

Confidential per WAC 480-07-160
Exh. TJH-1CT
Docket UE-19____
Witness: Timothy J. Hemstreet

**BEFORE THE WASHINGTON
UTILITIES AND TRANSPORTATION COMMISSION**

WASHINGTON UTILITIES AND
TRANSPORTATION COMMISSION,

Complainant,

v.

PACIFICORP dba
PACIFIC POWER & LIGHT COMPANY

Respondent.

Docket UE-19____

PACIFICORP

REDACTED DIRECT TESTIMONY OF TIMOTHY J. HEMSTREET

December 2019

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Exhibit No. TJH-2—Major Components of a Wind Generator

Exhibit No. TJH-3—List of Repowering Projects

Confidential Exhibit No. TJH-4C—Repowering Project Details, Capital Costs, and In-Service Dates

Exhibit No. TJH-5—Existing and Repowered Turbine Power Curve Comparison

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 Managing Director of
4 Renewable Energy Development for PacifiCorp. I am testifying for PacifiCorp dba
5 Pacific Power & Light Company (PacifiCorp or the Company).

6 **QUALIFICATIONS**

7 **Q. Briefly describe your education and professional experience.**

8 A. I hold a Bachelor of Science degree in Civil Engineering from the University of Notre
9 Dame in Indiana and a Master of Science degree in Civil Engineering from the
10 University of Texas at Austin. I am also a Registered Professional Engineer in the
11 state of Oregon. Before joining PacifiCorp in 2004, I held positions in engineering
12 consulting at CH2M HILL (now Jacobs Engineering, Inc.) and environmental
13 compliance at RR Donnelley Norwest, Inc. Since joining PacifiCorp, I have held
14 positions in environmental policy and compliance, engineering, project management,
15 and hydroelectric project licensing and program management. In 2016, I assumed a
16 role in renewable energy development, focusing on PacifiCorp's wind repowering
17 effort, and assumed my current role in June 2019, in which I oversee the development
18 of renewable energy resources that enhance and complement PacifiCorp's existing
19 renewable energy resource portfolio.

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

21 A. Yes. I have previously sponsored testimony in all of the states in which PacifiCorp
22 does business as a public utility.

1 **PURPOSE OF TESTIMONY**

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

3 A. To demonstrate that PacifiCorp’s upgrades to “repower” its wind fleet are prudent and
4 in the public interest, my testimony provides the following information:

- 5 • The scope of the wind repowering project;
- 6 • The financial benefits of repowering resulting from the qualification for
7 federal production tax credits (PTCs);
- 8 • The increased energy benefits following repowering;
- 9 • The reduced ongoing operating costs following repowering;
- 10 • The extension of wind facility asset lives after repowering;
- 11 • Project implementation status and construction schedule; and
- 12 • The disposition of removed equipment.

13 **SUMMARY OF TESTIMONY**

14 **Q. Please summarize your testimony.**

15 A. Through its wind repowering project, PacifiCorp is leveraging past investments in its
16 wind fleet and enhancing the future value of these resources for the benefit of its
17 customers. By executing wind turbine equipment purchases in late 2016, PacifiCorp
18 secured the opportunity to repower and renew its wind fleet and to thereby qualify the
19 repowered facilities for the full value of the PTCs for another 10-year period.
20 Repowering provides a unique opportunity to take advantage of efficiency and
21 reliability improvements in wind generation technology and return PacifiCorp’s wind
22 fleet to like-new condition while enhancing performance and minimizing
23 maintenance expenditures.

1 By incorporating recent technical advances that allow for installation of longer
2 blades and nacelles with higher capacity generators, repowering will result in
3 significantly more low-cost energy for customers—814 gigawatt-hours (GWh)
4 annually, or an average increase of 27 percent. Further, repowering with new
5 equipment will extend the asset lives of the wind facilities by at least 10 years,
6 allowing the wind facilities to continue serving customers well into the future.

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

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

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

12 A. Repowering broadly describes the upgrade of an existing, operating wind facility with
13 new wind-turbine-generator (WTG) equipment that can increase a facility's
14 generating capacity and the amount of electrical generation produced from the
15 facility. Specifically, PacifiCorp's repowering plan involves replacing the nacelle,
16 hub and rotor of the WTG at all facilities except the Foote Creek I facility, where
17 repowering will involve replacement of the existing WTGs. *See Exhibit No. TJH-2*
18 for a depiction of a wind turbine and its various components.

19 **Q. Which facilities will be repowered?**

20 A. PacifiCorp has or will repower the facilities known as High Plains, Glenrock I,
21 Glenrock III, Goodnoe Hills, Leaning Juniper, Marengo I, Marengo II, McFadden
22 Ridge, Rolling Hills, Seven Mile Hill I, Seven Mile Hill II, Dunlap, and Foote Creek I
23 facilities in Wyoming in 2020.

1 **Q. How many megawatts (MW) of installed wind capacity is PacifiCorp**
2 **repowering?**

3 A. PacifiCorp is repowering all of its 13 wind facilities in 2019 and 2020, representing
4 1,039.9 MW of installed wind capacity. Detailed information about the wind
5 facilities PacifiCorp is repowering is included in Exhibit No. TJH-3.

