

REDACTED

Docket No. UE 352

Exhibit PAC/200

Witness: Timothy J. Hemstreet

**BEFORE THE PUBLIC UTILITY COMMISSION
OF OREGON**

PACIFICORP

REDACTED

Direct Testimony of Timothy J. Hemstreet

December 2018

DIRECT TESTIMONY OF TIMOTHY J. HEMSTREET

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

2 A. My name is Timothy J. Hemstreet. My business address is 825 NE Multnomah
3 Street, Suite 1800, Portland, Oregon 97232. My title is Director of Renewable
4 Energy Development.

5 **QUALIFICATIONS**

6 **Q. Briefly describe your education and business experience.**

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

16 **Q. Have you testified in previous regulatory proceedings?**

17 A. Yes.

18 **PURPOSE OF TESTIMONY**

19 **Q. What is the purpose of your testimony in this proceeding?**

20 A. In support of PacifiCorp's application for recovery of costs for its wind repowering
21 project, my testimony provides technical information regarding the company's planned
22 upgrades to "repower" most of its wind fleet. Specifically, my testimony addresses:

- 23
- The scope of the project;

- 1 • The financial benefits of repowering resulting from the qualification for federal
2 production tax credits (PTCs);
- 3 • The increased energy benefits following repowering;
- 4 • The reduced ongoing operating costs following repowering;
- 5 • The extension of wind facility asset lives after repowering;
- 6 • Project contract status and construction schedule; and
- 7 • The disposition of removed equipment.

8 SUMMARY OF TESTIMONY

9 **Q. Please summarize your testimony.**

10 A. The wind repowering project presents the opportunity to leverage prior investments in
11 PacifiCorp's wind fleet and enhance the future value of these resources for customers.
12 By executing wind turbine equipment purchases in late 2016, PacifiCorp secured the
13 opportunity to repower and renew the wind fleet and qualify for the full value of the
14 PTCs for another 10-year period. Repowering now provides a unique opportunity to
15 return PacifiCorp's wind turbines to like-new condition while enhancing their
16 performance and avoiding expenditures that maintain but do not enhance the value of
17 the wind fleet.

18 By incorporating recent technical advances that allow for installation of longer
19 blades on the existing towers and foundations, repowering will result in significantly
20 more low-cost energy for customers—694 gigawatt-hours (GWh) annually, or an
21 average increase of 26.7 percent. Further, repowering with new equipment will
22 extend the asset lives of the wind facilities by at least 10 years—allowing the wind
23 facilities to continue serving customers well into the future.

1 Finally, these benefits from repowering can be delivered to customers while
2 reducing, rather than increasing, costs to customers, as further described in the
3 testimony of Mr. Rick T. Link.

4 **Q. What is the company’s proposal in this proceeding?**

5 A. PacifiCorp proposes to recover the costs of the wind repowering project through the
6 Renewable Adjustment Clause (RAC). As described in my testimony, the Public
7 Utility Commission of Oregon (Commission) should approve this proposal because
8 the wind repowering project is prudent and provides significant benefits to customers.

9 **OVERVIEW OF WIND REPOWERING AND PROJECT SCOPE**

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

11 A. Repowering broadly describes the upgrade of an existing, operating wind facility with
12 new wind-turbine-generator (WTG) equipment that can increase a facility’s
13 generating capacity and the amount of electrical generation produced from the
14 facility. Specifically, PacifiCorp’s repowering plan involves replacing the nacelle,
15 hub and rotor of the WTG. See Exhibit PAC/201 for a depiction of a wind turbine
16 and its various components.

17 **Q. Which facilities does PacifiCorp propose to repower?**

18 A. By the end of 2019, PacifiCorp is planning to upgrade: (i) all of its wind facilities in
19 Wyoming (except the company’s Foote Creek I, Glenrock III and Dunlap facilities),
20 including the facilities known as Glenrock I, Rolling Hills¹, Seven Mile Hill I, Seven
21 Mile Hill II, High Plains, and McFadden Ridge; (ii) its Leaning Juniper facility in
22 Oregon; and (iii) its Marengo I, Marengo II, and Goodnoe Hills facilities in

¹ The Rolling Hills wind project is not in Oregon rates and the company is not requesting in this filing to bring it in to Oregon rates through the RAC.

