BEFORE THE CORPORATION COMMISSION OF OKLAHOMA

IN THE MATTER OF THE APPLICATION OF	)	
OKLAHOMA GAS AND ELECTRIC COMPANY	)	
FOR AN ORDER OF THE COMMISSION	)	
AUTHORIZING APPLICANT TO MODIFY ITS	)	CAUSE NO. PUD 201700496
RATES, CHARGES, AND TARIFFS FOR RETAIL	)	
ELECTRIC SERVICE IN OKLAHOMA	)	

Direct Testimony

of

Robert J. Burch

on behalf of

Oklahoma Gas and Electric Company

January 16, 2018

Q. **Would you please state your name and business address?**

A. My name is Robert J. Burch. My business address is 321 North Harvey, Oklahoma City, Oklahoma 73102.

Q. **By whom are you employed and in what capacity?**

A. I am employed by Oklahoma Gas and Electric Company ("OG&E" or "Company") as Director, Power Supply Services. My duties entail managing the generation engineering group and operation of OG&E renewable generation assets. I began my career with OG&E in 2012.

Q. **Would you please summarize your professional and educational background?**

A. I have been employed by four electric utility companies, a specialty chemicals refinery and a nationwide food manufacturing company over the last 32 years in a number of positions of responsibility including engineering, maintenance and operations and encompassing various management and executive assignments. Prior to OG&E, I was employed by Duke Energy/Cinergy in several positions, the last of which was Director of Engineering, Edwardsport Integrated Gasification Combined Cycle ("IGCC") generation station at Edwardsport, IN. The Edwardsport IGCC generation station is a $3.6 billion state of the art, advanced coal facility that entered commercial operation in 2013. My duties on the project included leading the effort to obtain all of the required environmental permits, technical management of 27 engineers engaged in the review of the plant engineering design, including a $130 million zero liquid discharge system to treat process wastewater and project management responsibilities for an 8 mile, $32 million private rail spur into the facility.

I received a Bachelor's of Science degree in Mechanical Engineering in 1985 from Rose-Hulman Institute of Technology.

Q. **Have you previously filed testimony before the Oklahoma Corporation Commission ("Commission")?**

A. Yes. I have filed testimony in Cause No. PUD 201400229.

Q. **Have you previously testified before any other jurisdictions?**

A. Yes. I have filed testimony before the Arkansas Public Service Commission in Docket Nos. 16-014-U and 17-030-U. I have also testified before the Indiana Utility Regulatory Commission related to the construction of Duke Energy's IGCC Plant at Edwardsport, Indiana.

Q. **What is the purpose of your Direct Testimony in this proceeding?**

A. I will address the operational and engineering reasons why OG&E decided to retire Mustang Units 1, 2, 3 and 4 and to replace those old steam generating units with modern gas combustion turbines ("CTs"). I also discuss why OG&E decided that the Mustang site was the ideal place to locate the new CTs. Finally, I discuss the contracting and construction processes, including an update on the cost and timing of the CT installation.

The Decision to Retire Mustang Units 1, 2, 3, and 4

Q. **Please describe the old Mustang generating units.**

A. The Mustang Generating Facility is a natural gas fired plant, located on the west side of Oklahoma City in Canadian County, Oklahoma. It was originally constructed with four steam electric generating units that were designated as Mustang Units 1, 2, 3 and 4. The approximate total generating capability from this facility as constructed was 480 MW. Mustang Units 1 and 2 became operational in 1950 and 1951, respectively. Mustang Unit 3 became operational in 1955 and Mustang Unit 4 became operational in 1959. The Mustang plant is the oldest plant in OG&E's fleet.

Q. **What is the current age of the old Mustang units and what are the retirement plans for those units?**

A. Mustang Unit 1 had been in service 65 years and Mustang Unit 2 had seen 64 years of service when they were both retired in 2015. Mustang Unit 3 has been in service for 62

years and plans are for its retirement in 2017. Mustang Unit 4 has been in service for 58 years and plans also call for its retirement in 2017. OG&E's 2014 Integrated Resource Plan ("IRP") update addressed probable retirement dates for all the Mustang units based on recommendations from OG&E's Power Supply operations and engineering team.

Q. **What was the basis for retiring Mustang Units 1 and 2?**

A. OG&E concluded that it did not make sense to continue investing dollars in these very old units that were placed in service during the Truman Administration. Based on 2008 Energy Information Administration ("EIA") industry information, only 15 of over 400 operational units greater than 10 MW were older than Mustang Unit 1. Since that time, 7 of the 15 units have been retired. In 2012, OG&E engaged Burns and McDonnell, an independent engineering firm, to determine the "maximum" expected life of the Mustang Units and what level of investment in those old units would be required to reach those maximum service lives. Burns and McDonnell recommended OG&E undertake almost $17 million in capital investment on Mustang Unit 1 to get three more years life out of that unit. Also, Burns and McDonnell recommended another approximately $16 million in capital projects for Mustang Unit 2 in order to keep that unit operational until 2017. OG&E decided it made no sense to invest over $30 million for these two units in order to gain the potential of just a few more years of life, during which the utilization of these units would likely be very low. Plus, it would take a large part of the remaining life of those units to simply engineer, construct and install those capital projects. Proceeding along this strategy would leave most of this investment as stranded costs when the units did retire just a few years later.

Q. **Why was Mustang Unit 2 retired in 2015 after only 64 years of service instead of waiting until 2017?**

A. As sometimes happens with older units, a problem developed within the steam turbine. In this case, a water seal either partially or completely failed, allowing cold water to contact the turbine rotor. This caused the rotor to bow and experience severe vibration on hot start ups. Continued operation could have caused a failure. Costs necessary to open,

inspect and make repairs to Mustang Unit 2 were deemed to be unjustified given the service factor (how often the unit runs) and the anticipated 2017 retirement date.

Q. **Would any of the projects recommended in the Burns and McDonnell site assessment study have detected, prevented or repaired this condition?**

A. No. None of the projects identified by Burns and McDonnell would have caused us to open, inspect and repair the turbine on Mustang Unit 2. In other words, if OG&E had spent approximately $16 million on Mustang Unit 2 as suggested by Burns and McDonnell, it still would have sustained the turbine problem that led to the need to retire Mustang Unit 2. OG&E therefore saved customers money by ceasing to invest in Mustang Unit 2, a very old unit that later suffered a serious component failure that required early retirement.

Q. **Does OG&E have any information that supplements the original recommendations from Burns and McDonnell?**

A. Yes. According to retirement information obtained from SNL in 2014,[1] many generating units have been retired well before reaching 65 years of service and the average and median retirement age of gas fired units across the U.S. is between 45-49 years old. As an example, from 2010 through 2012, Entergy retired 16 gas fired steam units with commercial operation dates from 1943 to 1965. The average service life of these units was 54 years. Very few gas fired units in the U.S. operate past 65 years of service.