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

7 A. The wind facilities PacifiCorp is repowering began commercial operations between
8 1999 and 2010. Aside from the Foote Creek I facility, the facilities in PacifiCorp's
9 wind fleet can be economically repowered, or upgraded, with new technology that
10 will improve their efficiency and increase their generation output, without incurring
11 the cost to replace the existing towers, foundations, and energy collection systems,
12 which are of sufficient design to accommodate more modern equipment now
13 available. The existing foundations and towers, although more than 10 years old in
14 some instances, are adequately designed to accommodate larger, more modern WTG
15 equipment and still have a sufficient remaining useful life to economically justify the
16 associated investment.

17 In contrast, at the Foote Creek I facility developed more than 20 years ago, the
18 WTG equipment has a low generating capacity (600 kilowatt) and the towers and
19 foundations supporting the nacelle and rotor do not have the necessary height or
20 design strength to accommodate the installation of modern, larger nacelles and rotors
21 capable of generating a much greater amount of electricity per WTG. Thus, for the
22 Foote Creek I facility, as with older facilities of its type, repowering involves the
23 removal of all of the old wind turbine equipment, including towers, foundations, and

1 energy collection system, and replacement with new equipment and energy collector
2 circuits appropriately sized for the new equipment. Repowering at the Foote Creek I
3 facility will result in the replacement of 68 existing small-capacity wind turbines
4 currently at the site with just 13 modern wind turbines.

5 Because PacifiCorp is repowering all but its Foote Creek I facility in a way
6 that allows the company to reuse the existing infrastructure of the towers,
7 foundations, and energy collection systems, the energy and PTC benefits can be
8 realized with a lower capital investment than would be required for the
9 redevelopment of entire sites.

10 **Q. When did PacifiCorp initiate its wind repowering project?**

11 A. PacifiCorp began the wind repowering project in the fall of 2016, and authorized the
12 acquisition of safe harbor equipment to facilitate repowering of its fleet of General
13 Electric turbines in early December 2016.

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 and Foote Creek I. When the 2017 IRP was
17 developed, PacifiCorp had not assessed repowering either Goodnoe Hills or Foote
18 Creek I. After finalization of the 2017 IRP, however, PacifiCorp evaluated
19 repowering both facilities and determined that they could be repowered and provide
20 economic benefits to customers, similar to the other facilities evaluated in the 2017
21 IRP. Mr. Link describes the Company's analysis of the wind repowering project in
22 the 2017 IRP.

1 **Q. As you note above, the scope of repowering at Foote Creek I is different than**
2 **repowering at the Company's other wind facilities. Can you provide additional**
3 **background on the Company's decision to repower Foote Creek I?**

4 A. Foote Creek I was the Company's first wind energy facility, and reached commercial
5 operation in April 1999 as a demonstration project to evaluate the feasibility of
6 utility-scale wind energy. The facility was developed in partnership with the Eugene
7 Water & Electric Board (EWEB) and the Bonneville Power Administration (BPA).
8 As developed, Foote Creek I was co-owned by EWEB (21.21 percent ownership) and
9 PacifiCorp (78.79 percent ownership), with BPA taking 37 percent of the facility's
10 output through a 25-year cost-based power purchase agreement (PPA). As the first
11 utility-scale wind energy project in Wyoming, Foote Creek I was sited at one of the
12 most favorable wind sites in the United States and enjoys the highest wind speeds of
13 any of the Company's wind projects. Unlike the remainder of the facilities the
14 Company is repowering, the Foote Creek I project is unique in that it was co-owned
15 and also had a third-party PPA associated with the resource.

16 The Foote Creek I facility currently consists of 68 turbines with a 600-
17 kilowatt generating capacity, a rotor diameter of 42 meters and towers that support a
18 40 meter hub height. Although employing the latest technology when originally
19 installed, the existing turbines are costly to operate and maintain relative to the
20 Company's more modern turbines that have a much higher nameplate capacity, larger
21 rotor diameters, and taller towers. Accordingly, the operations and maintenance costs
22 of the Foote Creek I facility are the highest of all of the Company's owned wind
23 resources on a per-megawatt basis since the maintenance requirements for these

1 smaller turbines are similar to those of larger turbines, but the capacity of the Foote
2 Creek I turbines is much less.

3 The costs associated with continued operation of the existing turbines at Foote
4 Creek I for both the Company and EWEB were also anticipated to increase after the
5 expiration of the BPA PPA in April 2024 since 37 percent of the costs of the project
6 would no longer be covered through the cost-based PPA. Similarly, BPA was
7 required to take higher cost energy from the project until the PPA expired. For these
8 reasons, PacifiCorp, EWEB, and BPA were all motivated to explore whether the
9 existing Foote Creek I project could be unwound in order to achieve an outcome more
10 favorable to customers as compared to continuing to operate the facility through its
11 planned 30-year asset life. Repowering the facility presented the opportunity to
12 realize this outcome for customers.