1 Washington. PacifiCorp plans to repower its Dunlap and Glenrock III facilities in
2 Wyoming in 2020 and, as discussed below, is still evaluating whether it will proceed
3 to repower its Foote Creek I facility in Wyoming. See Exhibit PAC/202 for a map
4 depicting the locations of each of PacifiCorp's wind facilities.

5 **Q. How many megawatts (MW) of installed wind capacity is PacifiCorp proposing**
6 **to repower?**

7 A. PacifiCorp is planning to repower 11 of its 12 wind facilities that are in Oregon rates
8 in 2019 and 2020, representing 900.1 MW of installed wind capacity.² Broken down
9 by state, this consists of eight facilities in Wyoming comprising 495 MW, one facility
10 in Oregon of 100.5 MW, and three facilities in Washington comprising 304.6 MW.
11 Detailed information about the wind facilities PacifiCorp plans to repower is included
12 in Exhibit PAC/203.

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

14 A. The wind facilities PacifiCorp proposes to repower began commercial operations
15 between 2006 and 2010. Because of their age, they can be economically repowered,
16 or upgraded, with new technology that will improve their efficiency and increase their
17 generation output, without incurring the cost to replace the existing towers,
18 foundations, and energy collection systems. The existing foundations and towers,
19 although more than 10 years old in some instances, are adequately designed to
20 accommodate larger, more modern WTG equipment and have a sufficient remaining
21 useful life to economically justify the associated investment.

² The 900.1 MW capacity reflects all of PacifiCorp's wind repowering project, except Rolling Hills, which is not in Oregon rates. Inclusive of Rolling Hills, PacifiCorp is repowering 999.1 MW of company-owned wind capacity.

1 In contrast, at facility sites developed more than about 15 years ago, the WTG
2 equipment typically has a low generating capacity (*i.e.*, sub-1,000 kilowatt) and the
3 towers and foundations supporting the nacelle and rotor do not have the height or
4 design strength to accommodate the installation of modern, larger nacelles and rotors
5 capable of generating a much greater amount of electricity per WTG. With these
6 older facilities, repowering usually involves the removal of all of the old wind turbine
7 equipment, including towers, foundations, and energy collection system, and
8 replacement with new equipment and energy collector circuits appropriately sized for
9 the new equipment.

10 Because PacifiCorp plans to repower its facilities in a way that allows the
11 company to reuse the existing infrastructure of the towers, foundations, and energy
12 collection systems, the energy and PTC benefits can be realized with a lower capital
13 investment than would be required for the redevelopment of entire sites.

14 **Q. Did PacifiCorp's 2017 Integrated Resource Plan (IRP) evaluate repowering all**
15 **of the facilities described above?**

16 A. Yes, except for Goodnoe Hills. When the 2017 IRP was developed, PacifiCorp had
17 not assessed repowering Goodnoe Hills. Since that time, however, PacifiCorp has
18 evaluated the facility and determined that Goodnoe Hills can be economically
19 repowered similar to the facilities evaluated in the 2017 IRP. Mr. Link describes the
20 company's analysis of the wind repowering project in the 2017 IRP, and the
21 Commission's order on the 2017 IRP.

1 **Q. Are the costs to repower the Dunlap and Glenrock III facilities in Wyoming**
2 **included in this filing?**

3 A. No. The Dunlap and Glenrock III facilities will be repowered in 2020, which is
4 outside the 2019 period for this RAC filing. Consistent with the settlement agreement
5 approved by the Commission in the 2019 Transition Adjustment Mechanism
6 proceeding, docket UE 339, only the wind facilities repowered in 2019 are included
7 in this filing.

8 **Q. Why did PacifiCorp exclude Foote Creek I in Wyoming from the proposed wind**
9 **repowering project at this time?**

10 A. As noted in the 2017 IRP action plan item 1a, PacifiCorp is still evaluating the
11 potential of repowering Foote Creek I. Repowering this older facility would involve
12 more comprehensive site redevelopment, as described above, which is different in
13 scope than the repowering projects proposed here.

