Rocky Mountain Power
Docket No. 17-035-39
Witness: Timothy J. Hemstreet

BEFORE THE PUBLIC SERVICE COMMISSION
OF THE STATE OF UTAH

ROCKY MOUNTAIN POWER

Direct Testimony of Timothy J. Hemstreet

June 2017

Q. Please state your name, business address and present position with PacifiCorp.

A. My name is Timothy J. Hemstreet. My business address is 825 NE Multnomah Street, Suite 1500, Portland, Oregon 97232. My present position is Director of Renewable Energy Development. I am testifying on behalf of Rocky Mountain Power ("Company"), a division of PacifiCorp.

QUALIFICATIONS

Q. Briefly describe your education and business experience.

A. I hold a Bachelor of Science degree in Civil Engineering from the University of Notre Dame in Indiana and a Master of Science degree in Civil Engineering from the University of Texas at Austin. I am also a Registered Professional Engineer in the state of Oregon. Before joining the Company in 2004, I held positions in engineering consulting and environmental compliance. Since joining the Company, I have held positions in environmental policy, engineering, project management, and hydroelectric project licensing and program management. In 2016, I assumed the role of Director of Renewable Energy Development, in which I oversee the development of renewable energy resources.

PURPOSE OF TESTIMONY

Q. What is the purpose of your testimony?

A. In support of the Company's application for approval of wind repowering and associated ratemaking treatment, my testimony provides technical information regarding the Company's proposal to upgrade, or "repower," most of its wind fleet. Specifically, my testimony addresses:

- The scope of the project;

- The benefits of repowering resulting from the qualification for federal production tax credits ("PTCs");
- The increased energy benefits following repowering;
- The reduced ongoing operating costs following repowering;
- System transmission reliability related to the project;
- The extension of wind facility asset lives after repowering;
- Project contract status and construction schedule; and
- The disposition of removed equipment.

OVERVIEW OF WIND REPOWERING AND PROJECT SCOPE

Q. Please briefly describe what repowering a wind facility entails.

A. Repowering broadly describes the upgrade of an existing, operating wind facility with new wind-turbine-generator ("WTG") equipment that can increase a facility's generating capacity and the amount of electrical generation produced from the facility. Exhibit RMP___(TJH-1) is a depiction of a wind turbine and its various components. The Company proposes to repower its wind facilities by replacing the nacelle, hub and rotor of the WTG.

Q. Which facilities does the Company propose to repower?

A. The Company is planning to upgrade all of its wind facilities in Wyoming except the Foote Creek facility (Glenrock I, Glenrock III, Rolling Hills, Seven Mile Hill I, Seven Mile Hill II, High Plains, McFadden Ridge, and Dunlap); the Leaning Juniper facility in Oregon; and the Marengo I, Marengo II, and Goodnoe Hills facilities in Washington.

Q. Please explain why repowering is feasible for these wind facilities.

A. The wind facilities the Company proposes to repower began commercial operations

between 2006 and 2010. Because they were recently developed, they can be economically repowered, or upgraded, with new technology that will improve their efficiency and increase their generation output, while retaining the existing towers, foundations, and energy collection systems. The existing foundations and towers, although more than 10 years old in some instances, are adequately designed to accommodate larger, more modern WTG equipment and have a sufficient remaining useful life to economically justify the associated investment.

In contrast, at facility sites developed more than about 15 years ago, the WTG equipment typically has a low generating capacity (*i.e.*, sub-1,000 kilowatt) and the towers and foundations supporting the nacelle and rotor do not have the height or design strength to accommodate the installation of modern, larger nacelles and rotors capable of generating a much greater amount of electricity per WTG. With these older facilities, repowering usually involves the entire removal of the old wind turbine equipment and the redevelopment of the site with modern wind turbines that have much greater generating capacity. This can result in significantly fewer wind turbines needed to produce an equivalent generating capacity, while also increasing energy output.

The ability to repower facilities while reusing the existing infrastructure of the towers, foundations, and energy collection system is highly beneficial because the energy and PTC benefits can be realized with a lower capital investment, as compared to the more comprehensive site redevelopment required for older facilities.

Q. Did the Company's 2017 Integrated Resource Plan ("2017 IRP") evaluate repowering all of the resources covered by the application?

A. Yes, except for Goodnoe Hills. When the 2017 IRP was developed, the Company had

not assessed repowering Goodnoe Hills. Since that time, however, the Company has evaluated the facility and believes Goodnoe Hills can be economically repowered similar to the facilities evaluated in the 2017 IRP.

