating 1,127 turbines with a nameplate capacity of 2,200 MW, not including the Hale Wind Project.

Q. Has SPS applied the knowledge and experience that Xcel Energy has gained from those wind projects to its plan for operating and maintaining the Hale Wind Project?

A. Yes. Xcel Energy and SPS applied the best practices learned from Xcel Energy's experience at those wind farms to SPS's O&M plan for the Hale Wind Project. Based on this experience, SPS believes that its O&M activities and requested amount for the Hale Wind Project are reasonable and necessary.

[3] Xcel Energy's operating companies are: Northern States Power Company - Minnesota, Northern States Power Company – Wisconsin, Public Service Company, Public Service Company Colorado and SPS.

VI. SPS POWER PLANT O&M PROGRAMS

Q. Please describe SPS's O&M programs that help ensure generation efficiency.

A. SPS employs a number of strategies to control costs and ensure generation efficiency including: (1) scheduled routine maintenance practices; (2) predictive maintenance practices; (3) performance assurance programs; and (4) training of maintenance personnel and plant operators. The objective of these activities is to reduce O&M expenditures while maximizing unit availability. Improved unit availability allows system operations to optimize generation through increased use of the most cost-effective units.

A. Scheduled Maintenance Practices

Q. Please describe SPS's power plant maintenance program.

A. SPS uses a computerized maintenance information system software program to manage its power plant maintenance activities. This system integrates: (1) maintenance requests submitted by power plant personnel; (2) maintenance progress tracking; (3) man-hour time reporting; (4) parts inventory management; (5) scheduled maintenance; and (6) maintenance history. It also enables operators, maintenance personnel, engineers and other technical staff to identify, prioritize, plan, coordinate, and schedule maintenance activities for power plants. This system allows SPS operators and maintenance personnel to work together as a team toward the common goals of minimizing operating costs, maximizing unit availability, and complying with environmental regulations. Additionally, SPS uses project management software programs such as PLEXOS, Microsoft Project, and Primavera P6 to ensure efficient maintenance scheduling.

Q. Please describe SPS's scheduled maintenance practice.

A. SPS uses an equivalent, nine-year cycle on its major component inspections unless specific circumstances warrant more or less frequent inspections. Under this practice, all components in a turbine are inspected within a nine-year cycle of equivalent operating time. Actual durations vary and inspections may occur more or less often if component history, industry information, component assessment, projected retirements, and unit operations warrant an extension or reduction in the duration.

Maintenance on SPS's turbine generators is done on a component basis. Instead of a less frequent complete unit major overhaul (which involves disassembly, inspection, and repair of all major components of the turbine-generator at once), individual sub-components of the turbine generator are overhauled on a more frequent basis. This practice allows for more stable maintenance costs from year to year, and provides a higher average level of unit availability. Additionally, boilers are inspected and overhauled on a three-year cycle. When a unit must be shut down for boiler maintenance, SPS may take advantage of that outage to do component turbine or generator maintenance as well.

Q. Is the overhaul frequency the same for all units?

A. No. Generally, both steam and combustion turbines follow manufacturer recommendations. But some units are scheduled for maintenance on a more frequent basis due to operational concerns or the nature of the unit design specifications. SPS has a combustion turbine maintenance system that tracks the hours of operation and number of starts and trips and correlates that with total hours of operation. When a unit reaches the OEM recommended hours of operation, maintenance inspection and repairs are performed. SPS uses a similar method of tracking maintenance requirements for steam turbines. Additional hours of operation are added to the total hours when the units are cycled.

One example of a change to SPS's overhaul frequency due to the nature of a unit's design specifications occurred with respect to Tolk Unit 2's nozzle block during the February 2017 overhaul. The OEM recommended inspecting the nozzle block bolting every 50,000 hours of operation. With this recommendation the inspection frequency would be every 5.7 years and none of the other components would be required to be inspected during this time. However, during SPS's February 2017 overhaul of Tolk Unit 2, SPS installed a new nozzle block design that would not require bolting inspections. With the new slide-in nozzle block installation, all the hold down bolts were eliminated. The new design has an equivalent operating cycle extended to a nine-year inspection interval, which matches the inspection recommendations for the high pressure/intermediate pressure turbine.

Another recent example of an OEM recommendation occurred at the Cunningham 3 and 4 units. The original generator cooling fan design had limited life and can fail without warning. The new Siemens design has a two-stage set of blades and is currently being installed in Cunningham 3. Cunningham 4 will receive the upgrade during the generator rewind scheduled in 2020. The new blade design will extend the life of the cooling fan without concern of sudden failure.

An example of overhaul frequency being influenced by operational concerns is that coal-fired units, which may experience boiler slagging, usually require more frequent maintenance than gas-fired plants. Slagging is the formation of molten or partially fused deposits on the furnace walls or surfaces and forms when ash deposits are exposed to the radiant heat of the coal flames. These deposits are removed to recover the efficiency of the unit.

Q. How does SPS's scheduled maintenance practice affect system operations?

A. Scheduling outages on a component basis rather than incurring a complete unit outage results in higher availability because problems that occur due to normal degradation can be identified and corrected much sooner and with less disruption to the plant as a whole. Also, the manpower needs for a component outage are less than for a major outage. This reduces the need for outside contractors or higher internal staffing levels for scheduled outages. The ability to minimize the scheduled outage time of units provides more options to minimize costs to SPS's customers by increasing efficiency and maintaining the availability of these units. Minimizing outage times also provides SPS with more options to meet load and increases system reliability.

B. Predictive Maintenance Practices

Q. What is predictive maintenance?

A. Predictive maintenance is the process of analyzing equipment operations for degradation and performing maintenance at a cost effective time, prior to failures that could be more costly. If maintenance is performed too frequently, reliability remains very high, but maintenance costs can be higher than required for that level of reliability. If maintenance is performed too infrequently, then problems can go undetected and unaddressed – resulting in decreased reliability and increased repair costs once the problem emerges. SPS is a strong proponent of taking a proactive approach with our predictive maintenance programs rather than being in a position where we are simply reacting to failures.

Q. Please describe the tools SPS uses in its predictive maintenance program.

A. SPS uses several tools to help identify problems before forced outages occur. A performance assurance program is employed in which the steam turbine and the parameters of the steam turbine cycle are evaluated for problems that may require maintenance. Performance testing, as a predictive maintenance tool, is used to prevent problems that may result in a forced outage. This program allows the maintenance department to gather data from the performance test and act on that data by, for example, ordering parts and materials so that they can be prepared for an anticipated outage.

As part of the performance assurance program, a Valve Wide Open Test is performed with the unit on-line. The information obtained from this test allows the Performance Monitoring organization or power plant personnel to quantify the amount of degradation that has occurred since previous tests. If the level of degradation is large, then plant personnel can spend the needed time during the outage to identify and resolve any problems. Heat balance tests are scheduled every two to three years depending on the outage schedules for the major units (>200 MW). This ensures that the units that have the greatest effect on fuel costs are tested frequently. Minor units that have high capacity factors are scheduled for testing approximately every five years depending on need and resource availability. Peaking and low capacity factor units are not routinely tested as their use is based on need for capacity and not on economical generation.

Steam-path analysis is another tool SPS uses for predictive maintenance purposes. During a scheduled turbine outage, the steam-path areas of the turbine are thoroughly inspected. By taking precise measurements and conducting a detailed inspection, components are evaluated for wear, deposit buildup, foreign object damage, and steam leakage. A steam-path analysis will identify components that should be replaced to prevent a forced outage or improve the efficiency of the unit.

Vibration monitoring is another predictive maintenance tool utilized by SPS. Because vibration is recognized as an early indicator of problems in rotating machinery, SPS has installed continuous vibration detection and protection on critical equipment, such as large turbine generators, large boiler feed pumps and cooling tower fans. SPS collects computerized periodic vibration data. This data can be used to monitor and trend vibration problems.

SPS has invested in nondestructive examination capabilities by training and qualifying personnel in magnetic particle nondestructive examination. This enables SPS to determine the condition of components in a power plant without damage to the component being inspected. SPS has the capability to use several qualified nondestructive examination techniques, such as magnetic particle, dye penetrant, ultrasonic, eddy current, and x-ray. Each technique has a special application to identify components that could cause failure.

Generator tagging is another useful predictive tool that can provide early information of localized overheating in the generator. Used on the gas-cooled generators at Jones, Tolk, and Harrington, generator tagging involves painting or tagging different locations in the generator with various tagging compounds. If localized overheating occurs while the unit is on-line, a device called a generator condition monitor senses the condition and gives an alarm to the operator. A gas sample from the generator containing molecules of the burned tagging compound can be taken from the generator and the location of the overheating can be determined before entering the generator. This advanced warning system not only minimizes generator damage in the event of overheating, but also assists maintenance personnel in determining the location of the overheating and the steps to correct the overheating before disassembly of the generator.