13 **Q. What was necessary to achieve that outcome?**

14 A. Because of the very favorable wind conditions at the site, the Company was interested
15 in repowering the facility so that customers could benefit from the low-cost energy
16 that could be generated at the site with modern wind turbine equipment qualified at
17 100 percent of the value of the PTC. To achieve that, however, it was necessary for
18 the Company to acquire EWEB's ownership share of the facility and to cancel the
19 existing PPA with BPA. The Company negotiated a PPA termination agreement with
20 EWEB and BPA, and a purchase and sale agreement with EWEB for its interests in
21 the facility. The termination of the PPA was negotiated to be effective upon
22 PacifiCorp's acquisition of EWEB's interest in the project, and the closing of the
23 purchase and sale agreement with EWEB was contingent upon the Company

1 obtaining necessary regulatory and permitting approvals related to repowering as well
2 as satisfactory commercial arrangements for turbine supply and construction that
3 ensured repowering could occur.

4 **Q. How much did the Company pay EWEB for its interests in the facility?**

5 A. PacifiCorp paid EWEB approximately [REDACTED] for its interests in the facility.

6 **Q. Did the Company incur costs to terminate the Foote Creek I PPA with BPA?**

7 A. No. Under the termination agreement, BPA paid an early termination payment for the
8 facility in the amount of [REDACTED]—the Company's
9 78.79 percent ownership share of the facility—was paid to the Company. This
10 payment to the Company and EWEB reflected the fact that BPA realizes savings by
11 terminating the PPA early and replacing the power with lower cost energy resources.

12 **Q. Were these amounts consistent with the Company's expectations?**

13 A. Yes, these payments were consistent with the Company's economic analysis of the
14 Foote Creek I repowering project, which is described by Mr. Link.

15 **Q. Did the Company enter other commercial arrangements related to repowering at
16 Foote Creek I?**

17 A. Yes, the Company executed a turbine supply agreement with Vestas and executed a
18 balance of plant construction contract with Thorstad Companies, Inc. Both contracts
19 were awarded following competitive solicitation processes. When these contracts
20 were finalized, the Company proceeded to close on the purchase of EWEB's interest
21 in the project and terminate the PPA. The Company also purchased the wind energy
22 lease rights for the Foote Creek I facility.

1 **Q. Why did the Company purchase the wind energy lease rights for Foote Creek I?**

2 A. The Company was operating the Foote Creek I facility under land rights that were
3 subleased from Chandar Energy Land Associates, Inc. (CELA), which held the master
4 wind energy lease rights with the ultimate property owners upon whose land the
5 Foote Creek I turbines are located. The wind energy lease payments due to CELA
6 under the sublease were production-based and were costly as compared to what the
7 Company pays for similar production-based wind energy leases, even given the high-
8 value wind energy resource at the site. The Company was able to negotiate the
9 purchase of the master wind energy leases from CELA at a cost that improved the
10 economics of the Foote Creek I repowering project relative to continuing to operate
11 under the existing sublease. Additionally, the master wind energy lease rights can be
12 renewed for a total term of up to 99 years, providing potential future customer
13 benefits even beyond the asset life of the repowered Foote Creek I facility.

14 **Q. Were there unique permitting requirements related to Foote Creek I as**
15 **compared to the other repowering projects?**

16 A. Yes. It was necessary for the Company to obtain a new Certificate of Public
17 Convenience and Necessity from the Wyoming Public Service Commission related to
18 repowering the facility, and a new Conditional Use Permit from Carbon County,
19 Wyoming. The Company also had to obtain concurrence from the Bureau of Land
20 Management (BLM) that repowering was consistent with the existing right of way
21 grant from BLM for the facility, and the Company worked with the U.S. Fish and
22 Wildlife Service to review the locations of the new turbines on the existing project
23 footprint to evaluate potential avian impacts associated with the new turbine layout.

1 **Q. When did the Company finally approve repowering the Foote Creek I facility?**

2 A. The Company approved repowering the facility on June 25, 2019. The Company

3 then closed on the purchase of EWEB's interest in the facility on July 24, 2019.

4 Following approval of the repowering project, the Company was able to negotiate the

5 purchase of the master wind leases and incorporated this change in the project scope.

6 The Company subsequently closed on the purchase of the master wind energy lease

7 rights from CELA on August 8, 2019.

8 **Q. Are costs to repower all of the Company's wind facilities included in this filing?**

9 A. Yes. The Company's filing contains the cost associated with repowering the entirety

10 of PacifiCorp's owned wind fleet, as described above.

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

12 A. Repowering the Company's wind facilities requalifies them for PTCs, which are

13 benefits that are passed through to customers in this case. Additionally, repowering

14 increases the amount of emissions-free energy produced from the repowered facilities

15 by 17 to 59 percent, depending on the facility, as shown in Confidential Exhibit No.

16 TJH-4C. Further, by replacing older WTG equipment, which is subject to more

17 failure and maintenance issues than newer equipment, repowering will reduce

18 PacifiCorp's ongoing operating costs. Finally, repowering the wind facilities with

19 new WTG equipment will extend the useful lives of the facilities between 10 to 21

20 years, depending on the facility, creating substantial energy and capacity benefits for

21 customers in the future when these wind facilities would otherwise have been retired

22 from service.

