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. 292; (2) AUTHORIZATION AND APPROVAL TO ABANDON ITS PLANT X UNIT 3 GENERATING STATION; AND (3) OTHER ASSOCIATED RELIEF,	)	**CASE NO. 20-00038-UT**
SOUTHWESTERN PUBLIC SERVICE COMPANY,	)	
APPLICANT.	)	

DIRECT TESTIMONY

of

DAVID A. LOW

on behalf of

SOUTHWESTERN PUBLIC SERVICE COMPANY

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GLOSSARY OF ACRONYMS AND DEFINED TERMS

Acronym/Defined Term	**Meaning**
Base Period	October 1, 2019 through September 30, 2020
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
M&D	Monitoring and Diagnostic
MW	megawatt
NERC	North American Electric Reliability Corporation
O&M	Operation and maintenance
OEM	Original Equipment Manufacturer
Operating Companies	Northern States Power Company - Minnesota, a Minnesota Corporation; Northern States Power Company – Wisconsin, a Wisconsin Corporation; Public Service Company of Colorado, a Colorado Corporation and SPS
RFP	Rate Filing Package
Sagamore	Sagamore Wind Project

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 and O&M Services Provided by Energy Supply Group (*Non-native format*)
DAL-2	Tolk Station Annual Equivalent Availability Factors (*Filename*: DAL-2.xlsx)
DAL-3	Harrington Station Annual Equivalent Availability Factors (*Filename*: DAL-3.xlsx)
DAL-4	Gas Units (200-299 MW) Annual Equivalent Availability Factors (*Filename*: DAL-4.xlsx)
DAL-5	Tolk Station Annual Forced Outage Rates (*Filename*: DAL-5.xlsx)
DAL-6	Harrington Station Annual Forced Outage Rates (*Filename*: DAL-6.xlsx)
DAL-7	Gas Units (200-299 MW) Forced Outage Rates (*Filename*: DAL-7.xlsx)

Case No. 20-00038-UT
Direct Testimony
of
David A. Low

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"). SPS is a 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") in several cases, including Case Nos. 19-00170-UT[1] and 17-00255-UT,[2] among others. I have also filed testimony and testified in cases before the Public Utility Commission of Texas. My testimony in all of those cases has addressed the topics of SPS's generation and its power plant operation, maintenance, and cost control practices.

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[1] *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, Direct Testimony of David A. Low (Jul. 1, 2019).

[2] *In the Matter of Southwestern Public Service Company's Application for Revision of Its Retail Rates Under Advice Notice No. 272*, Case No. 17-00255-UT, Direct Testimony of David A. Low (Oct. 27, 2017).

II. ASSIGNMENT AND SUMMARY OF TESTIMONY AND RECOMMENDATIONS

Q. What is your assignment in this proceeding?

A. My testimony supports the Test Year[3] 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. I also discuss SPS's generation by operating plant and unit, and I describe SPS's 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 those expenses are representative of SPS's future costs. SPS operates its units in a prudent and efficient manner that ensures the safe and reliable operations of its units, with continued environmental

[3] The Test Year consists of the Base Period, which is the period from October 1, 2019 through September 30, 2020, and further incorporating all proper adjustments and capital additions.

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

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 that SPS witness Stephanie N. Niemi uses to develop the New Mexico retail revenue requirement in her Attachment SNN-6. Ms. Niemi is responsible for calculating jurisdictional allocation percentages that apply to the various cost components in the cost of service. My staff and I conferred with Ms. Niemi and her 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.

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 Ms. Niemi. It represents a portion of the jurisdictional cost of service provided in Ms. Niemi's direct testimony (Attachment SNN-6), as well as a listing of O&M services provided by the Energy Supply group. 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. 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. Do you incorporate RFP Schedule P-7 that you sponsor into your testimony?

A. Yes.

III. SPS GENERATING FACILITIES

Q. Please describe SPS's generating facilities.

A. During the Base Period, SPS had the following units in its fleet of generating facilities:

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

Other Production – Combustion Turbine (con't)

- Jones Unit 4
- Maddox Unit 2
- Maddox Unit 3
- Quay County Unit 1

Other Production – Wind

- Hale Wind Facility

In addition to these SPS-owned facilities, SPS also purchases energy from wind and solar generation facilities located in New Mexico and Texas.

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 peaking units.

Q. Are any units used primarily for emergency situations?

A. Yes. SPS uses Quay County Unit 1 and Maddox Unit 3 primarily for emergency use.

Q. Did SPS place any additional generating units in service after the end of the Base Period?

A. Yes. The Sagamore Wind Project ("Sagamore"), which is a 522-megawatt ("MW") wind generating facility located in Roosevelt County, New Mexico, began commercial operation in December 2020.

Q. Will any of the existing units be operated differently in the future?

A. Yes. As more and more renewable resources such as wind and solar generating facilities go into service, SPS must cycle the fossil-fuel units in its generation fleet more often. I explain later in my testimony how that change affects SPS's generation O&M costs.

In addition, SPS will soon complete the installation of synchronous condenser equipment at the Tolk Generating Station, which will allow the units to provide system grid support during the off-peak months. The Tolk units will still be available to provide generation if called upon during the off-peak months, but an adder will be included in the price at which SPS offers the generation to ensure that the units are dispatched less often. That will help conserve the limited water supply at Tolk and allow the generating units to continue operating during on-peak periods until 2032. SPS witness Jarred J. Cooley explains the need for synchronous condensers to support reliable grid operations in his testimony and SPS witness Mark Lytal discusses the installation of the equipment in his direct testimony.

Finally, SPS is proposing to abandon and retire Plant X Unit 3. Mr. Lytal discusses that issue in more detail in his testimony.

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. In terms of organization, the Energy Supply is composed of the following groups and subgroups:

- Performance Optimization
  - ➢ Fleet Engineering
  - ➢ Analytics and Practices
  - ➢ Reliability Engineering
- Energy Supply Projects
  - ➢ Renewable Project Development
  - ➢ Regional Capital Projects
  - ➢ Engineering Design and Document Services
  - ➢ Construction and Project Services
- Environmental Services
  - ➢ Auditing and Corporate Reporting

- Air, Water and Waste Compliance
- Chemistry Service
- Water Resources

- Business Operations
  - Strategic Asset Management
  - Business Planning and Performance Reporting
  - Work Management Process and Performance
  - Continuous Improvement
- North American Electric Reliability Corporation ("NERC") Standards Compliance

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

A. Yes. Attachment DAL-1 lists the types of O&M services that the Energy Supply business area provides to SPS, with the services categorized by FERC account. Attachment DAL-1 also provides the amounts of Energy Supply-related O&M expenses broken down by FERC account for the Test Year.

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

A. Yes. The O&M 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 comply with environmental regulations and receive sufficient technical support. Without the services provided by the Energy Supply business area, SPS would not be able to provide safe and reliable electric service to its customers.

Q. Do SPS's New Mexico retail customers benefit from the services 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. Are any of the O&M services that you are sponsoring provided by affiliates of SPS?

A. Yes. The O&M costs that I support are composed 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 to SPS by Xcel Energy Services Inc. ("XES")[4] or other Xcel Energy affiliates. These services are in addition to (i.e., not duplicative of) the services that SPS employees provide. Charges for affiliate services are provided "at cost," which means that XES realizes no profit from the provision of those services.

Q. Do any other SPS witnesses provide testimony supporting the O&M costs for the Energy Supply business area?

A. Yes. The costs for these services relate 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 Ross L. Baumgarten provides testimony explaining that the methodology of billings for labor and labor-related overheads and affiliate costs is reasonable.

[4] XES is a centralized service company that serves the operating companies of Xcel Energy, one of which is SPS.

Q. In Case No. 19-00170-UT, the parties to the stipulation agreed that "SPS's generation overhaul expense will be determined based on a four-year average."[5] Has SPS calculated its generation overhaul expense in this case based on a four-year average?

A. Yes. The four-year average amount for generation overhaul expense is $2,976,494 on a New Mexico retail basis ($9,070,552 total company), as shown in the table below:

Table DAL-1

SPS Generation Overhaul Expense

Period	**Generation Overhaul Expense Total Company**	**Generation Overhaul Expense New Mexico Retail**
Oct 2015 – Sept 2016	$7,229,497	$2,372,353
Oct 2016 – Sept 2017	$11,725,973	$3,847,868
Oct 2017 – Sept 2018	$4,928,045	$1,617,134
Oct 2018 – Sept 2019	$12,398,693	$4,068,620
Average	**$9,070,552**	**$2,976,494**

[5] Case No. 19-00170-UT, Uncontested Comprehensive Stipulation at 7 (Jan. 13, 2020).

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

A. Yes. Managers within each department of the Energy Supply business area monitor and evaluate differences between actual and expected expenditures on a monthly basis. When necessary, those managers develop action plans to mitigate variations between actual and budgeted expenditures. Those mitigation plans may either reduce or delay other expenditures so that overall spending complies with the authorized budget.

Q. Does SPS hold employees within the Energy Supply business area 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 to 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 is 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 to stay within an O&M budget.

V. SAGAMORE O&M EXPENDITURES

Q. Is SPS proposing any adjustments to its Base Period O&M costs for the Energy Supply business area?

A. Yes. The Base Period O&M costs for the Energy Supply business area do not reflect the O&M expenses for Sagamore, which began commercial operation in December 2020. SPS is therefore requesting a known and measurable adjustment of $3,690,894 on a New Mexico retail basis ($11,247,611 total company) for O&M services at Sagamore. That expense amount, which is shown in Ms. Niemi's Attachment SNN-6, is reasonable and necessary to pay for the O&M at Sagamore.