Q. Why did the Company exclude Foote Creek in Wyoming from the proposed wind repowering project at this time?

A. As noted in the 2017 IRP action plan item 1a, the Company is still evaluating the potential of repowering Foote Creek. Repowering this older facility would involve more comprehensive site redevelopment, as described above, which is different in scope than the repowering projects proposed here. If the Company determines that repowering Foote Creek is economic for customers, it will pursue the appropriate regulatory process for doing so.

Q. How many megawatts ("MW") of installed wind capacity is the Company proposing to repower?

A. The Company is proposing to repower 12 of its 13 wind facilities, representing 999.1 MW of installed wind capacity. Broken down by state, this consists of eight facilities in Wyoming comprising 594 MW, one facility in Oregon of 100.5 MW, and three facilities in Washington comprising 304.6 MW. Detailed information about the wind facilities the Company proposes to repower is included in Exhibit RMP___(TJH-2).

BENEFITS OF REPOWERING INCLUDING REQUALIFICATION FOR PRODUCTION TAX CREDITS

Q. What benefits will customers realize from wind repowering?

A. Repowering the proposed wind facilities will requalify them for PTCs, and the benefits

will be fully passed on to the Company's customers with the ratemaking treatment discussed by Company witness Mr. Jeffrey K. Larsen. Additionally, repowering will increase the amount of zero-fuel-cost energy produced from the repowered turbines which will range from 11 to 35 percent, depending on the facility.[1] It will reduce ongoing operating costs as a result of replacing older WTG equipment subject to more failure and maintenance issues than newer equipment. Finally, repowering the wind facilities with new WTG equipment will extend the useful lives of the facilities by at least 10 years, creating substantial energy benefits for customers in the future when these wind facilities would otherwise have been retired from service.

Q. How are the repowered wind facilities able to requalify for PTCs?

A. On December 18, 2015, Congress enacted changes to the federal Internal Revenue Code that extended the full value of the PTC for wind energy facilities that began construction in 2015 and 2016. The legislation also provided for a phase-out of the PTC over three years, reducing the PTC value by 20 percent for wind facilities beginning construction in 2017, 40 percent for wind facilities beginning construction in 2018, and 60 percent for wind facilities beginning construction in 2019. The Internal Revenue Service ("IRS") has issued guidance that establishes a "safe harbor" for taxpayers to demonstrate the year a facility will be deemed to "begin construction," thereby setting the value of the PTC. If at least five percent of the total project costs are incurred in 2016, then the facility qualifies under the IRS safe harbor for the full value of the PTC, provided the taxpayer can demonstrate "continuous efforts" to complete construction.

[1] This range reflects increases under existing transmission interconnection agreements. The range is 15 percent to 38 percent if transmission interconnection agreements are modified to reflect the additional capacity available from the repowered turbines.

The IRS has issued additional guidance that establishes a safe harbor for satisfying this continuous-efforts standard. Under the continuous-efforts safe harbor, the wind facilities must be in service by the end of the fourth calendar year following the calendar year in which construction began. Thus, wind facilities that began construction in 2016 must be in service no later than December 31, 2020, to satisfy the continuous-efforts safe-harbor provisions. If not installed by December 31, 2020, the projects must satisfy IRS requirements that continuous-efforts were expended to repower the facilities, which is a difficult standard to meet.

Q. Does the Company's repowering project qualify for the full value of the PTC under these rules?

A. Yes. Consistent with IRS guidance, a facility owner can demonstrate that construction of a facility has begun in the year in which at least five percent of the applicable project costs are incurred. If wind turbine equipment is purchased and delivered in 2016, and the equipment comprises at least five percent of the applicable project costs, a PTC safe harbor is created for the wind facilities subsequently constructed. To meet this requirement, the Company executed safe-harbor equipment purchases with General Electric International, Inc. ("GE") and Vestas American Wind Technology, Inc. in December 2016, and took delivery of equipment with a value sufficient to give the Company the ability to repower its entire wind fleet and qualify the repowered wind facilities for 100 percent of the PTC value.

Q. What is the value of the PTC for wind facilities?

A. For 2017, wind facilities that are qualified for the PTC receive 2.4 cents per kilowatt-hour, or $24 per megawatt-hour. This PTC value is adjusted annually based upon an

inflation index, and the PTC is available for energy produced during the 10-year period after the wind facility begins commercial operation.

Q. What other requirements must repowered projects satisfy to qualify for the PTC?

A. On May 5, 2016, the IRS issued Notice 2016-31[2] ("Notice"), which provides guidance on various aspects of qualifying for the PTC and whether new tax credits can be claimed when wind turbines are repowered or retrofitted. The Notice generally provides that the repowering costs must equal at least four times the fair market value of the equipment that the owner retains from the original facility for the repowered turbines to qualify for new PTCs. Thus, 80 percent of the fair market value of the repowered WTG must result from repowering project costs while the value of the retained components cannot exceed 20 percent of the fair market value of the new facility. This "80/20" test is applied on a turbine-by-turbine basis. Each wind turbine—composed of a foundation, tower, and machine head (including nacelle, hub and rotor)—is considered a separate facility.