14 **FINANCIAL BENEFITS OF REPOWERING INCLUDING REQUALIFICATION**
15 **FOR PTCS**

16 **Q. What benefits will customers realize from wind repowering?**

17 A. Repowering the proposed wind facilities will requalify them for PTCs, and these
18 benefits will be fully passed on to PacifiCorp's customers through the Transition
19 Adjustment Mechanism, beginning in 2019, as described in Ms. Etta P. Lockey's
20 testimony (Exhibit PAC/100). Additionally, repowering will increase the amount of
21 emissions-free energy produced from the repowered facilities by 21 to 39 percent,
22 depending on the facility, as shown in Confidential Exhibit PAC/204.³ Further, by

³ This range reflects increases under existing transmission interconnection agreements. The range is 22 percent to 39 percent if transmission interconnection agreements are modified to reflect the additional capacity available from the repowered turbines.

1 replacing older WTG equipment, which is subject to more failure and maintenance
2 issues than newer equipment, repowering will reduce PacifiCorp's ongoing operating
3 costs. Finally, repowering the wind facilities with new WTG equipment will extend
4 the useful lives of the facilities by at least 10 years, creating substantial energy and
5 capacity benefits for customers in the future when these wind facilities would
6 otherwise have been retired from service.

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

8 A. On December 18, 2015, Congress enacted changes to the federal Internal Revenue
9 Code that extended the full value of the PTC for wind energy facilities that began
10 construction in 2015 and 2016. The legislation also provided for a phase-out of the
11 PTC over three years, reducing the PTC value by 20 percent for wind facilities
12 beginning construction in 2017, 40 percent for wind facilities beginning construction
13 in 2018, and 60 percent for wind facilities beginning construction in 2019. The
14 Internal Revenue Service (IRS) has issued guidance that establishes a "safe harbor"
15 for taxpayers to demonstrate the year a facility will be deemed to "begin
16 construction," thereby setting the value of the PTC. If at least five percent of the total
17 project costs are incurred in 2016, then the facility qualifies under the IRS safe harbor
18 for the full value of the PTC, provided the taxpayer can demonstrate "continuous
19 efforts" to complete construction. The IRS has issued additional guidance that
20 establishes a safe harbor for satisfying this continuous-efforts standard. Under the
21 continuous-efforts safe harbor, the wind facilities must be in service by the end of the
22 fourth calendar year following the calendar year in which construction began. Thus,
23 wind facilities that began construction in 2016 must be in service no later than

1 December 31, 2020, to satisfy the continuous-efforts safe-harbor provisions. If the
2 facilities are not placed in service by December 31, 2020, the projects must satisfy
3 IRS requirements that continuous-efforts were expended to repower the facilities,
4 which is a difficult standard to meet.

5 **Q. Does PacifiCorp's repowering project qualify for the full value of the PTC under**
6 **these rules?**

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

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

18 A. For 2018, wind facilities that are qualified for the PTC will receive an estimated
19 2.4 cents per kilowatt-hour, or \$24 per megawatt-hour. This PTC value is adjusted
20 annually based upon an inflation index, and the PTC is available for energy produced
21 during the 10-year period after the wind facility begins commercial operation.

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

3 A. On May 5, 2016, the IRS issued Notice 2016-31⁴ (Notice), which provides guidance
4 on various aspects of qualifying for the PTC and whether new tax credits can be
5 claimed when wind turbines are repowered or retrofitted. The Notice generally
6 provides that the repowering costs must equal at least four times the fair market value
7 of the equipment that the owner retains from the original facility for the repowered
8 turbines to qualify for new PTCs. Thus, 80 percent of the fair market value of the
9 repowered WTG must result from repowering project costs while the value of the
10 retained components cannot exceed 20 percent of the fair market value of the new
11 facility. This “80/20” test is applied on a turbine-by-turbine basis. Each wind
12 turbine—composed of a foundation, tower, and machine head (including nacelle, hub
13 and rotor)—is considered a separate facility.

14 **Q. Do all of the wind turbines PacifiCorp is proposing to repower meet this 80/20**
15 **test?**

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

⁴ The IRS Notice 2016-31 is available at: https://www.irs.gov/irb/2016-23_IRB/ar07.html.

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

2 A. Repowering at Glenrock I and Glenrock III, which are located near Glenrock,
3 Wyoming, will not include all wind turbines. At these locations, 14 of the 92 wind
4 turbines will not be repowered because they were constructed atop mine tailings at
5 the company's reclaimed Glenrock coal mine and required special pile foundations.
6 These special foundations were more expensive to construct than the standard
7 foundations found elsewhere on those facility sites and at other PacifiCorp wind
8 facility locations. Because the original construction cost of these foundations was
9 higher than for standard foundations, the retained value of these foundations is also
10 higher than the other foundations. For these 14 wind turbine locations, the higher
11 retained value of the foundations means that repowering, while technically feasible,
12 would not qualify those turbines for PTCs, which is necessary for the repowering to
13 be economic. PacifiCorp plans to repower all of the turbines at the other wind
14 facilities discussed above.