Dissolved gas and oil testing, a predictive maintenance tool used for transformer condition assessment, enables SPS to identify localized overheating and insulation defects in oil-cooled transformers at the incipient stage so that repairs can be planned in conjunction with a scheduled outage of the unit. Early awareness of potential localized burning in the transformer can help prevent catastrophic forced outages of generating units. This testing involves taking oil samples from the transformer for evaluation by SPS's analytical chemistry lab for the presence of several gases, as well as degradation of insulation materials. Knowledge of how the different gaseous compounds are formed and trending analyses are used to interpret the data and detect problems before failure.

In addition to testing transformer oil, lubrication oils for the plants are sampled and tested. Lubrication oils are tested once per year for indication of oil degradation and unusual machine wear. Analyses include measuring oxidation resistance and the presence of wear metals. In addition to yearly testing, major rotating equipment is tested at least every six months at all facilities for indication of corrosion or contamination.

With regard to plant water chemistry, water samples are used to predict areas for corrective action. Automatic analyzers constantly measure the quality of the boiler feedwater, boiler water, and steam. Small amounts of impurities can be detected, which when immediately addressed, prevent costly long-term damage to the boiler and turbine equipment. Water samples are taken from every water source in each plant for indication of operational and maintenance problems as well as unusual corrosion conditions.

Another predictive maintenance tool SPS uses is insulation resistance testing of motors. An insulation resistance test is performed by applying a high voltage (at least twice the rated voltage) direct current to the motor windings. The test is conducted on motors during a scheduled outage, and the data obtained provides three alternative courses of action. If the data shows the insulation to be in good condition, then no action is necessary and repeat testing can be done at the next scheduled outage. If the data shows marginal results, the motor is disassembled, cleaned, and retested. Lastly, if the data indicates an imminent failure, the motor is repaired or replaced. The advantage of this predictive tool is that repairs can be done during a scheduled outage, and a forced outage can be avoided.

C. Performance Assurance Programs

Q. Please explain SPS's performance assurance programs.

A. Performance assurance programs are all activities undertaken to achieve optimum operating efficiency of SPS's power generating facilities.

Q. Please summarize SPS's policy relating to efficient operation of its plants.

A. SPS maintains an ongoing policy of monitoring its power plant performance, improving unit efficiency, and determining cost-effective ways to save on fuel and base rate costs for its customers. The Performance Monitoring department monitors, maintains, and recommends changes to enhance the operational performance of SPS's power plants. This group constantly evaluates unit operational conditions and identifies opportunities to improve availability and reduce process emissions based upon design and/or best achievable conditions. Over the years, SPS has developed performance assurance practices to maximize efficiencies by studying and evaluating the latest technologies in plant maintenance and/or operations. These technologies are then adapted to the unique power plant designs in SPS's system if technically and economically feasible.

The application of performance assurance practices to optimize power plant efficiency, availability, and reliability is not new to SPS. Since the early

1950s, SPS has had performance assurance practices in place to ensure that reliable electricity is generated at the lowest reasonable cost. These practices have resulted in an increasingly sophisticated testing program to monitor and improve power plant efficiency. The following is a list of the various testing and analytical services that SPS's performance testing staff currently provides:

- Power Plant Thermal Performance – Unit Cycle Testing;
- Development of Dispatch Performance Curves;
- Component Testing;
- Environmental Emissions Testing; and
- Independent Power Producing Facilities Capacity Testing.

Q. What indicators are available to monitor plant equipment and process performance?

A. Heat rates, unit availability, and process emissions are the primary indicators of unit performance. SPS uses these indicators in assessing the performance of its generation fleet.

Q. What other technology does SPS use to monitor generating fleet performance?

A. Energy Supply's M&D Center was established in 2014 to monitor the performance and health of SPS's generating fleet. Monitoring and diagnostic technology is used to help detect plant abnormalities before they result in equipment failures and lost generation. The M&D Center offers the potential to improve plant reliability, optimize performance, and minimize repair costs. Tolk Station and Harrington Station have been monitored by the M&D Center since January 2014. Jones Station Unit 1 and Unit 2 have been monitored by the M&D Center since September 2016.

The M&D Center is in the process of developing the needed models for monitoring the new wind turbines for the Hale Wind Project. The M&D Center expects the diagnostic services to the facility to be operational by February 2020. Once the system is operational there will be around 200 points of data for each turbine monitored that will alert operations of any operational issues.

Q. Please compare SPS's largest units' actual versus design heat rates.

A. The following definitions will be helpful to understanding this comparison:

Average Net Heat Rate is defined by SPS as: The fuel consumption in British thermal units ("Btu") divided by the net generation in kilowatt hours ("kWh"). Both the fuel consumption and the net generation are totals for the applicable time period. This heat rate is sometimes referred to as the operating or accounting heat rate.

Adjusted Design Net Heat Rate is defined by SPS as: The design net heat rate is estimated at the average load and adjusted for major equipment performance degradation and/or deviation from the manufacturers' design when the equipment was placed in service. This value approximates a unit's best achievable heat rate at the present time. The average net heat rates for SPS's largest units during the Base Period are provided below and have been compared to their adjusted design net heat rates.

Table DAL-1
Large Unit Heat Rates during the Base Period

Unit	Average Net Heat Rate (Btu/kWh)	Adjusted Design Net Heat Rate (Btu/kWh)	Percent Difference (%)
Harrington 1	10,800	10,511	2.76%
Harrington 2	10,505	10,337	1.62%
Harrington 3	10,543	10,382	1.56%
Tolk 1	10,729	10,412	3.05%
Tolk 2	10,343	10,334	0.08%

Q. How did SPS calculate the adjusted design net heat rate?

A. Monthly average loads were determined for each unit and then compared against original design heat rate curves for the units. In previous years, SPS calculated the design net heat rate using the average load for the entire base period. The monthly calculation method should produce a more representative result of adjusted design heat rate when compared to calculating one design heat rate value for the entire base period. Then, adjustments were applied to correct for degradations to boiler and turbine efficiencies. The degradation factors are time-based factors related to unit age and time between overhauls.

Adjusted design fuel usage was calculated on a monthly basis and then totaled for all months. The total adjusted design fuel usage was then used along with the total MWh to calculate the overall adjusted design heat rate values for the Base Period.

Q. Please explain the results shown in Table DAL-1.

A. As can be noted from Table DAL-1, the operating heat rates (i.e., Average Net Heat Rate) for SPS's largest units during the Base Period were within approximately 3% of the best achievable target or the adjusted design net heat rates. Tolk Unit 1's heat rate has always been higher than Tolk Unit 2's because the shared systems between both units are applied to Unit 1.

The Average Net Unit Heat rate is affected by several factors such as unit loading, measured generation, measured fuel consumption, measured fuel heating value, and overall process degradation. Heat rate determination is subject to measurement errors due to several factors including: type of instruments used, number of test points collected, and condition of the equipment being tested. SPS works to minimize uncertainties associated with power and fuel measurement through frequent calibration of measurement devices and installation of more accurate measurement devices.

Economic dispatching of SPS's units results in unit operation that varies from minimum load to full load. It is difficult to account for these variations in load when considering a design heat rate. Design heat rates are typically associated with a particular load point. Generally, operation at less than full load results in higher heat rates than under full load operation. Caution is advised when comparing a heat rate at any specific load point with an average heat rate, which includes start-up fuel consumption, low load operation, and station power. Heat rate is greatly affected, usually negatively, by variations in unit loading.

Q. Does the heat rate of a generating unit deteriorate over time?

A. Yes.

Q. Why does that deterioration occur?

A. Heat rate is a measure of the efficiency of a unit. There are many factors that cause the efficiency of a generating unit to deteriorate. The following are some major reasons that plant performance becomes less optimal over time:

- Deposits, erosion, and foreign object damage to turbine rotating and stationary blading;
- Excessive seal clearances on the turbine blading, which allow steam to bypass the blading;
- Buildup of deposits on and between boiler tubing, which reduces heat transfer and increases fan horsepower requirements;
- Oxidation inside boiler tubes, which also reduces heat transfer through the tubes;
- Plugging and oxidation of air preheaters, which reduce heat transfer from flue gas to incoming air and also increase required fan horsepower;
- Oxidation and deposits on (and/or in) feedwater heater tubes, which reduce heat transfer from the extraction steam to the feedwater;
- Erosion or holes, or both, on the partition plates in feedwater heaters, which allows feedwater to bypass the heaters;
- Pump performance degradation due to increased seal clearances and/or impeller erosion;
- Corrosion of inner surfaces of piping, which increases friction loss;
- Steam or high-energy water leaking through valves and/or steam traps, which develop leaks over time;
- Oxidation and deposit buildups on condenser tubes, which reduce heat transfer through the tubes; and
- Deterioration of cooling tower due to ice damage, algae growth, and other issues, which reduces heat transfer between air and water.