Q. Do all of the wind turbines the Company is proposing to repower meet this 80/20 test?

A. Yes. The repowering project has been scoped to ensure that the 80/20 test, which is applied at the time the turbine is repowered, will be met for each turbine repowered. Not all turbines at all wind facilities, however, will be repowered because the retained value of the towers and foundations at certain wind turbines does not allow them to meet the 80/20 test before the end of 2020, when the repowered wind facilities must be completed to obtain the full PTC value.

[2] The IRS Notice 2016-31 is available at: https://www.irs.gov/irb/2016-23_IRB/ar07.html.

Q. Which wind facilities will not have all wind turbines repowered?

A. Repowering at Glenrock I, Rolling Hills and Glenrock III, located near Glenrock, Wyoming, will not include all wind turbines. At this location, 32 of the 158 wind turbines will not be repowered because the facilities were developed at the Company's reclaimed Glenrock coal mine. These 32 wind turbines were constructed atop mine tailings and required special pile foundations. These special foundations were more expensive to construct than the standard foundations found elsewhere on those facility sites and at other Company wind facility locations. Because the original construction cost of these foundations was higher than for standard foundations, the retained value of these foundations, which is based on net book value, is also higher than other foundations. For these 32 wind turbine locations, the higher retained value of the foundations means that repowering, while technically feasible, would not qualify those turbines for PTCs, which is necessary for the repowering to be economic. The Company plans to repower all of the turbines at the other wind facilities discussed above.

Q. How else has the Company scoped the repowering project to maximize the benefits of available PTCs?

A. As shown in Exhibit RMP___(TJH-2), the majority of the wind facilities the Company proposes to repower, with the exception of Leaning Juniper, are still within 10 years of their original commercial online date. Thus, the PTCs from original construction are still accruing to the benefit of the Company's customers. The existing PTCs for these wind facilities will expire 10 years after the facilities' commercial online date. Between August 2017 and October 2020, the PTCs associated with approximately 2.64 terawatt-

hours ("TWh") of electricity generated at the Company's wind facilities will expire. On an annual basis, in 2017 dollars, the expiration of these PTCs represents the loss of approximately $100 million per year in customer PTC benefits, as shown in Exhibit RMP___(TJH-2).

To maximize the benefits of the existing PTCs available from the wind facilities, the Company will generally delay repowering until the original PTCs have expired. The exception to this is Dunlap, where the PTCs expire in October 2020. To repower Dunlap by the end of 2020, as required to re-qualify for PTCs, repowering must begin before October 2020 so construction can be completed before the winter season. This results in a slight truncation of the existing, original 10-year PTC period for that facility. As with all of the wind facilities, however, once Dunlap is repowered, it will then re-start a 10-year period where its generation is eligible for the full value of PTCs.

INCREASED ENERGY BENEFITS FOLLOWING REPOWERING

Q. Once repowered, how do the energy benefits of the wind facilities increase?

A. Repowering will involve the replacement of the existing machine heads including the nacelle, hub and rotor. The new nacelles have generators that, in most instances, have a greater nameplate generating capacity than the equipment that is removed. For example, the nameplate of each turbine at the Wyoming facilities will increase from 1.5 MW to 1.6 MW, while at the Marengo facility, the generator nameplate rating will increase from 1.8 MW to 2.0 MW. Details regarding the proposed wind turbine upgrades, capital project costs, in-service dates, and resulting energy benefits are shown in Confidential Exhibit RMP___(TJH-3).

In addition to the larger generators in the repowered turbines, the Company will also install larger blades. With the larger blades, the rotor-swept area of the wind turbines will increase between 28 to 56 percent, depending on the type of turbine. A larger rotor-swept area allows more of the wind energy flowing past the wind turbine to be captured and converted by the wind turbine into electricity. Because the size of the rotors will increase, the repowered turbines will also include more robust hubs, main shafts, bearings and couplings, and gearboxes suitable to handle the greater torque exerted by the larger rotors.

Q. Will the larger blades installed with repowering increase the potential for avian impacts at the Wyoming wind facilities?

A. Although the larger blades will increase the overall risk zone (rotor-swept area) of the repowered wind turbines, this does not necessarily correlate with an increased risk of avian impacts at existing turbine sites. The Company will continue to implement its current informed-curtailment protocols after repowering to minimize avian impacts. Informed curtailment involves the shutdown of wind turbines when species of interest are in the vicinity. The Company's informed-curtailment protocols avoid avian impacts regardless of the swept area of the rotor. The Company performs monthly monitoring at all Wyoming wind facilities and reports all findings to both the Wyoming Game and Fish Department and the U.S. Fish and Wildlife Service. The Company will continue this monthly monitoring to determine if the new turbine blades cause additional impacts to avian species and will engage with the appropriate agency to discuss and, if prudent and practicable, implement additional avoidance, minimization, or mitigation measures.

