BEFORE THE

WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION

WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION, Complainant, v. NORTHWEST NATURAL GAS COMPANY, Respondent.	Docket UG-_____

NORTHWEST NATURAL GAS COMPANY

Direct Testimony of Joe S. Karney

DISTRIBUTION SYSTEM AND STORAGE FACILITY PROJECTS

Exh. JSK-1T

December 18, 2020

DIRECT TESTIMONY OF JOE S. KARNEY

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I. INTRODUCTION AND SUMMARY

Q. Please state your name and position with Northwest Natural Gas Company ("NW Natural" or "the Company").

A. My name is Joe Karney. My business address is 250 SW Taylor Street, Portland, Oregon 97204. I am the Engineering Senior Director and Chief Engineer for NW Natural. I am responsible for design, construction, operation, and maintenance of the gas distribution system and utility storage plants, and operations support services including work management functions, mapping and compliance.

Q. Please describe your education and employment background.

A. I graduated from the University of Illinois at Urbana-Champaign with a Bachelor of Science in Mechanical Engineering, and I am a registered Professional Engineer in the State of Oregon.

Before being promoted in February 2019 to my current position at NW Natural, I was the Engineering Director for the Company. Prior to holding that position, I was the Senior Manager of Code Compliance for the Company, and managed the regulatory compliance department and represented the Company during safety audits performed by the Washington Utilities and Transportation Commission ("Commission") and the Public Utility Commission of Oregon. I also reviewed and ensured NW Natural's compliance with pending regulatory changes from the U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration ("PHMSA"). Previously, I managed the Company's Construction and System Operations groups. I started my career at the Company with the Integrity Management group and worked on the development and implementation of the Transmission Integrity Management

Program and the Distribution Integrity Management Program. Before joining NW Natural, I worked as an Integrity Management Engineer for Colonial Pipeline Company for four years.

Q. What is the purpose of your testimony?

A. I provide an overview of the Company's major distribution system projects serving Washington customers that have been completed on NW Natural's system since the last rate case (UG-181053), as well as those that are expected to be in service by the first rate effective date in this case. I also describe the projects that have been completed since the last rate case at the Company's storage facilities that are located in Oregon and partially allocated to Washington customers because those projects benefit them, as well as those that are expected to be in service by the first rate effective date in this case.

II. MAJOR DISTRIBUTION SYSTEM AND STORAGE FACILITY PROJECTS

Q. Has the Company previously sought cost recovery for any major distribution system and storage facility projects that have been completed since the Company's 2019 rate case (Docket UG-181053)?

A. Yes. In its last rate case, the Company sought cost recovery for projects called the Lacamas Regional Gate Station, the Mist Standby Generator and the Mist Fiber Network. By its Order 06 in Docket UG-181053, served on October 21, 2019, the Commission approved and adopted the parties' Joint Settlement Agreement that removed these three projects from rate base to reflect that they had yet to be completed and placed in service.

Q. Please provide an update of these three projects.

A. The Company completed and placed in service the Mist Standby Generator in May 2020 and the Mist Fiber Network in October 2020. The combined total cost to complete those two projects is $3.7 million, or $405 thousand on a Washington-allocated basis. The Lacamas Regional Gate Station is scheduled to be completed and in service in March 2021. The total cost to complete the Lacamas Regional Gate Station is expected to be approximately $753 thousand. The Company has included the costs of these three projects in its revenue requirement in this rate case.

Q. Please provide a brief description of the other major distribution system and storage facility projects that are included for recovery in this rate case.

A. In addition to the three projects mentioned above, the Company is requesting recovery for the following significant distribution system and storage facility projects:

- SE 1st Street Grading Project (Phase 1 and Phase 2)
- White Salmon Reinforcement Project
- Gate Station Rebuild Projects:
  - West Vancouver
  - Battle Ground and Ridgefield
- Major Storage Facility Projects – The projects listed below are designed to replace equipment and facilities that reached the end of their useful life and to promote the integrity and reliability of the Mist Storage Facility (or "Mist") or the Company's liquefied natural gas ("LNG") storage facilities.
  - Mist Large Dehydration System Project
  - Mist Instrument and Controls Project (Phase 2)

- Mist 300 and 400 Compressor Controls Upgrade Project
- Mist Well Rework Program (2020 and 2021)
- Mist Corrosion Abatement Project (Phase 3 and Phase 4)
- Mist Valve Control Upgrade Project
- Newport LNG H-2 Vaporizer Controls Project

A. Major Distribution System Projects

1. SE 1st Street Grading Project (Phase 1 and Phase 2)

Q. Please describe the SE 1st Street Grading Project.

A. The City of Vancouver has commenced a multi-phased project to improve the SE 1st Street corridor between SE 162nd Ave and SE 192nd Ave. The SE 1st Street Grading Project is required to preemptively relocate the sections of the Company's main that are in conflict with the City's project. During Phase 1, between SE 162nd Ave and SE 177th Ave, the Company relocated approximately 3,850 feet of Class D high pressure six-inch wrapped steel gas main, 500 feet of Class B gas main and two services, abandoned approximately 300 feet of Class B gas main, and removed a service regulator. During Phase 2, between SE 177th Ave and SE 192nd Ave, the Company is planning to relocate approximately 3,500 feet of Class D high pressure six-inch wrapped steel gas main, install a new district regulator, install Class B six-inch polyethylene gas main and reconnect several gas services. The City is in the early design stages for the Phase 2 roadway improvements.