The efficiency of a generating unit decreases over time, but some tasks can be performed to regain most of the lost efficiency. For example, boiler tubes can be cleaned, turbine blade damage can be repaired, new turbine seals can be installed, and leaking valves and steam traps can be repaired or replaced. SPS currently has programs specifically designed to implement these tasks. Moreover, as described in this section, SPS works to maintain and improve the efficiency of its generating units.

Q. Are there any other programs SPS uses for performance assurance?

A. Yes. SPS uses a turbine steam-path analysis program and other performance test methods in its performance assurance program.

Q. Please describe the turbine steam-path analysis program.

A. The purpose of this ongoing program is to economically optimize the performance of steam turbines through sound maintenance practices. The analysis consists of two phases: (1) pre-inspection test data is collected and analyzed for indications of turbine performance degradation; and (2) during the overhaul, numerous measurements and observations are made to further evaluate the condition of the turbine. After appropriate engineering and economic analyses are completed, repairs are made, if economically justified.

During the pre-inspection analysis, performance test data is analyzed for the following steam-path problems: solid particle erosion, foreign object damage, deposits, and steam-path leakage. As problems are identified, the extent of the damage and the probability of the component's failure are evaluated. The projected effect of these problems on fuel costs is also determined. With this knowledge, a determination is made as to which components may need to be replaced and the repair procedures needed. The pre-inspection information is then furnished to the plant maintenance department for scheduling repairs, ordering parts, and preparing repair procedures. During planned overhauls further inspections such as steam-path audits are made to determine the extent of damage and repairs required to bring the equipment back to design condition.

When the turbine is disassembled for inspection, the following evaluations are performed:

- Turbine nozzle and blade erosion and damage are assessed. Measurements are taken for throat and pitch dimension. The effect of these problems on heat rate is established;
- Measurements are made to determine deposit thickness and the degree of coverage on nozzles and blades. The result of excessive deposits on heat rate is calculated;
- Steam seal and steam packing clearances are measured, and the alignment of rotating and stationary components is evaluated. Their effect on heat rate is calculated; and

- The measurements and calculated values are used to cost justify the repair and/or the replacement of worn or damaged components.

Q. What are the costs of implementation and the estimated financial benefits resulting from the steam-path analysis program?

A. The steam-path analyses were conducted by SPS performance engineers. Steam path audits were conducted on Tolk Unit 1 in September 2018 for the Low Pressure ("LP") turbines, Jones 2 in January 2019 for the LP turbine and Harrington Unit 1 in February 2019 for the LP turbine. Table DAL-2 below displays potential fuel savings identified as a result of this inspection.

Table DAL-2

Potential Improvements from Steam Path Audits

	Potential Annual Fuel Savings (Total Company)	Potential Annual Fuel Savings (NM retail) [4]	Capacity Recoverable (kilowatt)	Heat Rate Improvement (Btu/net-kWh)
Tolk 1 LP Turbine Audit	$244,045	$70,012	4,674	81.9
Jones 2 LP Turbine Audit	$37,588	$10,783	740	29
Harrington 1 LP Turbine Audit	$136,901	$39,274	1,775	46

[4] NM retail amounts are derived by applying ENERGY allocator. Fuel impacts flow through SPS's fuel factor with no effect on base rates.

Q. Please describe the other performance test methods SPS uses in its performance assurance program.

A. SPS also uses the following test methods in its performance assurance program:

- The Unit Heat Rate Test. SPS currently uses two different test methods to determine the net unit heat rates for its units. The two methods are the input-output method and the heat balance method. As indicated previously, heat rate is a measure of unit efficiency.

- The Variable Throttle Pressure Operation Test. This test determines the operational mode that results in the optimum heat rate throughout the load range. This testing helps define how boiler pressure can be reduced at lower loads to improve unit heat rate. Heat rate improves because: (i) there is less pressure drop across the turbine steam admission valves; and (ii) less power is required to pump the feedwater into the boiler drum.

- The Unit Equipment Condition and Efficiency Test. These tests measure energy in and energy out. The results are compared with previous test results and/or design efficiency. For major plant equipment within the steam cycle, efficiency tests are periodically conducted to determine if there has been any degradation in the performance of the components, such as a boiler feed pump, condensate pump compressor, cycle heat exchanger, or cooling tower. From the results of this test, the cost benefit for replacing or reconditioning equipment parts can be evaluated, which enables SPS to make informed decisions.

D. Training of Plant Operators and Maintenance Personnel

Q. Do SPS plant operators receive training in efficient operating practices?

A. Yes. Every plant operator receives training to operate the plant equipment reliably, efficiently, and safely. No operator is allowed to perform operating duties or is promoted to a higher level until successfully completing the required training and passing the appropriate tests. Each test consists of a written and demonstration portion.

Q. Briefly describe SPS's power plant training programs.

A. Power plant personnel are required to complete a three- to four-year apprentice program depending on the individual's progress. Training includes classroom, computer-based, programmed text, video, and on the job training. Apprenticeships are available in the areas of Operations, Maintenance, Electrical, Instrument, Technician, and Chemist Technician programs. Following apprentice training, power plant personnel are continually provided training in their area of operations. SPS provides operator refresher and scenario training on an on-going basis. Operator refresher training reviews all of the major systems and cycles every three to four years. Scenario training is conducted about once a month with a simulator to go through "what if" scenarios in the plant.

The Power Plant Engineer training program is designed to guide the new engineer through a six-year development plan with a goal to have a well-rounded power plant engineer ready to be considered for the full performance level Engineer "C" role by the end of the six-year period. The program is designed to take a relatively inexperienced engineer and expose them to all facets of power plant operations. It includes role-specific formal power plant training classes such as Power Plant Fundamentals, Heat Rate Analysis, Predictive Maintenance, and Equipment and Plant Balancing. This is followed by numerous training modules specific to the systems in their assigned power plant. Also incorporated are formalized rotational on-the-job training assignments in Operations, Maintenance, Environmental, and Chemistry. In addition, rotations outside the department, including at other power plants, and other engineering departments are required. To maximize the engineer's ability to work within the Xcel Energy accounting and budgeting environment, the training also covers the use of financial software systems. Other topics include numerous safety-related modules, time management, and project management. For professional development, the program includes a completion requirement of an Engineer-in-Training program. As components of the program are completed, participants become eligible for promotional consideration to Engineer "B" and "C" positions in the Plant Engineering and Technical Support organization. To assist in identifying and coordinating training, SPS has formed a Regional Training Activity Committee that includes at least one member from each power plant and from each of the following disciplines: Safety, Environmental, Engineering, Management, and Human Resources. This committee meets quarterly to discuss the training needs for each SPS plant.

VII. RESULTS OF SPS'S O&M PRACTICES

Q. Are there indications that SPS's O&M practices are effective?

A. Yes. Several comparisons indicate that SPS's practices are highly effective. First, Attachments DAL-2, DAL-3, and DAL-4 graphically display the EAF of SPS's coal-fueled plants, Tolk and Harrington Stations, and its larger gas-fueled units compared with the national average from the North American Electric Reliability Corporation/Generating Availability Data System ("NERC/GADS") for historical periods. EAF is the ratio of the time a unit was available for full-load operation (or at full capacity) over the time a unit was planned to be available for such operation expressed as a percentage. A higher EAF indicates higher unit availability. These attachments demonstrate that SPS's coal-fueled units have historically had a higher availability than the national average for comparably-sized units. SPS's gas-fired units generally track the national average for comparably sized units.

Second, Attachments DAL-5, DAL-6, and DAL-7 display the FORs of SPS's coal-fueled units and larger gas-fueled units compared to NERC/GADS data. The FOR indicates how much time SPS's units were off-line because of an unscheduled outage; the smaller the FOR, the better. SPS's coal units have a much better FOR than the national average. Generally, SPS's gas units have had a better FOR than the national average.

Q. Please describe Tolk's historical EAF and FOR.

A. Tolk's EAF and FOR were better than the NERC average for units of similar size in 2016 and 2017. In comparison to NERC/GADS averages, Tolk achieved the following performance during 2016 and 2017:

Table DAL-3
Tolk Operational Statistics Comparison

	NERC 2016	Tolk 2016	NERC 2017	Tolk 2017
EAF	79.52%	90.05%	77.24%	86.41%
FOR	6.56%	5.16%	9.8%	1.97%

Tolk's performance from prior years is reflected in Attachments DAL-2 (EAF) and DAL-5 (FOR).