Q. How did the Company determine the amount of additional generation that will be produced from the repowered wind turbines?

A. The Company retained the engineering consulting firm of Black & Veatch, Inc. ("Black & Veatch") to evaluate increased energy production expected at each of the wind facilities from repowering. To complete this assessment, Black & Veatch used site wind data, wind turbine location data, operational performance data, and other available site-specific information for each facility to model this increased generation. The wind model also evaluated generation losses resulting from the wake losses at each turbine location. Wake losses are the reduction in generation at turbines downwind of other turbines due to reduced wind speed and increased turbulence in the airflow—or wake—behind a turbine.

Q. What are the major power production advantages of the new equipment?

A. The larger rotor size and improvements in blade design of the new equipment generate more power at all ranges of wind speeds. Additionally, some of the new turbines begin producing power at a lower wind speed than the existing equipment; thus, the turbines can produce energy during lower wind conditions in which the current equipment may sit idle. Because the new turbines, at most facilities, will have an increased generator capacity, the turbines will also produce more energy when wind speeds are high and the turbines are at their maximum output. These power production advantages are illustrated in Exhibit RMP___(TJH-4). This exhibit compares the power curves of an existing wind turbine to those of a repowered wind turbine.

Q. Why wasn't this larger equipment installed when the wind facilities were initially constructed?

A. Wind turbine technology has continued to advance since the facilities were first constructed between 2006 and 2010. The use of new composite materials has allowed blade lengths to increase without adding weight, allowing for the extraction of more energy from the available wind resources at the facility sites. In addition, more sophisticated sensor and control systems in the wind turbines, combined with improved blade pitch control systems, increase the ability of the wind turbine control systems to implement load mitigation strategies on the wind turbines to reduce the loading on the power train, towers and foundations. For new wind facilities, these technology improvements mean that longer blades and additional generating capacity is possible without a commensurate increase in cost to strengthen the turbine structural components (including the tower and foundation). For new wind facilities, this is one of the drivers towards reduced energy costs. For existing wind facilities, these new load mitigation technologies mean that the existing towers and foundations are suitable for the installation of larger equipment through repowering.

Q. How much additional energy will the repowered wind facilities produce?

A. As shown in Confidential Exhibit RMP___(TJH-3), across the wind fleet, the proposed repowered wind facilities are estimated to increase generation by 550,601 megawatt-hours ("MWh") per year if the facilities are operated within the limits of their existing large generator interconnection agreements—an increase of 19 percent. If the facilities are operated at their full generating capability following a modification to their

interconnection agreements, the additional generation increases to 597,671 MWh per year, or an increase of 21 percent.

Q. Is the Company planning to use the additional generating capacity provided by the repowered wind turbines?

A. Yes. The Company has submitted generation interconnection applications to request increased output from the repowered wind facilities and transmission service requests to transmit power so that the full generation capability of the repowered facilities can be delivered to customers.

Q. Is the repowering project economic even without the ability of the wind facilities to generate at their full repowered nameplate capacity?

A. Yes, as Company witness Mr. Rick T. Link demonstrates in his testimony, the repowering projects are economic even if the facilities are operated within their existing transmission capacity limits. An adjustment to the large-generator interconnection agreements allows the facilities to be operated at full nameplate capability following repowering and simply improves the economics of the repowering project.

Q. With the rapid technological advances in the wind industry, will the Company be able to leverage any advancements for the repowering projects before the new equipment is installed?

A. Yes. Turbine manufacturers continue to develop new technologies and offerings to improve efficiency and reliability and reduce the overall cost of wind energy—both for new and repowered facilities. To the extent the Company's repowering projects can leverage these advancements, the Company will evaluate them and negotiate with the turbine suppliers to incorporate new product offerings to further enhance the benefits

of the repowering the facilities for customers. For example, GE is developing a 91-meter rotor for repowering projects like the Company's that is based upon the proven designs of its existing rotor offerings. This new rotor will be compatible with the safe-harbor equipment the Company purchased in December 2016, and with the nacelles the Company is purchasing as follow-on equipment consistent with the contract with GE. This new rotor, if it can be applied to the Company's repowering project, would further increase the amount of energy produced as a result of repowering, resulting in additional customer benefits.

REDUCED ONGOING OPERATIONAL COSTS FOLLOWING REPOWERING

Q. Aside from increased generation and the associated PTC benefits, what other benefits will be realized with the repowering project?