Q. Please describe Sagamore in more detail.

A. As I noted earlier in my testimony, Sagamore is a 522 MW wind generating facility located in Roosevelt County, New Mexico. To develop Sagamore, SPS installed 240 turbines, along with site infrastructure such as access roads, foundations, electrical cable collection systems, and collection system substations. The generation output ties into the Southwest Power Pool, Inc. ("SPP") transmission system through a generation tie line from the Sagamore collector station to the interconnection tie breaker at the SPP transmission grid point.

Q. How did SPS develop the amount included in the cost of service for O&M services at Sagamore?

A. SPS developed the Sagamore O&M costs in the cost of service based in part on the annual amount that SPS has agreed to pay under the Service, Maintenance and Warranty Agreement ("SMWA") with Vestas-American Wind Technology, Inc. ("Vestas"), which is the Original Equipment Manufacturer ("OEM") of the turbines at Sagamore. Based on the terms of the contract, that amount is known with certainty.

In addition to the costs incurred under the SMWA, SPS must make annual easement payments to landowners in the Sagamore area. Those payments are also included in the O&M expense.

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

A. SPS entered into the SMWA because it was able to negotiate reasonable terms with Vestas, and because Vestas was the OEM. Using the OEM to perform O&M services offers several benefits, including:

- reducing the risk of claims that the maintenance was inadequate during the warranty period;
- allowing the turbine owner to readily obtain controls and software updates that help maintain reliability; and

- allowing the turbine owner 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.

In addition, Vestas provides O&M services to owners of other wind projects, which provides SPS additional assurance that Vestas is highly qualified to do the O&M work. SPS entered into an identical agreement with Vestas for the Hale Wind Project.

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

A. The SMWA obligates Vestas to perform warranty work and to provide both scheduled and unscheduled maintenance. The warranty work covers equipment such as wind turbines, towers, and climb assists. Vestas is obligated to replace failed parts such as bearings and electronic components and to provide the labor associated with the replacement. Vestas must also perform all maintenance, diagnostics, repair and replacement services on the serviced equipment, such as:

- 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 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's own employees have provided the same services that Vestas is providing through the SMWA?

A. No. SPS does not have employees specially trained to operate and maintain wind generation facilities, and SPS does not currently have training programs to support such activities. SPS and XES employees will, however, assist with the O&M at Sagamore.

Q. How many internal SPS or XES employees will be assigned to work on Sagamore O&M?

A. At this time, SPS estimates that two XES employees will be assigned to provide plant management, engineering, and administrative services to Sagamore, in addition to overseeing the SMWA contractors. XES personnel will also provide various support services such as assistance with engineering issues, material and chemical analysis, grid reliability, equipment analysis, environmental services, safety services, and site security.

Q. How do SPS and XES work with Vestas to provide O&M activities for a wind generation project?

A. SPS and XES employees work with Vestas during all phases of the project construction process and thereafter in the operation of the project. SPS and XES employees coordinate with Vestas on scheduling maintenance and on responding to issues at the site. Vestas bears the responsibility for reporting conditions at the site and for reporting any operational or maintenance issues that affect the site.

In an instance where monitoring of SCADA data or other O&M-related monitoring has revealed a potential operations issue, an SPS or XES employee directs Vestas to schedule a technician to inspect 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 Vestas to address the cause of the issue and fix it as timely as possible.

Q. What type of plant management technology does Sagamore use?

A. Sagamore uses the Energy Supply business area's Monitoring and Diagnostic ("M&D") Center, which I describe in a later section of my testimony.

Q. How is Sagamore monitored?

A. SPS and XES have employees on site Monday through Friday during normal business hours, so if an issue arises during that time those employees 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 occurs that requires the turbine to be taken offline. Under both emergency and non-emergency situations, however, the O&M response is just like any other power plant: When an alarm occurs, it is necessary to go to the site and address it as soon as practicable given the issue.

Q. Do SPS and XES have experience coordinating the O&M activities at any other wind projects?

A. Yes. SPS and XES now have experience coordinating O&M activities at the Hale Wind Project, which is located in Hale County, Texas. In addition, XES employees have extensive experience coordinating O&M activities at numerous other wind projects owned by Xcel Energy Operating Companies.[6] As of the end of 2020, Xcel Energy Operating Companies were operating 1,551 turbines with a total nameplate capacity of 3,078.7 MW, not including Sagamore.

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

Q. Has SPS applied the knowledge and experience that XES gained from those other wind projects to its plan for operating and maintaining Sagamore?

A. Yes. SPS and XES have applied the best practices learned from XES's experience at those wind projects to develop and implement the O&M plan for Sagamore. Based on that experience, SPS's planned O&M activities and requested O&M amounts for Sagamore are reasonable and necessary.

Q. Do you have any other observations regarding the O&M costs that SPS is requesting for Sagamore?

A. Yes. Because the SMWA does not cover all of the contingencies that could occur at Sagamore, the O&M costs that SPS is requesting for Sagamore in this rate case are almost certainly less than the actual costs that SPS will experience at Sagamore on a going-forward basis, as SPS develops operational experience with the new plant. For example, a tornado recently damaged a turbine at Hale. Because the contract with Vestas did not cover the cost of repairing the turbine, SPS had to pay for the repairs, and SPS will probably experience those types of unplanned costs at Sagamore as well. Therefore, the Sagamore O&M amount included in the cost of service is likely conservative.

VI. SPS POWER PLANT O&M PROGRAMS

Q. Please describe SPS's O&M programs for the Energy Supply group.

A. SPS employs a number of O&M programs to maintain reliability, control costs and ensure generation efficiency, including:

- scheduled routine maintenance practices;
- predictive maintenance practices;
- performance assurance programs; and
- training of maintenance personnel and plant operators.

The objective of these activities is to reduce O&M expenditures while maximizing unit availability, which allows SPS 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, SPS inspects all components in a turbine within a nine-year cycle of equivalent operating time. Actual durations vary, and SPS may inspect more or less often if component history, industry information, component assessment, projected retirements, and unit operations warrant an extension or reduction in the duration.

SPS maintains its turbine generators 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), SPS overhauls individual sub-components of the turbine generator on a more frequent basis, which allows for more stable maintenance costs from year to year and provides a higher average level of unit availability. Additionally, SPS inspects and overhauls boilers on a three-year cycle. When a unit must be shut down for boiler maintenance, SPS may take advantage of that outage to perform component turbine or generator maintenance as well.

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

A. No. SPS generally follows manufacturers' recommendations for both steam and combustion turbines, 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 the system correlates that information with total hours of operation. When a unit reaches the OEM's recommended hours of operation, SPS performs maintenance inspection and repairs. 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.

Q. You testified earlier that SPS overhauls individual sub-components of a turbine generator more frequently than it performs a general overhaul, which provides a higher level of unit availability. Can you provide examples?

A. Yes. One example of a change to SPS's overhaul frequency due to the nature of a unit's design specifications occurred with respect to the Tolk Unit 2 throttle and intercept valves during the November 2020 overhaul. Based on the OEM's recommendation, SPS modified the valves with improved internal parts that will prevent the valves from malfunctioning when they are required to close. With the new internal parts installation, the inspection time will be extended from 39 to 60 operating months. The new design materials eliminate deposits forming on the valves and improved positive sealing which allows for safer operation of the high pressure/intermediate pressure turbine.

Another recent example of OEM recommendation occurred on Cunningham Unit 4, which had an original generator cooling fan design that was at risk of failing without warning. During a generator rewind at Cunningham Unit 4 in 2020, SPS installed a new Siemens cooling fan with a two-stage set of blades, which will extend the life of the cooling fan and reduce the likelihood of sudden failure.

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. In addition, 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 refers to 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 SPS performs maintenance too frequently, reliability remains very high, but maintenance costs can be higher than required for that level of reliability. If SPS performs maintenance too infrequently, 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 simply reacting to failures.

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

A. SPS uses numerous programs and tools to help identify problems before forced outages occur:

- Performance Assurance Program – Under this program, SPS evaluates the steam turbine and the parameters of the steam turbine cycle to detect problems that may require maintenance. This program, which is designed to prevent problems that may result in a forced outage, allows the maintenance department to gather data from the performance test and act on that data by, for example, ordering parts and materials in preparation for an anticipated outage. I discuss the Performance Assurance Programs in more detail later in my testimony.
- Valve Wide Open Test – As part of the performance assurance program, SPS performs a Valve Wide Open Test with the unit on-line. The information obtained from this test allows the Analytics & Practices 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 have historically been scheduled every two to three years depending on the outage schedules for the major units (i.e., those greater than 200 MW). Beginning in 2021, SPS will implement online thermal performance monitoring on these units to provide near real-time monitoring of thermal performance and equipment degradation, as well as predictive analytics to highlight deviations from expected performance. In the absence of online thermal performance monitoring, alternative methods of heat rate and efficiency evaluation will still be employed on three-year intervals. This ensures that the units with the greatest effect on fuel costs are tested frequently. Minor units that have high capacity factors are scheduled for heat rate evaluation approximately every five years depending on need and resource availability. Peaking and low capacity factor units are not routinely tested because their use is based on the need for capacity and not on economical generation.