Q. When was Phase 1 of the SE 1st Street Grading Project completed?

A. Phase 1 of the SE 1st Street Grading Project was completed in December 2020, and it is currently in service and providing a benefit to Washington customers.

Q. What was the total cost of Phase 1 of the SE 1st Street Grading Project?

A. The total cost of Phase 1 of the SE 1st Street Grading Project was $2.4 million.

Q. When does the Company expect to complete Phase 2 of the SE 1st Street Grading Project?

A. The Company expects that Phase 2 of the SE 1st Street Grading Project will be completed in October 2021.

Q. What is the Company's most recent cost estimate for Phase 2 of the SE 1st Street Grading Project?

A. The Company's most recent cost estimate for Phase 2 of the SE 1st Street Grading Project is $2.3 million. As explained in the Direct Testimony of Zachary Kravitz (Exh. ZDK-1T), we are proposing to include this project in the second year of the Company's two-year rate plan.

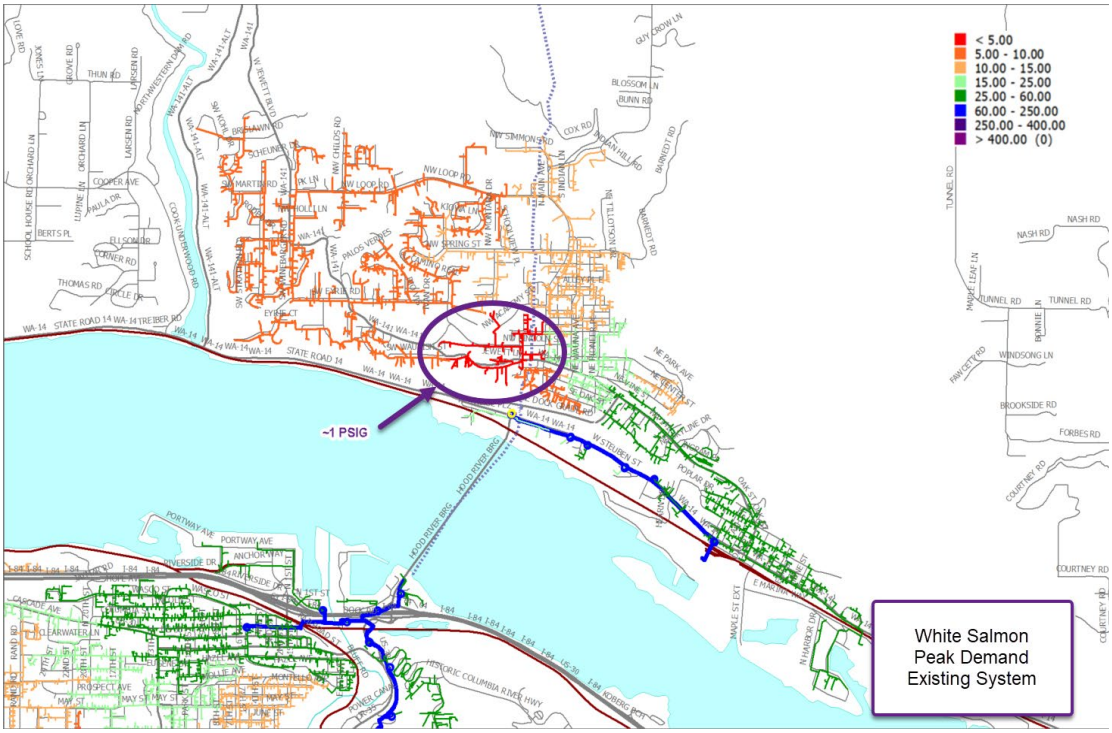
2. White Salmon Reinforcement Project

Q. Please describe the Company's current assets serving White Salmon, Washington.

A. White Salmon currently is fed by a single Class B three-inch steel pipeline that was built in 1963, up East Jewett Boulevard. White Salmon has grown over the years, and the existing pipeline is nearing capacity to meet future demand. Importantly, on February 23, 2018, the Company observed a low pressure of 6 pounds per square inch gauge ("psig") at a telemetry site located on White Salmon's Class B distribution system. The 6 psig low pressure, which was recorded on a non-peak cold weather event, is below the Company's planning criteria of 10 psig to initiate a system reinforcement improvement to avoid potential service disruptions during colder

weather conditions. As shown in Figure 1 below, NW Natural's Synergi modeling[1] indicates that a significant portion of the White Salmon distribution system will experience pressures less than 10 psig, and customer outages during simulated extreme cold weather could occur, absent implementation of a remediating solution.