A. The repowering project will lower the ongoing costs of operating the existing wind facilities. The Company's turbine-supply contracts for repowering, consistent with wind industry standards for new equipment, will include a two-year warranty on the new equipment. This will reduce capital costs associated with replacing or refurbishing the equipment currently in service. Additionally, the new turbine equipment associated with repowering, will obviate, to a large extent, capital costs associated with major turbine component replacements and refurbishments (generators, gearboxes, blades, and small components). After the two-year warranty period for the new equipment expires, these costs are expected to be lower than the costs for the current equipment that has now been in service for up to 11 years. Further, capital costs will be reduced before repowering as the investment horizon for the existing wind turbines closes and

various capital replacements no longer make economic sense given the short remaining installed life of the turbines to be repowered.

Q. Will the Company's reduced capital investments during the transition to repowering cause a reduction in the generation from the facilities?

A. Yes, before repowering is complete, some of the existing turbines may experience component failures that render them unable to provide economic service. It will be more economic for customers to idle these turbines than repair them given the short period before repowering. As a result, the Company estimates that generation from the wind facilities targeted for repowering will be reduced before repowering. These pre-repowering generation impacts are factored into the economic analysis.

Q. Will the new equipment address any other operational cost issues?

A. Yes. In addition to the reduced capital run rate of the new equipment in its early years after installation, repowering will avoid costs from replacing certain major turbine components that are experiencing high failure rates. One category of avoided costs relates to failures of certain models of gearboxes found in the Wyoming wind fleet and Leaning Juniper and Marengo. These gearboxes, which are original equipment from the manufacturer, are experiencing high failure rates compared to other models of gearboxes installed in WTGs at these facilities and elsewhere within the wind fleet. Consequently, the Company has experienced increased capital costs in recent years to address the gearbox failures, and these models are no longer being re-installed as long-term replacement equipment after failure, given their poor historical performance.

Q. Why are these gearbox failures significant?

A. These gearbox failures generally cannot be repaired "up-tower." The repair cannot be

completed within the nacelle without removing the damaged equipment by crane. These failures cost approximately $400,000 per occurrence, including equipment and labor costs to purchase and install a replacement gearbox and the costs of mobilizing a large crane to the site to remove and replace the equipment. These costs also do not account for the lost generation from the time the turbine is down until the repair is completed.

Q. How many gearbox failures of this type are expected if there is no repowering?

A. There are 230 of these gearbox models remaining in the wind fleet, and the Company anticipates that all of these remaining gearboxes will fail within the next 15 years.

Q. Will repowering completely address these gearboxes with shorter-than-anticipated service lives?

A. No. Ten of the 32 wind turbines that will not be repowered at Glenrock I, Glenrock III, and Rolling Hills have these gearbox models that will need to be replaced, which is factored into the economic analysis. Following repowering, these gearboxes—as well as potential failures of other gearbox models at the non-repowered units—can be replaced with those removed from the existing turbines as part of the repowering effort, reducing the repair costs of the remaining gearboxes. The cost savings of doing so, however, have not been factored into the Company's economic analysis because the Company is still evaluating how best to realize value for customers from the removed equipment.

Q. Are other significant capital costs avoided with repowering?

A. Aside from the gearbox issues, repowering will also avoid ongoing capital expenditures related to blade costs at Goodnoe Hills. Blade expenditures at this facility represent

approximately 60 percent of the budgeted capital costs associated with blade failures and refurbishments across the Company's wind fleet, even though Goodnoe Hills accounts for only seven percent of the turbines. Repowering is expected to bring blade costs for that facility in line with the Company's expenditures at its other facilities, resulting in reduced capital costs to keep the wind fleet meeting its operational performance targets.

Given these ongoing gearbox and blade failure costs, repowering is particularly attractive because repowering avoids significant forecast capital expenditures to maintain turbine production. This addresses the predicted turbine failure, replaces the turbine equipment with new equipment that extends the asset life, and provides the benefit of increased generation from the turbine, while requalifying the wind turbine for PTCs for another 10-year period.

Q. Will the new repowering equipment have similar failure issues as the old gearboxes?

A. No. The gearbox models in the fleet that are experiencing high failure rates will not be included in the equipment installed for repowering because the gearbox specifications for the new equipment differ from the existing equipment. Thus, the Company does not expect to see these same gearbox models and their attendant reliability concerns. Further, the equipment that will be installed has evolved from the product lines of the existing turbines, rather than arising from new product offerings. Thus, the turbine suppliers have presumably learned from past experience with these turbine models and made adjustments in their designs, specifications, and choice of subcomponent suppliers to enhance turbine reliability. Because of the warranty service requirements

in the turbine-supply contracts and because the turbine suppliers are often under long-term service agreements for the turbines they supply, the turbine suppliers have an incentive to improve the reliability of their turbines.