- <u>Steam Path Analysis</u> – SPS uses this tool for predictive maintenance purposes. During a scheduled turbine outage, SPS thoroughly inspects the steam-path areas of the turbine. By taking precise measurements and conducting a detailed inspection, SPS evaluates the components evaluated for wear, deposit buildup, foreign object damage, and steam leakage. That helps identify components that should be replaced to prevent a forced outage or improve the efficiency of the unit.

- Vibration Monitoring – SPS uses vibration monitoring as another predictive maintenance tool. 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 to monitor and trend vibration problems.
- Magnetic Particle Nondestructive Examination - SPS has invested in nondestructive examination capabilities by training and qualifying employees 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 – Generator tagging is another useful predictive tool that can provide early information of localized overheating in the generator. When 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 generator condition monitor senses the condition and gives an alarm to the operator. SPS can then take a gas sample from the generator containing molecules of the burned tagging compound and determine the location of the overheating 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 – This predictive maintenance tool, which is 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. SPS uses information about how the different gaseous compounds are formed and trending analyses to interpret the data and to detect problems before failure.

- Lubrication Oil Testing – In addition to testing transformer oil, SPS samples and tests lubrication oils for the plants once per year for indication of oil degradation and unusual machine wear. Analyses include measuring oxidation resistance and identifying the presence of wear metals. In addition to yearly testing, SPS tests major rotating equipment at least every six months at all facilities for indication of corrosion or contamination.
- Plant Water Chemistry – SPS analyzes water samples to predict areas for corrective action. Automatic analyzers constantly measure the quality of the boiler feedwater, boiler water, and steam, and they detect small amounts of impurities that, when immediately addressed, prevent costly long-term damage to the boiler and turbine equipment. SPS takes water samples from every water source in each plant for indication of operational and maintenance problems, as well as unusual corrosion conditions.
- Insulation Resistance Testing – Another predictive maintenance tool SPS uses is insulation resistance testing of motors, which is performed by applying a high voltage (at least twice the rated voltage) direct current to the motor windings.

SPS conducts the test 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, SPS disassembles, cleans, and retests the motor. Finally, if the data indicates an imminent failure, SPS repairs or replaces the motor. The advantage of this predictive tool is that SPS can perform repairs during a scheduled outage, which avoids a forced outage.

C. Performance Assurance Programs

Q. Please explain SPS's performance assurance programs.

A. SPS undertakes performance assurance programs to achieve optimum operating efficiency of 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 Optimization department monitors performance and recommends changes to enhance the operational performance of SPS's power plants. This group 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 it can generate electricity reliably 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. Equipment performance and reliability is monitored through online condition monitoring (vibration, temperatures, pressures, etc.…) and route based condition monitoring (vibration data collection, motor testing, thermography, etc.…) I discuss some of those indicators, which SPS uses in assessing the performance of its generation fleet, in a later section of my testimony.

Q. Please describe what you mean when you refer to heat rates.

A. Heat rate is a measure of the efficiency of a unit. There are two types of heat rates. One is the Average Net Heat Rate, which is defined 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. The Average Net Heat Rate calculation is affected by several factors such as unit loading, measured generation, measured fuel consumption, measured fuel heating value, and overall process degradation.[7]

[7] The 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.

The second type of heat rate is the Adjusted Design Net Heat Rate, which is the average load 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. To calculate the Adjusted Design Net Heat Rate, SPS first determines the monthly average loads for each unit and then compares them against original design heat rate curves for the units. SPS then applies adjustments 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 is calculated on a monthly basis and then totaled for all months. The total adjusted design fuel usage is then used along with the total MW-hours to calculate the overall adjusted design heat rate values for the Base Period.

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

A. Yes.

Q. Why does that deterioration occur?

A. There are many factors that cause the efficiency of a generating unit to deteriorate, causing plant performance to become 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.

Q. Is it possible to take steps to restore some of the lost efficiency?

A. Yes. 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) SPS collects and analyzes pre-inspection test data for indications of turbine performance degradation; and (2) during the overhaul, SPS makes numerous measurements and observations to further evaluate the condition of the turbine. After appropriate engineering and economic analyses are completed, SPS makes the repairs that are economically justified.

During the pre-inspection analysis, SPS analyzes the performance test data for the following steam-path problems: solid particle erosion, foreign object damage, deposits, and steam-path leakage. As problems are identified, SPS evaluates the extent of the damage and the probability of the component’s failure, and SPS also determines the projected effect of these problems on fuel costs. Armed with this knowledge, SPS decides which to replace and which repair procedures to undertake. The pre-inspection information is then furnished to the plant maintenance department for scheduling repairs, ordering parts, and preparing repair procedures. During planned overhauls, SPS makes further inspections to determine the extent of damage and repairs required to bring the equipment back to design condition.

When the turbine is disassembled for inspection, SPS performs the following evaluations:

- Assessments of turbine nozzle and blade erosion and damage, with measurements taken for throat and pitch dimension, and establishment of the effect of these problems on the heat rate;
- Measurements to determine deposit thickness and the degree of coverage on nozzles and blades, along with the resulting effect of excessive deposits on heat rate; and
- Measurement of steam seal and steam packing clearances, and evaluation of the alignment of rotating and stationary components, along with the effect on the heat rate.

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

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 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, and the results are compared with previous test results and/or design efficiency. For major plant equipment within the steam cycle, SPS periodically conducts efficiency tests 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, SPS evaluates the costs and benefits associated with replacing or reconditioning equipment parts, which enables SPS to make informed decisions.

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

A. The Energy Supply business area's M&D Center was established in 2014 to monitor the performance and health of SPS's generating fleet. SPS uses monitoring and diagnostic technology 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, and Jones Station Unit 1 and Unit 2 have been monitored by the M&D Center since September 2016. In addition, the M&D Center will be used to monitor wind turbines at Hale and Sagamore. The system monitors approximately 235 points of data for each turbine that will alert operations of any operational or mechanical issues. This system will be refined in 2021.

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 employees are required to complete an apprentice program that lasts three or four years, depending on the individual's progress. That program 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 employees are provided ongoing training in their area of operations. SPS also provides operator refresher and scenario training on an on-going basis. 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 that employee 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 the employee's assigned power plant. SPS also provides formalized rotational on-the-job training assignments in Operations, Maintenance, Environmental, and Chemistry. In addition, SPS requires rotations outside the department, including at other power plants, and other engineering departments. 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. EXTERNAL FACTORS AFFECTING THE PERFORMANCE OF SPS'S GENERATING UNITS

Q. Have any external events affected the performance of SPS's generating units and the expenditures of O&M dollars in recent years?

A. Yes. Two key developments over the last decade have had a dramatic effect on how SPS operates its generating units and how it spends the O&M dollars needed to operate and maintain those generating units. First, in 2014 the SPP instituted the Integrated Marketplace ("IM"), which led to generating resources being dispatched in economic order across the SPP footprint (with some exceptions that are not relevant here). Second, thousands of MWs of low marginal cost wind and solar generation have been added to the SPP footprint over the last decade. Collectively, these two events have reduced fuel costs for customers, but they have also required that SPS's fossil-fueled generating units be started and stopped more often in recent years, and in some instances they have required the generating units to run at a lower minimum load.[8]

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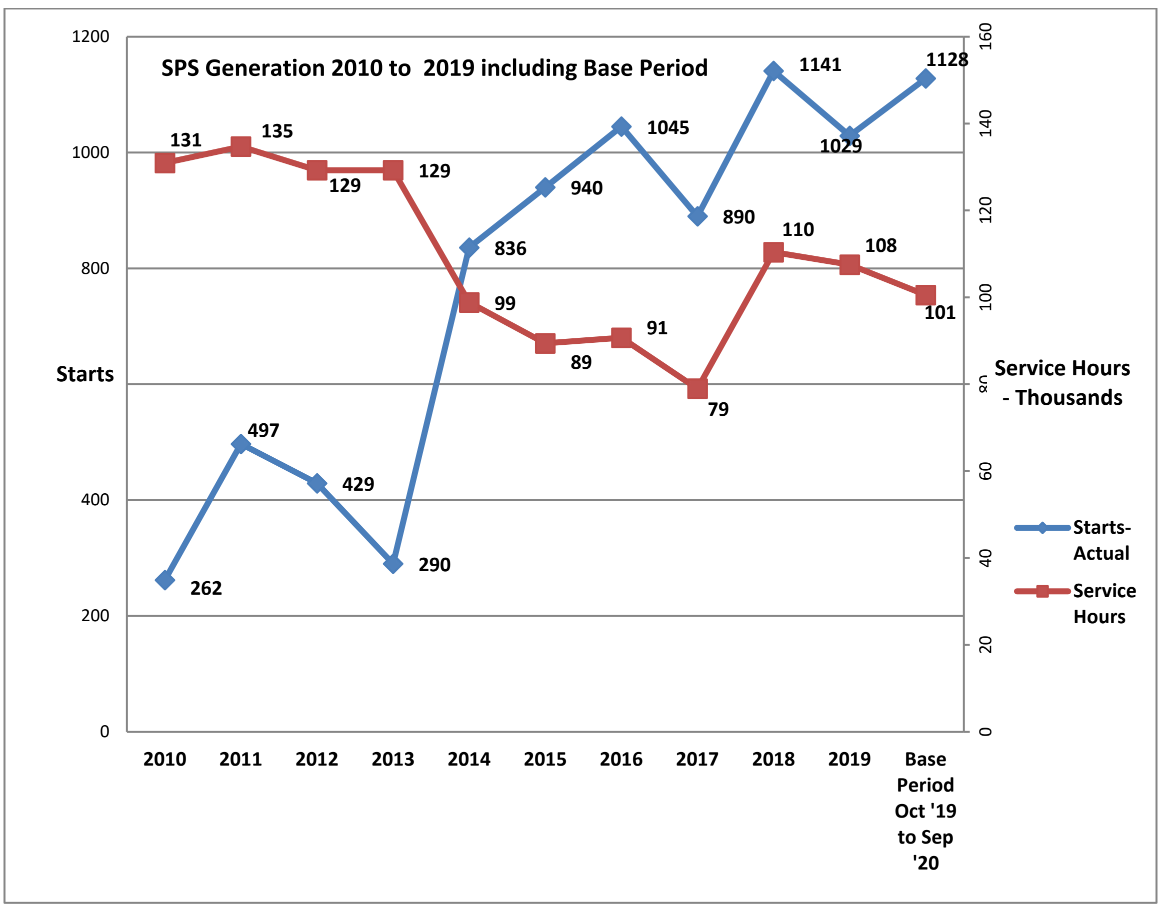
[8] In general, units are shut down when the SPP market optimization model determines that the unit will not be needed the following day. Unit startups are normally triggered when the SPP model determines that a unit is an economic choice to run or that there is a system reliability improvement to be gained by starting a unit. SPP decides which units to dispatch (i.e., run) based on modeling software that includes pricing information, unit heat rates, fuel cost, etc.