1 **REQUALIFICATION FOR PTCS**

2 **Q. How do wind facilities qualify for the PTC extension enacted in 2015?**

3 A. On December 18, 2015, Congress enacted changes to the federal Internal Revenue
4 Code extending the full value of the PTC for wind facilities that began construction in
5 2015 and 2016. The legislation also provided for a phase-out of the PTC over three
6 years, reducing the PTC value by 20 percent for wind facilities beginning
7 construction in 2017, 40 percent for wind facilities beginning construction in 2018,
8 and 60 percent for wind facilities beginning construction in 2019. The Internal
9 Revenue Service (IRS) has issued guidance that establishes a “safe harbor” for
10 taxpayers to demonstrate the year a facility will be deemed to “begin construction,”
11 thereby setting the value of the PTC. If at least five percent of the total project costs
12 were incurred in 2016, then the facility qualifies under the IRS safe harbor for the full
13 value of the PTC, provided the taxpayer can demonstrate “continuous efforts” to
14 complete construction. The IRS has issued additional guidance that establishes a safe
15 harbor for satisfying this continuous-efforts standard. Under the continuous-efforts
16 safe harbor, the wind facilities must be in service by the end of the fourth calendar
17 year following the calendar year in which construction began. Thus, wind facilities
18 that began construction in 2016 must be in service no later than December 31, 2020,
19 to satisfy the continuous-efforts safe-harbor provisions. If the facilities are not placed
20 in service by December 31, 2020, the projects must satisfy IRS requirements that
21 continuous-efforts were expended to repower the facilities, which may be a more
22 challenging standard to meet.

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

2 A. For 2019, wind facilities that are qualified for the PTC will receive 2.5 cents per
3 kilowatt-hour, or \$25 per megawatt-hour. This PTC value is adjusted annually based
4 upon an inflation index, and the PTC is available for energy produced during the
5 10-year period after the wind facility begins commercial operation.

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

8 A. Yes. Consistent with IRS guidance, a facility owner can demonstrate that
9 construction of a facility has begun in the year in which at least five percent of the
10 applicable project costs are incurred. If wind turbine equipment is purchased and
11 delivered in 2016, and the equipment comprises at least five percent of the applicable
12 project costs, a PTC "safe harbor" is created for the wind facilities subsequently
13 constructed. To meet this requirement, PacifiCorp executed safe harbor equipment
14 purchases with General Electric International, Inc. (GE) and Vestas American Wind
15 Technology, Inc. (Vestas) in December 2016, and took delivery of equipment with a
16 value sufficient to give the company the ability to repower its entire wind fleet and
17 qualify the repowered wind facilities for 100 percent of the PTC value. For the Foote
18 Creek I facility, PacifiCorp will use safe harbor equipment obtained from Berkshire
19 Hathaway Energy Renewables (BHER), a Berkshire Hathaway Energy affiliate,
20 which similarly made safe harbor equipment purchases from Vestas in December
21 2016 of equipment that can be used to qualify the Foote Creek I project for
22 100 percent of the PTC value.

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 2016-31 (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. Are all of the facilities PacifiCorp is repowering subject to this 80/20 test?**

15 A. No. Because the Foote Creek I facility will be repowered without using any retained
16 components—meaning the tower and foundations of the existing turbines at the site
17 will not be reused—the 80/20 test does not apply to this repowered facility. Thought
18 of another way, the applicable repowering costs at this project, on a per-turbine basis,
19 would equal 100 percent of the repowering costs at this facility since there are no
20 retained components, satisfying the 80/20 test.

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

23 A. Yes. The repowering project has been scoped to ensure that the 80/20 test, which is

1 applied at the time the turbine is repowered, will be met for each turbine repowered.
2 Not all turbines at all wind facilities, however, will be repowered because the retained
3 value of the towers and foundations at certain wind turbines does not allow them to
4 meet the 80/20 test before the end of 2020, when the repowered wind facilities must
5 be completed to obtain the full PTC value.

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

7 A. Repowering at Glenrock I, Rolling Hills, and Glenrock III, which are located near
8 Glenrock, Wyoming, did not include all wind turbines. At these locations, 32 of the
9 158 wind turbines were not repowered because they were constructed atop mine
10 tailings at the Company's reclaimed Glenrock coal mine and required special pile
11 foundations. These special foundations were more expensive to construct than the
12 standard foundations found elsewhere on those facility sites and at other PacifiCorp
13 wind facility locations. Because the original construction cost of these foundations
14 was higher than for standard foundations, the retained value of these foundations is
15 also higher than the other foundations. For these 32 wind turbine locations, the
16 higher retained value of the foundations means that repowering, while technically
17 feasible, would not qualify those turbines for PTCs, which is necessary for the
18 repowering to be economic. PacifiCorp will repower all of the turbines at the other
19 wind facilities discussed above.