Q. Please describe Harrington's historical EAF and FOR.

A. Harrington's EAF and FOR were better than the NERC average for units of similar size in 2017. In comparison to NERC/GADS averages, Harrington achieved the following performance during 2016 and 2017:

Table DAL-4
Harrington Operational Statistics Comparison

	NERC 2016	Harrington 2016	NERC 2017	Harrington 2017
EAF	76.79%	86.80%	78.91%	91.95%
FOR	9.72%	3.04%	6.44%	1.47%

Harrington's performance from prior years is reflected in Attachments DAL-3 (EAF) and DAL-6 (FOR).

Q. Please describe the historical EAF and FOR of SPS's gas-fueled units.

A. SPS's gas-fueled units have had an EAF better than, or comparable to, the NERC/GADS averages, with the exception of Jones 2 in 2016, when the unit was taken off line to rebuild the cooling tower due to a high wind event. Attachment DAL-4 shows that SPS's gas-fueled units have generally outperformed the NERC/GADS averages since 2007. SPS's larger gas-fueled units have generally performed better than the NERC/GADS FOR averages, even though some of the gas units have been used for peaking and cycling service, which causes greater wear and tear on the unit than other operating regimes. Attachment DAL-7 shows that SPS's gas-fueled units have generally had a much lower FOR than the NERC/GADS averages since 2007.

Q. Are EAF and FOR indicators of efficient operation and maintenance practices?

A. Yes. Both EAF and FOR are indicators of efficient operation and maintenance practices because they relate to the percentage of time that the units were available and ready for dispatch to full load. Better unit availability helps ensure utilization of the lowest cost dispatchable energy.

Q. Please describe how SPS operates its units in the SPP Integrated Marketplace ("IM").

A. The SPP operates a two-settlement, locational marginal price energy market model. SPS operates its units in accordance with the SPP market optimization models. This market structure has had the effect of increasing unit starts and decreasing plant operating service hours.

Unit starts is the process of preparing the unit to come back on-line either from reserve shut down or outage. For example, with respect to a steam unit, the unit start process begins with placing the unit's equipment back into service and firing the boiler to establish the proper steam temperature and pressure. Once achieved, the turbine is rolled to predetermined speeds to warm the casing and rotor prior to synchronization speed (3,600 rpm). Once this is established, the generator is synchronized to the electrical system.

During all unit startups, there are periods when fuel is consumed before the unit generates power. These fuel costs are referred to as startup costs. Startup costs are highest whenever a unit is cold at the beginning of the startup sequence. Startup costs are less when a unit is warm, and startup costs are lowest when a unit is hot. Whether a unit is hot, warm, or cold is defined by the number of hours a particular unit has been offline. Each unit has a specific number of hours that define a hot, warm, and cold start, which is determined by a number of factors, including unit size.

Q. Are there any other factors affecting the number of unit starts?

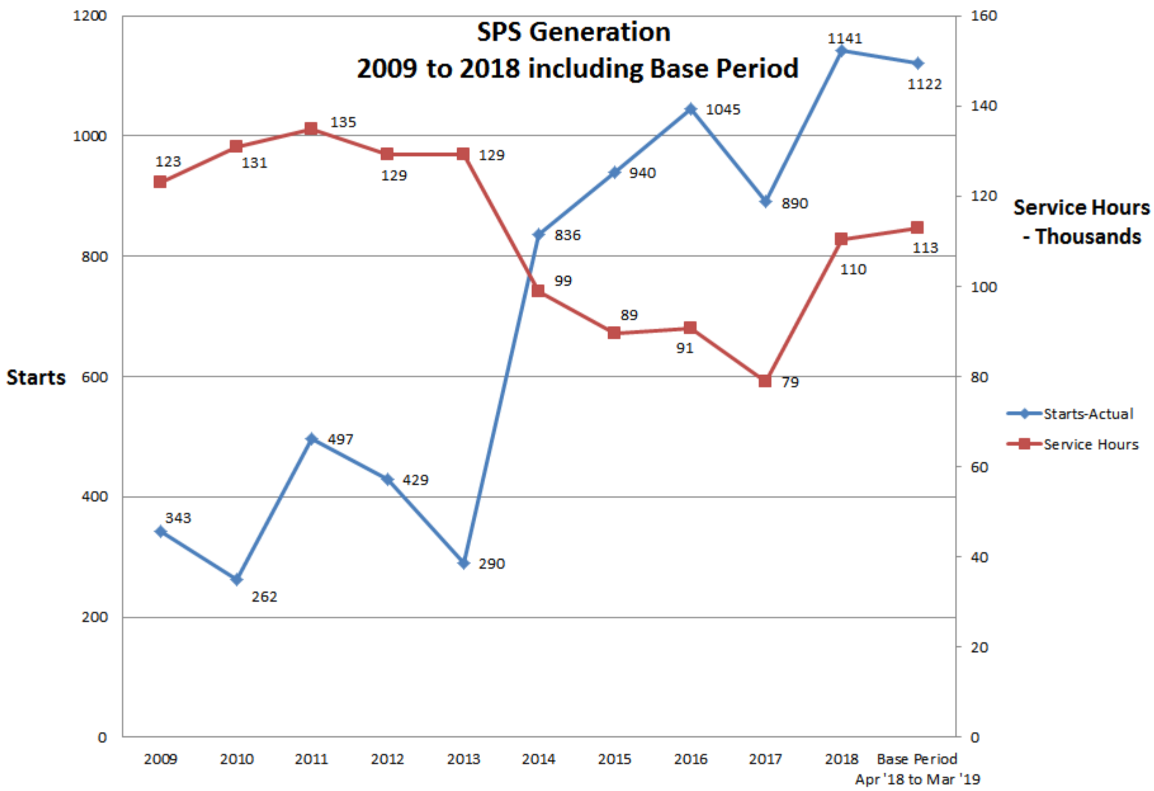
A. Yes. The increase in wind generation on the system has also caused the unit loads to swing and increased the cyclic effect on the system. Lower gas prices have also changed how the units have been dispatched over the last year. The region has experienced record low gas pricing due to the limits of the basin's available takeaway capacity. Additional gas pipelines should be in service in the fall of 2019 that will return the gas pricing back to normal.

Q. Will you please show the relationship between unit starts and operating hours?

A. Table DAL-5 reflects the relationship between unit starts and operating service hours from 2009 to 2018 including the Base Period. As noted above, in general, the SPP IM has had the effect of increasing unit starts and decreasing operating service hours.

Table DAL-5

SPS Unit Starts and Operating Hours 2009 - 2018



Q. How have the increases in unit starts affected the unit equipment?

A. Since the increase in starts began, the units have experienced an increase in boiler, motor, and other equipment failures. The increase in failures has resulted in increased maintenance and repair cost. For example, Maddox Unit 1, Jones Unit 2, and Plant X Units 1, 2, 3, and 4 have experienced boiler casing tears and boiler tube leaks from cycle fatigue. Motor failures occurred at Maddox Unit 2, Nichols

Unit 1, and Harrington Unit 3. A generator cooling fan blade failure at Cunningham Unit 4 and hardware failure at Cunningham Unit 3 required a compressor rebuild.

Q. What effect will the increased cycling of the units have on SPS's O&M costs going forward?

A. While SPS has experienced fuel cost savings due to the IM, SPS has also experienced an increase in O&M costs associated with the increase in starts and continued cycling of the units, in addition to increases in expenses due to the advanced age of several units.

Prior to the IM, units were brought on line and stayed on line for long periods. The equipment stayed in a steady state of temperature and the load was raised and lowered as needed. Motors ran continually, and were not shut down and started again as frequently as they are in today's market. With frequent cycling of the units, an increase in boiler tube failures, boilers casing failures and motor failures have increased. These failures can reduce the reliable operation of the units and increase repair costs (some equipment replacements can be capitalized). Table DAL-6 below summarizes the maintenance cost of SPP cycling for the SPS region. The repair cost reflects cycling failures to equipment.

Table DAL-6

Summary of Maintenance Cost of SPP Cycling for the SPS Region[5]

Facility	2017 Cost Total Company	2017 Cost NM Retail	2018 Cost Total Company	2018 Cost NM Retail
Cunningham	$ 59,137	$ 16,370	$ 153,869	$ 42,593
Maddox	-	-	18,108	5,013
Jones	230,000	63,667	56,983	15,774
Tolk	199,166	55,132	-	-
Plant X	56,004	15,503	32,950	9,121
Harrington	-	-	248,680	68,838
Nichols	210,000	58,131	50,244	13,908
Total Cost	**$ 754,307**	**$ 208,802**	**$ 560,834**	**$ 155,246**

Q. How is cycling of the units determined?

A. Cycling of the units is based on modeling software that includes pricing information, unit heat rates, fuel cost, etc. In general, units are shut down when the SPP market optimization model has determined that the unit will not be needed the following day. There should be an economic benefit (fuel savings) when a unit is shut down for economic purposes. Unit startups are normally triggered when the SPP model determines that a unit is an economic choice to run or if there is a system reliability improvement gained by starting up a unit.