15 **Q. How else has PacifiCorp scoped the repowering project to maximize the benefits**
16 **of available PTCs?**

17 A. As shown in Exhibit PAC/203, several of the wind facilities PacifiCorp proposes to
18 repower are still within 10 years of their original commercial online date, though
19 most have just recently completed 10 years of operation. Thus, the PTCs from
20 original construction have either recently expired or are still accruing to the benefit of
21 PacifiCorp's customers for a small remaining period until these existing PTCs expire
22 10 years after the facilities' commercial online date. Between May 2018 and October
23 2020, the PTCs associated with approximately 2.0 terawatt-hours (TWh) of electricity

1 generated at PacifiCorp's wind facilities in Oregon rates will expire. On an annual
2 basis, in 2018 dollars, the expiration of these PTCs represents the loss of
3 approximately \$64 million per year in customer PTC benefits, as shown in Exhibit
4 PAC/203.

5 To maximize the benefits of the existing PTCs available from the wind
6 facilities, PacifiCorp will generally delay repowering until the original PTCs have
7 expired. The exceptions to this are the High Plains, McFadden Ridge, and Dunlap
8 facilities (although Dunlap is not included in this case). To take advantage of
9 available construction capacity and the low-wind season in 2019, High Plains and
10 McFadden Ridge repowering will begin in advance of when PTCs expire at those
11 facilities in September 2019. In addition, if the company waited until the Dunlap
12 PTCs expire in October 2020, there would be insufficient time to complete
13 construction at Dunlap by the end of 2020, as required to re-qualify for PTCs. This
14 results in a slight truncation of the existing, original 10-year PTC period for these
15 facilities. As with all of the wind facilities, however, once these projects are
16 repowered a new 10-year period will begin where its generation is eligible for the full
17 value of PTCs.

18 **Q. Have recent changes to federal tax laws impacted the ability of the repowering**
19 **projects to qualify for PTCs?**

20 A. No. The recent tax law changes enacted into law in December 2017 have not
21 impacted the ability of the repowering projects to qualify for the full value of PTCs.

1 **INCREASED ENERGY BENEFITS FOLLOWING REPOWERING**

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

3 A. Repowering will involve the replacement of the existing machine heads including the
4 nacelle, hub and rotor. The new nacelles have generators that have a greater
5 nameplate generating capacity than the equipment that is removed. For example, the
6 nameplate rating of each turbine at the Wyoming facilities will increase from 1.5 MW
7 to 1.85 MW, while at the Marengo facility, the generator nameplate rating will
8 increase from 1.8 MW to 2.0 MW. Details regarding the proposed wind turbine
9 upgrades, capital project costs, in-service dates, and resulting energy benefits are
10 shown in Confidential Exhibit PAC/204.

11 In addition to the larger generators in the repowered turbines, PacifiCorp will
12 also install larger blades. With the larger blades, the rotor-swept area of the wind
13 turbines will increase between 37 to 56 percent, depending on the type of turbine. A
14 larger rotor-swept area allows more of the wind energy flowing past the wind turbine
15 to be captured and converted by the wind turbine into electricity. Because the size of
16 the rotors will increase, the repowered turbines will also include more robust hubs,
17 main shafts, bearings and couplings, and gearboxes suitable to handle the greater
18 torque exerted by the larger rotors.

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

21 A. Although the larger blades will increase the overall risk zone (rotor-swept area) of the
22 repowered wind turbines, this does not necessarily correlate with an increased risk of
23 avian impacts at existing turbine sites. PacifiCorp will continue to implement its

1 current informed-curtailment protocols after repowering to minimize avian impacts.
2 Informed-curtailment involves the shutdown of wind turbines when species of interest
3 are in the vicinity. PacifiCorp's informed-curtailment protocols avoid avian impacts
4 regardless of the swept area of the rotor. PacifiCorp performs monthly monitoring at
5 all of its wind facilities and reports all findings to state wildlife agencies and the U.S.
6 Fish and Wildlife Service. PacifiCorp will continue this monthly monitoring to
7 determine if the new turbine blades cause additional impacts to avian species and will
8 engage with the appropriate agency to discuss and, if prudent and practicable,
9 implement additional avoidance, minimization, or mitigation measures.