Q. **What is the basis for the retirement dates for Mustang Units 3 and 4?**

A. Mustang Units 3 and 4 are some of the oldest natural gas units in the entire country. Based upon similar class/size of units, there are only 6 out of 58 operating units with longer service lives than Mustang Unit 3. Mustang Unit 4 now has the longest service life of any unit of its size/class still in operation. Not only are Mustang Units 3 and 4 the

[1] SNL Financial LC is a nationally recognized business intelligence company. The company focuses its research on business sectors including energy, banking, financial services, media and communication, insurance, and real estate. It collects, standardizes and disseminates all relevant corporate, energy, financial, market, and mergers and acquisition data using a wide variety of public sources such as SEC, FERC, EIA, etc. SNL has 24 offices worldwide.

oldest units in the OG&E fleet and some of the oldest units in the U.S., but OG&E had concerns about unit reliability, the risk of catastrophic failure and the need to invest significant dollars in outdated technology. After considering all factors, OG&E concluded that continuing to operate Mustang Units 3 and 4 beyond 2017 would require an increased level of investment to maintain reliability and safety. But, even with needed investment in key areas, the units are still at a greater risk of catastrophic failure as many key components are approaching or exceeding their design life.

Q. **Has OG&E attempted to quantify the costs of maintenance and capital investment that would be needed to give Mustang Units 3 and 4 the potential of reaching their maximum useful service life of 65 years?**

A. Yes. The 2012 Burns and McDonnell condition assessment study indicated that approximately $60 million in capital investment would be needed for Mustang Units 3 and 4 to reach their maximum useful life of 65 years. This would have made the retirement dates for Unit 3 and Unit 4 2021 and 2025, respectively. However, this study concentrates only on needed investment in a very few key areas such as the boiler, control systems, and main electrical transformers. The study does not address the need for investment in areas such as high energy piping, major headers, plant infrastructure, and large rotating equipment such as turbine generators and boiler feedwater pumps, all of which would add to the needed capital investment for continued operation. In fact, OG&E engaged Black & Veatch to perform an independent review of the Company's decision to retire the old Mustang units and they identified several additional projects totaling another $15.5 million at Mustang Units 3 and 4. Altogether, with the Burns and McDonnell and Black & Veatch projects that were identified, the total amount of investment for Mustang Units 3 and 4 was over $75 million.

Q. **What is OG&E's assessment of the reasonableness of making a minimum investment of approximately $75 million to keep Mustang Units 3 and 4 operational until they reach their maximum useful life?**

A. OG&E believes that making the approximately $75 million of investments identified in the Burns and McDonnell and Black & Veatch studies during the last few years of an

assets useful life does not make sense for the Company or its customers. A good analogy would be replacing the transmission in an old car immediately before deciding to take the car to the salvage yard.

Performing such work currently could also leave stranded investment and assets when the units are retired. Most of the investment items are sized and specifically designed for these units which are already the oldest or nearly the oldest in the nation, and as such, could not be reasonably expected to be reused or resold, thus reducing their value to near scrap value.

Q. **Does making the investment advocated by Burns and McDonnell and Black & Veatch guarantee a service life of 65 years?**

A. Absolutely not. Making the investment noted in the Burns and McDonnell report does not guarantee a 65 year service life. As I have said, the Burns and McDonnell report only focuses on certain areas and omits other critical areas. As stated above, the turbine condition on Mustang Unit 2 that led to its early retirement would not have been detected, prevented or repaired even if OG&E had executed all of the $16 million worth of projects identified in the Burns and McDonnell report for Mustang Unit 2.

Q. **What are some of the other critical components and areas of the plant not identified in the report that could fail unexpectedly?**

A. The Burns and McDonnell report did not address the risk of failure associated with critical high energy piping systems, such as superheater and reheat piping and headers that operate at high temperature and pressures. Another area not considered was the circulating water system that is comprised of very large underground piping that is subject to corrosion, cooling towers, large pumps and motor combinations, and condenser tubing. Burns and McDonnell also did not include investment in aging plant infrastructure including high and low voltage wiring and switchgear, which is becoming obsolete. In addition to obsolesce issues with the switchgear, this equipment is not designed to protect our members who operate and maintain it from arc flash hazards. Many of these switchgear sets have potential arc flash ratings that exceed the protective capabilities of personal protective equipment available. Consistent with

OG&E's commitment to member safety in the area of arc flash exposure at all of its facilities, it would in some circumstances, become necessary to remove Mustang units from service in order to mitigate the hazard to members associated with operating or resetting certain circuit breakers or performing work within their enclosures. This can be true even for work on unit component level equipment. This would result in a further decrease in unit availability and an increase in operating costs. Replacement of such switchgear was not contemplated in the Burns and McDonnell report but rough estimates indicate it would be expensive, on the order of $8-10 Million for all the units at Mustang. This equipment generally has a long lead time, thus reducing unit availability while the equipment is designed, procured and installed. It is possible that replacing and coordinating protective relays could reduce the arc flash risk to below 40 cal/cm^2 for a cost of between $200-$300K. 40 cal/cm^2 represents the maximum arc flash intensity that is considered survivable by a human being while wearing a protective suit. While protective suits are made to protect personnel for incident ratings above 40 cal/cm^2 in thermal intensity, they do not protect against the concussive forces that accompany those events. Industry experts have indicated that concussive forces of an arc flash incident above 40 cal/cm^2 are not survivable.

It is also OG&E's intention to reduce the arc flash exposure to our members to well below the maximum survivable limit with the goal for existing facilities being below 25 cal/cm^2 and any new installations designed to be below 8 cal/cm^2. Given this, achieving a protection rating of less than 40 cal/cm^2 through relaying would be considered as a temporary measure until greater levels of protection can be engineered, procured and installed, meaning that continued operation of Mustang would require a permanent reduction of the arc flash hazard.

The report also did not include large rotating equipment such as steam turbine/generator combinations and boiler feedwater pumps. The cost of replacing each of these components varies; however, each individual component could run in the millions of dollars with a total steam turbine replacement approaching as much as $70 Million.

Q. **What additional areas of investment did Black & Veatch identify?**

A. Black & Veatch identified additional areas of investment that Burns and McDonnell did not cite in their report. These included condenser tubes (a portion of the circulating water system), large fans and motors (a portion of large rotating equipment), steam drums and high energy piping (a portion of the plant's pressure containing parts).

Q. **Are there specific components at risk of catastrophic failure with continued operation of Mustang Units 3 and 4?**

A. Yes. Certain components in units of this age are more susceptible to catastrophic failure. These components include items such as pressure containing parts, high voltage equipment and high speed rotating equipment. The risk of component failure due to age could also create a greater safety risk for our employees placing them at risk of significant injury or fatality.

Employees become at risk in these situations when their duties place them in proximity to aging equipment that could experience a catastrophic failure. Many times these failures are associated with startup and shut down events when the thermal conditions of the assets are changing and internal stresses are increasing.

In the case of a pressure vessel event, employees are at risk of severe burns and concussive forces related to the sudden release of high pressure and temperature steam that escapes when such equipment fails. An example of such a tragedy occurred at the Mohave Generating Station in June of 1985 when a pipe containing steam at 600 pounds per square inch at almost 1000 degrees Fahrenheit ruptured. The result was 6 employees fatally scalded and a number of other critically injured.

The industry has seen other, similar tragedies including a fatality at a Virginia nuclear plant in 1986.

