EXH. DJL-3 (Apdx. G)
DOCKETS UE-240004/UG-240005
2024 PSE GENERAL RATE CASE
WITNESS: DAVID J. LANDERS

BEFORE THE
WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION

WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION, **Complainant,** **v.** **PUGET SOUND ENERGY,** **Respondent.**	**Docket UE-240004** **Docket UG-240005**

APPENDIX G (NONCONFIDENTIAL) TO THE SECOND EXHIBIT TO THE PREFILED DIRECT TESTIMONY OF

DAVID J. LANDERS

ON BEHALF OF PUGET SOUND ENERGY

FEBRUARY 15, 2024

PUGET SOUND ENERGY

Grid Modernization: Substation Reliability

Corporate Spending Authorization (CSA)

Date Created:	Friday, February 10, 2023
Discretionary/ Non-Discretionary:	Discretionary
Multi Year Rate Plan:	Programmatic
Equity Impact:	Yes
Strategic Alignment:	Operate the Business-Reliability
Estimated In-Service Date:	Sunday, December 31, 2028
Current State (Business Need):	PSE has over 400 transmission and distribution substations that are aging and critical to maintaining reliability for PSE's customers. Many substations have assets that are over 40 years old and can contain oil creating an environmental hazard if failure occurs. It is imperative to replace these assets before failure results in large outages and potential spills. The consequence cost of an unexpected failure can be costly if there is no other way to provide power to major customers. Not only is there a consequence impact to the customers, associated substation equipment may be damaged which increases the cost of managing the system. Unexpected failures of older generations of equipment can be costly to repair as spares may not be readily available. PSE reviews diagnostic systems to understand condition as well as field informed concerns to develop program plan. Other drivers include NERC and WECC compliance for substation protection to ensure physical security.

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Desired State (Proposed Solution):	Aging, poor condition, and hazardous threat assets are proactively replaced with current technology to reduce the risk and cost of unplanned outages due to equipment failure and to ensure continuous safe, reliable service and power quality to PSE's transmission grid and distribution system. Asset replacement plans consider reliability and capacity needs where possible while maximizing within historic funding and resources considerations.

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Outcome/Results (What are the anticipated benefits):	The program intends on replacing 339 assets with substation footprints. This results in avoided 1.3M CMI due to unplanned failures as well as ensure worker safety and benefits to the environment of avoided oil spills.

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Dependencies: No

Dependencies comment: None.

Escalation Included: No, escalation has not been included.

Total Estimated Costs: $137,500,000

Estimated Five Year Allocation:

Funds Type	ID	Line Item Description	Previous Years Actuals	Fiscal 2024 Requested	Fiscal 2025 Requested	Fiscal 2026 Requested	Fiscal 2027 Requested	Fiscal 2028 Requested
O&M	79203	5-Year Plan 7.7.23	$ -	$ -	$ -	$ -	$ -	$ -
Capital	R.10009.14.05.06	E Subs Replacement Dist	$ 8,436,488	$ 30,600,000	$ 30,656,250	$ 29,531,250	$ 30,341,250	$ 30,597,750
O&M	R.10009.14.05.06	E Subs Replacement Dist	$ -	$ -	$ -	$ -	$ -	$ -
Capital	W_R.10009.14.05.09	E Substation Reliability Trans	$ -	$ 3,400,000.00	$ 3,406,250.00	$ 3,281,250.00	$ 3,371,250.00	$ 3,399,750.00
O&M	79420	E Substation Reliability Dist	$ -	$ -	$ -	$ -	$ -	$ -
Capital	W_R.10009.14.01.01	E Substation Replacement Battery Dist	$ -	$ -	$ -	$ -	$ -	$ -

Incremental O&M: Both

Qualitative Benefits:

The primary benefit of replacing substation assets is to improve the reliability & resiliency of the overall substation infrastructure cost effectively. Improved reliability & resiliency through smarter, modern equipment enables quicker restoration of power to customers and reduces outage time. Additional benefits can include operational capacity, redundancy, and flexibility. Replacing bank protection fuses, oil breakers and disconnect switches with new technology reduces the risk of safety concerns. Also, replacing equipment with known concern for catastrophic failure increases safety to the Public and employees.