Q. Has SPS quantified the increase in the number of starts and stops during recent years?

A. Yes. Figure DAL-2 shows that unit starts have increased significantly during the period from 2010-2020, even though total operating hours of the units have decreased during that time.

Figure DAL-2

SPS Unit Starts and Operating Hours 2010 – Sept. 2020



Q. What effect does the increased number of stops and starts have on SPS's generating units?

A. The increased number of starts and stops, which is typically referred to as "cycling," has two primary effects. First, it increases the wear and tear on the generating resources, which leads to more outages and elevates O&M costs relative to what they would be if the fossil-fueled generating units ran for longer periods and at more stable levels. Second, it increases the heat rates of the units, which leads to increased fuel costs when the units are ordered to run.

Q. Please describe why cycling of the units leads to increased wear and tear on the units.

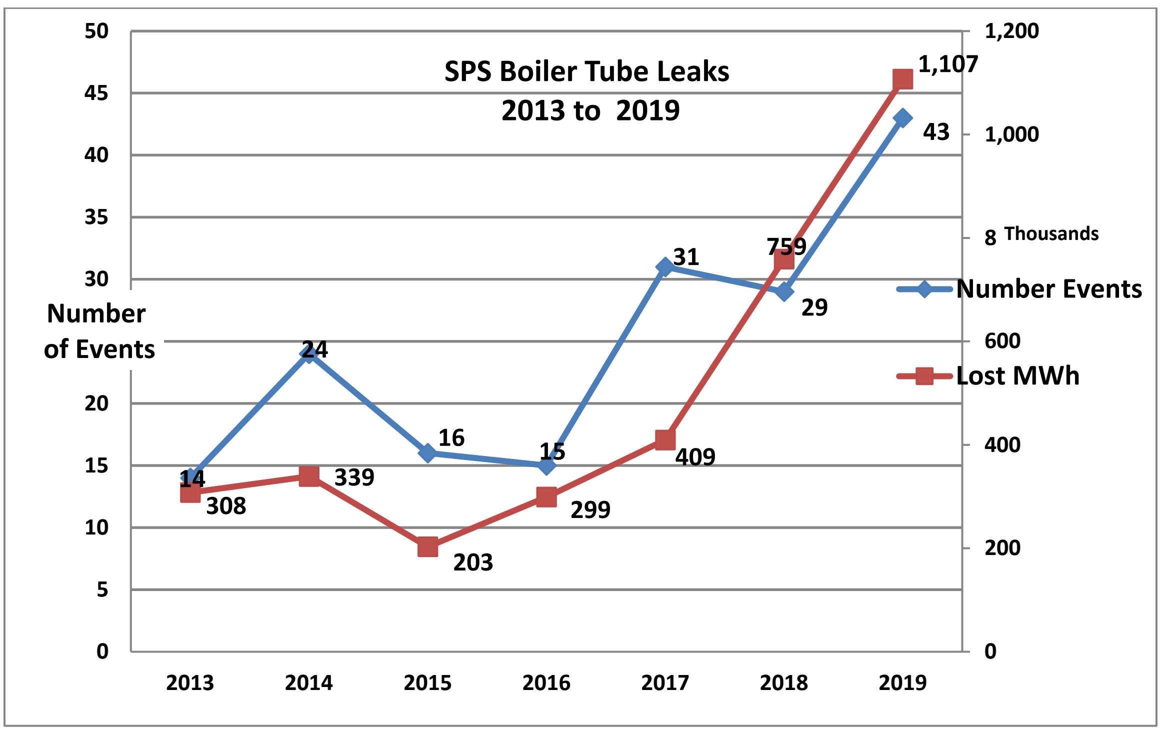
A. Generating units, particularly steam units, are constructed using materials of various types and thicknesses, and those materials expand and contract at different rates when the unit goes from hot to cold, or vice versa. When a unit is cycled frequently, its component parts expand and contract much more often than they would if the units were run at a constant level. That leads to metal fatigue, which causes boiler tube leaks and other component failures.

Q. Do you have any empirical data showing that cycling is increasing the number of boiler tube leaks for SPS's generating units?

A. Yes. Figure DAL-2 shows the number of boiler tube leaks during the period from 2013 to 2019.

Figure DAL-2

SPS Unit Boiler Tube Leaks 2013 to 2019



Q. Have the increases in unit starts affected components other than boiler tubes?

A. Yes. For example, during the Base Period Maddox Unit 1, Jones Unit 2, and Plant X Units 1, 2, 3, and 4 all experienced boiler casing tears from cycle fatigue.

SPS also experienced motor failures at Maddox Unit 2, Nichols Unit 1, and Harrington Unit 3. SPS also experienced a generator failure at Cunningham Unit 4 and a Generator Step-Up Transformer fault at Plant X Unit 4.

Q. You testified earlier that increased cycling also increases the heat rates of the units. Why does that occur?

A. During all unit startups, there are periods when fuel is consumed before the unit generates power.[9] That reduces the number of kilowatts produced per Btu, which increases the heat rate. In contrast, if the units were base loaded and stayed online at the optimal load point, the units would achieve lower heat rates, all else being equal.

Q. Does the increased cycling of generating units provide a net benefit to SPS's retail customers?

A. Yes. The SPP modeling software is designed to create fuel cost savings when a unit is shut down for economic purposes, and there should be a fuel cost savings each time a unit is started for economic purposes. SPS certainly has no objection to

[9] These fuel costs, which are referred to as 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.

operating its units in the way that produces fuel cost savings for its customers, but it is important to realize that there are trade-offs such as increased wear and tear on the generating equipment and somewhat higher heat rates.

VIII. RESULTS OF SPS'S O&M PRACTICES

Q. What do you discuss in this section of your testimony?

A. I provide a few key statistics that show SPS's generating units continue to operate economically and efficiently, despite the increased cycling that I discussed in the previous section of my testimony.

Q. In an earlier part of your testimony, you discussed Average Net Heat Rates and Adjusted Design Net Heat Rates. Did SPS measure those types of heat rates for the Base Period?

A. Yes. Table DAL-2 contains the Average Net Heat Rates and Adjusted Design Net Heat Rates for SPS's largest units during the Base Period.

Table DAL-2
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	11,542	11,281	2.31%
Harrington 2	11,218	11,052	1.51%
Harrington 3	10,781	10,706	0.70%
Tolk 1	11,458	11,059	3.61%
Tolk 2	11,002	10,912	0.82%

Q. Does the comparison of the Average Net Heat Rate to the Adjusted Design Net Heat Rate demonstrate that SPS operates and maintains its units well?

A. Yes. As I explained earlier in my testimony, the Adjusted Design Net Heat Rate represents a unit's best achievable heat rate considering age-related equipment performance degradation and other factors. The fact that the actual performance (i.e., the Average Net Heat Rate) is so close to the best achievable performance (i.e., the Adjusted Design Net Heat Rate) demonstrates that SPS is operating and maintaining the units in a way that maximizes their efficiency under the circumstances.

Q. What steps does SPS take to minimize the difference between the Average Net Heat Rate and the Adjusted Design Net Heat Rate?

A. In addition to all of the steps I discussed earlier in my testimony, SPS routinely inspects and maintains equipment such as feedwater heaters and turbine components. SPS also takes proactive steps such as monitoring the feedwater chemistry, keeping the condenser tubes clean, inspecting all steam vent and drain valves for leaks, and monitoring turbine backpressure to achieve the most efficient design point. In addition, SPS operates the units at the most efficient manner at the SPP load points. All of these efforts help ensure that the units operate at or near their design conditions.

Q. Have SPS's O&M practices been effective in maintaining appropriate availability factors and outage rates?

A. Yes. Attachments DAL-2 through Attachment DAL-7 graphically depict the Equivalent Availability Factors ("EAF") and Forced Outage Rates ("FOR") of SPS's coal-fueled plants and larger gas-fueled units, compared to the national average EAFs and FORs from the NERC/Generating Availability Data System for historical periods.[10] These attachments demonstrate SPS's units have historically fared well against the national average for comparably-sized units, with certain exceptions that I discuss below.