While the accidents cited above are not directly attributable to the age of the assets, they do illustrate the dangers to employees of such failures. In my experience, I have seen or am aware of a number of steam line and pressure part ruptures and failures that thankfully, but only by luck, did not result in severe personal injury. Three cases where steam piping ruptured, that I am familiar with, occurred at a power plant where I previously worked. In two of those instances a piping segment was expelled through the

concrete roof panels and out of the building, coming to rest in various parts of the facility, including employee parking, in all three cases high pressure and temperature steam escaped into areas of the plant where employees routinely performed their duties. These three instances discussed occurred in the mid 1990's to early 2000's on boilers that were constructed from 1953 to 1956. These units, while coal units, were constructed similarly to the Mustang units and in that same general time frame. Interestingly enough, the utilization of those units over the years also progressed from base load units to a mode that saw them cycle more than their design basis.

In the case of high speed rotating equipment such as steam turbines the risk to employees not only includes burn risk from escaping steam, but the risk of being struck by expelled components. While I am not personally familiar with such a failure, the National Institute for Occupational Safety and Health in 2001 investigated the failure of a 70 year old steam turbine failed during a startup, liberating an internal blade through the casing. The blade and the casing debris struck and killed the employee.

To illustrate our concern with an OG&E example, Mustang Unit 4 experienced a cracked rotor in 2010 during a startup that could have led to a catastrophic event. During startup, the operations staff noticed unusual steam turbine vibrations and the startup was aborted. Subsequent investigation revealed that the unit had a cracked low pressure turbine rotor resulting in the unit being offline for three months while repairs were made. The part for the repair was provided by the original equipment manufacturer, Siemens, out of surplus inventory. If not for the availability of this older rotor part, the repair cost would have been much greater and duration would have been up to 18 to 24 months if a forging would have been required. If the unit was actually brought online with the cracked rotor, the rotor likely would have failed completely, rendering the machine inoperable and/or irreparable. The further risk would have been that turbine rotor parts could have exited the machine and placed employees in harm's way. This risk still exists with the other components for this machine due to age. And, as stated above, a new steam turbine could cost as much as $70 Million.

Q. **Are there any reliability impacts that would result from the component failures described above?**

A. Yes. If failure were to occur in one of several major components such as the turbine, boiler headers or a generator step up transformer, the units could be offline for up to 2 years. Parts for units of this age are often non-existent, not supported by manufacturers or were produced by manufacturers that are no longer in business. This often requires that parts must be reverse engineered and specially made at a significant expense and delay.

Q. **How has the operation of the Mustang units changed over time?**

A. The Mustang units were originally designed for base-load type operation. They ran this way until the 1980s when the OG&E coal units became operational. As they have aged and as OG&E and others have obtained newer technologies, such as combustion turbines, they have shifted their operating mode to more cyclic and intermittent duty. As an example, Mustang 4 from the late 1980s until 2006 operated in more of a mid-merit type mode (filling the gap between base load coal units and peaking units). In the SPP Energy Imbalance Services Market, they have experienced more seasonable/mid-merit operation. With the integration of the OG&E fleet into the Southwest Power Pool ("SPP") Integrated Marketplace ("IM"), the Mustang units, with their relatively higher cost, tend to operate in the 5% capacity factor ("CF") range and have seen greater amounts of daily cyclic and intermittent duty. The retiring Mustang units, because of their design, are not well suited for this cyclic mode of operation, which tends to shorten their remaining useful life, further increase the risk of unplanned outages, as well as increase the possibility of a catastrophic failure event.

As an example, the table below details the starts seen by Mustang Units 3 and 4 from 2011 through year to date 2017. A dramatic increase in starts is seen to occur in 2014 with the start of the SPP IM with the average number of starts on Unit 3 increasing by an average 279% per year in the four years after the SPP IM and Unit 4 seeing a 297% increase over that same time.

Table 1

Mustang Units 3 and 4 Starts per Year

Year	Mustang 3	Mustang 4
2011	7	8
2012	9	5
2013	5	12
2014	17	24
2015	22	24
2016	27	40
2017	12	11
2011-2013 Average	7	8
2014-2017 Average	20	25
Percentage increase	279%	297%

Q. **What are the effects of cycling units that were originally designed for baseload or load following operation?**

A. The effects of cycling are well known within the industry. Cycling units off and on creates significant thermal stresses on pressure components and rotating machinery. These increased stresses tend to reduce the lifecycle of such components and cause premature failures. This tendency increases with the age of the asset and the number of cycling events.

Q. **Are there any additional concerns that OG&E has with running these units past 2017?**

A. Yes. OG&E has concerns with the safety of its employees. While OG&E exercises the appropriate measures of safety with all its generating units and can somewhat reduce exposure to its employees through access control, the Company cannot eliminate all risks to its employees as their being around this equipment is necessary to operate and

maintain the plants. As detailed above, units of this age are subject to pressure part failures, failures of high speed rotating equipment, and failure of high voltage equipment which could place employees in harm's way. Inspection and maintenance practices can help identify areas of concern, but it is not possible to fully inspect every component and have complete certainty that a catastrophic event cannot occur on these very old units.

Q. **Is the decision to retire the remaining Mustang units by year-end 2017 consistent with OG&E's past approach as it relates to the retirement age of gas fired steam units**?

A. Yes, in my judgment it is. OG&E has retired a number of gas fired steam units over its 115 year history. Since the early 1980s, OG&E has retired several gas-fired units including Muskogee unit 3, the Arbuckle Plant, the Osage Plant, and the Belle Isle plant. The average retirement of these OG&E gas fired steam plants came after 51 years of service. I view the decision to retire the Mustang units consistent with this accepted practice by OG&E.

Q. **Has OG&E conducted any additional studies to corroborate its decision to retire Mustang**?

A. Yes. As discussed above, OG&E retained the services of Black & Veatch to review OG&E's decision to retire the Mustang Plant by the end of 2017.

Q. **Did Black & Veatch concur that OG&E's decision was prudent?**

A. Yes. The September 2016 Report issued by Black & Veatch validates OG&E's decision to retire Mustang. That report states that "retiring the existing [Mustang] units was a prudent decision."

Q. **What did Black & Veatch rely on to make a prudency determination**?

A. Black & Veatch evaluated OG&E's decision to retire the Mustang plant by the end of 2017 and the information that supported that decision, including OG&E testimony filed in other regulatory proceedings, the 2012 Burns and McDonnell Condition Assessment

Study and their experience in the industry regarding similar retirement decisions. For specific supporting information please refer to the Direct Testimony of Phillip Webster.

Q. **The 2012 Burns and McDonnell report indicated that a certain level of investment through capital projects could extend the life of the plant to 65 years of age. Does Black & Veatch disagree with the Burns and McDonnell study?**

A. No. Black & Veatch believes the projects recommended in the 2012 Burns and McDonnell Condition Assessment Study were technically sound and could have been implemented if the goal was to reach 65 years of service for each unit.

Q. **Did Black & Veatch make any further recommendations on additional investment at Mustang?**

A. Yes. Based on their experience, Black & Veatch suggested a limited number of additional projects that should have been considered given the age of the units. As stated above, Black & Veatch identified approximately $15.5 million in additional projects needed at Mustang units 3 and 4.