10 **Q. How did PacifiCorp determine the amount of additional generation that will be**
11 **produced from the repowered wind turbines?**

12 A. PacifiCorp worked with its consultant, Black & Veatch (B&V), to use the extensive
13 data history from PacifiCorp's facilities to derive precise estimates of the energy
14 production expected from repowering. This analysis used millions of data points
15 from the operational record of the wind facilities and incorporated additional modeled
16 wake losses anticipated from the new equipment. Wake losses are the reduction in
17 generation at turbines downwind of other turbines due to reduced wind speed and
18 increased turbulence in the airflow—or wake—behind a turbine.

19 Based on its analysis, PacifiCorp and B&V estimate that energy production
20 following repowering will increase as shown in Confidential Exhibit PAC/204, and as
21 further discussed below. These results reflect as accurately as possible the energy
22 production that would have occurred from the repowered turbines under the same
23 operational conditions and availability as the existing equipment. However, these

1 repowering energy estimates likely are conservative. They are based solely on the
2 different equipment performance specifications of the newer equipment and do not
3 account for expected improvements in operational availability of the wind facilities
4 following repowering. Availability of the wind turbines likely will improve after
5 repowering given the additional sensors and condition monitoring systems in the
6 repowered turbines that should allow for improved diagnostics and implementation of
7 preventative maintenance measures that can reduce turbine down-time. Additionally,
8 PacifiCorp will enter into service agreements with the turbine suppliers GE and
9 Vestas with performance guarantees and incentives that are likely to result in more
10 availability and generation than PacifiCorp has achieved in the past under similar
11 wind conditions. These contracts are discussed in more detail later in this testimony.

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

13 A. The larger rotor size and improvements in blade design of the new equipment
14 generate more power at all ranges of wind speeds. Additionally, some of the new
15 turbines begin producing power at a lower wind speed than the existing equipment;
16 thus, the turbines can produce energy during lower wind conditions in which the
17 current equipment may sit idle. Because the new turbines will have an increased
18 generator capacity, the turbines will also produce more energy when wind speeds are
19 high and the turbines are at their maximum output. Exhibit PAC/205 illustrates these
20 power production advantages and compares the power curve of an existing wind
21 turbine to that of a repowered wind turbine.

1 **Q. Why did PacifiCorp not install this larger equipment when the wind facilities**
2 **were initially constructed?**

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

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

18 A. As shown in Confidential Exhibit PAC/204, across the wind fleet, the proposed
19 repowered wind facilities are estimated to increase generation by 694 GWh per year
20 if the facilities are operated within the limits of their existing large generator
21 interconnection agreements—an increase of 26.7 percent.

1 **Q. Is PacifiCorp planning to use the additional generating capacity provided by the**
2 **repowered wind turbines?**

3 A. Yes. To use the additional maximum generating capacity of the facilities provided by
4 the repowered wind turbines, PacifiCorp will need to modify its existing transmission
5 interconnection agreements for these facilities. Accordingly, PacifiCorp has filed
6 generation interconnection applications for the additional generation at the existing
7 points of interconnection for the planned repowering projects, except for Leaning
8 Juniper and Goodnoe Hills. Due to transmission constraints at Leaning Juniper and
9 Goodnoe Hills, PacifiCorp does not expect additional transmission capacity to be
10 available for those facilities.

11 PacifiCorp's transmission function is currently reviewing the submitted
12 applications and preparing the required studies under the company's Open Access
13 Transmission Tariff. Two separate studies are required, including (i) a system impact
14 study and (ii) a facilities study. The completed studies will provide information on
15 the transmission upgrades, if any, needed to accommodate the interconnection
16 request. Once all studies are complete, PacifiCorp's transmission function will
17 determine if it can offer revised Large Generator Interconnection Agreements to the
18 company's merchant function.

19 Transmission studies for the Marengo I and Marengo II facilities have been
20 completed and the company has executed a new interconnection agreement with
21 PacifiCorp's transmission function that allows the additional capacity to be
22 interconnected so that these facilities can deliver the increased capacity and the
23 associated energy to customers. The remaining transmission studies are still pending.