Q. Please describe what Attachment DAL-2 depicts with respect to SPS's performance.

A. Attachment DAL-2 demonstrates that, over the eleven-year period from 2009 through 2019, the EAF of Tolk was above the national average in every year except 2018, when a transformer at Tolk failed. That transformer failure caused Tolk to be out of service for approximately three months in 2018.

[10] The 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. The FOR indicates how much time SPS's units were offline because of an unscheduled outage; the smaller the FOR, the better.

Q. Why was Tolk out of service for three months as a result of the transformer failure?

A. Manufacturers of transformers as large as the ones at Tolk typically do not maintain an inventory that can be shipped and placed in service quickly. Because of the time needed to manufacture and ship transformers of that size, it can take up to a year to acquire and replace such transformers. Fortunately, SPS had a spare transformer at Harrington that it was able to use at Tolk, but even installing that spare transformer took a considerable amount of time. For example, it took approximately a month just to get the permit from the Texas Department of Transportation to move the extremely heavy transformer from Harrington to Tolk. Under those circumstances, it was remarkable that Tolk's EAF for 2018 was even close to the national average.

Q. What does Attachment DAL-3 demonstrate with respect to SPS's performance?

A. Attachment DAL-3 shows that Harrington's EAF has been higher than the national average in every one of the six years from 2014 through 2019, even though Harrington is currently cycled far more than it was prior to 2014.

Q. What does Attachment DAL-4 demonstrate with respect to SPS's performance?

A. Attachment DAL-4 shows that SPS's largest gas-fired units have performed reasonably well against the national average EAF, with the exception of 2019, when three of the five units were well below the national average EAF.

Q. Does the fact that three of the gas units had a low EAF in 2019 demonstrate that SPS failed to operate or maintain them well?

A. No. It is important to recognize that some of SPS's gas plants have been in service for many decades and are nearing the end of their service lives. Cunningham Unit 2, for example, was placed in service in 1965, and Plant X Unit 4 was placed in service in 1964. Therefore, both units have been in service for approximately 55 years.

Moreover, in recent years all of the gas units have experienced the increased cycling that I discussed earlier, which has accelerated the wear and tear on those units. And because of the age of the units, the parts needed to repair or refurbish the units are sometimes available only from overseas vendors, which causes shipping times to be longer.

In addition, Plant X Unit 4 had a planned overhaul that was extended due to the generator failing a post re-wedge high-pot test, which indicated a weakness in the insulation somewhere in the windings. Further investigation and testing narrowed the problem to a top bar and a bottom bar. SPS could not perform localized repairs, so an emergent project was approved to rewind the generator. The generator work extended the overhaul, which accounted for the unit being out of service for five months.

Jones Unit 2 was out of service due to several events throughout 2019. A planned outage that lasted 85.7 days reduced service time, and the turbine had a bearing and stub shaft failure during a startup of the unit that took 52.8 days to repair, in part because the bearing and stub shaft had to be sent off for repairs. The damaged area also affected the turbine journal, and that area had to be machined in place to clean up the grooves.

Another issue that affected the EAF of Jones 2 was the reduced availability of cooling water from the City of Lubbock. SPS de-rated the units at night to allow for water to replenish the make-up pond and allow for full load operations during the day, and those de-ratings were equivalent to 24 days offline. Lubbock also had issues with its supply line and dropped pressure to prevent another failure of the pipeline. To prevent similar issues in the future, SPS has installed a new holding pond at Jones to allow a flywheel of water supply during the year. The new pond became available for operation in December 2020. Mr. Lytal discusses the construction of the holding pond in his testimony.

Q. What information is presented in Attachments DAL-5, DAL-6, and DAL-7?

A. Those attachments depict the FORs of Tolk, Harrington, and the five largest gas-fired units. The FORs for Tolk and Harrington are generally lower than the national average, with the exception of 2018 for Tolk. I explained the reason for that anomaly earlier in my explanation of the Tolk EAF. In addition, the FORs for the gas units are generally at or below the national average, with the exception of Cunningham Unit 2.

Q. Why has the FOR of Cunningham Unit 2 been high in recent years?

A. That unit had extensive hydrogen damage to the boiler water wall tubing. To determine the areas that were damaged, SPS hired a contractor to perform low frequency electromagnetic technique testing on the tubing to map out the damaged area that should be replaced. The first set of test data produced additional questions, and the contractor came back for a second round of testing to determine the extent of damage in the boiler. SPS ultimately determined that six sections of tubing were damaged, and SPS decided to replace those sections in 2020. It took a considerable amount of time, however, for the vendor to manufacture the 8,531 feet of tubing needed to replace the tube sections. Then, after the tubing was replaced, SPS conducted an extensive boiler chemical cleaning on the internal surfaces of the boiler. Since those repairs were completed, the unit has not had another hydrogen damage failure.

Q. Do you have any other comments regarding the performance of the SPS generating units?

A. Yes. Operating statistics such as EAFs and FORs are important, but they have to be considered in the context of the broader market. When SPS relied primarily on its own units to serve load, it was sometimes necessary to rush units back into service to save fuel costs, even if that meant paying overtime and hiring contractors to work around the clock. But as a result of the SPP IM and the addition of thousands of MWs of renewable energy, SPS now has access to much more low marginal cost generation. Thus, when a unit experiences an outage, SPS performs an economic analysis to determine whether it needs to incur the additional costs to return a unit to service as quickly as possible. In some instances, it is more economical to purchase energy from the market than it is to pay the additional costs necessary to return a unit to service quickly. That saves O&M dollars, but it makes the availability factor for the unit appear much lower than it would be if SPS were to spend the O&M dollars without regard to the most economic option.

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

A. Yes.

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. 292; (2) AUTHORIZATION AND APPROVAL TO ABANDON ITS PLANT X UNIT 3 GENERATING STATION; AND (3) OTHER ASSOCIATED RELIEF,	**)**	**CASE NO. 20-00038-UT**
SOUTHWESTERN PUBLIC SERVICE COMPANY,	**)**	
APPLICANT.	**)**	

VERIFICATION

On this day, December 22, 2021, I, David A. Low, swear and affirm under penalty of perjury under the law of the State of New Mexico, that my testimony contained in Direct Testimony of David A. Low is true and correct.

/s/ David A. Low
DAVID A. LOW

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**	**Operation Supervision and Engineering**	**$**	**3,479,339**	**$**	**1,069,106**
2	501.35	Coal Non-Mine; Non-Freight		33,361,562		10,947,567
3	**507.7**	**Coal Ash Sales**		**94,518**		**31,016**
4	**502**	**Steam Expenses**		**11,359,090**		**3,490,340**
5	**505**	**Electric Expenses**		**9,335,877**		**2,868,661**
6	**506**	**Miscellaneous Steam Power Expenses**		**12,953,786**		**3,980,347**
7	**507**	**Rents**		**4,521,223**		**1,389,249**
8	**509**	**Steam Operation SO2 Allowance Expense**		**-**		**-**
9	**510**	**Maintenance Supervision and Engineering**		**579,638**		**178,107**
10	**511**	**Maintenance of Structures**		**4,283,276**		**1,316,134**
11	**512**	**Maintenance of Boiler Plant**		**17,168,511**		**5,633,832**
12	**513**	**Maintenance of Electric Plant**		**8,443,902**		**2,770,859**
13	**514**	**Maintenance of Miscellaneous Steam Plant**		**10,046,276**		**3,086,948**
14	**546**	**Operation Supervision and Engineering**		**479,948**		**150,570**
15	**548**	**Generation Expenses**		**283,222**		**87,026**
16	**549**	**Misc Other Power Generation Expenses**		**9,109,828**		**2,976,817**
17	**550**	**Rents**		**5,889,382**		**1,920,702**
18	**551**	**Maintenance Supervision and Engineering**		**468,558**		**143,975**
19	**552**	**Maintenance of Structures**		**316,098**		**97,128**
20	**553**	**Maintenance of Generating and Electric Equipment**		**5,987,285**		**1,931,581**
21	**554**	**Maintenance of Misc Other Power Generation Plant**		**4,144,122**		**1,359,070**
22	556	System Control and Load Dispatching		1,209,269		371,576
23	**557**	**Purchased Power Other**		**1,319,343**		**441,717**
24	**Total Production O&M Expense**		**$**	**144,834,052**	**$**	**46,242,328**