[5] NM retail amounts are derived by applying 12CP-PROD allocator.

Q. Does the IM provide a net benefit to SPS's retail customers?

A. Yes. The IM is providing a net benefit to SPS's customers. The SPP modeling software should lead to fuel cost savings when a unit is shut down for economic purposes. As stated previously, there should be a fuel cost savings each time a unit is started for economic purposes.

VIII. POWER PLANT MAINTENANCE AND OUTAGES

Q. Has SPS provided power plant maintenance information?

A. Yes. In RFP Schedule P-7, SPS provides the following information: total maintenance by operating unit for four years prior to the Test Year; scheduled maintenance for the Test Year; and projected scheduled maintenance for five years beyond the Test Year.

Q. What does SPS do to bring a unit back on-line after an unplanned outage?

A. As I discussed earlier, SPS has a thorough inspection program, as well as scheduled and predictive maintenance programs for its units. SPS takes all reasonable steps to avoid unplanned outages, but occasionally events occur that are unavoidable.

When unplanned outages occur, SPS has processes and procedures in place to react quickly to get units back on-line in an efficient and safe manner. Once a unit experiences an outage, plant engineers and technical staff quickly evaluate the unit to determine what caused the outage. SPS then immediately takes steps to make any necessary repairs, considering any safety issues that may be implicated. In evaluating the problem, engineers and technical staff assess whether it is reasonable and prudent to have additional repairs or upgrades performed while the unit must remain down for repair of the initial problem.

XES's Commercial Operations group assists in evaluating the cost of working overtime versus normal working hours. Depending on the unit that is out, the market pricing of the generating resources available in the IM, and various other factors, it may be more cost effective to conduct work only during normal business hours.

Q. Were there significant operational events during the Base Period that affected the availability of SPS's generating units?

A. Yes. Of the five largest events that caused a forced outage and large loss in equivalent megawatt hours ("MWh") during the Base Period: four occurred in 2018 and the other one occurred in 2019. These outages are summarized below in Table DAL-7.

Table DAL-7

**Largest Forced Outages by MWh
April 1, 2018 to March 31, 2019**

Date	Unit	Net Dep. Cap. (MW)	Type	Fuel Source	Description	Equivalent MWh
4/1/18	Tolk 1	532	Steam	Coal	Main Power Transformer Failure	716,899*
8/1/18	Cunningham 3	106	Combustion Turbine	Gas	Compressor Damage	615,758*

Date	**Unit**	**Net Dep. Cap. (MW)**	**Type**	**Fuel Source**	**Description**	**Equivalent MWh**
9/21/18	Maddox 1	112	Steam	Gas	Hot Reheat header seal box skin leak and boiler tube leaks	247,031
1/15/19	Plant X2	90	Steam	Gas	Generator Rotor collector brushes	162,450*
10/24/18	Cunningham 4	103	Combustion Turbine	Gas	Generator cooling fan blade failure	119,510

*** Hours extend outside the April 1, 2018 to March 31, 2019 dates**

The most common events that have otherwise affected availability of SPS's units were outages caused by boiler tube leaks. During the Base Period, twenty-five boiler tube leaks contributed to a combined total loss of 805,182 equivalent MWh during multiple forced outages.

When reasonably feasible, SPS undertakes minor upgrades and repairs to non-affected equipment during unplanned outages in order to best utilize the downtime. Typically, these minor upgrades and repairs are those that would otherwise be performed during a scheduled outage. Any work performed that is unrelated to the unplanned outage work is made with an emphasis on returning the unit to service in the most cost-effective way possible.

Q. Does this conclude your pre-filed direct testimony?

A. Yes.

<u>**VERIFICATION**</u>

STATE OF TEXAS)
) ss.
COUNTY OF POTTER)

DAVID A. LOW, first being sworn on his oath, states:

I am the witness identified in the preceding direct testimony. I have read the direct testimony and the accompanying attachment(s) and am familiar with their contents. Based upon my personal knowledge, the facts stated in the testimony are true. In addition, in my judgment and based upon my professional experience, the opinions and conclusions stated in the testimony are true, valid, and accurate.

DAVID A. LOW

SUBSCRIBED AND SWORN TO before me this 24th day of June, 2019 by DAVID A. LOW.

CARRIE OLIVER
Notary Public, State of Texas
Comm. Expires 06-08-2020
Notary ID 13069198-2

Notary Public of the State of Texas
My Commission Expires: 06-08-2020

Southwestern Public Service Company

Total Company SPS Operation and Maintenance Expenses

Line No.	FERC Acct	Account Description	SPS Total Company O&M Expense - Adjusted Test Year Period	SPS NM Retail O&M Expense - Adjusted Test Year Period
	Production			
1	**500.0**	**Operation Supervision and Engineering**	**$ 2,268,554**	**$ 627,965**
2	501.35	Coal Non-Mine; Non-Freight	36,822,078	10,563,515
3	**507.7**	**Coal Ash Sales**	**(638,126)**	**(183,066)**
5	**502.0**	**Steam Expenses**	**10,999,173**	**3,044,713**
6	**505.0**	**Electric Expenses**	**9,804,750**	**2,714,081**
7	**506.0**	**Miscellaneous Steam Power Expenses**	**12,308,638**	**3,407,190**
8	**507.0**	**Rents**	**6,346,153**	**1,756,697**
9	**509.0**	**Steam Operation SO2 Allowance Expense**	**159,720**	**69,444**
12	**510.0**	**Maintenance Supervision and Engineering**	**1,487,576**	**411,780**
13	**511.0**	**Maintenance of Structures**	**5,165,862**	**1,429,977**
14	**512.0**	**Maintenance of Boiler Plant**	**17,498,911**	**5,020,086**
15	**513.0**	**Maintenance of Electric Plant**	**12,292,355**	**3,526,430**
16	**514.0**	**Maintenance of Miscellaneous Steam Plant**	**11,085,594**	**3,068,636**
17	**546.0**	**Operation Supervision and Engineering**	**20,803**	**5,759**
18	**548.0**	**Generation Expenses**	**607,534**	**168,173**
19	**549.0**	**Misc Other Power Generation Expenses**	**4,229,813**	**1,209,556**
20	**550.0**	**Rents**	**509,638**	**141,074**
21	**551.0**	**Maintenance Supervision and Engineering**	**215,299**	**59,598**
22	**552.0**	**Maintenance of Structures**	**396,710**	**109,815**
23	**553.0**	**Maintenance of Generating and Electric Equipment**	**5,156,506**	**1,466,076**
24	**554.0**	**Maintenance of Misc Other Power Generation Plant**	**303,609**	**84,043**
25	556.00	System Control and Load Dispatching	1,086,063	300,636
26	**557.0**	**Purchased Power Other**	**1,649,520**	**476,935**
27	**Total Production O&M Expense**		**$ 139,776,736**	**$ 39,479,115**

Southwestern Public Service Company

Total Company SPS Operation and Maintenance Expenses

Line No.	FERC Acct	Account Description	SPS Total Company O&M Expense - Adjusted Test Year Period	SPS NM Retail O&M Expense - Adjusted Test Year Period
	Transmission			
28	560	Operation Supervision and Engineering	$ 9,782,898	$ 2,049,023
29	561	Load Dispatch - Reliability	231,641	47,369
30	561	Load Dispatch - Monitor and Operate Trans. System	3,248,302	664,252
31	561	Scheduling, System Control and Dispatching Services	4,043,263	989,084
32	562	Reliability, Planning and Standards Development	31	6
33	562	Transmission Service Studies	66,498	13,598
34	562	Generation Interconnection Studies	(55,916)	(11,434)
35	562	Reliability Planning and Standards Development Services	3,190,183	875,170
36	562	Station Expenses	1,936,338	405,565
37	563	Overhead Line Expenses	834,686	174,825
38	564	Underground Line Expenses	-	-
	565	Wheeling Lamar DC Tie	(420)	(116)
41	565	Wheeling Meter Charges	912,309	-
42	565	Wheeling Miscellaneous	31,117	6,363
46	565	Wheeling Schedule 12	1,833,497	588,980
47	565	Wheeling Schedule 12 - Wholesale	493,218	-
48	565	Wheeling Schedule 1 - Wholesale	762,783	-
49	565	Wheeling Schedule 2	4,678	1,503
50	565	W-Wheeling Schedule 2 - Wholesale	1,115	-
51	565	Wheeling Schedule 7&8	-	-
52	565	Wheeling Schedule 9	6,062,371	1,239,706
53	565	Wheeling Schedule 9 - Wholesale	25,175,406	-
54	565	565000S11T-Wheeling Schedule 11 - Total	135,171,319	33,009,456
55	565	565Z2DAUC - Z2 Direct Assigned Upgrade Charge	81,490	26,180
56	565	565Z2DAUCW - Z2 Direct Assigned Upgrade Charge - Wholesale	16,962	-
57	565	565Z2Sch11 - Z2 Schedule 11 Charges	(182,512)	(58,629)
58	565	565Z2Sch11W - Z2 Schedule 11 Charges - Wholesale	(4,093)	-
59	566	Misc Transmission Expenses	3,050,286	638,881
60	567	Rents	1,966,505	411,884
61	568	Maintenance Supervision and Engineering	8,520	1,784
62	570	Maintenance of Station Equipment	1,742,671	365,002
63	571	Maintenance of Overhead Lines	1,288,468	269,869
66	**Sub-Total Total Transmission O&M Expenses**		**$ 201,693,613**	**$ 41,708,320**
	Regional Market Expenses			
67	575	Operation Supervision	$ 158,137	$ 45,366
68	575	Day-Ahead and Real-Time Market Administration	306,568	87,948
69	576	Ancillary Services Market Administration	24,516	7,033
70	576	Market Monitoring and Compliance	41,429	11,885
71	576	Market Admin, Monitoring, and Compliance Services	8,199,872	2,005,954
	576	Regional Market Rents	51,609	14,806
73	**Total Regional Market Expenses**		**$ 8,782,132**	**$ 2,172,993**
74	**Total Transmission O&M Expenses**		**$ 210,475,744**	**$ 43,881,313**