Q. **What was the basis for Black & Veatch's conclusion that OG&E's decision to retire the old Mustang units was prudent?**

A. Black & Veatch concluded that OG&E's decision to retire the Mustang units in 2017 was prudent based on the required investment and continuing and potentially increasing Operations and Maintenance costs to keep the units in service until age 65, as compared to the experienced and expected low capacity factors for the units moving forward. The costs that would have to be expended are not justified by the little amount of energy the retiring Mustang units would produce, especially when there is a cost effective option available to the Company.

Q. **Did Black & Veatch identify any additional risks for increased costs associated with continuing to operate the old Mustang units?**

A. Yes. Black & Veatch found that the various Mustang projects could trigger a New Source Review ("NSR") analysis. One outcome of an NSR review could be a

requirement to install air pollution control equipment using the Best Available Control Technology ("BACT") for each pollutant exceeding national ambient air quality standards ("NAAQS"). In the case of Mustang, BACT could require the installation of Selective Catalytic Reduction Systems ("SCR")[2].

Q. **Why did OG&E enlist Black & Veatch now to study and comment on OG&E's 2014 decision to retire Mustang in 2017?**

A. OG&E was criticized in its Environmental Compliance Plan filing in August 2014 for not performing an engineering study to support its decision to retire Mustang in 2017. While the decision in 2014 was made based on the opinion of the Company's technical experts, years of successful operating experience and an excellent track record, the Company determined that an independent third party study was necessary in order to respond to critics. OG&E remains confident that retiring Mustang in 2017 is the right decision and believes that Black & Veatch's conclusions validate that decision.

Capacity Need Created by the Mustang Retirement

Q. **How was OG&E's capacity planning margin affected by the decision to retire Mustang Units 1 and 2 in 2015 and Mustang Units 3 and 4 in 2017.**

A. As depicted in OG&E's 2014 Integrated Resource Plan Update submitted in August 2014, the Mustang plant represented 463 MWs of net dependable capacity. This capacity contributes to the capacity planning margin requirement which was 12% in 2014. As shown in Table 17 of that IRP update, failing to replace the Mustang capacity would have resulted in OG&E having an 8% capacity planning margin in 2018 and 5.6% by 2020. These drops in capacity planning margin would have resulted in shortfalls of 289 MWs in 2018 and 460 MWs by 2020. These gaps required the Mustang capacity to be replaced in order to maintain OG&Es obligation of having a 12% capacity planning margin. For a

[2] *Evaluation Report: Mustang Power Plant Retirement Consideration* September 20, 2016 by Black & Veatch, pages 3-10.

more detailed explanation of OG&E's capacity needs and expansion plans please refer to the Direct Testimony of Leon Howell.

Required Operating Characteristics of the Replacement Capacity

Q. **What did OG&E determine were the required operating characteristics for the replacement capacity for Mustang and why were those needs important to customers.**

A. OG&E routinely evaluates its generation assets and how those assets meet the needs of its customers. Over the course of many years those needs have evolved from traditional base load generation with peaking capacity that was designed to serve the native load of a utility, to a fully integrated economic market, encompassing multiple utilities and geographically diverse assets that stretch north to south from Texas to the Canadian border and east to west from nearly Illinois to central Montana. Adding to that change has been the influence of significant and growing amounts of non-dispatchable renewable generation, primarily in the form of wind generation. As an example, wind capacity in the SPP during 2016 grew by more than 30%, up from 12 GW to more than 16 GW.

As OG&E evaluated the need to replace the Mustang capacity in 2014 it recognized that new assets needed to be extremely flexible in order to maximize their value to customers in the evolving marketplace. Flexibility was considered to be the ability to start quickly to respond to system needs, ability to start multiple times per day if necessary and ideally be sized in smaller blocks of generation in order to better match demand. The selected units will meet all of those criteria while exhibiting better efficiencies and lower maintenance costs than typical peaking units.

The ability to start quickly is beneficial in a number of respects. Quick start units are ideal in support of non dispatchable resources. As generation from those resources can vary considerably, the ability to start units and have them on line and at full load within 10 minutes reduces any system impacts that variability may create. With the SPP seeing an increasing percentage of its total generation coming from wind, the ability to fill and smooth those gaps will be critical. As an example, the SPP footprint set a record of over 54% of the energy being generated coming from wind generation. The previous record was 48.3% in March 2016. In terms of total energy consumed within the SPP, the

contribution from wind generation has increased from 13.5% in 2015 to 17.07% or approximately 45.5 GW in 2016.

Quick start units are also better suited to respond to transmission system upsets and provide voltage support than other types of units. For a more thorough discussion of system reliability benefits provided by quick start units please see the Direct Testimony of Gregory McAuley.

Quick start units can also mitigate price spikes caused by the loss of another generating unit on the system. There are times where the loss of generation drives the local cost of electricity to high levels as other generating units either have to be started up or units already on line are ramped up to cover the loss. In this scenario, quick start units can come on line and replace that generation in a matter of minutes, covering the loss and tending to mitigate the price spike to customers.

The ability to start units multiple times per day in support of system demand is very beneficial in terms of controlling customer costs. It is common for system demand to have two definite peaks, particularly in colder months. Units that can start multiple times per day can cover the demand during those peaks but come off line when the system needs are lower and can be covered by other units with lower costs.

Smaller block of generation vs. larger capacity units also allow flexibility on the system. This allows units to be started and operated at lower minimum loads if necessary and in different services simultaneously. For example, a unit at OG&E's Redbud plant has a minimum load of 130 MWs and can either run based loaded or in regulation assist (following system load), it cannot do both at the same time. By contrast, two Mustang units can meet that need better. One unit could be in regulation assist between minimum load of 32 MWS and full load at 66 MWs while the other unit is at full load at 66 MWs. These two units essentially represent the same capacity on line, but in this scenario the Mustang units would be filling multiple roles while the Redbud unit can only operate in one role at a time.

The long term service agreement ("LTSA") with General Electric, the OEM for the CT, and changes to a starts based agreement when the units see 900 starts during the operating life of the combustion hardware. Once 900 starts are achieved, this hardware must be replaced. Instituting the minimum 35 hours run time keeps the units from

achieving 900 starts before it sees 32,000 hours of service. Avoiding a starts based LTSA spreads the downtime and expense of the combustion hardware outages over a longer interval and spreads the customer spend over a longer timeframe. By contrast the units at Mustang are not limited to starts and can be cycled on and off to optimize customer value with respect to real time pricing.

Q. **Do CTs make up a large percentage of OG&E's capacity?**

A. No. That is one of the drivers that led OG&E to conclude the required operating characteristics provided by quick start CTs was lacking in its generation fleet. Presently, only a very small percentage of OG&E's generating capacity is filled by CTs and the majority of those units are not registered with the SPP as a quick start resource. Those consist of four units (Tinker 5A & 5B and Horseshoe Lake Units 9 & 10) totaling 154 MWs based on the 2017 SPP capacity report. This is down from the 2014 IRP update where the number was 176 MWs. The difference is driven by the retirement of Seminole GT1 and small seasonal fluctuations on unit capacities at the time they were tested. These CT capacities are out of a generation fleet totaling nearly 7000 MW of capacity.