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			
25	560	Operation Supervision and Engineering	$ 8,429,849	$ 2,093,757
26	561.1	Load Dispatch - Reliability	(170,029)	(41,221)
27	561.2	Load Dispatch - Monitor and Operate Trans. System	3,401,279	824,590
28	561.4	Scheduling, System Control and Dispatching Services	4,702,582	1,271,258
29	561.5	Reliability, Planning and Standards Development	35,018	8,490
30	561.6	Transmission Service Studies	34,917	8,465
31	561.7	Generation Interconnection Studies	23,849	5,782
32	561.8	Reliability Planning and Standards Development Services	3,221,212	963,289
33	562	Station Expenses	1,548,254	384,546
34	563	Overhead Line Expenses	442,401	109,881
35	564	Underground Line Expenses	-	-
36	565	Transmission of Elec By Others	288,806	70,017
37	565	Wheeling Meter Charges	391,050	-
38	565	Wheeling Miscellaneous	35,240	8,543
39	565	Wheeling Schedule 11	106,286,672	37,146,779
40	565	Wheeling Schedule 11 - Wholesale	31,231,118	-
41	565	Wheeling Schedule 12	2,224,452	777,437
42	565	Wheeling Schedule 12 - Wholesale	538,968	-
43	565	Wheeling Schedule 1 - Wholesale	504,926	-
44	565	Wheeling Schedule 2	69,152	24,168
45	565	Wheeling Schedule 2 - Wholesale	20,132	-
46	565	Wheeling Schedule 9	8,201,216	2,866,293
47	565	Wheeling Schedule 9 - Wholesale	25,866,440	-
48	565	Z2 Direct Assigned Upgrade Charge	249,444	86,962
49	565	Z2 Direct Assigned Upgrade Charge - Wholesale	17,766	-
50	566	Misc Transmission Expenses	3,241,880	805,199
51	567	Rents	2,146,864	533,226
52	568	Maintenance Supervision and Engineering	-	-
53	570	Maintenance of Station Equipment	1,345,024	334,069
54	571	Maintenance of Overhead Lines	902,988	224,279
55	**Sub-Total Total Transmission O&M Expenses**		**$ 205,231,470**	**$ 48,505,810**
56	**Regional Market Expenses**			
57	575	Operation Supervision	$ 160,378	$ 52,628
58	575	Day-Ahead and Real-Time Market Administration	312,292	102,478
59	575	Ancillary Services Market Administration	14,773	4,848
60	575	Market Monitoring and Compliance	27,675	9,081
61	575	Market Admin, Monitoring, and Compliance Services	8,158,155	2,204,755
62	575	Regional Market Rents	49,736	16,321
63	**Total Regional Market Expenses**		**$ 8,723,009**	**$ 2,390,111**
64	**Total Transmission O&M Expenses**		**$ 213,954,479**	**$ 50,895,922**

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
65	**Distribution**			
66	580	Operation Supervision and Engineering	$ 4,083,691	$ 1,471,703
67	581	Load Dispatching	326,676	124,027
68	582	Station Expenses	1,008,922	383,050
69	583	Overhead Line Expenses	896,658	857,599
70	584	Underground Line Expenses	663,984	236,792
71	585	Street Lighting and Signal Systems Expenses	607,411	230,611
72	586	Meter Expenses	2,242,784	1,005,727
73	587	Customer Installations Expenses	629,268	238,910
74	588	Misc Distribution Expense	9,998,513	2,968,634
75	589	Rents	3,139,096	1,079,187
76	590	Maintenance Supervision and Engineering	28,574	10,849
77	591	Maintenance of Structures	(71)	3
78	592	Maintenance of Station Equipment	668,741	253,896
79	593	Maintenance of Overhead Lines	6,337,535	2,566,736
80	594	Maintenance of Underground Lines	101,569	15,682
81	595	Maintenance of Line Transformers	-	-
82	596	Maintenance of Street Lighting and Signal Systems	282,248	147,745
83	597	Maintenance of Meters	24,865	9,440
84	598	Maintenance of Misc Distribution Plant	17,891	12
85	**Total Distribution O&M Expenses**		**$ 31,058,354**	**$ 11,600,604**
86	**Customer Accounts**			
87	901	Supervision	$ 28,774	$ 8,994
88	902	Meter Reading Expenses	4,920,322	1,537,920
89	903	Customer Records and Collection Expenses	7,705,766	2,408,552
90	904	Uncollectible Expenses	5,497,465	1,718,345
91	904	Uncollectible Expenses Misc	324,063	101,293
92	905	Customer Acct - Misc	136,841	42,772
93	DEPINT	Customer Deposit Interest Expense	126,563	15,689
94	**Total Customer Accounts Expense**		**$ 18,739,793**	**$ 5,833,564**
95	**Customer Service**			
96	908	Customer Asst Expense	$ 2,342,346	$ 732,135
97	908	Historical EE Amortization	-	-
98	908.04	SaversSwitch	667,409	-
99	909	Informational and Instructional Advertising Expense	292,042	91,284
100	910	Miscellaneous Customer Service Expense	98,844	30,896
101	**Total Customer Service Expense**		**$ 3,400,642**	**$ 854,315**

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
102	**Sales**					
103	912	Demonstration and Selling Expense-Economic Development	$	284,818	$	89,024
104	916	Misc Sales Expense		8,598		2,687
105	**Total Sales Expense**		$	**293,415**	$	**91,711**
106	**Administrative and General Expenses**					
107	920	Administrative and General Salaries	$	33,814,014	$	10,165,291
108	921	Office Supplies and Expenses		19,848,518		5,966,933
109	922	Administrative Expenses Transferred-Credit		(22,762,323)		(6,842,892)
110	923	Outside Services Employed		6,190,128		1,860,899
111	924	Property Insurance		3,738,738		1,133,506
112	925	Injuries and Damages		7,941,830		2,387,502
113	926	Employee Pensions and Benefits		29,060,743		8,736,346
114	926.30	Deferred Pension Expense		1,132,943		-
115	928	Regulatory Commision Expense		40		12
116	928	Regulatory Commission Expense -TX		1,195,043		-
117	928.01	Regulatory Commission Expense - NM		5,372,336		5,372,336
118	928.02	Regulatory Commission Expense - Wholesale		1,949,917		-
119	928	Regulatory Commission Expense - Misc		(83,949)		(29,799)
120	929	Duplicate Charges-Credit		(1,162,226)		(348,553)
121	930	Misc General Expenses		1,280,946		384,157
122	931	A&G Rents		14,067,307		4,418,551
123	935	Maintenance of General Plant		47,251		14,214
124		Recoverable Contributions, Dues, and Donations		264,190		264,190
125	**Total Administrative and General Expenses**		$	**101,895,444**	$	**33,482,692**
126	**Total Operations and Maintenance Expense**		**$**	**514,176,179**	**$**	**149,001,136**

Production-Related FERC O&M Accounts

FERC Account	FERC Account Title	Description of Costs Included in FERC Account
500	Operation Supervision and Engineering	Cost of labor and expense incurred in the general supervision and direction of the operation of steam power generating stations.
502	Steam Expenses	Cost of labor, materials used, and expenses incurred in the production of steam for electric generation.
505	Electric Expenses	Cost of labor, materials used, and expenses incurred in the operating prime movers, generators, and their auxiliary apparatus, switch gear and other electric equipment to the points where electricity leaves for conversion for transmission or distribution.
506	Miscellaneous Steam Power Expenses	Cost of labor, materials used, and expenses incurred which are not specifically provided for or are not readily assignable to other steam generation operation expense accounts.
507	Rents	Rents of property of others used, occupied or operated in connection with steam power generation.
509	Allowances	Cost of allowances expensed concurrent with the monthly emission of sulfur dioxide.
510	Maintenance Supervision and Engineering	Cost of labor and expenses incurred in the general supervision and direction of maintenance of steam generation facilities.
511	Maintenance of Structures	Cost of labor, materials used, and expenses incurred in maintenance of

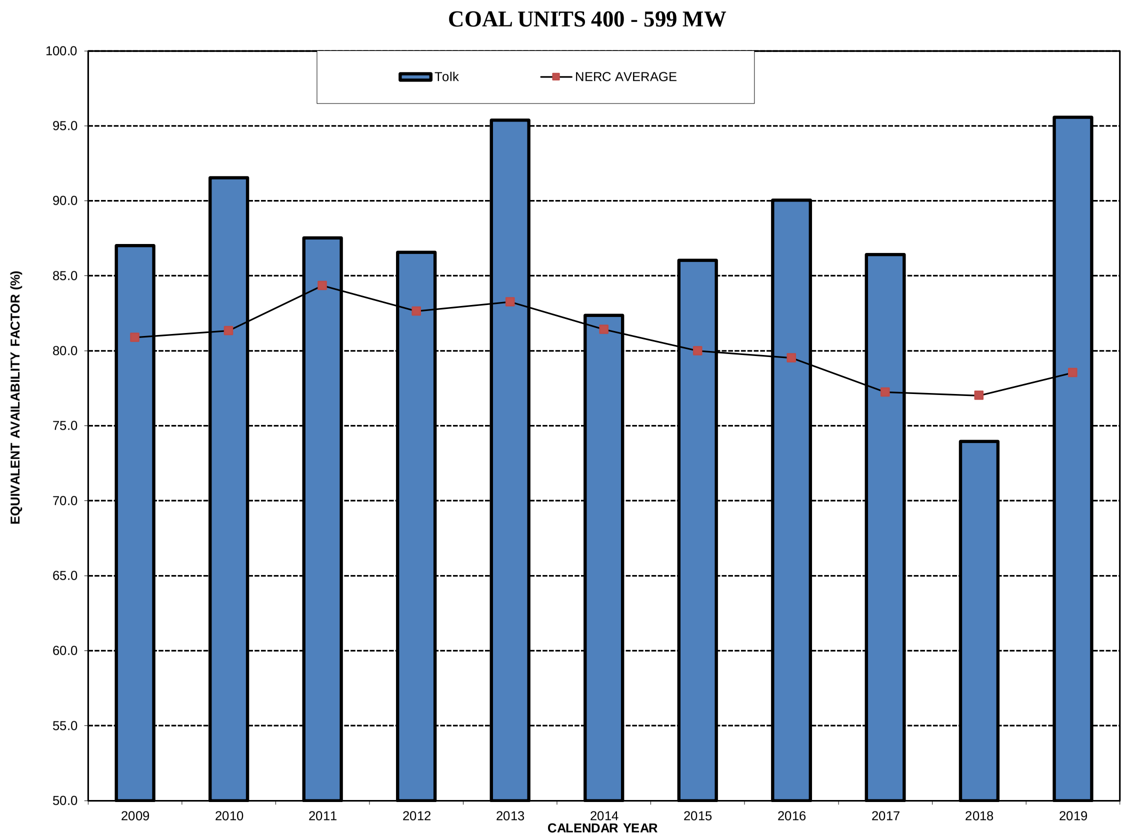
FERC Account	FERC Account Title	Description of Costs Included in FERC Account
		steam structures, the book cost of which is includible in FERC Account 311, Structures and Improvements.
512	Maintenance of Boiler Plant	Cost of labor, materials used, and expenses incurred in maintenance of steam plant, the book cost of which is includible in FERC Account 312, Station Equipment, and FERC Account 312, Boiler Plant Equipment.
513	Maintenance of Electric Plant	Cost of labor, materials used, and expenses incurred in maintenance of electric plant, the book cost of which is includible in FERC Account 313, Engines and Engine-Driven Generators, FERC Account 314, Turbogenerator Units, and FERC Account 315, Accessory Electric Equipment.
514	Maintenance of Steam Plant	Cost of labor, materials used, and expenses incurred in maintenance of miscellaneous steam generation plant, the book cost of which is includible in FERC Account 316, Miscellaneous Power Plant Equipment
546	Operation Supervision and Engineering	Cost of labor and expense incurred in the general supervision and direction of the operation of other power generating stations.
548	Generation Expenses	Cost of labor, materials used, and expenses incurred in operating prime movers, generators and electric equipment in other power generating stations, to the point where electricity leaves for conversion for transmission or distribution.