Figure 1. Map of White Salmon Peak Demand Modeling Results



Q. Please describe the White Salmon Reinforcement Project.

A. A system reinforcement is needed to increase gas supply in White Salmon and stabilize system pressures during cold weather events. NW Natural intends to construct a new

[1] Synergi is an advanced hydraulic modeling software that allows operators to model large complex integrated multi-pressure pipeline systems. The modeling platform used to monitor gas systems – Synergi – is industry standard (used by 96 percent of large local distribution companies in the United States) and is extensively utilized by NW Natural and other natural gas utilities. Synergi software has been used by the industry for over 40 years to help operators make design, planning, and operating decisions based on its calculations. The Synergi models of NW Natural's distribution system are built using pipe size, customer load information, and telemetry inputs (flow, metering, and pressures) located throughout NW Natural's system.

segment of eight-inch polyethylene pipeline to reinforce its existing pipeline into White Salmon. Two routes, identified as "Route 1" and "Route 2," are being evaluated. Route 1 follows Highway 14 and Dock Grade Road and Route 2 follows Ash Street and East Jewett Boulevard (also known as Highway 141). The pipeline will be installed using open trench methods. The proposed eight-inch polyethylene pipeline allows the Company to supply gas to the White Salmon community from the existing gate station on the south side of White Salmon.

Q. Did the Company consider alternatives to performing the White Salmon Reinforcement Project?

A. Yes. Initially, the Company considered installation of a new gate station along the high-pressure pipeline of The Williams Companies, Inc. ("Williams") on the north side of the White Salmon community. Although it had a similar estimated capital cost as the Company's White Salmon Reinforcement Project, the gate station would have been developed, built and operated under the ownership of and control by Williams, and NW Natural would have incurred an additional recurring expense to Williams for the ongoing maintenance of the new gate station. Factoring in such additional annual expense and the added reliance on a third-party to complete that alternative project on-budget and in a timely fashion, the Company determined that the White Salmon Reinforcement Project was the least-cost, least-risk option.

Q. When does the Company expect to complete the White Salmon Reinforcement Project?

A. The Company expects that the White Salmon Reinforcement Project will be completed in October 2021.

Q. What is the Company's most recent cost estimate for the White Salmon Reinforcement Project?

A. The Company's most recent cost estimate for the White Salmon Reinforcement Project is $2.7 million. As explained in the Direct Testimony of Zachary Kravitz (Exh. ZDK-1T), we are proposing to include this project in the second year of the Company's two-year rate plan.

3. West Vancouver Gate Station Rebuild Project

Q. Please describe the West Vancouver Gate Station Rebuild Project.

A. The Company rebuilt several components of the West Vancouver Gate Station in order to improve the reliability and operability of its system. The Company replaced an end-of-life odorizer with a new injection pump odorization system from the industry leading YZ Systems. It also replaced a bulk odorant storage tank with a modern new tank with updated controls and double containment that enhances the safety of the station. The existing telemetry, controls and electrical service could not support the new odorizer and were replaced with a new telemetry infrastructure and radio connection. This ensures that the Gas Control team can safely monitor this station, which is a critical feed for the City of Vancouver. In addition, NW Natural constructed a rain shelter over the new odorant storage tank and controls to protect and extend the life of the equipment and improve reliability. The Company referenced the West Vancouver Gate Station Rebuild Project at page 7.15 of its 2016 Integrated Resource Plan ("IRP") Action Plan (UG-151776).

Q. Did the Company consider alternatives to performing the West Vancouver Gate Station Rebuild Project?

A. The Company determined that there were no alternatives to the West Vancouver Gate Station Rebuild Project, as the primary goal of the project was to replace the existing end-of-life and obsolete odorization pump equipment and single-wall odorant storage tank. Doing so enhanced the safety of the odorization system by installing a double-containment bulk storage tank, and modern injection pump odorizers. The alternative to this project would have been to continue using existing equipment, which had reached the end of its useful life and could no longer be maintained safely and reliably.

Q. When was the West Vancouver Gate Station Rebuild Project completed?

A. The West Vancouver Gate Station Rebuild Project was completed in December 2019, and it is currently in service and providing a benefit to Washington customers.

Q. What was the total cost of the West Vancouver Gate Station Rebuild Project?

A. The total cost of the West Vancouver Gate Station Rebuild Project was $749 thousand.

4. Battle Ground Gate Station Rebuild Project and Ridgefield Gate Station Rebuild Project

Q. Please describe the Battle Ground Gate Station Rebuild Project and the Ridgefield Gate Station Rebuild Project.

A. Due to growth in the Battle Ground and Ridgefield areas, obsolescence of equipment at the sites and flow regularly exceeding the upstream pipeline's equipment design, these stations require an increase in capacity to accommodate customer load requirements. The projects will include replacement of metering, regulation, controls, odorization and possible installation of a line heater. The upstream pipeline also

requires transfer of regulation and overpressure protection to NW Natural as part of these projects, which will necessitate changes to upstream pipeline components to accommodate that transfer.