20 **Q. How else did PacifiCorp scope the repowering project to maximize the benefits**
21 **of available PTCs?**

22 A. As shown in Exhibit No. TJH-3, most of the wind facilities PacifiCorp repowered just
23 recently completed 10 years of operation. Thus, the PTCs from original construction

1 have either recently expired or are still accruing to the benefit of PacifiCorp's
2 customers for a small remaining period until these existing PTCs expire 10 years after
3 the facilities' commercial online date. Between May 2018 and October 2020, the
4 PTCs associated with approximately 2.3 terawatt-hours (TWh) of electricity
5 generated at PacifiCorp's wind facilities will expire. On an annual basis, in 2019
6 dollars, the expiration of these PTCs represents the loss of approximately \$75 million
7 per year in total system customer PTC benefits, as shown in Confidential Exhibit No.
8 TJH-4C.

9 To maximize the benefits of the existing PTCs available from the wind
10 facilities, PacifiCorp has generally delayed repowering until the original PTCs have
11 expired. The exceptions to this are the High Plains, McFadden Ridge, and Dunlap
12 facilities. To take advantage of available construction capacity and the low-wind
13 season in 2019, High Plains and McFadden Ridge repowering began in advance of
14 when PTCs expired at those facilities in September 2019. In addition, if the
15 Company waited until the Dunlap PTCs expire in October 2020 to repower the
16 facility, there would be insufficient time to complete construction at Dunlap by the
17 end of 2020, as required to requalify for PTCs. This results in a slight truncation of
18 the existing, original 10-year PTC period for these facilities. As with all of the wind
19 facilities, however, once these facilities are repowered a new 10-year period will
20 begin for the full value of PTCs.

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

3 A. No. The Tax Cuts and Jobs Act enacted into law in December 2017 does not change
4 the repowered facilities qualification for the full value of PTCs.

5 **INCREASED ENERGY BENEFITS FOLLOWING REPOWERING**

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

7 A. Repowering will involve the replacement of the existing machine heads including the
8 nacelle, hub and rotor, while the Foote Creek I facility will employ entirely new wind
9 turbines with new foundations and taller towers. The new nacelles have generators
10 that have a greater nameplate generating capacity than the equipment that is removed.
11 For example, the nameplate rating of each turbine at the Wyoming facilities will
12 increase from 1.5 MW to 1.85 MW, while at the Marengo facility, the generator
13 nameplate rating will increase from 1.8 MW to 2.0 MW. At Foote Creek I, the new
14 turbines installed at the site will have generator nameplate ratings of 2.0 MW and
15 4.2 MW, replacing existing turbines with a 0.6 MW nameplate rating. Details
16 regarding the proposed wind turbine upgrades, capital project costs, in-service dates,
17 and resulting energy benefits are shown in Confidential Exhibit No. TJH-4C.

18 In addition to the larger generators in the repowered turbines, the new turbines
19 also include larger blades, which will increase the rotor-swept area of the wind
20 turbines. A larger rotor-swept area allows more of the wind energy flowing past the
21 wind turbine to be captured and converted by the wind turbine into electricity.
22 Because the size of the rotors will increase, the repowered turbines will also include

1 more robust hubs, main shafts, bearings and couplings, and gearboxes suitable to
2 handle the greater torque exerted by the larger rotors.

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

5 A. Not necessarily. Although the larger blades will increase the overall risk zone (rotor-
6 swept area) of the repowered wind turbines, this does not necessarily correlate with
7 an increased risk of avian impacts at existing turbine sites. PacifiCorp will continue
8 to implement its current informed-curtailment protocols employed at sites with higher
9 avian usage after repowering to minimize avian impacts. Informed-curtailment
10 involves the shutdown of wind turbines when species of interest are in the vicinity.
11 PacifiCorp's informed-curtailment protocols avoid avian impacts regardless of the
12 rotor-swept area. Additionally, PacifiCorp performs monthly monitoring at all of its
13 wind facilities and reports all findings to state wildlife agencies and the U.S. Fish and
14 Wildlife Service. PacifiCorp will continue this monthly monitoring to determine if
15 the new turbine blades cause additional impacts to avian species and will engage with
16 the appropriate agency to discuss and, if prudent and practicable, implement
17 additional avoidance, minimization, or mitigation measures.

18 **Q. Are there other ways that the Company has attempted to minimize avian**
19 **impacts?**

20 A. Yes. At the Foote Creek I facility, the significant reduction in the number of turbines
21 required with site repowering means that less of the overall project site area will be
22 covered by wind turbines. This has allowed the Company to adjust the layout of the

1 wind turbines at the project site to avoid areas of higher avian use such as the edges
2 of Foote Creek Rim.

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

5 A. For all projects other than Foote Creek I, where the turbine locations and turbine hub
6 heights are not changing, PacifiCorp worked with its consultant, Black & Veatch
7 (B&V), to use the extensive data history from PacifiCorp's facilities to derive
8 estimates of the energy production expected from repowering. This analysis used
9 millions of data points from the operational record of the wind facilities and
10 incorporated additional modeled wake losses anticipated from the new equipment.
11 Wake losses are the reduction in generation at turbines downwind of other turbines
12 due to reduced wind speed and increased turbulence in the airflow—or wake—behind
13 a turbine.