FERC Account	FERC Account Title	Description of Costs Included in FERC Account
549	Miscellaneous Other Power Generation Expenses	Cost of labor, materials used and expenses incurred in the operation of other power generating stations which are not specifically provided for or are not readily assignable to other generation expense accounts.
550	Rents	Rents of property of others used, occupied, or operated in connection with other power generation.
551	Maintenance Supervision and Engineering	Cost of labor and expenses incurred in the general supervision and direction of the maintenance of other power generating stations.
552	Maintenance of Structures	Cost of labor, materials used and expenses incurred in maintenance of facilities used in other power generation, the book cost of which is includible in FERC Account 341, Structures and Improvements, and FERC Account 342, Fuel Holders, Producers and Accessories.
553	Maintenance of Generating and Electric Equipment	Cost of labor, materials used and expenses incurred in maintenance of plant, the book cost of which is includible in FERC Account 343, Prime Movers, FERC Account 344, Generators, and FERC Account 345, Accessory Electric Equipment.
554	Maintenance of Miscellaneous Other Power Generation Plant	Cost of labor, materials used and expenses incurred in maintenance of power generation plant, the book cost of which is includible in FERC Account 346, Miscellaneous Power Plant Equipment.

FERC Account	FERC Account Title	Description of Costs Included in FERC Account
557	Other Expenses	Costs incurred directly in connection with the purchase of electricity, which are not specifically provided for in other production expense accounts.

Southwestern Public Service Company

Tolk Station Annual Equivalent Availability Factors

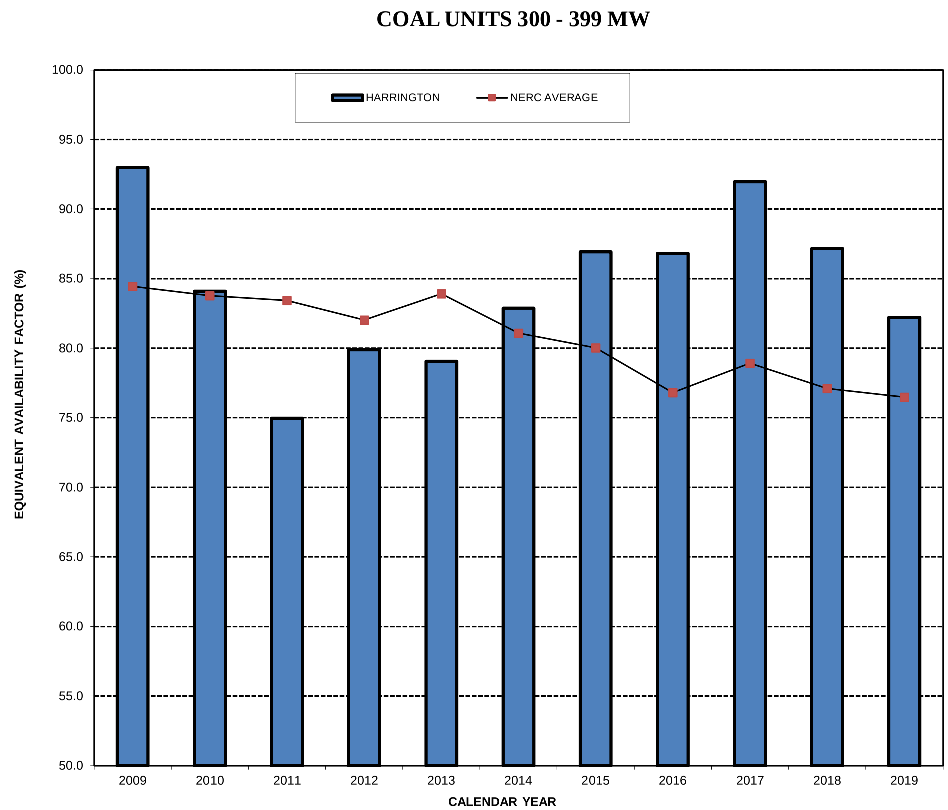


	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
NERC AVERAGE	80.88	81.33	84.35	82.64	83.25	81.43	79.99	79.52	77.24	77.02	78.54
Tolk	87.01	91.54	87.52	86.57	95.37	82.37	86.04	90.05	86.41	73.96	95.56

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

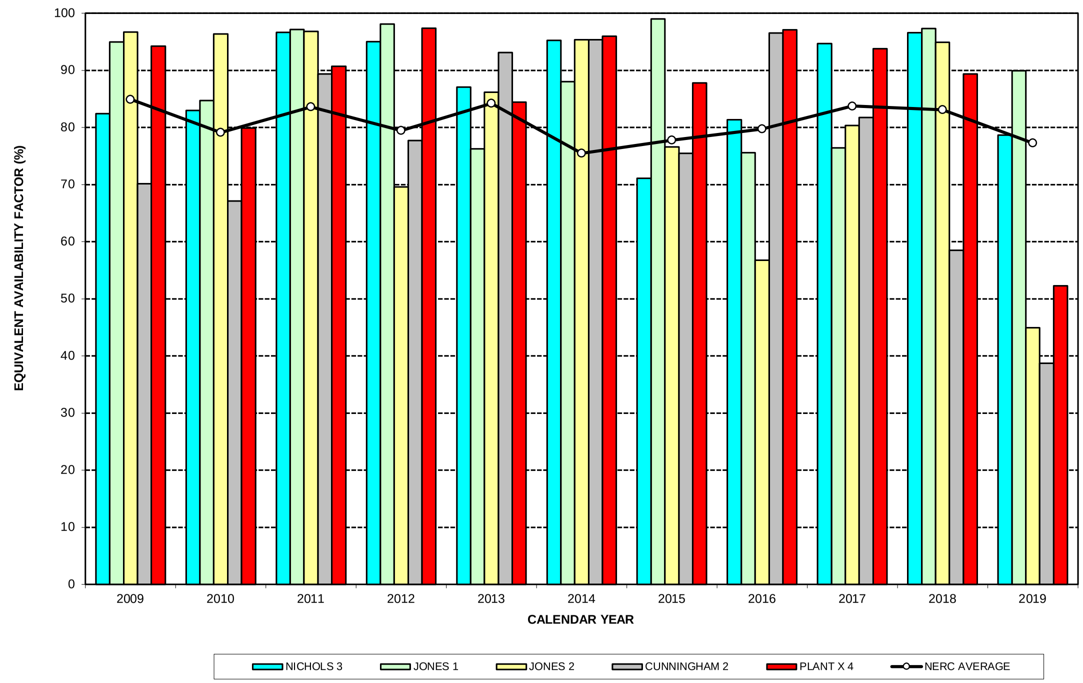


	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
NERC AVERAGE	84.4	83.8	83.4	82	83.9	81.09	80.03	76.79	78.91	77.10	76.48
HARRINGTON	93	84.1	75	79.9	79.1	82.87	86.92	86.80	91.95	87.14	82.21