Evaluation and Selection of the Replacement Capacity

Q. **What technologies did OG&E evaluate to meet its need for flexible generation?**

A. OG&E continually evaluates and maintains resource planning level information on types of generation available, their overnight capital and operating costs and their performance characteristics. This information is included in IRPs that the Company submits every three years or when there are major changes, as was the case when the 2014 IRP update was submitted. Page 30 of that document lists the options considered. Simply based on overnight price the decision was made to install natural gas fired generation. The Company did not consider renewable generation as a viable alternative in this case, for a number of reasons. First, this generation had to count as capacity toward our capacity planning margin. As discussed on pages 31 and 32 of the 2104 IRP update, neither wind nor solar technologies would allow full accreditation. Second, the overnight price for both technologies in 2014 was on the order of twice the cost of gas generation. And finally, based on the necessary operating characteristics stated above, quick start and

multiple starts per day, renewables did not meet this need. For a more thorough discussion of OG&E's generation selection process please see the Direct Testimony of Leon Howell.

Q. **After OG&E concluded that natural gas generation would be the optimal replacement for the capacity need, what types of natural gas generation were evaluated?**

A. OG&E considered conventional and advanced combined cycle units and traditional and aero derivative simple cycle combustion turbines and screened those types of generation against the required operating characteristics described above. As a result of that screening, OG&E concluded that aero derivative combustion turbines were the best choice based on their quick start capability, ability to start multiple times per day and the fact that they were sized in smaller sized smaller blocks of generation. These units are able to meet all of these criteria with good efficiency and lower maintenance costs.

Q. **Did OG&E's decision to install quick start CTs come at a premium cost over installing a combined cycle unit?**

A. No. OG&E's Resource Planning group evaluated the life cycle costs of various combined cycle and simple cycle alternatives. The aero derivative CTs at Mustang had a lower life cycle cost than a combined cycle unit. These evaluations are based on the lowest revenue requirement from the customer over the life of the asset and include evaluation of costs such as capital costs, fuel and maintenance costs. This lower price combined with the ability for aero derivative CTs to better meet OG&E's required operating criteria drove the decision to select aero derivative CTS for the Mustang project. For a more thorough discussion of OG&Es economic analysis related to revenue requirements please see the Direct Testimony of Leon Howell.

Q. **Are there any other benefits to the customer that the new units at Mustang could provide?**

A. Yes. The new Mustang units are eligible to receive payments for providing operating reserves. Operating reserve payments can take the form of spinning reserves, regulation and supplemental reserves. Spinning reserves represents unloaded capacity on units that are on line but not fully loaded. The benefit is flexibility to respond to system needs. Regulation represents an on line units' capability to follow system demand, raising or lowering output as required to balance the system. Supplemental reserves represent off line capacity that can be started up in 10 minutes or less, meeting an unexpected need on the system. The new Mustang units would qualify for supplemental reserves. The only other units in the OG&E system that meet this criteria would be the approximately 70 MWs of capacity in the Tinker units (Mustang 5 A and B). From the start of the Market in March 2014 through December 6, 2017, OG&E customer share received payments totaling $1.3 million for supplemental reserves on the Tinker units.

In the SPP Marketplace, aging fossil fuel resources and extreme variability in renewable resources output is resulting in more occurrences in which there is not enough ramp-able generation capacity in the Marketplace to cover short-lived scarcity events. To address this challenge, highly flexible, faster responding resources can provide this ramp-able capacity and for this reason the Marketplace is discussing the addition of a ramp product market. A ramp product market represents rewarding units that can not only respond to system changes but do so quickly. This market would be well suited to the new Mustang units and be beneficial to the SPP Marketplace as a whole as it continually seeks to ensure system reliability. Should a ramp product market develop, OG&E would be well positioned with its new Mustang units to capture customer benefit in this area.

Q. **What methods did OG&E consider for obtaining aero derivative CTs?**

A. OG&E's Resource Planning Group was unaware of any quick start aero derivative CTs for sale or for contract in the market in the 2014 timeframe. Given that no CTs were available and the benefits to customers from re-using the Mustang site, as discussed below, OG&E concluded that a self-build option at Mustang was in the best interest of

customers. For a more thorough discussion of OG&Es efforts to source capacity that met its operating criteria, please see the Direct Testimony of Leon Howell.

Q. **How does OG&E's decision to install quick start CTs compare to decisions made by other utilities.**

A. OG&E asked two of our partners to relay their experience with regard to equipment and services they are being asked to quote and provide regarding new generation projects.

Siemens, who is providing the CT equipment on this project, and does so for numerous customers worldwide, has indicated that IHS and their own order history indicates that beginning in 2020 and beyond CTs are the preferred generation with more than 50% of the market being CTs.

Burns and McDonnell, who is a worldwide Engineering and Construction company with vast experience in the Power sector, was also contacted and responded that their experience indicates that the trend toward fast and flexible gas generation begin in 2010 making up approximately 2/3 of the simple cycle market with Aero derivatives accounting for more than half of the installations.

Description of the Replacement Capacity

Q. **Please describe the aero derivative units OG&E intends to install at the Mustang site.**

A. The CTs being installed at Mustang are of a class known as Aero-derivative and can best be described as resembling a jet engine on a commercial aircraft. Many of the attributes that one would hope for in a commercial airline engine apply to the needs at Mustang. Fast starts, multiple starts per day, reliable operation, low operating and maintenance costs and low emissions. A form of the selected CT is in aviation service around the world with many installed on Boeing 777's.

Q. **How do CTs produce electricity?**

A. Much like airline engine operation, ambient air is introduced to the unit through a compressor that brings it to a higher pressure. Energy is then added by spraying fuel (natural gas) into the air and igniting it so the combustion generates a high pressure, high

temperature flow that expands through a turbine. The difference between the airline engine and the CTs at Mustang is that the turbine is connected by a shaft to a generator, which produces electricity. In the airline the hot exhaust exits the engine to propel the airplane.

Q. **Which aero derivative CTs are being installed at Mustang?**

A. OG&E conducted a comparative bidding event for aero derivative CTs and as a result selected and are installing seven Siemens Trent 60 units at the Mustang Plant site, with a nameplate rating of 66 MWs each.

Why at Mustang Energy Center?

Q. **Why did OG&E select the Mustang site to locate new generating units?**

A. The Mustang site offers several clear and distinct advantages to OG&E's customers. Those advantages include being in close proximity to OG&E's largest load center, having an established infrastructure in place, having a trained and experienced workforce and having existing environmental permits and strong community support. Each of these advantages saves customers money.

Q. **Please explain the advantages the existing Mustang site has with respect to its proximity to the load center.**

A. Maintaining generation at this location is very important to OG&E system operations. The Mustang site already has an existing, robust high voltage transmission system in place consisting of nine different transmission lines on two separate voltage systems. This results in better reliability of the transmission grid as opposed to locating the new generation at a more remote location. Generation close to the load source reduces line losses, reduces line congestion and cost, supports voltage control, and facilitates our system restoration plan. Witnesses McAuley and Nickell discuss the reliability benefits of CTs at the Mustang site.