Q. Did the Company consider alternatives to performing the Battle Ground Gate Station Rebuild Project and/or the Ridgefield Gate Station Rebuild Project?

A. The Company determined that there were no alternatives to the Battle Ground Gate Station Rebuild Project or the Ridgefield Gate Station Rebuild Project because both gates are single feeds to the communities they serve, and the stations are both undersized to serve the increased customer load growth.

Q. When does the Company expect to complete the Battle Ground Gate Station Rebuild Project and the Ridgefield Gate Station Rebuild Project?

A. The Company expects that the Battle Ground Gate Station Rebuild Project and the Ridgefield Gate Station Rebuild Project each will be completed in October 2021.

Q. What is the Company's most recent cost estimate for the Battle Ground Gate Station Rebuild Project and the Ridgefield Gate Station Rebuild Project?

A. The Company's most recent cost estimates for the Battle Ground Gate Station Rebuild Project and the Ridgefield Gate Station Rebuild Project are $1.4 million and $1.7 million, respectively. As explained in the Direct Testimony of Zachary Kravitz (Exh. ZDK-1T), we are proposing to include these projects in the second year of the Company's two-year rate plan.

B. Major Storage Facility Projects

Q. Please identify the Company's storage facilities.

A. The Company has three storage facilities: Mist, Newport LNG and Portland LNG. This rate case includes projects related to the Company's Mist and Newport LNG storage facilities.

Q. Please describe the Company's Newport LNG facility.

A. The Newport LNG facility is a peak shaving facility located in Newport, Oregon and consists of a 1,000,000 Dth capacity storage tank, liquefaction facilities capable of processing about 5,500 Dth/day, and vaporization capacity of up to 100,000 Dth/day. This facility was constructed by Chicago Bridge and Iron, and commissioned in 1977.[2]

Q. Please describe the Mist Storage Facility.

A. NW Natural operates the Mist Storage Facility located in Mist, Oregon, which features a natural gas storage field consisting of seven different underground pools and a total of 21 injection/withdrawal wells. Miller Station is the compressor station within the Mist Storage Facility that contains the operations and controls facility as well as the process equipment for conveying natural gas between the wells and utility pipelines. The natural gas compression and dehydration systems for the site are both located at Miller Station.

[2] Because the Company's pipeline system limits Newport to serving the central coast and Salem market areas, the full 100,000 Dth/day vaporization rate is not achievable. Instead, 60,000 Dth/day is the effective limit on vaporization at Newport.

Q. Please describe the Company's most recent study of its Mist Storage Facility.

A. In June 2016, the Company completed an engineering facility assessment of the Mist Storage Facility ("Mist Storage Facility Assessment") and identified a number of needed improvements to the facility to improve site reliability, resulting in the Mist Reliability Program. Without many of the suggested upgrades, Miller Station and the Mist storage operation will likely experience equipment failures, increased operations and maintenance costs, cyber threats, and other risks over the next 25 years.

Q. Do any projects included in this rate case address recommendations in the Mist Storage Facility Assessment?

A. Yes. As described in greater detail below, the Mist Corrosion Abatement Project (Phase 3 and Phase 4) and the Mist Valve Control Upgrade Project address recommendations in the Mist Storage Facility Assessment.

Q. Are the Company's storage facility projects allocated to both Oregon and Washington?

A. Yes. The Company allocates storage facility projects to both states. Gas acquisition, including both capacity and commodity costs, has historically been accomplished on a system basis, with customers in both states providing recovery of pipeline capacity and storage costs proportionally, even though gas from the storage facilities in Oregon is not physically deliverable to Washington. In that sense, storage is considered as a substitute for pipeline capacity, and the lower cost of storage as compared to pipeline demand is shared among the customers in both states.

Q. Please describe further how the storage facility projects affect the Company's Washington operations.

A. For its gas supply portfolio, NW Natural operates its three storage facilities in Oregon – Mist, Newport LNG, and Portland LNG – on an integrated basis with Washington. That is, gas supplies from those facilities work in tandem with supplies delivered by Northwest Pipeline ("NWP") to serve the requirements of customers in Washington as well as in Oregon. For example, withdrawals from the Mist Storage Facility flow directly to Oregon customers in and around the Portland area, which in turn allows the Company to divert an equivalent volume of NWP deliveries from interconnection points (gate stations) serving Oregon to gate stations serving Washington customers. So while not physically connected or delivered to Washington, in this way, i.e., via displacement, Washington customers receive storage gas from the Company's storage facilities.

The gas supplies used to fill the three storage facilities come through NWP and other upstream pipelines during the spring/summer/fall months when customer usage is low and the Company's agreements with NWP are not fully utilized. Withdrawals from storage avoid the need for additional upstream pipeline capacity – and associated demand charges - during the winter months when customer usage is high. The costs of the Company's upstream pipeline agreements flow to Oregon and Washington customers through the purchased gas adjustment ("PGA") process. In the PGA, upstream pipeline demand charges are allocated evenly between Oregon and Washington customers based on sales volumes. This allows the benefits created by

storage through the reduction of upstream pipeline demand charges to flow to both states.