MAINTAINING TRANSMISSION SYSTEM RELIABILITY

Q. With the high concentration of wind in eastern Wyoming, and the increased wind turbine capacity from the repowering project, what measures are being taken by the Company to assure continued transmission system reliability?

A. In addition to adding new transmission infrastructure necessary to support the new wind resources that are the subject of the concurrently filed application for approval of the resource decision for transmission and new wind, the Company has identified the need to add two features to the wind turbine capabilities of the repowered facilities that will improve the reliability of the transmission system for eastern Wyoming. These reliability features will provide added support for system voltages during a wide range of operating conditions and increased system inertia to provide needed transmission system support during under-frequency system events.[3] These two features are summarized below and will be installed on the repowered units of the GE wind fleet in Wyoming:

- The WindFREE™ Reactive Power feature has been developed by GE for wind turbines to provide smooth fast voltage regulation by delivering controlled reactive power through all operating conditions. By supervising individual wind turbines, the WindCONTROL™ system ensures that the reactive power performance of a wind power plant can meet—and often exceed—the

[3] Under-frequency events occur when imbalances in system generation resources and load cause transmission system frequency to drop below 60 hertz, which can result in load shedding to restore system frequency.

performance of a conventional (non-wind) power plant. Even when wind turbines are not generating active power, GE's wind turbine generators equipped with the WindFREE™ Reactive Power control feature can provide reactive power. The provision of continued voltage support and regulation provides grid benefits not possible with conventional generation, while mitigating adverse voltage impacts of wind turbines being off-line due to wind conditions. This feature can eliminate the need for grid reinforcements specifically designed for no-wind conditions, and may allow for more economic commitment of other generating resources that will enhance grid security by reducing the risk of voltage collapse.

- The WindINERTIA™ control has been developed by GE to provide an inertial response capability for wind turbines that is similar to that of conventional synchronous generators during under-frequency grid events. By utilizing the mechanical inertia of the rotor, GE has designed the WindINERTIA™ power pulse characteristics to provide a five percent to 10 percent increase in turbine power over operational wind speeds. The duration of the power pulse is up to several seconds and benefits the grid by allowing other non-wind power generation assets time to respond by increasing power production.

Q. Are these features part of the current Wyoming GE wind fleet?

A. No, but with the additional capacity from repowering, and the increased amount of wind generation anticipated as part of the Company's current CPCN application, the Company believes these features will provide important system support capabilities after the facilities are repowered.

Q. How will these features benefit customers?

A. These features will improve transmission system reliability and will allow the Company greater flexibility in managing the transmission system in Wyoming. These features should defer the need to separately provide for transmission system voltage support through the construction of synchronous condensers or static VAr (volt-amp reactive) compensators.

Q. Have these reliability and deferred transmission system support costs been factored into the economic analysis of the repowering project?

A. No, these customer benefits are not currently included in the economic analysis because transmission studies are needed to quantify these benefits as compared to other alternatives. The Company is currently undertaking these studies.

EXTENSION OF WIND FACILITY ASSET LIFE AFTER REPOWERING

Q. What is the current asset life of the wind facilities that will be repowered?

A. All of the existing wind facilities are currently being depreciated assuming a 30-year asset life. The facilities the Company plans to repower are currently scheduled to be retired between 2036 and 2040.

Q. Will repowering the wind facilities extend their useful operating lives beyond the currently planned retirement dates?

A. Yes, repowering the wind facilities will extend their life an additional 30 years from the repowering date, extending their useful lives by at least 10 years.

Q. How will repowering extend the useful life for an additional 30 years?

A. The repowering projects are being designed by the turbine equipment suppliers to meet the same design requirements that apply to complete wind turbine generators used in

new wind facility construction. The wind turbine equipment suppliers are contractually required, as would be the case with a new wind facility, to have their wind turbine designs for the repowering projects certified by an independent third party to ensure that they meet or exceed applicable International Electrotechnical Commission design standards used in the wind turbine industry. These design standards are intended to ensure that the equipment is appropriate for the site conditions and will perform satisfactorily over the standard design life.

Q. What factors will be independently reviewed to assess and certify the design?

A. The third-party design assessment evaluates the site-specific load assumptions based upon the climactic conditions at each facility and will assess the control and protection systems for the wind turbine and their ability to meet the site design conditions. It will also assess the electric components, the rotor blades, hub, machine components (*i.e.*, drivetrain, main bearing and gearbox), and the suitability of the existing tower upon which the new wind turbine equipment will be installed.

Q. Does the design certification also evaluate the ability of the existing foundations to handle the loads associated with the repowered turbines?