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

3 A. Yes. Mr. Link demonstrates in his testimony (Exhibit PAC/300) that the repowering
4 project is economic even if the facilities are operated within their existing
5 transmission capacity limits. An adjustment to the large-generator interconnection
6 agreements to allow the facilities to be operated at full nameplate capability following
7 repowering simply improves the already favorable economics of the repowering
8 project. Because of the uncertainty regarding the ability of the Wyoming wind
9 facilities to interconnect the additional capacity, PacifiCorp's economic analysis is
10 based upon a scenario in which the Wyoming projects are operated within the
11 existing capacity of their transmission interconnection agreements.

12 **REDUCED ONGOING OPERATIONAL COSTS FOLLOWING REPOWERING**

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

15 A. The repowering project will lower the ongoing capital costs of operating the existing
16 wind facilities. PacifiCorp's turbine-supply contracts for repowering, consistent with
17 wind industry standards for new equipment, will include a two-year warranty on the
18 new equipment. This will reduce capital costs associated with replacing or
19 refurbishing the equipment currently in service. Additionally, the new turbine
20 equipment associated with repowering, will obviate, to a large extent, capital costs
21 associated with major turbine component replacements and refurbishments
22 (generators, gearboxes, blades, and small components). After the two-year warranty
23 period for the new equipment expires, these costs are expected to be lower than the
24 costs for the current equipment that has now been in service for up to 12 years.

1 Further, capital costs will be reduced before repowering as the investment horizon for
2 the existing wind turbines closes and various capital replacements no longer make
3 economic sense given the short remaining installed life of the turbines to be
4 repowered.

5 The repowering project will also result in more certainty related to ongoing
6 operations and maintenance costs of the existing wind facilities. PacifiCorp will
7 execute full service agreements on the new GE turbines under which GE will be
8 responsible for operating and maintaining the new turbines for a fixed cost while
9 attaining a guaranteed production-based availability on the turbines. Under these
10 agreements, failure to meet the guaranteed availability, if not the result of an
11 excusable event defined in the contract, will result in the payment of liquidated
12 damages to the company. Customers will benefit by having operations and
13 maintenance costs fixed for the term of the agreement. Thus, there is greater cost
14 certainty related to the run-rate capital expenditures and operations and maintenance
15 costs of the repowering projects in addition to the cost certainty related to
16 construction. PacifiCorp's negotiated full service agreement with GE is for a [REDACTED]
17 [REDACTED]. For facilities employing
18 Vestas turbines, PacifiCorp has executed service agreements [REDACTED]
19 [REDACTED].

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

22 A. Yes. Before repowering is complete, some of the existing turbines will experience
23 component failures that render them unable to be economically returned to service. It

1 will be more economic for customers to idle these turbines than repair them given the
2 short period before repowering. As a result, PacifiCorp estimates that generation
3 from the wind facilities targeted for repowering will be reduced before repowering.
4 These estimates of pre-repowering generation impacts are factored into the economic
5 analysis presented in Mr. Link's testimony.

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

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

18 **Q. Why are these gearbox failures significant?**

19 A. These gearbox failures generally cannot be repaired "up-tower". This means that the
20 repair cannot be completed within the nacelle without removing the damaged
21 equipment by crane. These failures cost approximately \$400,000 per occurrence,
22 including equipment and labor costs to purchase and install a replacement gearbox
23 and the costs of mobilizing a large crane to the site to remove and replace the

1 equipment. These costs also do not account for the lost generation from the time the
2 turbine is down until the repair is completed.

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

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

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

8 A. No. Three of the 14 wind turbines that will not be repowered at Glenrock I and
9 Glenrock III have these gearbox models that will need to be replaced, which is
10 factored into the economic analysis. Following repowering, these gearboxes—as well
11 as potential failures of other gearbox models at the non-repowered units—can be
12 replaced with those removed from the existing turbines as part of the repowering
13 effort, reducing the repair costs of the remaining gearboxes. The cost savings of
14 doing so, however, have not been factored into PacifiCorp’s economic analysis
15 because the company is still evaluating how best to realize value for customers from
16 the removed equipment.