Q. **What are some of the other operational advantages of the existing Mustang site?**

A. The Mustang site already has the overall infrastructure needed to support a generating facility, *i.e.*, secure property, existing roads; facilities to support maintenance & operation, water supply/water rights, as well as existing transmission infrastructure. This avoids the significant expense and need to develop a completely new site and infrastructure. Additionally, the Mustang site is currently staffed with a highly skilled/trained workforce.

Q. **Are there any quantifiable benefits of utilizing the Mustang site for the new CTs?**

A. Yes. The value of re-using the Mustang site, as compared to a new typical Oklahoma greenfield site, has conservatively been estimated by Burns and McDonnell at approximately $45 million and is detailed in Exhibit RJB-1. Major components of the project that do not need to be recreated include:

1. Switchyard facilities - $8 million
2. Transmission facilities, including any interconnect studies and associated transmission lines and transmission system upgrades - $26 million
3. Water utilities into the site - $10 million

This value is conservative in the fact that it does not fully quantify the value of the robust transmission system that is comprised of nine (9) outgoing transmission lines on two (2) voltage systems. The robustness of the transmission system at Mustang provides customer value in maintaining system reliability and flexibility as well as supporting a more expedient system restoration effort, if required. These benefits of a robust transmission system at Mustang are more fully explained in the testimony of OG&E Witness McAuley. For comparative purposes, a generic greenfield site was estimated by Burns and McDonnell as having a single transmission line exiting the facility on one system voltage which is the bare minimum required for site operations. Those costs would be required for any greenfield site. Another reason that this estimate is conservatively low is that Burns and McDonnell used the lower end of its cost estimate for SPP Network Upgrades ($10 million) instead of the higher end of the range ($40 million).

Q. **Did Burns and McDonnell's estimate of cost savings from using the Mustang site include the cost of comparable real property?**

A. No. It is difficult to develop a cost estimate for such a unique piece of property. The property is unique because it is difficult, if not impossible, to locate a similarly sized parcel of land located as close to a major load center that has the ability to be permitted as a power plant. Also, complicating that search would be the difficulty in finding a site that has enjoyed a long history of public support from and with the local residents, businesses and communities.

Nevertheless, to illustrate the potential customer savings from re-using the land at the Mustang site, OG&E reviewed public records of 20 parcels sold within a 10 mile radius of the Mustang site since 2014. While it was difficult to find comparable pieces of land, the weighted average cost per acre of the 20 parcels examined was about $43,000/acre. Extending that price to the 111 acres of the Mustang site would yield a conservative value of almost $5 Million. Adding this to the cost savings identified by Burns and McDonnell, OG&E's utilization of the existing Mustang site conservatively saved the Company, and its customers, nearly $50 Million.

Q. **Are there any other benefits to the Mustang site?**

A. Yes, as testified by Witness Donald Rowlett, OG&E has permitted the new CTs through a process known as netting. OG&E had the ability to utilize emission "netting" to combine the retirements of the old units with the construction of the new units and obtain a permit without a "net" increase in emissions. This emission "netting" allows OG&E to maximize the Mustang site for newer, more efficient generation. Emissions netting simplifies the process to obtain a permit from the ODEQ by allowing the emissions from the new units to be offset by that of the agency-approved and permitted historic operations ("emission window") thereby creating no new environmental impact to the air shed that would require further evaluation by the ODEQ.

Absent netting, incremental new generation that is not authorized through netting process would likely have to obtain a major source construction permit under the Clean Air Act. The additional time, expense and uncertainty associated with a major source construction permit could affect the viability of the project at the Mustang site.

The netting process brought with it certainty in obtaining the necessary permits to construct the new units. With tightening environmental regulations, the ability to obtain a brand new permit near a major load center with other industries contributing to the air shed is uncertain.

Q. **What other benefits does the Mustang site offer?**

A. The Mustang site is served by nine different transmission lines operating on two separate voltages. This robust system provides for a variety of benefits and system flexibility. The cost to recreate this would be well into the millions of dollars; however, OG&E has not estimated the value of the flexibility or the cost to recreate on another site. OG&E is unaware of any other site in or near any of its major load centers that contains this advantage. Finally, the Mustang facility currently has a highly trained and capable workforce. While the value of that existing workforce is difficult to quantify, there is no doubt that our trained employees working at the Mustang site have enormous value.

Project Progress

Q. **How did the Company approach the process of buying equipment and constructing the CTs at the Mustang site?**

A. OG&E has issued approximately 39 different competitive bid packages for equipment, materials and services, including labor. Each of these packages was sent to an average of three to four bidders, in some cases more. Each package was awarded on price and value and as of December 2017, all major contracts have been awarded. OG&E has seen significant savings on these packages as compared to the budgeted amounts totaling approximately $6 Million to date.

Q. **Are there other examples of how OG&E has reduced the cost of the Mustang CTs?**

A. Yes. OG&E believed there were greater savings by managing the project without an Engineering, Procurement and Construction ("EPC") contract. We forecast this will save approximately $45 million.

Q. **Please elaborate on the benefits of using OG&E's direct contracting approach instead of the EPC contracting approach.**

A. OG&E's contracting strategy, which includes the use of competitive bidding, has contributed to an estimated $45 Million in savings over the original project budget by controlling the competitive procurement process and keeping any achieved savings. Using this approach for the Mustang project allowed OG&E to control contingency costs. If a risk associated with the project does not happen, OG&E customers see the direct savings through an overall reduction in the project's cost rather than increased profits for the EPC contractor. OG&E's approach also eliminated any EPC contractor fee and overhead charges.

Q. **Why was this project conducive for OG&E's contracting strategy?**

A. On the Mustang project, OG&E determined that the complexity and the risk of installing seven identical units did not warrant the additional costs that an EPC contract would require. OG&E believed it could manage the project to maximize the amount of savings and allow OG&E customers to benefit from any savings realized instead of the EPC contractor. Other factors that influenced that decision included:

1. OG&E has recruited and developed employees with significant experience in successfully managing similarly scoped projects. OG&E can, and has, leveraged that experience to utilize contracting strategies that result in cost savings for customers.
2. The Mustang Site has ample room on the property, which significantly reduces risks associated with construction on a congested site. These risks would include the safety risks of performing multiple work tasks in the same general vicinity. A larger site also helps mitigate risks to the overall project cost by reducing unproductivity and inefficiency of multiple construction workers trying to all work in close proximity to one another.
3. Most major components are covered under the contract between the Original Equipment Manufacturer ("OEM") of the CTs and OG&E. Since these CTs are part of a mature product line in service at multiple locations worldwide, their outstanding performance is well documented. A similar facility in Bayonne, NJ,

which utilizes the same combustion turbine that were selected for Mustang, has well over a 99% availability factor since it went commercial in 2012. During such time, those units have experienced over 19,000 starts. As such, the performance risk was determined to be minimal and what risk remains are covered under the warranty provisions of that contract.

4. Construction, commissioning and startup activities are being managed by Burns and McDonnell which has a wealth of experience performing the same tasks on numerous similar projects.

Q. **Are all projects suited to the direct contracting approach utilized at Mustang?**

A. No. Projects that have high degree of execution or performance risk due to their complexity or other factors may be better suited to an EPC approach. Also projects that require skill and experience above or different than what exists on the Owners staff would be candidates for an EPC contracting strategy.