Southwestern Public Service Company

Total Company SPS Operation and Maintenance Expenses

Line No.	FERC Acct	Account Description	SPS Total Company O&M Expense - Adjusted Test Year Period	SPS NM Retail O&M Expense - Adjusted Test Year Period
	Distribution			
75	580	Operation Supervision and Engineering	$ 3,163,274	$ 1,111,790
76	581	Load Dispatching	313,310	111,864
77	582	Station Expenses	1,595,635	569,703
78	583	Overhead Line Expenses	3,666,655	1,454,447
79	584	Underground Line Expenses	145,869	50,477
80	585	Street Lighting and Signal Systems Expenses	154,975	55,332
81	586	Meter Expenses	3,381,132	1,205,442
82	587	Customer Installations Expenses	918,200	327,833
83	588	Misc Distribution Expense	13,631,759	3,709,454
84	589	Rents	2,595,221	799,926
85	590	Maintenance Supervision and Engineering	19,407	6,929
86	591	Maintenance of Structures	4,271	(2,928)
87	592	Maintenance of Station Equipment	789,883	282,019
88	593	Maintenance of Overhead Lines	7,027,707	2,463,915
89	594	Maintenance of Underground Lines	407,483	130,209
90	595	Maintenance of Line Transformers	346	346
91	596	Maintenance of Street Lighting and Signal Systems	637,197	242,783
92	597	Maintenance of Meters	13,267	4,737
93	598	Maintenance of Misc Distribution Plant	(240,996)	(158,415)
94	**Total Distribution O&M Expenses**		**$ 38,224,594**	**$ 12,365,862**
	Customer Accounts			
95	901	Supervision	$ 29,486	$ 9,165
96	902	Meter Reading Expenses	4,784,352	1,487,047
97	903	Customer Records and Collection Expenses	6,947,307	2,159,325
98	904	Uncollectible Expenses	4,380,461	1,361,536
99	904	Uncollectible Expenses Misc	1,058,042	328,861
100	905	Customer Acct - Misc	-	-
101	DEPINT	Customer Deposit Interest Expense	151,110	34,508
102	**Total Customer Accounts Expense**		**$ 17,350,759**	**$ 5,380,441**
	Customer Service			
103	908.00	Customer Asst Expense	$ 2,113,147	$ 656,797
104	908.00	Historical EE Amortization	388,237	-
107	908.04	SaversSwitch	855,119	-
109	909.00	Informational and Instructional Advertising Expense	600,478	186,641
	910.00	Miscellaneous Customer Service Expense	17,088	5,311
115	**Total Customer Service Expense**		**$ 3,974,069**	**$ 848,749**

Southwestern Public Service Company

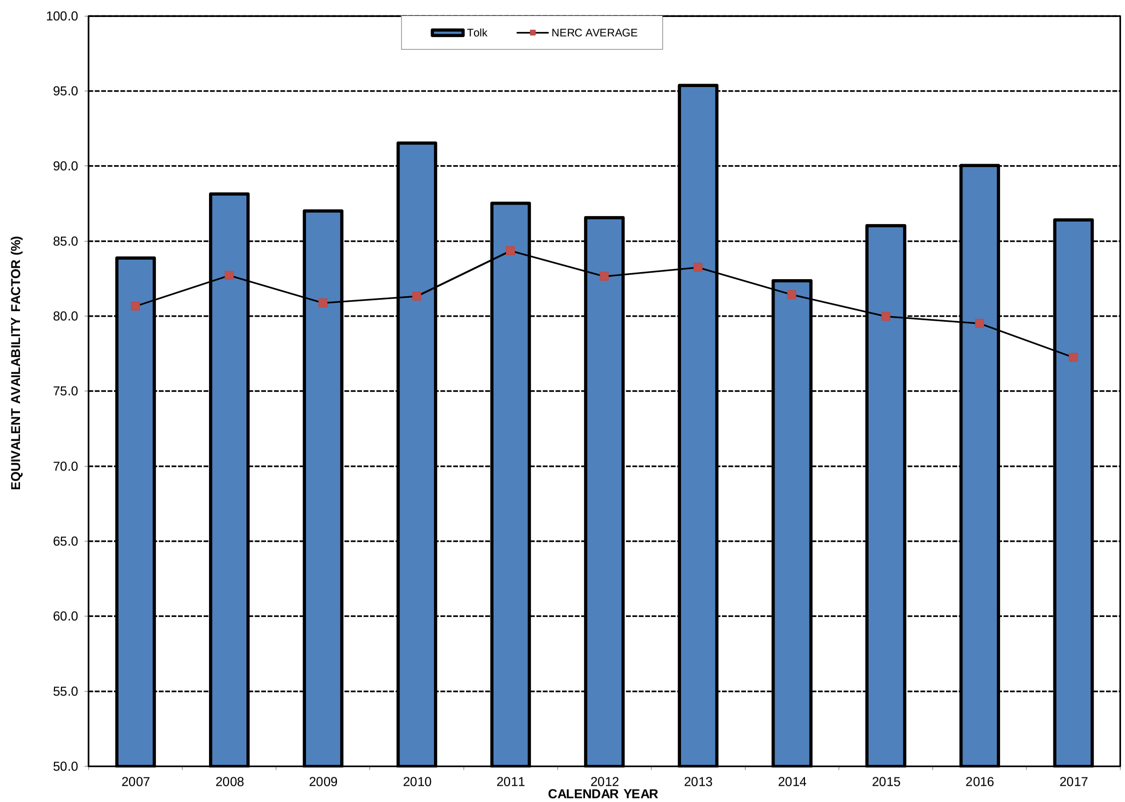
Total Company SPS Operation and Maintenance Expenses

Line No.	FERC Acct	Account Description	SPS Total Company O&M Expense - Adjusted Test Year Period	SPS NM Retail O&M Expense - Adjusted Test Year Period
	Sales			
116	912.00	Demonstration and Selling Expense-Economic Development	$ 260,978	$ 81,116
117	**Total Sales Expense**		**$ 260,978**	**$ 81,116**
	Administrative and General Expenses			
118	920	Administrative and General Salaries	$ 28,862,730	$ 8,012,705
119	921	Office Supplies and Expenses	19,880,024	5,518,978
120	922	Administrative Expenses Transferred-Credit	(17,541,474)	(4,869,763)
121	923	Outside Services Employed	10,024,264	2,782,878
122	924	Property Insurance	3,263,374	866,236
123	925	Injuries and Damages	6,582,771	1,827,471
124	926.00	Employee Pensions and Benefits	34,553,810	9,592,630
126	926.03	Deferred Pension Expense	(2,798,525)	-
128	928.01	Regulatory Commission Expense - NM	6,452,462	6,452,462
130	928.04	Regulatory Commission Expense - Misc	5,528,868	30,507
131	929.00	Duplicate Charges-Credit	(1,390,153)	(367,516)
135	930.20	Misc General Expenses	1,192,983	315,390
136	931	A&G Rents	12,941,448	3,752,019
138	935	Maintenance of General Plant	185,735	51,677
139		Recoverable Contributions, Dues, and Donations	228,213	228,213
140	**Total Administrative and General Expenses**		**$ 107,966,529**	**$ 34,193,886**
141	**Total Operations and Maintenance Expense**		**$ 518,029,409**	**$ 136,230,481**