A. No. The design certification will assess the design loads and the design assumptions regarding the ability of the new turbines and the existing towers to handle those loads. But as with new wind facility development, the facility owner must provide a foundation suitable to handle the loads imparted by the tower on the foundation.

Q. Has the Company reviewed the foundations to ensure they are capable of handling the new turbines?

A. Yes. The Company retained Black & Veatch to evaluate the ability of the existing

foundations to handle the loads of the repowered turbines. For the Wyoming facilities and Marengo I and Marengo II, which have been fully designed, Black & Veatch's evaluation indicates that the existing foundations are suitable for the repowered turbines. For Leaning Juniper and Goodnoe Hills, foundation load evaluations have not yet been completed because those facilities are still under design review, which is expected to be completed by this fall. The suitability of the foundations will be confirmed when the design process is completed for those facilities and before executing contracts. Because of the load-mitigation controls now available with newer equipment, the future foundation loads at some of the facilities, even with the larger equipment, are less than the original design loads the foundations were engineered to withstand.

Q. Has the Company evaluated the foundations to determine if they are suitable for an additional 30-year service life following repowering?

A. Yes, for the foundations in which fatigue loading is a controlling design variable, and for which foundation load specifications are now available, the Company's consultant assessed the ability of the foundations to handle the estimated fatigue loading anticipated from an additional 30-year life following repowering and determined the foundations are able to accommodate the additional loading.

PROJECT CONTRACT STATUS AND CONSTRUCTION SCHEDULE

Q. What is the status of contracting related to the proposed repowering projects?

A. For the facilities that will be repowered with GE equipment, the Company is negotiating a turn-key master retrofit contract with GE to perform the repowering at a fixed price per turbine. This fixed-price contract will provide the Company the ability

to execute retrofit work orders for the facilities to be repowered and will significantly mitigate cost uncertainty related to the facilities. For the facilities that will be repowered with Vestas equipment, the Company executed a master turbine-supply agreement on December 28, 2016, that facilitates future equipment supply in support of repowering, and will negotiate an installation contract with Vestas or with other qualified wind energy contractors.

Q. When must the Company execute contracts with the equipment suppliers to proceed with the repowering projects?

A. Under the terms of the master retrofit contract being negotiated with GE, for repowering projects to be completed before March 31, 2020, the Company must notify GE of its intent to execute a retrofit work order eight months before the date requested by the Company for commissioning of the first retrofitted unit for any facility. For repowering projects to be completed on or after March 31, 2020, the Company must notify GE of its intent to execute a retrofit work order 12 months before the date requested by the Company for completion of commissioning of the first retrofitted unit for that project. Similarly, the Company will need to execute a contract with Vestas 12 months before equipment deliveries begin for a particular repowering project. The Company's construction schedule has been developed to optimize the PTC benefits of the facilities and ensure that the facilities can be constructed during the low-wind season—between March and November. To meet the equipment supply lead times requires contract execution beginning in early April 2018. Allowing time to finalize and execute the repowering contracts, the Company must be in a position by March

2018 to proceed with these facilities. A detailed project schedule for the repowering projects is attached as Exhibit RMP___(TJH-5).

Q. Why is there such a long lead time between the execution of retrofit contracts and the time that turbines can actually be repowered or delivered to the site to support the repowering projects?

A. Like all equipment suppliers in the wind industry, both GE and Vestas are currently responding to unprecedented demand to supply equipment for wind facilities that are slated to be installed before December 31, 2020, to qualify the facilities for the full value of the PTC. Because this equipment is manufactured to order, long lead times are required to ensure manufacturing capacity is available and to meet specific project delivery requirements. In some cases, additional manufacturing capacity may need to be sourced or constructed to meet the equipment supply demands.

Q. Aside from manufacturing lead times, are there other drivers for the lead times associated with constructing these facilities?

A. Yes, in addition to the manufacturing constraints, lead times are necessary to ensure that construction contractors and work crews and cranes are available to install the repowering equipment. Because of the large-scale efforts involved in repowering the facilities, these resources must be secured well in advance of project construction to ensure project schedules are met. Also, both skilled labor resources and construction cranes are likely to be in short supply given the amount of activity involved in new wind facility construction and wind repowering projects across the country that must achieve commercial operation by December 31, 2020, to meet the safe-harbor rules summarized above in my testimony to qualify for the full value of the PTC. Thus,

securing these necessary resources well before beginning these time-sensitive projects mitigates both cost and schedule risk for these beneficial projects.

Q. How has the Company designed the repowering projects to work within these constraints?

A. As discussed above, the 2019 construction schedule for most of the facilities, other than Dunlap, optimizes the existing PTC benefits of the facilities and also allows for their construction, generally, more than a year in advance of the December 31, 2020 deadline to achieve commercial operation.