Quantitative Benefits:

Quantitative Benefits	Benefit Type	Previous Years	Fiscal 2024	Fiscal 2025	Fiscal 2026	Fiscal 2027	Fiscal 2028	Fiscal 2029	Remaining Costs	Life Total
Reliability - avoided CMI	Other	$ -	$ 40,100,000	$ 40,100,000	$ 40,100,000	$ 40,100,000	$ 40,100,000	$ -	$ -	$ 200,500,000

Risk Summary:

Project risk is limited as work generally is within the fence reducing permit complexities. However, schedule outages can create challenge and added scope to address more than originally identify can increase costs. Additionally, 2023 deferral pushed into 2024 is a substantial increase in work in one year $13M to $41M making project planning extremely important.

Benefit risk are minimal as they are realized with completed work.

System risk associated with substation components failing unexpectedly is that there is more outage time to source parts and replace failed equipment.

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Change Summary:

Planning Cycle	Change Summary	Last Update Date
2022 Baseline Cycle	This CSA has been migrated into the EPPM tool at go-live as part of the Phase 1 EPPM implementation effort. The projects in this CSA were previously approved for the 2023-2027 capital plan. Please refer to the original CSA document for additional information (if available.)	2/10/2023

PUGET SOUND ENERGY

Grid Modernization: Substation Reliability

Corporate Spending Authorization (CSA)

Approval History:

Approved By	Date Approved
Approved by Cost Center Owner: Lambert , Ryan	3/30/2023
Approved by Cost Center Owner: Lambert , Ryan	4/3/2023
Approved by Director Sponsor: Landers , David	4/7/2023
Approved by Executive Sponsor: Jacobs , Josh	4/8/2023
CSA Status changed to Approved	4/8/2023
Approved by Cost Center Owner: Shrum , Bailey	12/4/2023
Approved by Director Sponsor: Shrum , Bailey	12/4/2023
Approved by Executive Sponsor: Shrum , Bailey	12/4/2023
CSA Status changed to Approved	12/4/2023
Approved by Cost Center Owner: Lambert , Ryan	1/29/2024
Approved by Director Sponsor: Landers , David	1/29/2024
Approved by Executive Sponsor: Jacobs , Josh	2/2/2024
CSA Status changed to Approved	2/2/2024

SUBSTATION RELIABILITY

ENERGY TYPE: ELECTRIC

1. SHORT DESCRIPTION

The Substation Reliability Plan is an on-going proactive plan to replace major substation assets to reduce the risk and cost of unplanned outages due to equipment failure and to ensure continuous safe, reliable service and power quality to PSE's transmission grid and distribution system.

2. BACKGROUND

The Substation Reliability plan has matured into a proactive programmatic approach to ensure the system's assets meet system performance requirements safely and reliably.

PSE has over 400 Transmission and Distribution substations combined that are key hubs connecting high voltage transmission lines with the distribution system, the stations provide the ability to deliver electrical loads to cities and large industrial zones at the appropriate voltages safely. Currently there is a large number of older major substation assets, which will need to be replaced gradually to maintain current reliability performance. By implementing the Substation Reliability plan, PSE can reduce system unplanned outages that affect customers. Upgrades to the substations and equipment are important strategies for reliability and overall asset management. Specific types of equipment are proactively replaced to maintain system reliability, improve resiliency, reduce operational costs and offset impacts from aging infrastructure.

The substation assets of concern are identified in Table 1. Each piece of equipment is vital to the safe and effective operation of the substation, however the major assets that make up the basis of the Substation Reliability plan are Transformers, Regulators, Breakers, Fuses, Electro-mechanical relays and Switches. Many of the larger assets are over 40 years of age.