Q. **Can you please discuss how contracts for equipment, materials and services were awarded?**

A. Yes. Once engineering had progressed to the point that sufficient technical detail had been developed to support the creation of technical specifications, contract bid packages were prepared based on those specifications and issued for bid. Most events had a "pre-bid" meeting to answer any questions from prospective contractors and afford them the opportunity to visit the site. Following the prebid meeting, a period of time was set aside for contractors to develop their proposals. Following the bidding period, the proposals were evaluated by OG&E and its Owners Engineer (Burns and McDonnell) and finalists were selected. Negotiations were then conducted with the finalists, resulting in a selected contractor and an awarded contract based on the lowest reasonable risk adjusted price. All contract packages followed a similar process. The timeframes and durations for each procurement event varied based on a number of factors including, the number of bidders, the complexity of the scope of supply, the difficulty of the negotiations and the schedule needed to have a contract in place.

The largest contracts related to the Mustang project were the contracts for the procurement of the combustion turbines (approximately $170 million), the foundation and substructures construction (approximately $26.3 million) and the general installation contract (approximately $38.4 million).

Q. **Did OG&E utilize any other contracting techniques to provide additional value for customers?**

A. Yes. A number of critical contracts were negotiated with schedule and performance liquidated damage ("L/D") clauses. These L/D clauses financially incentivize contractors and suppliers to provide materials that meet project specifications in time to support the overall project schedule. Failure to do so triggers pre-negotiated financial penalties. These funds are then used to offset more costly contingency plans to maintain the success criteria of the project. To date, OG&E has enforced approximately $1.3 million in liquidated damage claims.

Q. **What engineering and construction milestones has OG&E already achieved?**

A. The most important construction milestone achieved is that OG&E and its contractors have worked over 1.2 Million man-hours on the Mustang Modernization Project without an OSHA recordable injury.

Status of the Project

- The project was 90% complete as of October 31, 2017 and approximately 95% through the end of November, pending final numbers, and continues to progress ahead of schedule with all units expected to be in commercial service by early February 2017. The air permit was received on December 11, 2015, which was required to commence construction. All other permits were obtained in time to support construction.

- Site construction began with earthmoving on April 4, 2016. The first concrete for foundations was placed on August 5, 2016. All foundations and underground work have been completed.

- All major material and equipment has been received and installed.

- Mechanical and electrical work are progressing on all units with, Units 6 through 11 having achieved mechanical completion, been first fired and synchronized

to the electric grid. Unit 6 initial synchronization to the grid occurred on September 24, 2017.

- Activities necessary to connect the new units to the existing 69kV and 138 kV switchyards are complete.

- OG&E contracted with Oklahoma Natural Gas (ONEOK), the lowest bidder for the project, to supply natural gas service to the Mustang facility. Installation of approximately 20 miles of pipe from its storage facility near Edmond, OK was complete ahead of schedule and in time to support first fire on Unit 6.

Q. **When does OG&E expect the new units to put power onto the grid?**

A. As of September 24, 2017 OG&E had placed electricity from Unit 6 onto the grid for sale into the SPP integrated Market as a part of testing, Units 7–10 have also been synchronized to the grid and produced power as a result of testing. Units 11 and 12 are expected to be synchronized before the end of 2017. OG&E is on pace to meet this date.

Q**. When does OG&E expect the Mustang units to be in commercial service?**

A. OG&E is in the process of commissioning and testing all units at the site, including conducting performance testing. Once the units have passed these tests and the balance of plant facilities are compete so as to support normal operations the units they will be declared available for commercial service and moved to Plant in Service. The expected commercial date for Units 6-8 is January 8, 2018 with other units following as their performance tests are passed. The expected commercial date for Unit 12 is February 9, 2018.

Expected Utilization

Q. **Does OG&E expect the Mustang CTs to be dispatched differently in the SPP IM than the retiring Mustang steam units?**

A. Yes. As an example, the Company's Horseshoe Lake Units 9 and 10, which are also aero-derivative CTs similar to the new Mustang CTs, have been called to start 1,486 times from January 1, 2014 through December 2016, the last full year of data. This equates to an average of approximately 248 starts per unit per year. These same units averaged 63 starts per year over the previous three years (2011 – 2013) before the start of the SPP IM.

Other examples would include a sister type plant in Bayonne, NJ. As previously mentioned, the Bayonne plant has seen in excess of over 19,000 starts since its start up in 2012. This averages almost 400 starts per unit, per year not taking into account any planned outages or unforeseen events.

A more local example would be two natural gas reciprocating engines located at the City of Stillwater and operated by the Grand River Dam Authority ("GRDA"). These units see frequent starts often running 2-3 hours per start. Starts are often in response to congestion created by excess wind generation.

Q. **How does the flexibility of the new CTs directly compare to the existing Mustang units.**

A. The new units at Mustang have much more operational flexibility than the existing units. Three measures where this is apparent include start up time, ramp rate and turndown.

Startup time indicates the length of time required to take the unit from an offline, cold state to full load operationally. In the case of the new units this is now 10 minutes and all units will be capable of starting up simultaneously making 462 MWs available in those 10 minutes. In the case of Mustang Units 3 and 4, start up times offered into the market for those units range from 6 to 48 hours depending on if the start is a cold, warm or hot start. Actual start times have considerable variability based on a number of factors including difficulty and challenges associated with units approaching 60 years old or older.

A review of 2016 startup data indicates that the quickest start was on Unit 4 at 2 hours and 24 minutes and the longest start was also on Unit 4 at 20 hours and 9 minutes. It would also be very difficult to coordinate starts on two units and achieve a simultaneous on line time.

Ramp rate indicates the rate at which the unit can change load or unload once in service, measured in megawatts per minute. The comparative ramp rate performance for the replacement CTs is 39 MW/minute versus an average of 2.0 MW/minute for the retiring Mustang units. As an example of how this capability is helpful, consider the case of OG&E's Crossroads windfarm. Assume the fleet of ninety-five (95) 2.3 MW turbines at Crossroads is fully available and the wind speed drops from 10 m/s to 9 m/s over the

course of 1 minute. In this case the output of those 95 turbines drops from approximately 183 MWs to approximately 138 MWs, a drop of approximately 45 MWs. In this case, just two new Mustang units being on line could easily handle that load drop whereas, with all four of the old Mustang units on line, they could only have accounted for 8 MWs of that load reduction during that same scenario. This example focuses on one windfarm; however, as previously discussed, when one considers the significant increase in the installed capacity of wind in the SPP, and specifically in western Oklahoma, a 1 m/s drop (or increase) in wind speed over that region would create a substantial loss (or gain) of generation and units like the new Mustang units are well suited to react to those changes.

Turndown indicates the lowest stable load the unit can achieve before it must be removed from service. Each CT being installed at Mustang can be turned down to 32 MWs. The turndown for Units 3 and 4 is 40 and 80 MWs, respectively, this also ignores the fact that the new units can simply go off and come back on line as needed whereas cycling the old Mustang units in that manner is not practical.

Q. **Why does OG&E believe this flexibility will make the new Mustang units valuable to the market?**

A. As previously stated, the ability of the new Mustang units to react rapidly to changes in the electric system and cover a multiple spectrum of needs increases their value. Also as previously discussed, units with the same or even less flexibility such as the Bayonne units, the units at the City of Stillwater and even OG&E's Horseshoe Lake units see the market use them to cover these needs. It can reasonably be expected that the new Mustang units which will provide similar value will be utilized in a similar fashion.