17 **Q. Are other significant capital costs avoided with repowering?**

18 A. Aside from the gearbox issues, repowering will also avoid ongoing capital
19 expenditures related to blade costs at Goodnoe Hills. Blade expenditures at this
20 facility to address a blade design deficiency account for approximately 60 percent of
21 the budgeted capital costs associated with blade failures and refurbishments across
22 PacifiCorp’s wind fleet, even though Goodnoe Hills accounts for only seven percent
23 of the turbines. Repowering is expected to bring blade costs for that facility in line

1 with PacifiCorp's expenditures at its other facilities, resulting in reduced capital costs
2 to keep the wind fleet meeting its operational performance targets.

3 Given these ongoing gearbox and blade failure costs, repowering is
4 particularly attractive because repowering avoids significant forecast capital
5 expenditures to maintain turbine production while extending asset life, increasing
6 generation, and requalifying the wind turbine for PTCs for another 10-year period.

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

9 A. No. The gearbox models in the fleet that are experiencing high failure rates will not
10 be included in the equipment installed for repowering. Further, the equipment that
11 will be installed has evolved from the product lines of the existing turbines, rather
12 than arising from entirely new product offerings. Thus, the turbine suppliers have
13 had time to learn from their past experience with these turbine models and have made
14 adjustments in their designs, specifications, and choice of subcomponent suppliers to
15 enhance turbine reliability. Because of the warranty service requirements in the
16 turbine-supply contracts and because the turbine suppliers are often under long-term
17 service agreements for the turbines they supply—such as will be the case with the GE
18 turbines—the turbine suppliers have an incentive to improve the reliability of their
19 turbines. Thus, PacifiCorp does not expect to have the problems and expense it has
20 had in the past with specific gearbox models and the associated reliability concerns.

21 **EXTENSION OF WIND FACILITY ASSET LIFE AFTER REPOWERING**

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

23 A. All of the existing wind facilities are currently being depreciated assuming a 30-year

1 asset life. The facilities PacifiCorp plans to repower are currently scheduled to be
2 retired between 2036 and 2040 (see Confidential Exhibit PAC/204).

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

5 A. Yes, repowering the wind facilities will extend their life 30 years from the repowering
6 date, adding approximately 10 years to their planned retirement dates.

7 **Q. How will repowering extend the useful life by 30 years from the repowering**
8 **date?**

9 A. The repowering projects are being designed by the turbine equipment suppliers to
10 meet the same design requirements that apply to WTGs used in new wind facility
11 construction. The wind turbine equipment suppliers are contractually required, as
12 would be the case with a new wind facility, to have their wind turbine designs for the
13 repowering projects certified by an independent third party to ensure that they meet or
14 exceed applicable International Electrotechnical Commission design standards used
15 in the wind turbine industry. These design standards are intended to ensure that the
16 equipment is appropriate for the site conditions and will perform satisfactorily over
17 the standard design life.

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

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

1 upon which the new wind turbine equipment will be installed.

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

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

8 **Q. Has PacifiCorp reviewed the foundations to ensure they are capable of handling**
9 **the new turbines?**

10 A. Yes. PacifiCorp retained B&V to evaluate the ability of the existing foundations to
11 handle the loads of the repowered turbines. B&V's evaluation indicates that the
12 existing foundations are suitable for the repowered turbines. At the Leaning Juniper
13 and Goodnoe Hills facilities, the foundations will require a standard retrofit to
14 increase their strength.

15 **Q. Has PacifiCorp evaluated the foundations to determine if they are suitable for a**
16 **30-year service life following repowering?**

17 A. Yes. For the foundations in which fatigue loading is a controlling design variable,
18 B&V has assessed the ability of the foundations to handle the estimated fatigue
19 loading anticipated for a 30-year period following repowering and has determined
20 that all the foundations will be able to accommodate the additional loading.

21 **PROJECT CONTRACT STATUS AND CONSTRUCTION SCHEDULE**

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

23 A. PacifiCorp has executed a master retrofit contract with GE for the Wyoming projects

1 and the Leaning Juniper project in Oregon, and has executed turbine supply contracts
2 with Vestas for the other three projects. The scope, language, and risk profile of the
3 agreements with each of the companies is different.

4 The master retrofit contract commits GE to perform turn-key supply, delivery,
5 installation, and commissioning of the repowering turbines at a fixed price.

6 PacifiCorp has also executed fixed-price turbine supply agreements with Vestas and
7 has executed and negotiated separate contracts with wind energy construction
8 companies for installation of the Vestas equipment.