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

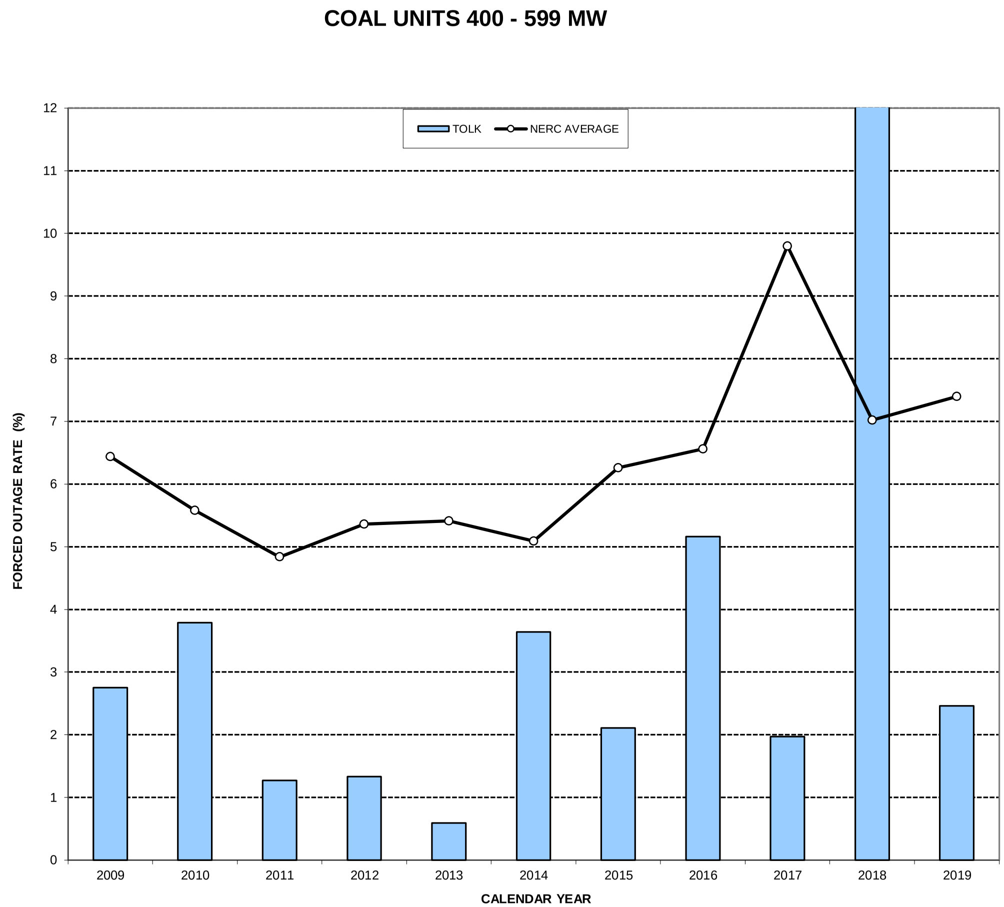


	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
NERC AVERAGE	84.9	79.13	83.6	79.48	84.25	75.47	77.79	79.76	83.75	83.11	77.27
NICHOLS 3	82.45	82.99	96.68	95.01	87.1	95.24	71.11	81.35	94.68	96.58	78.69
JONES 1	94.98	84.74	97.17	98.1	76.29	88.04	99.03	75.58	76.44	97.32	89.96
JONES 2	96.7	96.36	96.85	69.6	86.17	95.40	76.58	56.74	80.37	94.91	44.93
CUNNINGHAM 2	70.16	67.14	89.4	77.71	93.14	95.36	75.48	96.56	81.74	58.50	38.74
PLANT X 4	94.25	79.9	90.7	97.38	84.43	96.00	87.82	97.11	93.83	89.36	52.31

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



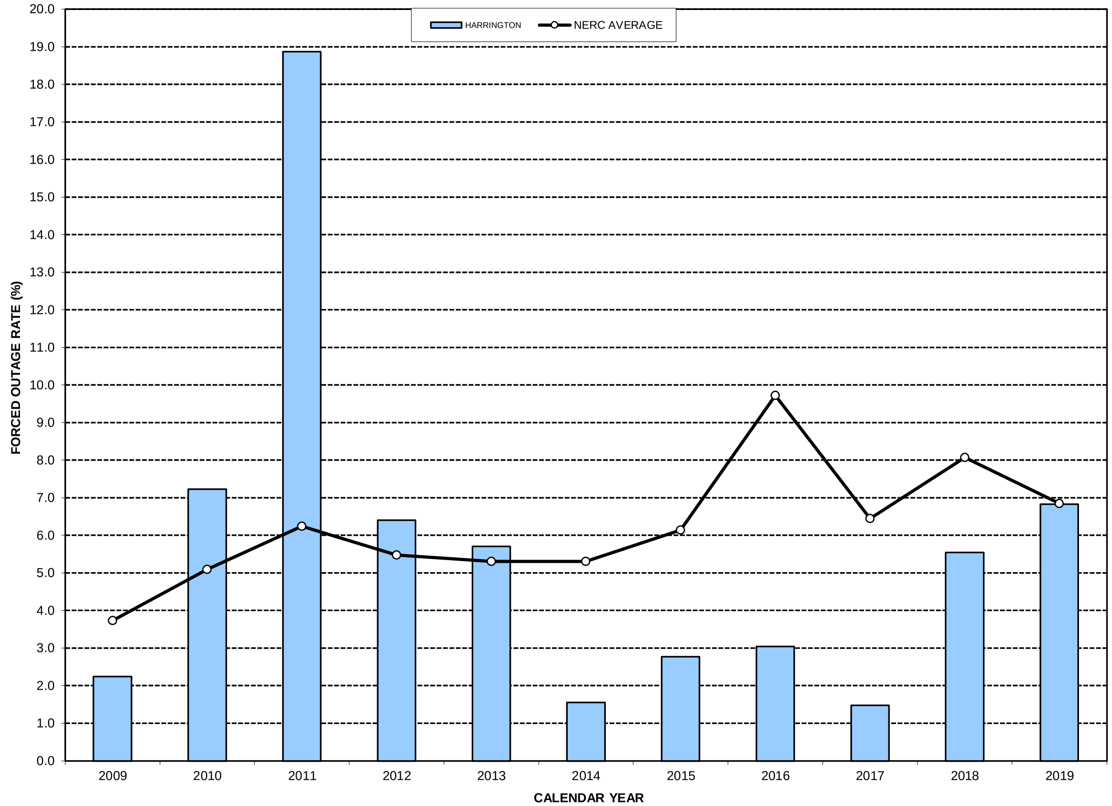
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
NERC AVERAGE	6.44	5.58	4.84	5.36	5.41	5.09	6.26	6.56	9.8	7.02	7.4
TOLK	2.75	3.79	1.27	1.33	0.59	3.64	2.11	5.16	1.97	19.15	2.46

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

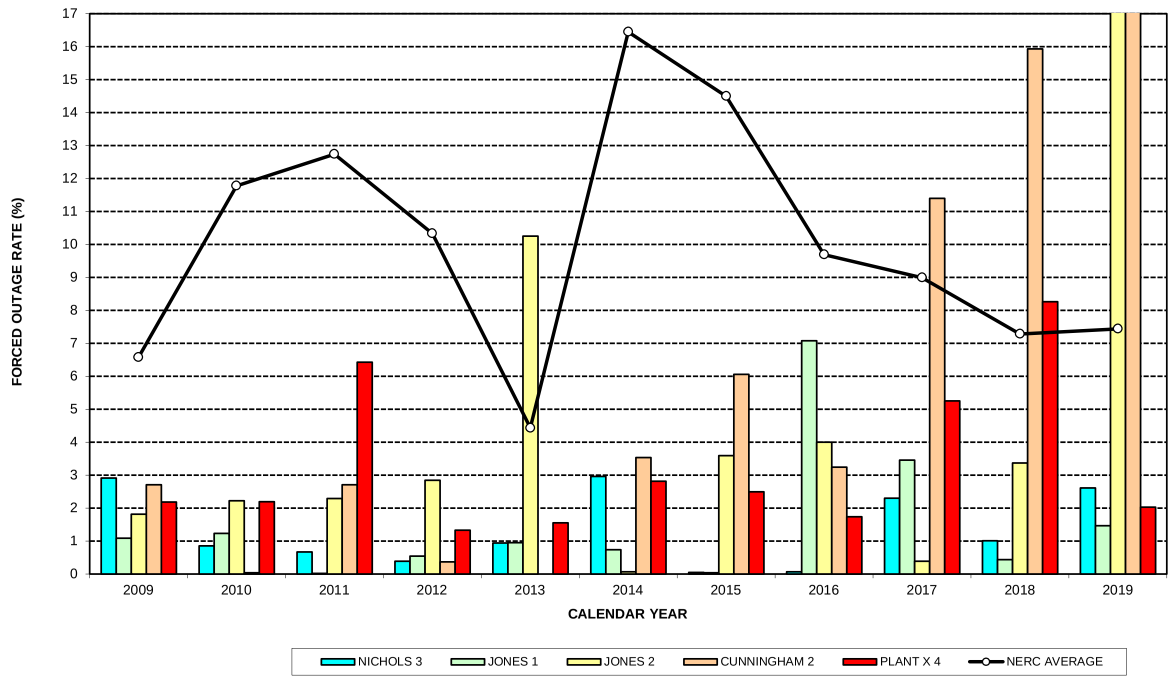


	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
NERC AVERAGE	3.73	5.09	6.24	5.47	5.30	5.30	6.14	9.72	6.44	8.07	6.84
HARRINGTON	2.24	7.23	18.87	6.40	5.70	1.55	2.77	3.04	1.47	5.54	6.83

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)



	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
NERC AVERAGE	6.58	11.78	12.74	10.33	4.43	16.45	14.50	9.69	8.99	7.28	7.44
NICHOLS 3	2.91	0.85	0.67	0.39	0.94	2.96	0.05	0.07	2.3	1.01	2.61
JONES 1	1.09	1.23	0.02	0.54	0.95	0.74	0.04	7.08	3.46	0.43	1.46
JONES 2	1.81	2.22	2.29	2.84	10.25	0.07	3.59	4.00	0.39	3.37	30.12
CUNNINGHAM 2	2.71	0.04	2.71	0.37	0.00	3.53	6.06	3.24	11.40	15.94	44.93
PLANT X 4	2.18	2.19	6.43	1.33	1.55	2.81	2.49	1.74	5.25	8.26	2.03

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