Q. **Is OG&E limited in how these units are offered into the market?**

A. No. The advantage of having multiple units with a high level of operational flexibility along with good efficiency will open options up to OG&E on how to offer them to maximize the benefit to customers. For example, with a 9,258 BTU/kWhr heat rate these units would dispatch economically right after the combined cycle units and before legacy gas and traditional peaking units. Depending upon natural gas price, this could also be on par with or before coal assets. This means that at certain times of the year they could be

called upon to run long periods of time when prices are high such as in the summer. In this case, some or all of the units could be offered into the Day Ahead Market and be dispatched based on economics.

When prices are not high all day these units can be offered into the Real Time Market and be dispatched to cover peaks and respond to system needs such, renewable influences and to cover transmission reliability needs.

The units can also be eligible for ancillary payments such as reserve standby and quick start standby type payments. The advantage of having seven units that all exhibit this flexibility is that OG&E can offer some units differently than others in order to maximize opportunity for customers.

Q. **Will the new Mustang units help optimize the operation of other OG&E units?**

A. Yes. OG&E believes they will. While actual operating data is not available yet it is intuitive that the new units with their flexibility and efficient heat rate could work to change the way other OG&E units are dispatched.

For example, there are times where Seminole units are operated at or near their minimum load in order to address transmission reliability issues. In those scenarios often times a Redbud unit is cycled off in order to make room for the Seminole generation when system load drops, particularly at night. If a Mustang unit were to come online and displace the Seminole unit it would produce that power at less cost and it is possible that the Redbud unit could avoid a startup and the subsequent need to remain on line for 35 hours, regardless of day ahead prices. Please see the Direct Testimony of Gregory McAuley for a more detailed description of how the new Mustang units could impact the operation of other OG&E units.

From an Operations perspective, the benefits of starting a Mustang unit instead of cycling a Redbud unit are in the form of startup costs and less maintenance. For example at gas prices of $3 per Million BTU a startup of one Redbud unit uses $2,400 worth of natural gas. By contrast a startup of one new Mustang unit uses $96 of natural gas. Also, the Redbud units tend to experience an increase in heat recovery steam generator (HRSG) tube leaks as the number of cycles increases. In previous years with a high number of starts Redbud could see 3 to 4 tube leaks during that year. Each of these tube leaks is

expensive to fix with repairs ranging between $60K and $400K per event depending upon where the leak occurs. Repairs also can require several days of downtime, again depending upon location. Other impacts include accelerated wear to bypass valves and attenuators that represent significant expense to repair.

Conclusion

Q. **Do you have any concluding remarks?**

A. Yes I do. Based on a long, diverse career in this industry I strongly believe that OG&E has made the right decision to retire the old Mustang Units. Those units clearly needed to be retired, as they have significantly exceeded their original design life and are experiencing typical end of life issues. These are issues that would require unjustified capital investment to attempt to mitigate and even with that investment might not see any significant increase in life or employee safety.

I also believe that the aero-derivative CTs that were selected for Mustang provide much better operational flexibility than other existing units or other types of CTs, including the ability to start and stop multiple times each day to maximize customer benefit in the SPP market. These units are best suited to respond to a growing percentage of renewable generation in the SPP footprint, while working to maintain transmission system reliability.

The Mustang site itself not only saves customers significant money as compared to a greenfield site but having generation at that location is critical in maintaining transmission system reliability in the region.

Lastly, I am extremely proud of the project execution team and am pleased to say the project is being executed with a zero safety recordable incident rate, is coming in ahead of its original schedule and significantly under budget. This is a major accomplishment when one considers the trends in our industry where similar projects routinely exceed budget, do not meet schedule and have significant safety issues.

Q. **Does this conclude your testimony?**

A. Yes.

BURNS McDONNELL

May 24, 2017

Mr. Rob Burch
Managing Director Power Supply Services
OGE Energy Corp
321 North Harvey Avenue
Oklahoma City, OK 73102-3405

Re: Greenfield versus Brownfield Savings Assessment

Dear Mr. Burch:

At the request of OG&E, Burns & McDonnell (BMcD) reviewed the estimate for the installation of seven Trent 60 simple cycle combustion turbines at the Mustang Power Plant in March 2016. The purpose of our review and the assessment below was to identify specific areas where use of the Mustang "brownfield" facility has generated project savings opportunities as compared to typical costs to develop a nominal "greenfield" site for similar purposes. We reviewed the March 2016 Greenfield versus Brownfield assessment, and are of the opinion that the estimates provided are still reasonable.

Brownfield vs Greenfield Estimated Savings*		
Savings:	**OGE Mustang**	**Notes**
Switchyard	$8,000,000	
GSU	$1,000,000	Re-use of existing Mustang Units 1 and 2
Transmission to Site	$15,000,000	Assuming 10 miles at $1.5MM/mile
Water Treatment	$0	Water treatment savings negated by well water system upgrade
Gas		Gas Supply costs are not apart of this project
Water	$10,000,000	20 miles at $500k/mile
U/G Utilities onsite (Water/Fire Water/Gas)		Utilities distribution savings; however, within the accuracy of estimates.
Roads/Access		Road savings; however, within the accuracy of estimates.
Security		Fence savings; however, within the accuracy of estimates.
Earthwork	$1,000,000	
Adds:		
Day-lighting	-$1,000,000	Pilot trenching, etc.
Demo/Relocations		
	$34,000,000	
Owners Cost Savings		
Permitting	$0	Air Permit savings; however, within the accuracy of estimates.
Staffing		OG&E sees value, including financial value, in the ability to retain and re-utilize highly trained and capable workforce; however, at this time has not quantified that value.
SPP Interconnect Study	$1,000,000	No study required for Mustang.
SPP Network Upgrades	$10,000,000	Per review of DISIS data (public data on interconnection filings in SPP), we are seeing a range of $10MM - $40MM for a 200MW project.
Total Cost Savings	$45,000,000	

*Estimates and projections prepared by BMcD relating to construction costs are based on experience, qualifications, and judgment as a professional consultant. BMcD has no control over

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weather, cost and availability of labor, material and equipment, labor productivity, construction contractor's procedures and methods, unavoidable delays, construction contractor's method of determining prices, economic conditions, government regulations and laws (including interpretation thereof), competitive bidding and market conditions or other factors affecting such estimates or projections. Actual rates, costs, performance ratings, schedules, etc., may vary from the data provided. The (assessment) herein is screening-level in nature and includes a comparison of costs and characteristics of natural gas simple cycle at a generic Greenfield location in Oklahoma. It is the understanding of BMcD that this Assessment will be used for preliminary information in support of the Owner's internal discussion and understanding of project costs. Any estimated costs of interest to the Owner should be followed by additional detailed studies to further investigate each option and its direct application within the Owner's long-term plans and objectives. All information in this letter is confidential. It is not intended for the development of construction specifications or budget allocations. Further study would be required to develop site-specific performance and cost estimates with improved accuracy.

Sincerely,

Clarice Kinsella
Project Manager

JWM