Q. What permitting requirements apply to repowering projects and what steps has the Company taken to acquire any needed regulatory approvals for the repowering projects?

A. Because repowering does not increase the footprints of the existing wind facilities, and since the facilities are operating under current local, state and federal permits and authorizations, the permitting requirements for repowering are minimal. Because the facility footprints are not altered and since repowering is unlikely to disturb additional acreage not already covered by existing permits, additional standard construction permits, such as storm-water permits and fugitive dust permits, are likely not required. Throughout the repowering process the Company will ensure that the requirements of the existing permits and authorizations are met, and will provide needed information to permitting authorities to amend or modify the existing permits for the facilities to reflect the change in turbine equipment, if needed. This involves assessing whether amendments to the existing Wyoming Industrial Siting Division ("ISD") permits are required to reflect the new wind turbine equipment installed in Wyoming, as well as

similar processes to amend existing county authorizations in other states, as well as modifications to Federal Aviation Administration authorizations to reflect the increased height of the turbine blades.

The Company has engaged with the Wyoming ISD to determine requirements for performing the repowering activities and based on those discussions, no additional permitting or permit amendments are anticipated, as the repowering efforts can be performed as operations and maintenance activities under the existing permits. Additionally, the Company has spoken with county authorities to determine local permitting requirements. Based on those discussions, the Company has identified the need for new building permits and/or amendments to existing county authorizations in several counties. The Company will obtain these permits/amendments before beginning the repowering project. The Company will continue to work with the appropriate regulatory and permitting authorities to provide information necessary to obtain any needed permits or to process any amendments or modifications to the existing facility permits.

DISPOSITION OF REMOVED EQUIPMENT

Q. What is the Company planning to do with the existing equipment that will be removed?

A. The Company has not yet determined how it will dispose of this equipment, but will explore various options to realize the greatest customer benefit from the equipment. Because the Company will be replacing the entire machine head (nacelle, hub, and rotor) of the repowered turbines, the removed equipment has the potential to be reused and redeployed to another site location. This may make the equipment valuable for

redeployment elsewhere in the country, or perhaps elsewhere in North America.

The Company understands that a significant number of turbines of all makes and models will be repowered before 2020. This creates potential value for the removed equipment as spare parts for similar type turbines that will remain in service. This also makes it difficult, however, to use current market pricing for used turbines as a proxy for the potential salvage value of the equipment given the large number of repowered turbines and associated spare parts that will become available in the next several years. Because not all the Company's GE turbines will be repowered, some of the equipment can potentially be used as spare parts to service the non-repowered turbines.

Q. Given the uncertainty of the market for the removed equipment either for redeployment or as spare parts, what was assumed in the economic analysis for the salvage value of the equipment?

A. The Company did not assume any salvage value for the removed equipment in its economic analysis, which is a conservative assumption given the potential for the equipment to be reused, repurposed as spare parts, or merely salvaged for scrap metal value. To the extent the Company determines any salvage value by reusing the equipment, or by selling or auctioning it to third parties, the Company will pass through any and all additional financial benefits to its customers.

SUMMARY AND CONCLUSION

Q. Please summarize your testimony.

A. The wind repowering project presents the opportunity to leverage prior investments in the wind fleet and enhance its future value for customers. By executing wind turbine equipment purchases in late 2016, the Company was able to secure the opportunity to

repower and renew the wind fleet and deliver the maximum value of these facilities to customers by qualifying for the full value of the PTC. Repowering now provides a unique opportunity to return the Company's wind turbines to like-new condition while enhancing their performance and avoiding expenditures that maintain but do not enhance the value of the wind fleet.

By incorporating recent technical advances that allow for longer blades to be installed on the existing towers and foundations, repowering will result in significantly more low-cost energy for customers—550 TWh annually, or an increase of 19 percent. With increases to the allowable transmission capacity of the facilities, these generation benefits will be 598 TWh, or an increase of 21 percent. If new equipment now being developed by GE for repowering projects can be successfully applied to these facilities, generation will be further increased with resulting benefits to customers. Further, repowering with new equipment will extend the asset lives of the wind facilities by at least 10 years—allowing the wind facilities to continue serving customers well into the future.

Finally, these benefits from repowering can be delivered to customers while reducing rather than increasing costs to customers, as further described by Company witness Mr. Link.

Q. What is your recommendation to the Commission?

A. I recommend the Commission enter a finding that the decision to repower certain wind facilities is prudent and in the public interest and approve the Application as filed, including the request for continued cost recovery of the wind equipment that will be

replaced and the proposed rate-making treatment for the new costs and benefits of the wind repowering project.

Q. Does this conclude your direct testimony?

A. Yes.