Southwestern Public Service Company

Tolk Station Annual Equivalent Availability Factors

COAL UNITS 400 - 599 MW



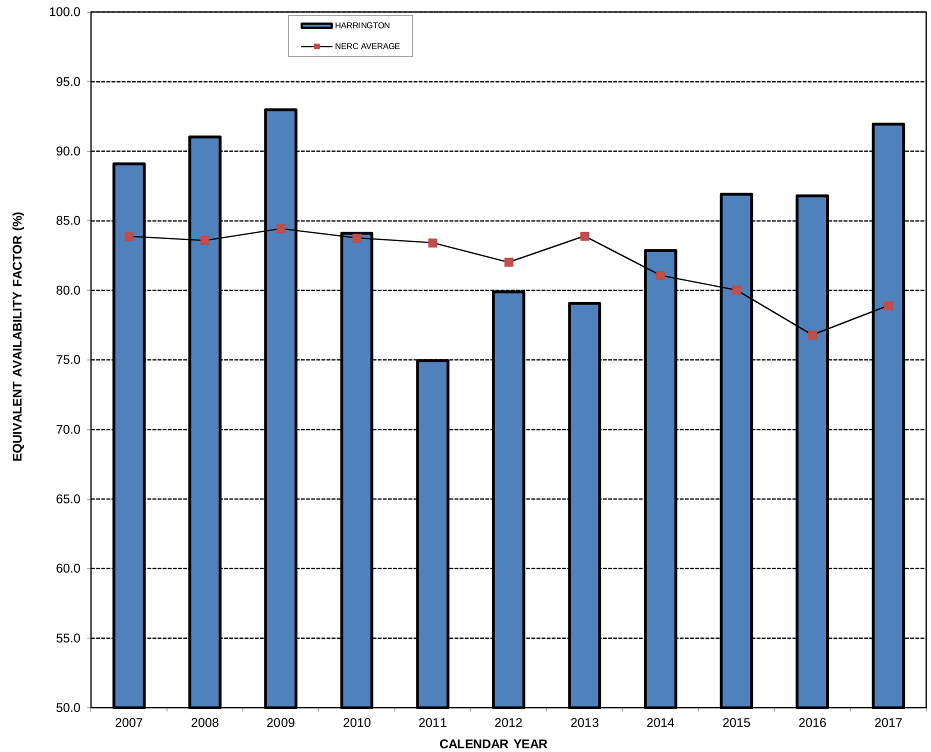
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
NERC AVERAGE	80.66	82.72	80.88	81.33	84.35	82.64	83.25	81.43	79.99	79.52	77.24
Tolk	83.88	88.14	87.01	91.54	87.52	86.57	95.37	82.37	86.04	90.05	86.41

NERC Average data taken from Generating Availability Data System (GADS) Reports - Generating Unit Statistical Brochure - All Units Reporting
http://www.nerc.com
Unit data taken from Meridian

Southwestern Public Service Company

Harrington Station Annual Equivalent Availability Factors

COAL UNITS 300 - 399 MW

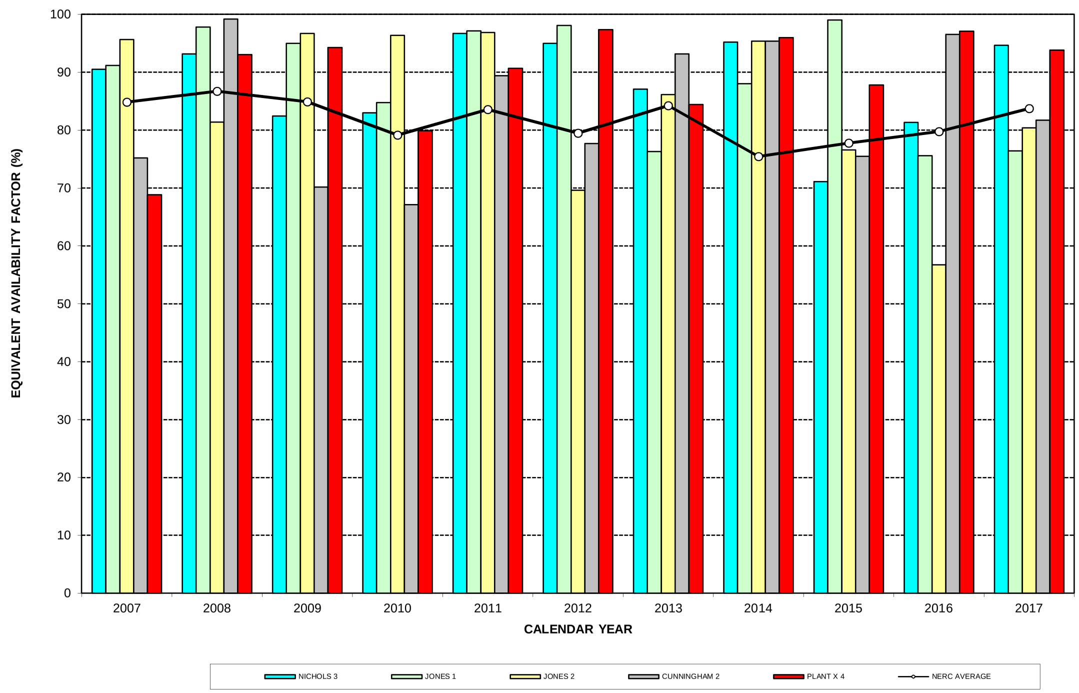


	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
NERC AVERAGE	83.9	83.6	84.4	83.8	83.4	82	83.9	81.09	80.03	76.79	78.91
HARRINGTON	89.1	91	93	84.1	75	79.9	79.1	82.87	86.92	86.80	91.95

NERC Average data taken from Generating Availability Data System (GADS) Reports - Generating Unit Statistical Brochure - All Units Reporting
http://www.nerc.com
Unit data taken from Meridian

Southwestern Public Service Company

Gas Units (200-299 MW) Annual Equivalent Availability Factors



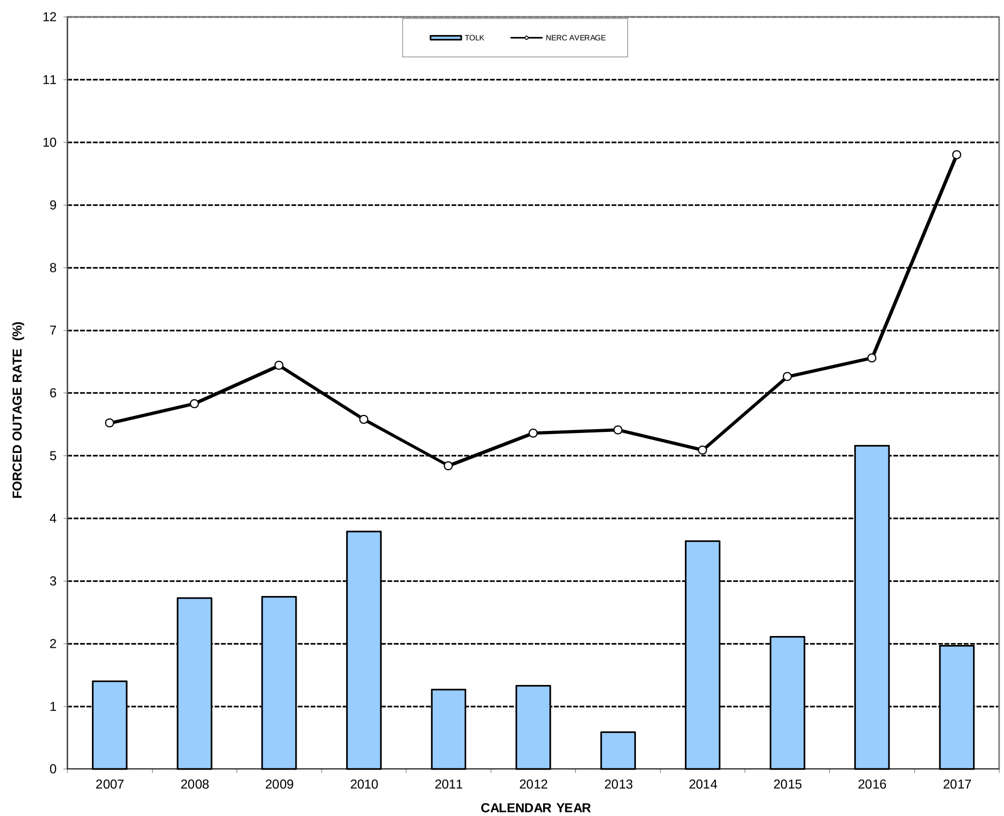
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
NERC AVERAGE	84.86	86.74	84.9	79.13	83.6	79.48	84.25	75.47	77.79	79.76	83.75
NICHOLS 3	90.51	93.15	82.45	82.99	96.68	95.01	87.1	95.24	71.11	81.35	94.68
JONES 1	91.19	97.83	94.98	84.74	97.17	98.1	76.29	88.04	99.03	75.58	76.44
JONES 2	95.64	81.37	96.7	96.36	96.85	69.6	86.17	95.40	76.58	56.74	80.37
CUNNINGHAM 2	75.22	99.22	70.16	67.14	89.4	77.71	93.14	95.36	75.48	96.56	81.74
PLANT X 4	68.84	93.05	94.25	79.9	90.7	97.38	84.43	96.00	87.82	97.11	93.83