9 **Q. Has PacifiCorp begun the repowering projects under the GE master retrofit**
10 **contract?**

11 A. Yes. Retrofit work orders have been issued for all of those projects and the majority
12 of construction work will be completed in 2019.

13 **Q. Are the projects with Vestas also moving forward at this time?**

14 A. Yes. The turbine supply contracts with Vestas for the repowering of the Marengo I,
15 Marengo II and Goodnoe Hills facilities have been executed and Vestas is currently
16 manufacturing the equipment that will be supplied for the projects.

17 **Q. Do the contracts with the turbine suppliers provide for the costs of the turbines**
18 **(and installation in the case of GE) to be adjusted up or down for factors such as**
19 **inflation, currency indexes, or steel price indexes?**

20 A. No. The contracts provide that the prices are fixed and have no adjustment
21 mechanisms for those common price indexes. Generally, the turbine suppliers can
22 only seek a change order for price relief as a result of changes in state and/or local
23 law that impacts their costs. As such, the vast majority of repowering costs are now

1 fixed under these negotiated contracts which substantially reduces risk of cost over-
2 run.

3 **Q. When will the repowering projects be constructed?**

4 A. The repowering projects will mostly be completed in 2019—a year in advance of the
5 deadline for completing construction and achieving commercial operations of other
6 repowered facilities. PacifiCorp’s construction schedule has been developed to
7 optimize the PTC benefits of the facilities and ensure that the facilities can be
8 constructed during the low-wind season—between March and November. A detailed
9 project schedule for the repowering projects is attached as Confidential Exhibit
10 PAC/206.

11 **Q. How has PacifiCorp designed the repowering projects to work within PTC-
12 timing constraints?**

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

17 **Q. What permitting requirements apply to repowering projects and has the
18 company obtained all the necessary permits to ensure the construction schedule
19 will not be delayed due to permitting issues?**

20 A. Because repowering does not increase the footprints of the existing wind facilities,
21 and since the facilities are operating under current local, state and federal permits and
22 authorizations, the permitting requirements for repowering are minimal. Because the
23 facility footprints are not altered and since repowering is unlikely to disturb additional

1 acreage not already covered by existing permits, additional standard construction
2 permits are limited. PacifiCorp has obtained all of the necessary major permits
3 required for the repowering projects to be completed, such as Federal Aviation
4 Administration permits, county conditional use permits, and Wyoming Industrial
5 Siting Division approvals. Necessary building permits, where not already in hand,
6 will be obtained a few months before construction efforts begin. Throughout the
7 repowering process PacifiCorp will ensure that the requirements of the existing
8 permits and authorizations are met, and will provide needed information to permitting
9 authorities to amend or modify the existing permits for the facilities to reflect the
10 change in turbine equipment, if needed.

11 **DISPOSITION OF REMOVED EQUIPMENT**

12 **Q. What is PacifiCorp planning to do with the existing equipment that will be**
13 **removed?**

14 A. PacifiCorp has issued a request for proposals related to the disposition of the existing
15 equipment that will be removed and is still evaluating those proposals against options
16 for equipment disposal that have been offered by the repowering construction
17 contractors. Because PacifiCorp will be replacing the entire machine head (nacelle,
18 hub, and rotor) of the repowered turbines, the removed equipment has the potential to
19 be reused and redeployed to another site location. This may make the equipment
20 valuable for redeployment elsewhere in the country, or perhaps elsewhere in North
21 America.

22 PacifiCorp understands that a significant number of turbines of all makes and
23 models will be repowered before 2020. This creates potential value for the removed

1 equipment as spare parts for similar type turbines that will remain in service. This
2 also makes it difficult, however, to use current market pricing for used turbines as a
3 proxy for the potential salvage value of the equipment given the large number of
4 repowered turbines and associated spare parts that will become available in the next
5 several years. Because not all of PacifiCorp's GE turbines will be repowered, some
6 of the equipment can potentially be used as spare parts to service the non-repowered
7 turbines.

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

11 A. PacifiCorp has not assumed any salvage value for the removed equipment in its
12 economic analysis. To the extent PacifiCorp determines any salvage value by reusing
13 the equipment, or by selling or auctioning it to third parties, the company will pass
14 through any and all additional financial benefits to its customers.

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

16 A. Yes.