Table 1: Substation Asset Population

Asset Type	VBR	OBR	OSW	VSW	GSW	REG	LFR	XFR	Bank Fuses	EM Relays
Count	1322	60	28	169	338	53	289	54	75	146

2.1. DETERMINING EQUIPMENT NEED & INPUT FOR REPLACEMENT

There are multiple decisions and inputs into considering proactive replacement of substation assets. The considerations include the following items:

- Lifecycle optimization evaluation
- Specific asset class concerns
- Escalated concerns from maintenance and testing
- Escalated concerns from Engineering & Operations
- Escalated concern due to Dissolved Gas Analysis (DGA) monitoring
- Over-dutied equipment and Capacity concerns

2.2. SUBSTATION RELIABILITY ASSET BACKGROUND

The substation reliability plan is funded through various WBS (Work Breakdown Structure) codes. The breakdown of the plan is outlined below by the following WBS codes:

- Electric Substation Reliability Distribution (R.10009.14.05.06)
- Electric Substation Reliability Transmission (R.10009.14.05.09)
- OMRC Electric Substation Reliability Distribution (R.10009.14.05.13)
- OMRC Electric Substation Reliability Transmission (R.10009.14.05.17)

The Substation Reliability projects are aligned as much as possible with Substation SCADA and Resilience Enhancement projects to take advantage of crew mobilization efficiencies and eliminate the need to take additional substation outages.

The addition of Dissolved Gas Analysis (DGA) monitoring equipment provides multiple benefits to maintenance and substation teams. By automatically monitoring the oil properties on a daily basis, PSE can determine the health of the equipment without having to take an outage or carry out major maintenance, reducing O&M dollars. The monitoring equipment is set up such that it sends an electronic alert to maintenance staff if it detects data outside its normal limits. This aids in decision making, such as if PSE should replace or repair a transformer as it approaches end of life, so that an unplanned outage can be avoided for its customers.

3. STATEMENT OF NEED

The Substation Reliability plan is intended to ensure aging substation assets are proactively replaced in time to minimize the risk of major outage events due to equipment failures. PSE has a number of pieces of aging equipment that are still functioning past the normal

economic life, and it becomes more cost effective to replace equipment than to continually maintain or repair units after a certain time period. The consequence cost of an unexpected failure can be expensive if there is no other way to provide power from another source to major customers during major outage events.

Without a proactive plan, the risk of equipment failure increases over time. Not only is there a consequence impact to the customers, associated substation equipment may be damaged which increases the cost of managing the system. Unexpected failures of older generations of equipment can be costly to repair as spares may not be readily available. Such unplanned failures may require taking potentially lengthy outages that negatively impact PSE's reliability index and ability to operate its system effectively.

Other program drivers include NERC and WECC compliance for substation protection to ensure physical security and the installation of condition based monitoring systems to run diagnostic systems and reports on a regular basis independently. Through effective implementation of the plan, there is also a reduction in O&M business expenses as new diagnostic equipment decreases manual maintenance efforts.

3.1. NEED DRIVERS

- **Grid Modernization**
    - **Reliability** – Proactive replacement of equipment reduces unplanned outages that impact customers due to substation equipment failures. This supports Grid Modernization efforts by improving the reliability of the infrastructure.
    - **Safety –**Many pieces of equipment are oil filled and present the risk of fire to employees and the public in the event of a failure. Oil spillage is also an environmental risk. Replacing oil filled equipment reduces these risks. Replacing bank protection fuses which have exceeded their rating minimizes the risk for localized explosion/fragmentation during a fault. Such failures may also have detrimental effects on upstream and downstream equipment.
    - **Resiliency** – Replacing PSE's aging substation infrastructure adds resilience to the system as the new equipment and technology enables faster recovery and restoration of power minimizing outage duration. Modernizing PSE's aging infrastructure improves its performance and supports the effective operation of future Grid Modernization plans.

3.2. EQUITY

PSE evaluates equity in the planning process with consideration of the four core tenets of energy justice: Recognition Justice, Procedural Justice, Distributional Justice, and Restorative Justice in various steps of the process.
As specific studies are performed and projects proposed to further a business plan, planners review system, customers, and now equity data to recognize the specific customer burdens, whether there are highly impacted or vulnerable customers that are or will be affected by addressing the specific business need. Planners must prioritize where to focus study each year,

thus the full understanding of the historic and ongoing inequities for the entire business plan is extrapolated at this time, maturing over time which greater tools and data.

PSE is building process and tools to enable procedural inclusion in defining the need and solutions through engagement with specific communities and community based organizations, increasing understanding of local needs and consequences to inform specific study development as well as options to address need. Maturity in where and how this occurs will increase over the next several years. Business plans will be updated as informed this collective engagement to reflect broader equity benefits and burdens as this engagement increases over time.