The treatment of storage on an integrated basis between Oregon and Washington is also reflected in the resource acquisition decisions determined in the Company's IRP process.

Q. Has the Commission approved or accepted the inclusion of the Company's storage facility projects in Washington rates?

A. Yes. The state allocation methodology has been in use since its first implementation in 2000 (UG-000073). The most recent application of the methodology was in the Company's 2019 rate case (UG-181053).

Q. How are the Company's storage facility projects allocated to Washington customers?

A. The Company's storage facility projects are allocated to Washington and Oregon customers on the basis of firm volumes. The Washington allocation factor for firm volumes is currently 10.810 percent. The Direct Testimony of Kyle Walker (Exh. KTW-1T) addresses the topic of allocation factors and their associated methodology.

1. Mist Large Dehydration System Project

Q. Please describe the Mist Large Dehydration System Project.

A. The Mist Large Dehydration System Project replaces the large dehydration system at Mist that went into service in 1998 and has reached end of life. The dehydration system is critical for the withdrawal operation of gas at the Mist Storage Facility. Natural gas stored in underground reservoirs usually contains a large amount of water. This water can cause several problems for downstream processes and equipment, such as freezing

in pipe or forming hydrates that can plug equipment. NW Natural's pipeline quality specification tariff requires that the water content should not exceed 7 pounds per million standard cubic feet to prevent such problems. The dehydration system removes the water from the gas so that our storage and distribution system can operate safely.

Q. Did the Company include the Mist Large Dehydration System Project in its 2016 IRP Action Plan?

A. Yes. The Company included the Mist Large Dehydration System Project in its 2016 IRP Action Plan (UG-151776), in conjunction with another relevant alternative. In particular, NW Natural concluded that it should "[r]eplace or repair, depending on relative cost-effectiveness, the large dehydrator at Mist's Miller Station." The Company stated that "[r]eplacement is currently estimated to cost between $6 million and $7 million based on estimates obtained from a third-party engineering consulting firm engaged by [NW Natural]."

Q. Did the Company update the Mist Large Dehydration System Project after its 2016 IRP Action Plan?

A. Yes. After its 2016 IRP Action Plan, the Company received the final report from its engineering consultant ("Engineering Report") regarding whether to repair or replace the large dehydrator, and it assessed the recommendations and proposed solutions provided in the Engineering Report. The Engineering Report was conducted during the 2017 injection season and included examinations of service and maintenance records, operability, external structural integrity, age, and cost estimations. The Engineering Report recommended both interim repairs to the dehydration system and

replacement of the large dehydrator because it had reached the end of its useful life and was not functioning as designed.

Q. Did the Company attempt interim repairs to the large dehydration system at the Mist Storage Facility after it received the Engineering Report?

A. Yes, the Company attempted interim repairs to the large dehydration system (i.e., a shorter-term solution recommended in the Engineering Report in advance of the system replacement), but those repairs were not successful. The Company identified several additional critical issues during its repair efforts, most notably the increasing malfunction of the large dehydrator's regeneration and scrubber systems that would continue if they were not replaced.

Q. Did the Company conduct a request for proposals ("RFP") as part of its assessment of the recommendations and proposed solutions provided in the Engineering Report?

A. Yes. The Company issued an RFP to prospective contractors for the design and construction of the Large Mist Dehydration System Project. The RFP responses contained pricing substantially higher than the initial estimated cost range that the Company provided in its 2016 IRP Action Plan. The initial estimate received did not include adequate engineering, project management, or construction labor costs. In addition, material costs have increased in the subsequent four years. The Company evaluated the RFP responses and awarded the contract to the winning RFP bidder in August 2018, at a contract cost of $16.8 million (without the Company's engineering costs or construction overhead, based upon 2018 prices, and assuming construction in 2019).

Q. Did the Company update the status of the Mist Large Dehydration System Project in its 2018 IRP Action Plan?

A. Yes. In its 2018 IRP filing (UG-170911), the Company stated that the large dehydration system at Mist had reached end-of-life and was not functioning as designed, and that the Engineering Report concluded that the existing dehydration system should be replaced. The Company commented that an in-depth economic and alternatives analysis was underway.

Q. Did the Company complete that in-depth economic and alternatives analysis?

A. Yes. The Company conducted a Six-Sigma Failure Mode and Effects Analysis ("FMEA") in the third quarter of 2018. The FMEA concluded that replacement of the Mist large dehydration system was necessary as soon as possible for both safety and compliance. It found that the system had performance and operational issues and had a high probability of experiencing a failure impacting safety and/or compliance by 2024. Consequently, the Company concluded that the replacement of the large dehydrator at Mist through the Mist Large Dehydration System Project was necessary as soon as possible.