14 Based on its analysis, PacifiCorp and B&V estimate that energy production
15 following repowering will increase as shown in Confidential Exhibit No. TJH-4C,
16 and as further discussed below. These results reflect as accurately as possible the
17 energy production that would have occurred from the repowered turbines under the
18 same operational conditions and availability as the existing equipment. However,
19 these repowering energy estimates may be conservative. They are based solely on the
20 different equipment performance specifications of the newer equipment and do not
21 account for expected improvements in operational availability of the wind facilities
22 following repowering. Availability of the wind turbines likely will improve after
23 repowering given the additional sensors and condition monitoring systems in the

1 repowered turbines that should allow for improved diagnostics and implementation of
2 preventative maintenance measures that can reduce turbine down-time. Additionally,
3 PacifiCorp will operate the new turbines under service agreements with the turbine
4 suppliers GE and Vestas with performance guarantees and incentives that are likely to
5 result in more availability and generation than PacifiCorp has achieved in the past
6 under similar wind conditions. These contracts are discussed in more detail later in
7 this testimony.

8 **Q. How did the energy estimate methodology differ for the Foote Creek I facility?**

9 A. At the Foote Creek I facility, B&V evaluated historical project generation and
10 availability data from the existing Foote Creek I turbines, local and project-specific
11 meteorological information, and the new proposed turbine layout to model the
12 anticipated energy output of the repowered wind project, similar to the approach used
13 by the Company to estimate the energy output from its new wind projects now under
14 construction.

15 **Q. Why was this approach most suitable for Foote Creek I?**

16 A. This approach was most suitable because the turbine locations are changing at Foote
17 Creek I, as discussed above, and also because the turbine hub heights are increasing
18 from 40 meters to 80 meters. Thus, the wind conditions—wind speeds, turbulence
19 intensity, and inflow angle to the wind turbines—experienced by the existing turbines
20 may not be representative of what the new turbines will experience. For these
21 reasons, wind modeling was relied upon to develop the energy estimate for Foote
22 Creek I.

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

2 A. The larger rotor size and improvements in blade design of the new equipment
3 generate more power at all ranges of wind speeds. Additionally, some of the new
4 turbines begin producing power at a lower wind speed than the existing equipment;
5 thus, the turbines can produce energy during lower wind conditions in which the
6 current equipment may sit idle. Because the new turbines will have an increased
7 generator capacity, the turbines will also produce more energy when wind speeds are
8 high and the turbines are at their maximum output. Exhibit No. TJH-5 illustrates
9 these power production advantages and compares the power curve of an existing wind
10 turbine to that of a repowered wind turbine.

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

13 A. Wind turbine technology has continued to advance since the facilities were first
14 constructed between 2006 and 2010. The use of new composite materials has
15 allowed blade lengths to increase without adding weight, allowing for the extraction
16 of more energy from the available wind resources at the facility sites. In addition,
17 more sophisticated sensor and control systems in the wind turbines, combined with
18 improved blade pitch control systems, increase the ability of the wind turbine control
19 systems to implement load mitigation strategies on the wind turbines to reduce the
20 loading on the power train, towers and foundations. For facilities employing entirely
21 new wind turbines, these technology improvements mean that longer blades and
22 additional generating capacity are possible without a commensurate increase in cost
23 to strengthen the turbine structural components (including the tower and foundation).

1 For new wind facilities, this is one of the drivers towards reduced energy costs. For
2 existing wind facilities where the tower and foundation can be re-used, these new
3 load mitigation technologies mean that the existing towers and foundations are
4 suitable for the installation of larger equipment through repowering.

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

6 A. As shown in Confidential Exhibit No. TJH-4C, across the wind fleet, the proposed
7 repowered wind facilities are estimated to increase generation by 814 GWh per year,
8 an increase of 27 percent.

9 **REDUCED ONGOING OPERATIONAL COSTS FOLLOWING REPOWERING**

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

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

22 The repowering project will also result in more certainty related to ongoing
23 operations and maintenance costs of the existing wind facilities. PacifiCorp will

1 operate the repowered projects under full service agreements with the turbine
2 equipment suppliers who will be responsible for operating and maintaining the new
3 turbines for a fixed cost while attaining a guaranteed availability of the turbines.
4 Under these agreements, failure to meet the guaranteed availability, if not the result of
5 an excusable event defined in the contract, will result in the payment of liquidated
6 damages to the company. Customers will benefit by having operations and
7 maintenance costs fixed for the term of the agreement. Thus, there is greater cost
8 certainty related to the run-rate capital expenditures and operations and maintenance
9 costs of the repowering projects.

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

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

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

23 A. These gearbox failures generally cannot be repaired “up-tower.” This means that the

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

7 **Q. How many gearbox failures of this type did PacifiCorp expect if there was no**
8 **repowering?**

9 A. There were 230 of these gearbox models remaining in the wind fleet before
10 repowering, and PacifiCorp anticipated that all of these remaining gearboxes would
11 have failed between 2017 and 2031.