As specific projects are proposed, PSE investment decision optimization tool captures equity benefits. An optimized portfolio of projects across many business plans ensures the distribution of benefits and burdens are spread across all segments of the community and aim to ensure that marginalized and vulnerable communities do not receive an inordinate share of burdens or are denied access to benefits. As an initial step, PSE leverages Customer Benefit Indicators ("CBI") and information established as part of the 2021 Clean Energy Implementation Plan ("CEIP") to identify an equity framework to evaluate system projects. The CBI approach was developed through an iterative process that was coordinated with the Equity Advisory Group. These CBI span the core tenets of energy justice and provide a framework to evaluate the comparative equity benefit of each solution alternative considered. Refer to Table 2 for a brief description of the CBIs that address equity and the applicable benefits for the Substation Reliability Plan. PSE will continue to adjust and refine equity consideration in projects when necessary as the process continues to mature.

Projects will be evaluated on each CBI category and a total equity benefit score will be provided.

Table 2: Equity Applicable Benefits

Customer Benefit Indicator	Description	Program Applicable Benefit
Customer Energy Savings	Solutions that lead customers to use less energy, which leads to less energy that must be purchased and potentially a reduction in planned system upgrades.	No
Greenhouse Gas Emissions	Solutions that lead to a reduction of greenhouse gas emissions, either directly or indirectly	No
Enables Cleaner Energy	Solutions that either directly integrate DER on the system or enable the grid to more readily accommodate future DER.	Yes
Air Quality	Solutions that either directly eliminate the source of a common pollutant or reduce the risk that could cause a common pollutant to increase, such as enabling Electric Vehicle or DER adoption	No
Resilience	Solutions that address major event outages or harden critical facilities to prevent catastrophic events from creating long duration outages.	Yes

Cost Reduction	Solutions that identify least cost alternatives and therefore reduce costs for all customers	No
Clean Energy Jobs	Solutions that increase clean energy jobs by furthering clean energy technology application, as described in the CEIP	No
Home Comfort	Solutions that deploy residential energy efficiency in either a targeted solution area or by leveraging load reduction from system wide energy efficiency installations	No

The Substation Reliability Plan is programmatically optimized based on total benefit value to cost. Specific program projects are identified based total benefit to cost with named communities receiving additional scored benefit based on vulnerable population designation and highly impact community characteristics, ensuring investments are distributed appropriately to named communities.

Business plans in isolation do not address restorative justice, but continued planning process improvements which include considerations of data, tools, and documentation as well as operational practices will help to restore equity over time.

4. PLAN DETAIL

4.1. PLAN SIZE/POPULATION

The Substation Reliability plan is ongoing and addresses substation assets as they age each year, which means the count of aging equipment changes each year. Although some assets are replaced each year, other assets are being strategically phased out completely and replaced with new technology.

Table 1, presented in Section 2 of this plan, reflects the count of substation equipment as of September 2023. Of the equipment identified, the oil breakers (OBR) and oil switches (OSW) are targeted to be replaced completely with new generations of oil-free substation assets. Other assets such as electro-mechanical relays (EM Relays), over-dutied fuses (OD Fuse) are being replaced with updated technology and equipment to improve their function and performance.

Oil Switches are also replaced with new vacuum switches under the Substation SCADA plan which helps accelerate removal of oil switches.

Other assets such as LFR transformers will remain and be replaced annually as needed based on condition, performance and remaining life. However there are many units over 40 and 50 years old which will be escalated via diagnostics and electrical test results if necessary.

4.2. PROPOSED COMPLETION DATE

The timeline to replace aging assets depends on different factors including severity of condition, available budget, crew resources and engineering delivery. There are two objectives to be achieved in this replacement plan: one is to replace aging assets which

demonstrate poor condition, and the other objective is to retire oil filled assets such as Oil breakers with Gas filled breakers. Transformer fuses will be replaced with circuit switchers and protection relays when aligned with transformer replacement.

Although not all aging equipment can be replaced or retired in a short time-frame, we continue to ensure reliable service to customers and improve the safety of the substation assets. Aligning the work of this plan with other plans and strategies may enable us to replace additional equipment more efficiently and reduce the timeline indicated above, so project engineering and delivery teams proactively coordinate planned substation work.