Q. Please describe the events that have occurred from the time the Company conducted the FMEA to present.

A. The project estimate was $18.9 million (without construction overhead) with an anticipated completion in 2019 when the project's Move to Execution was approved in August 2019. The approval granted the project to proceed with a two-phased approach, whereby Phase I would complete the design and procurement on a "Time-and-Material" basis, and Phase II would construct the project on a "Fixed-Price" basis.

The engineering, procurement and construction ("EPC") contractor's original proposal assumed the design would be completed in Fall 2018 to allow for construction to proceed in 2019. However, project implementation delays and a 36- to 38-week manufacturing lead time to procure the new dehydration unit prevented construction and installation in 2019. As a result, construction was pushed into 2020. Moving the construction into 2020 further increased the cost of the Mist Large Dehydration System Project. Labor costs in 2020 are higher than labor costs in 2019. Further, materials costs have increased as a result of the tariffs being imposed by the United States and market volatility.

The original RFP and initial project estimate were based on high level design requirements and the operational experience and maintenance issues encountered with the existing dehydration system. These requirements could not be refined until the design review process was completed in December 2019. As a result, quite a few changes were needed to the design assumptions made by the EPC contractor in order to fulfill the safety, reliability, and compliance requirements for the project. In order to meet those safety, reliability, and compliance requirements, the design was refined and the final January 2020 EPC costs increased from the original estimates provided in July 2018.

Q. When was the Mist Large Dehydration System Project completed?

A. The Mist Large Dehydration System Project was completed in October 2020, and it is currently in service and providing a benefit to Washington customers.

Q. What was the total cost of the Mist Large Dehydration System Project?

A. The total cost to complete the Mist Large Dehydration System Project was $28.0 million, or $3.0 million on a Washington-allocated basis. A calculated portion of the total cost of this project has been allocated to Oregon.

Q. Despite the increase in cost from the initial preliminary estimate in the IRP, is the Mist Large Dehydration System Project still the least-cost, least-risk option?

A. Yes. Without an operational dehydration unit, the Company would have to purchase, at around two times the cost of replacing the dehydration unit (the FMEA quantified a $58 million incremental cost), additional capacity from interstate pipelines to meet peak customer demand, but even such additional capacity likely would not provide the resiliency needed to sustain service to our customers during incidents such as the Canadian pipeline rupture in 2018.

2. Mist Instrument and Controls Project (Phase 2)

Q. Please describe the Mist Instrument and Controls Project (Phase 2).

A. The Mist Instrument and Controls Project (Phase 2) replaced failing, functionally-reduced and end-of-life flow transmitters, moisture analyzers and ultrasonic flow transmitters with new industry and Company standard units. The new standard units provide greater reliability, better accuracy, improved functionality and less required maintenance. The project also involved updating as-built drawings to facilitate the creation of a master instrument index to aid in maintenance activities and equipment troubleshooting and to maintain compliance with Title 49, Part 192 of the Code of Federal Regulations.

Q. Did the Company include the Mist Instrument and Controls Project (Phase 2) in its last rate case (UG-181053)?

A. No. The Company included the Mist Instrument and Controls Project (Phase 1) in its last rate case, UG-181053.

Q. Did the Company consider alternatives to performing the Mist Instrument and Controls Project (Phase 2)?

A. The Company determined that there were no alternatives to the Mist Instrument and Controls Project (Phase 2) because this project is end of life equipment replacement for critical infrastructure.

Q. When was the Mist Instrument and Controls Project (Phase 2) completed?

A. The Mist Instrument and Controls Project (Phase 2) was completed in October 2020, and it is currently in service and providing a benefit to Washington customers.

Q. What was the total cost of the Mist Instrument and Controls Project (Phase 2)?

A. The total cost to complete the Mist Instrument and Controls Project (Phase 2) was $1.0 million, or $111 thousand on a Washington-allocated basis. A calculated portion of the total cost of this project has been allocated to Oregon.

3. Mist 300 and 400 Compressor Controls Upgrade Project

Q. Please describe the Mist 300 and 400 Compressor Controls Upgrade Project.

A. The "300" and "400" reciprocating compressors at the Mist Storage Facility were initially installed in 1988. Components and subsystems within the control systems for those compressors became outdated and no longer supported. The Mist 300 and 400 Compressor Controls Upgrade Project replaced and modernized the control systems of the reciprocating compressors to obtain more useful life out of that aging equipment.

Doing so has relieved the inefficient usage rates on the turbine engine driven centrifugal compressors at the Mist Storage Facility, which in turn has lowered the maintenance requirements on those turbine compressors and has extended their useful lives. From a broader perspective, the Mist 300 and 400 Compressor Controls Upgrade Project is one of a number of projects recommended by AECOM's Mist Compressor Evaluation Study completed in June 2020 to increase the reliability of the compressor units at Mist.

Q. Did the Company consider alternatives to performing the Mist 300 and 400 Compressor Controls Upgrade Project?

A. Yes. If the Company had done nothing and the upgrades were not completed, the usage rates on the Mist turbine compressors would have continued to be high and likely would have resulted in continuing failures that would have been costly to repair. NW Natural also analyzed replacing the 300 and 400 reciprocating compressors with new Caterpillar engine-driven Ariel compressors, but doing so would have been more expensive and complex and taken years to complete.