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

14 A. No. Ten of the 32 wind turbines that will not be repowered at Glenrock I, Glenrock
15 III, and Rolling Hills have these gearbox models that will need to be replaced, which
16 was factored into the Company's economic analysis when it decided to proceed with
17 repowering. Under the terms of PacifiCorp's negotiated full service agreement for
18 these facilities, these costs will be the responsibility of either GE or Vestas, depending
19 on the equipment used at the site.

20 **Q. Did gearbox failures also factor in to the Company's decision to repower the**
21 **Foote Creek I facility?**

22 A. Yes. Similar to the gearbox models discussed above, gearboxes at the Foote Creek I
23 facility have also experienced high failure rates relative to other gearboxes in the

1 wind fleet. However, the impact to the Company of these failures has been mitigated
2 by an agreement that was set to expire in 2024, at which point the cost of addressing
3 failed gearboxes would be borne entirely by the Company and EWEB. Given the
4 short remaining life of the project in 2024—with just 5 years of operational life
5 remaining—turbines that experienced a failed gearbox after that time could not be
6 economically returned to service given the limited remaining generation anticipated
7 from the turbines and the estimated cost to replace a failed gearbox. Thus, the
8 Company was also facing diminished generation from the Foote Creek I facility after
9 the expiration of the gearbox warranty.

10 **Q. Have other significant capital costs been avoided with repowering?**

11 A. Yes. Aside from the gearbox issues, repowering also avoids ongoing capital
12 expenditures related to blade costs at Goodnoe Hills. Blade expenditures at this
13 facility to address a blade design deficiency accounted for approximately 60 percent
14 of the budgeted capital costs associated with blade failures and refurbishments across
15 PacifiCorp’s wind fleet, even though Goodnoe Hills accounts for only seven percent
16 of the turbines. Repowering is expected to bring blade costs for that facility in line
17 with PacifiCorp’s expenditures at its other facilities, resulting in reduced capital costs
18 to keep the wind fleet meeting its operational performance targets.

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

1 **Q. Will the new repowering equipment have similar failure issues as the old**
2 **gearboxes in the old turbines?**

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

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

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

17 A. All of the existing wind facilities are currently being depreciated assuming a 30-year
18 asset life. The facilities PacifiCorp is repowering were previously scheduled to be
19 retired between 2029 and 2040 (*see* Exhibit No. TJH-3).

20 **Q. Has repowering the wind facilities extended their useful operating lives beyond**
21 **the previously planned retirement dates?**

22 A. Yes, repowering the wind facilities extends their life 30 years from the repowering
23 date, adding approximately 10 years or more to their planned retirement dates.

1 **Q. How does repowering extend the useful life by 30 years from the repowering**
2 **date?**

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

12 **Q. What factors have been independently reviewed to assess and certify the design?**

13 A. The third-party design assessment evaluated the site-specific load assumptions based
14 upon the climatic conditions at each facility and assessed the control and protection
15 systems for the wind turbine and their ability to meet the site design conditions. It
16 also assessed the electric components, the rotor blades, hub, machine components
17 (*i.e.*, drivetrain, main bearing and gearbox), and the suitability of the existing tower
18 upon which the new wind turbine equipment was installed.

19 **Q. Did the design certification also evaluate the ability of the existing foundations to**
20 **handle the loads associated with the repowered turbines?**

21 A. No. The design certification assessed the design loads and the design assumptions
22 regarding the ability of the new turbines and the existing towers to handle those loads.

1 But as with new wind facility development, the facility owner must provide a
2 foundation suitable to handle the loads imparted by the tower on the foundation.

3 **Q. Has PacifiCorp reviewed the existing foundations to ensure they are capable of**
4 **handling the new turbines?**

5 A. Yes. PacifiCorp retained B&V to evaluate the ability of the existing foundations to
6 handle the loads of the repowered turbines. B&V's evaluation indicates that the
7 existing foundations are suitable for the repowered turbines. At the Leaning Juniper
8 and Goodnoe Hills facilities, the foundations required a standard retrofit to increase
9 their strength to ensure they have adequate design strength and meet current design
10 standards.

11 **Q. Has PacifiCorp evaluated the foundations to determine if they are suitable for a**
12 **30-year service life following repowering?**

13 A. Yes. For the foundations in which fatigue loading is a controlling design variable,
14 B&V assessed the ability of the foundations to handle the estimated fatigue loading
15 anticipated for a 30-year period following repowering and determined that all the
16 foundations are able to accommodate the additional loading.

17 **PROJECT CONTRACTS AND CONSTRUCTION STATUS**

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

19 A. PacifiCorp executed a master retrofit contract with GE for the Wyoming projects
20 (except for Foote Creek I) and the Leaning Juniper project in Oregon in June 2018,
21 and has executed turbine supply contracts with Vestas for the other four projects. The
22 scope, language, and risk profile of the agreements with each of the companies is
23 different.

1 The master retrofit contract commits GE to perform turn-key supply, delivery,
2 installation, and commissioning of the repowering turbines at a fixed price.
3 PacifiCorp has also executed fixed-price turbine supply agreements with Vestas and
4 has executed and negotiated separate contracts with wind energy construction
5 companies for installation of the Vestas equipment at the remainder of the repowering
6 projects.