4.3. SUMMARY OF PLAN BENEFITS

The primary benefit of replacing substation assets is to improve the reliability & resiliency of the overall substation infrastructure in a cost effective manner. Improved reliability & resiliency through smarter, modern equipment enables quicker restoration of power to customers and reduces outage time. Through proactive replacement of assets, PSE maintains service reliability to its customers and reduces the opportunity for unexpected equipment failure.

With proactive replacement, PSE can optimize capital investment to replace the most at-risk assets and maintain assets to extend the service life of others. Additional benefits are obtained during the Engineering pre-scope evaluation for each substation reliability project, as it's an opportunity to increase system operational capacity, redundancy, and flexibility and reliability where applicable.

Through Asset Management implementation, PSE can proactively replace suspect transformer or breaker models that have developed an increased failure trend and prevent additional unplanned substation outages.

Replacing bank protection fuses, oil breakers and disconnect switches with new technology reduces the risk of safety concerns. Also, replacing equipment with known concern for catastrophic failure increases safety to the public and employees.

4.4. INVESTMENT DECISION BENEFITS

PSE employs an Investment Decision Optimization Tool (iDOT) to evaluate benefits of projects and optimize annual portfolios of work. The primary iDOT benefits this plan addresses are:

- Outage Concern
- Worker Health & Safety Concerns
- Flexibility

Table 3: Summary of Plan Benefits, Population and iDOT B/C Score

	Total Projects	Total Plan ($M)	Number of Stations	Non-MED CMI Saved	iDOT B/C Score
2024-2025	40	$55.2	37	254,830	2.00

4.5. ESTIMATED COSTS

Estimates rely on historical replacement costs for like components to inform forecasted future replacement cost. Specific size, quantity, and type of components associated with equipment replacement will vary from substation to substation. Estimates also account for an increase in project cost due to inflation, and include contingency to account for unforeseen conditions associated with the project.

5. FUNDING ALTERNATIVES

5.1. SOLUTION ALTERNATIVES

No Action – There will be increased risk to substation components failing unexpectedly, requiring more outage time to source parts and replace failed equipment. Some specific older types of equipment do not have spares available so repair is not an option, thus a proactive planned replacement is preferred to reduce outage time and maintain system reliability. By waiting to replace equipment when it fails, there is a risk to safety to personnel and other substation equipment. Unplanned failures have a negative impact on customer reliability and add more emergency repair costs.

5.2. FUNDING ALTERNATIVES

Increased Funding – With new equipment, planned outages are reduced for maintenance activities, and this will continue to strengthen the resiliency of the electrical system. This will help modernize PSE substation infrastructure to more effectively support Grid Modernization changes. Increased funding may also allow for further implementation of online diagnostic monitoring equipment that provides alerts and condition data, enabling proactive decision making before an unplanned failure.

Decreased Funding – Will affect the overall resiliency and reliability of the electrical system which will negatively affect customers who rely on continuous service 24 hours per day, 365 days per year. Planning and prioritizing of the significant quantity of aging units will not be as effective.

6. PLAN DOCUMENT HISTORY

Date	Reason(s) for Update	Summary of Significant Change(s)	Modified By
6/17/2020	Business Case Report – New Plan Template	Document history and development of the program	Stephen Hartnett
3/24/2021	2021 update	Annual update plus 5 year budget impacts on iDOT evaluation	Stephen Hartnett
7/12/2021	Used and Useful Policy guidance	Update current information; add alternative and cost information	Stephen Hartnett
12/1/2021	Annual Review	Minor word and format changes	Stephen Hartnett
11/10/2023	2024 MYRP Business Plan Updates	Added Equity, removed ISP, updated program metrics, other minor updates.	Erik Engels
12/4/2023	2024 MYRP Updates	Updated Top 3 Primary iDOT categories and Program Summary Table to align with 2025-2026 project submittals	Krista Malmgren

7. SUPPORTING DOCUMENTATION

Document Name
PSE LIFECYCLE MODEL
PSE AGING INFRASTRUCTURE REPLACEMENT PROGRAM
PSE ELECTRIC ASSET MANAGEMENT STRATEGY DOCUMENTATION
SUBSTATION RELIABILITY 5 YEAR PLAN
SYSTEM PLANNING IDOT OPTIMIZATION TOOL