Q. When does the Company expect to complete the Mist 300 and 400 Compressor Controls Upgrade Project?

A. The Company expects that the Mist 300 and 400 Compressor Controls Upgrade Project will be completed in April 2021.

Q. What is the Company's most recent cost estimate for the Mist 300 and 400 Compressor Controls Upgrade Project?

A. The Company's most recent total cost estimate for the Mist 300 and 400 Compressor Controls Upgrade Project is approximately $2.4 million, or approximately $261

thousand on a Washington-allocated basis. A calculated portion of the total cost of this project will be allocated to Oregon.

4. Mist Well Rework Program (2020 and 2021)

Q. Please describe the regulatory setting covering the Mist Well Rework Program.

A. In December 2016, PHMSA adopted new safety regulations specifically for underground gas storage facilities. In compliance with those regulations, NW Natural completed the development of its Well Integrity Plan and accelerated the development of a Risk Management Plan for the underground storage fields at Mist that included a schedule to rework the storage wells over the federally mandated eight-year guideline.

Q. Did the Company consider alternatives to performing the Mist Well Rework Program?

A. The investment is necessary at this time for regulatory compliance, and there are no alternatives to performing the assessment and remediation.

Q. What is the scope of the Mist Well Rework Program for 2020?

A. The Mist Well Rework Program for 2020 involves the rehabilitation of eight (8) underground storage wells within the Mist storage fields and ensures their functional integrity complies with the Company's Risk Management Plan and PHMSA requirements.

Q. When was the Mist Well Rework Program for 2020 completed?

A. The Mist Well Rework Program for 2020 was completed in October 2020, and it is currently in service and providing a benefit to Washington customers.

Q. What was the total cost of the Mist Well Rework Program for 2020?

A. The total cost of the Mist Well Rework Program for 2020 was $4.1 million, or $441 thousand on a Washington-allocated basis. A calculated portion of the total cost of this project has been allocated to Oregon.

Q. What is the scope of the Mist Well Rework Program for 2021?

A. The Mist Well Rework Program for 2021 involves the rehabilitation of five (5) underground storage wells within the Mist storage fields and ensures their functional integrity complies with the Company's Risk Management Plan and PHMSA requirements.

Q. When does the Company expect to complete the Mist Well Rework Program for 2021?

A. The Company expects to complete the Mist Well Rework Program for 2021 in October 2021.

Q. What is the Company's most recent cost estimate for the Mist Well Rework Program for 2021?

A. The Company's most recent total cost estimate for the Mist Well Rework Program for 2021 is approximately $3.4 million, or approximately $362 thousand on a Washington-allocated basis. As explained in the Direct Testimony of Zachary Kravitz (Exh. ZDK-1T), we are proposing to include this project in the second year of the Company's two-year rate plan. A calculated portion of the total cost of the Mist Well Rework Project for 2021 will be allocated to Oregon.

5. Mist Corrosion Abatement Project (Phase 3 and Phase 4)

Q. Please describe the Mist Corrosion Abatement Project (Phase 3 and Phase 4).

A. As discussed earlier in my testimony, NW Natural's 2016 Mist Storage Facility Assessment identified a number of needed improvements to Mist to enhance site reliability. One of the identified improvements was the development and implementation of an internal and external corrosion monitoring program, because there was no internal corrosion monitoring data at that time and there was a strong potential for internal and external corrosion within the Mist gathering systems. The Mist Corrosion Abatement Project is a key component of the Mist Reliability Program and provides data and trending for NW Natural to better evaluate the conditions in the field and respond appropriately. Phase 1 and Phase 2 of the Mist Corrosion Abatement Project were completed in prior years. In Phase 3 and Phase 4, the Company is utilizing In-Line Inspection ("ILI") tools to evaluate the existing conditions and validate the integrity of specific pipelines of the Mist gathering systems. As part of Phase 3 and Phase 4, the Company also is modifying certain pipelines to accommodate the insertion, transmission and extraction of the ILI tools.

Q. Did the Company consider alternatives to performing the Mist Corrosion Abatement Project?

A. Yes. The only alternative would have been to not perform the pipeline modifications and ILI assessments. The investment is necessary at this time to assess the risk and repair any anomalies prior to failure. Not performing the inspections would leave a higher risk of pipeline failure.

Q. Has Phase 3 of the Mist Corrosion Abatement Project been completed?

A. Yes. Phase 3 of the Mist Corrosion Abatement Project was completed in October 2020, and it is providing a benefit to Washington customers.

Q. What was the total cost of Phase 3 of the Mist Corrosion Abatement Project?

A. The total cost of Phase 3 of the Mist Corrosion Abatement Project was $1.2 million, or $125 thousand on a Washington-allocated basis. A calculated portion of the total cost of this project has been allocated to Oregon.