7 **Q. Has PacifiCorp completed the majority of construction for the repowering**
8 **projects under the GE master retrofit contract?**

9 A. Yes. Retrofit work orders were issued for all of those projects and the majority of
10 construction work will be completed in 2019. Indeed, seven of the nine projects that
11 will be repowered under the GE master retrofit contract have achieved commercial
12 operation.

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 were executed in 2018 and Vestas has
16 completed delivery of the new turbine equipment it is supplying for the projects that
17 are being completed in 2019. All the new turbine equipment has been installed at the
18 Goodnoe Hills facility and installation of the new equipment is currently ongoing at
19 the Marengo facilities. Electrical and turbine commissioning work to bring all of
20 these projects to completion is also ongoing. The Foote Creek I project, which will
21 also use turbines supplied by Vestas, has initiated civil and foundation construction,
22 but the majority of the work will be completed in 2020.

1 **Q. Given that the repowering projects are now under construction, with some**
2 **having now reached commercial operations, are the project capital costs still**
3 **consistent with those used by the Company in its financial analysis?**

4 A. Yes. Project costs remain consistent with the estimated costs used to inform the
5 Company's economic analysis of repowering. I do not anticipate project costs will, in
6 aggregate, exceed those amounts. However, construction efforts are still underway at
7 many projects, and some will not complete construction until next year. The
8 Company will update its in-service amounts for the projects when final cost
9 information is known.

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

13 A. No. The contracts provide that the prices are fixed and have no adjustment
14 mechanisms for those common price indexes. Generally, the turbine suppliers can
15 only seek a change order for price relief as a result of changes in state and/or local
16 law that impacts their costs, or for civil infrastructure improvements and construction
17 delays related to wind conditions. As such, the vast majority of repowering costs are
18 now fixed under these negotiated contracts, which substantially reduces risk of cost
19 over-run.

20 **Q. When will the repowering projects be completed?**

21 A. Eleven of the thirteen repowering projects are being constructed in 2019—well in
22 advance of the deadline for completing construction and achieving commercial
23 operations of the repowered facilities. The remaining two projects—Dunlap and

1 Foote Creek I—are scheduled to be completed in 2020. PacifiCorp’s construction
2 schedule has been developed to optimize the PTC benefits of the facilities and ensure
3 that the facilities can be constructed during the low-wind season—between March
4 and November.

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

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

11 **Q. Do permitting requirements apply to repowering facilities that will re-use the**
12 **existing towers and, if so, has the Company obtained all the necessary permits to**
13 **ensure the construction schedule will not be delayed due to permitting issues?**

14 A. Because these repowering projects do not increase the footprints of the existing wind
15 facilities, and since the facilities are operating under current local, state, and federal
16 permits and authorizations, the permitting requirements for repowering are minimal.
17 Because the facility footprints are not altered and since repowering is unlikely to
18 disturb additional acreage not already covered by existing permits, additional
19 standard construction permits are limited. PacifiCorp has obtained all of the
20 necessary permits required for the repowering projects to be completed, such as
21 Federal Aviation Administration permits, county conditional use permits, and
22 Wyoming Industrial Siting Division approvals. Necessary building permits have also
23 been obtained. Throughout the repowering process PacifiCorp will ensure that the

1 requirements of the existing permits and authorizations are met, and will provide
2 needed information to permitting authorities to amend or modify the existing permits
3 for the facilities to reflect the change in turbine equipment, if needed.

4 **DISPOSITION OF REPLACED EQUIPMENT**

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

7 A. PacifiCorp issued a request for proposals related to the disposition of the existing
8 equipment in which the Company sought proposals for the purchase or removal of the
9 equipment that will be replaced as part of repowering. In general, proposals received
10 from this solicitation were not favorable as compared to the equipment removal
11 proposals offered by the construction contractors that will be installing the new
12 equipment.

13 PacifiCorp understands that a significant number of turbines of all makes and
14 models are currently being repowered, and will likely continue to be before the sunset
15 of the PTCs available for wind energy projects in 2024. As a result, there is very
16 little market for used turbines and the salvage value of the equipment is very low
17 given the large number of repowered turbines and associated spare parts that have
18 become available as a result of the significant repowering effort that the wind industry
19 is now undertaking. While some individual turbine sales will result from
20 PacifiCorp's efforts to obtain the highest salvage value from the removed equipment,
21 the lowest cost alternative for the disposition of the remaining equipment is generally
22 to allow the construction contractors to retain the equipment so the scrap value offsets
23 their equipment removal, handling, and transportation costs. Given the relative

1 inefficiency of the replaced equipment compared to new equipment, it does not make
2 economic sense to redeploy the replaced equipment at other potential wind sites.

3 **Q. Does the Company's inability to achieve a salvage value for the replaced**
4 **equipment impact the Company's economic analysis of the repowering project?**

5 A. No. PacifiCorp did not assume any salvage value for the replaced equipment in its
6 economic analysis. Thus, project economics are not impacted by the limited amount
7 equipment that will ultimately be re-sold when it is removed.

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

9 A. Yes.