NERC Average data taken from Generating Availability Data System (GADS) Reports - Generating Unit Statistical Brochure - All Units Reporting
(NERC Data - Gas Primary 200-299 MW range)
http://www.nerc.com
Unit data taken from Meridian

Southwestern Public Service Company

Tolk Station Annual Forced Outage Rates

COAL UNITS 400 - 599 MW



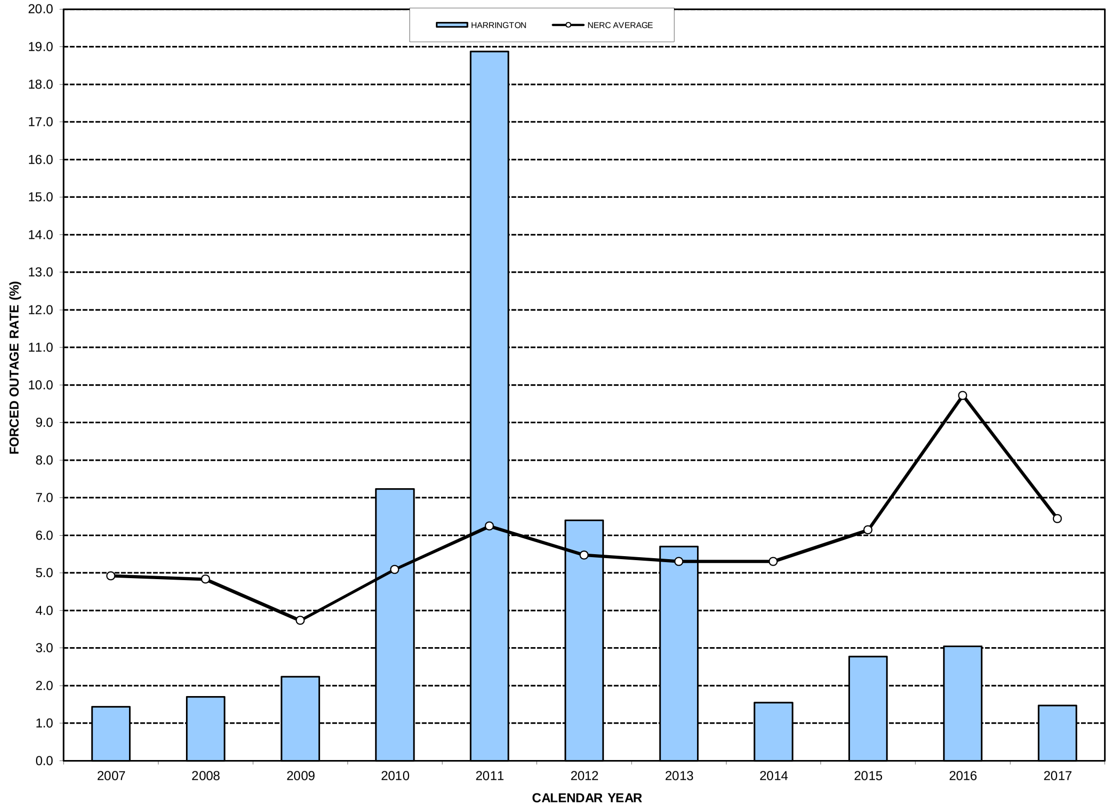
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
NERC AVERAGE	5.52	5.83	6.44	5.58	4.84	5.36	5.41	5.09	6.26	6.56	9.8
TOLK	1.40	2.73	2.75	3.79	1.27	1.33	0.59	3.64	2.11	5.16	1.97

NERC Average data taken from Generating Availability Data System (GADS) Reports - Generating Unit Statistical Brochure - All Units Reporting
http://www.nerc.com
Unit data taken from Meridian

Southwestern Public Service Company

Harrington Station Annual Forced Outage Rates

COAL UNITS 300 - 399 MW

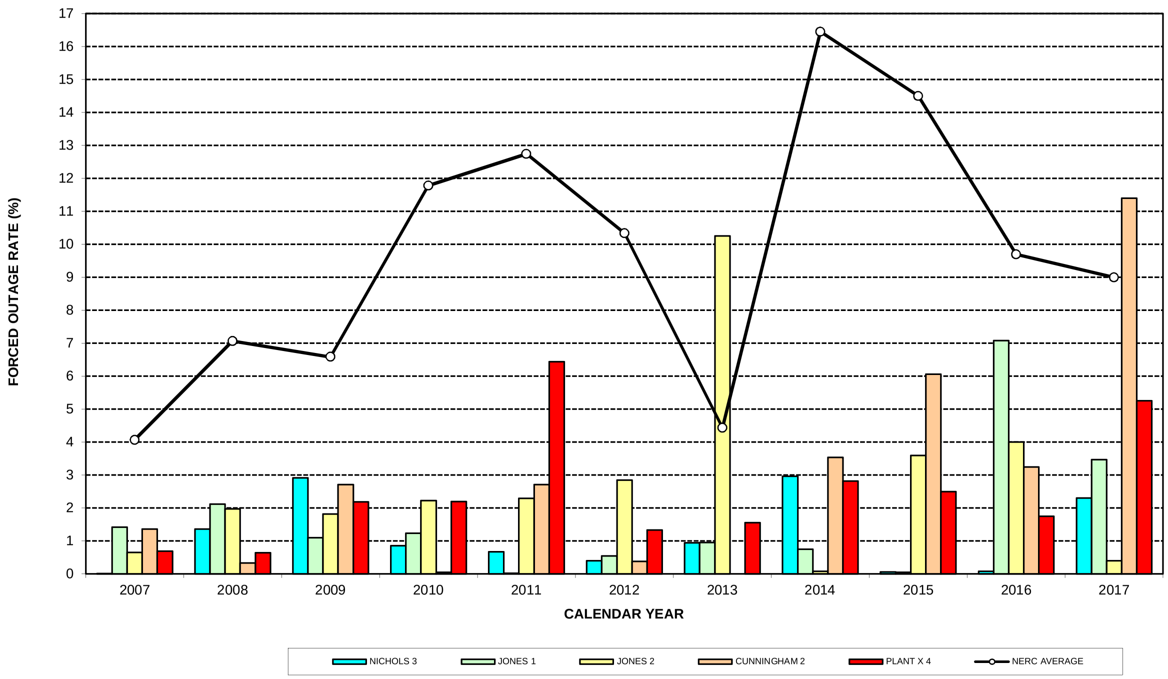


	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
NERC AVERAGE	4.92	4.83	3.73	5.09	6.24	5.47	5.30	5.30	6.14	9.72	6.44
HARRINGTON	1.44	1.70	2.24	7.23	18.87	6.40	5.70	1.55	2.77	3.04	1.47

NERC Average data taken from Generating Availability Data System (GADS) Reports - Generating Unit Statistical Brochure - All Units Reporting
http://www.nerc.com
Unit data taken from Meridian.

Southwestern Public Service Company

Gas Units (200-299 MW)
Forced Outage Rates (FOR)



	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
NERC AVERAGE	4.06	7.06	6.58	11.78	12.74	10.33	4.43	16.45	14.50	9.69	8.99
NICHOLS 3	0.01	1.36	2.91	0.85	0.67	0.39	0.94	2.96	0.05	0.07	2.3
JONES 1	1.41	2.11	1.09	1.23	0.02	0.54	0.95	0.74	0.04	7.08	3.46
JONES 2	0.65	1.97	1.81	2.22	2.29	2.84	10.25	0.07	3.59	4.00	0.39
CUNNINGHAM 2	1.36	0.33	2.71	0.04	2.71	0.37	0.00	3.53	6.06	3.24	11.40
PLANT X 4	0.69	0.64	2.18	2.19	6.43	1.33	1.55	2.81	2.49	1.74	5.25

NERC Average data taken from Generating Availability Data System (GADS) Reports - Generating Unit Statistical Brochure - All Units Reporting
(NERC Data - Gas Primary 200-299 MW range)
http://www.nerc.com
Unit data taken from Meridian