Q. When does the Company expect to complete Phase 4 of the Mist Corrosion Abatement Project?

A. The Company expects to complete Phase 4 of the Mist Corrosion Abatement Project in October 2021.

Q. What is the Company's most recent cost estimate for Phase 4 of the Mist Corrosion Abatement Project?

A. The Company's most recent total cost estimate for Phase 4 of the Mist Corrosion Abatement Project is approximately $3.2 million, or approximately $344 thousand on a Washington-allocated basis. As explained in the Direct Testimony of Zachary Kravitz (Exh. ZDK-1T), we are proposing to include this project in the second year of the Company's two-year rate plan. A calculated portion of the total cost of the Mist Well Rework Project for 2021 will be allocated to Oregon.

6. Mist Valve Control Upgrade Project

Q. Please describe the Mist Valve Control Upgrade Project.

A. In the process of performing upgrades recommended by NW Natural's 2016 Mist Storage Facility Assessment, the Company identified other related issues involving the facility

valves. Those issues included meter valves that leak, non-double block-and-bleed configurations as defined by the Occupational Safety and Health Administration ("OSHA"), pressure relief valves without block valves, and non-standard valve configurations that impede the site operations team both in finding replacement parts and responding to emergencies. The objective of the Mist Valve Control Upgrade Project was to remedy these valve issues so that the facility can remain in compliance and operate safely. This project replaced and upgraded failing valves and end-of-life valve configurations at Mist, including the removal of unsafe conditions due to leaking valves and the addition of double block-and-bleed configurations as defined by OSHA.

Q. Did the Company consider alternatives to performing the Mist Valve Control Upgrade Project?

A. Yes. If the Company had done nothing and the upgrades were not completed, unsafe leaking valves and control issues would have continued, a strong potential for equipment failure would have existed, opportunities to add OSHA-compliant double block-and-bleed configurations would have been missed, and maintenance costs, frequency and duration of the problematic equipment were expected to increase. Doing nothing also would have been counter to the industry standard, which is to replace equipment upon failure identification. Further, NW Natural determined that reconfiguring the site process piping to bypass leaking valves would have been very expensive, time consuming and short-sighted.

Q. Has the Mist Valve Control Upgrade Project been completed?

A. Yes. The Mist Valve Control Upgrade Project was completed in October 2020, and it is providing a benefit to Washington customers.

Q. What was the total cost of the Mist Valve Control Upgrade Project?

A. The total cost of the Mist Valve Control Upgrade Project was $1.8 million, or $197 thousand on a Washington-allocated basis. A calculated portion of the total cost of this project has been allocated to Oregon.

7. Newport LNG H-2 Vaporizer Controls Project

Q. Please describe the vaporizer systems at the Newport LNG facility.

A. The Newport LNG facility utilizes two parallel vaporizer systems, "H-1" and "H-2," that receive LNG and utilize a heated water bath to vaporize the LNG and distribute the gas to customers. The LNG is pumped from the storage tank into the H-1 and/or H-2 systems through a manifold located in the vaporizer building. The LNG passes through a submerged heating coil, with the water on the hot side of the exchanger being heated by three parallel gas-fired heaters. The H-1 and H-2 systems operate on temperature control of the vaporized natural gas that exits the systems and enters a pressurized natural gas vapor pipeline. Both the H-1 and H-2 units are required for the plant to reach the facility's defined send out capacity of 60 MMSCF per day. The H-1 vaporizer was fully replaced by a new system in 2017.

Q. Has the Company replaced any parts of the H-2 vaporizer system?

A. The Company replaced the H-2 heat exchanger in 2009; however, none of the mechanical and automation control components were or have since been upgraded or replaced. As a result, the existing automation system is out of date and is no longer supported by the manufacturer, and the mechanical system, control valves and shut off valves are at the end of life.

Q. What is the purpose of the Newport LNG H-2 Vaporizer Controls Project?

A. This project extends the useful life and improves the reliability of the H-2 vaporizer by replacing the majority of the piping and automation components mounted on the deck of the H-2 vaporizer. This replacement includes the fuel gas piping, water piping, burners, valves, instrumentation, and controls.

Q. Did the Company consider alternatives to performing the Newport LNG H-2 Vaporizer Controls Project?

A. Yes. The Company considered operating the H-2 vaporizer equipment until failure and performing repairs as needed, but determined such a temporary, short-term option to be unreliable, costlier and more time-consuming over the long run.

Q. Has the Newport LNG H-2 Vaporizer Controls Project been completed?

A. Yes. The Newport LNG H-2 Vaporizer Controls Project was completed in October 2020, and it is providing a benefit to Washington customers.

Q. What was the total cost of the Newport LNG H-2 Vaporizer Controls Project?

A. The total cost of the Newport LNG H-2 Vaporizer Controls Project was $2.8 million, or $308 thousand on a Washington-allocated basis. A calculated portion of the total cost of this project has been allocated to Oregon.

III. CONCLUSION

Q. Does this conclude your testimony?

A. Yes.