EXH. DJL-5 (Apdx. F)
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 F (NONCONFIDENTIAL) TO THE FOURTH EXHIBIT TO THE PREFILED DIRECT TESTIMONY OF

DAVID J. LANDERS

ON BEHALF OF PUGET SOUND ENERGY

FEBRUARY 15, 2024

PUGET SOUND ENERGY

Grid Modernization: Submarine Cable

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:	Friday, December 31, 2027
Current State (Business Need):	PSE's electrical system consists of 18 circuit miles of submarine transmission fluid filled cables installed between 1960 and 1962 and 35 circuit miles of submarine distribution cables installed as early as 1957 and even as recent as 2013. As the infrastructure has aged, failures have become more frequent in the last ten years resulting in environmental spills and risk of significant outages. Even though PSE proactively replaced all bonding boxes, terminations are subject to lightning strikes, vibrations, and earthquakes and cable splices are subject to fail and leak. Leak and fault location and oil containment is very time-consuming, difficult, and even impossible with a remotely operated vehicle (ROV). In-service components, such as immersion reservoirs, oil gages, and alarm systems, and spare parts, such as cable and splices, may not be replaceable or usable. The cable armor has been determined to be severely corroded on the transmission lines within saltwater conditions. Due to the corrosion, it is difficult to repair the cable and the cable cannot be used for its full rated capacity. In addition to age and construction, the transmission capacity of the submarine cables to Vashon are in adequate for the growing load and reliability needs.

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Desired State (Proposed Solution):

Alternative solutions including replacement must be identified and implemented before unplanned failure occurs. PSE does not have deep submarine cable expertise in engineering or operations which requires support from and external vendor to help develop solutions and mitigation. Initial focus in on transmission submarine cables due to ongoing failures and risk. Solutions include new cable and substation work. DERs are potential partial solutions, but don't solve the full need and you don't install 1/2 of a cable.

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Outcome/Results (What are the anticipated benefits):	Transmission cable failures put almost 7000 customers on Vashon and almost 11000 customers at risk of outages should catastrophic failure occur. Almost 3000 customers are at risk associated with 16 distribution submarine cables. Current maintenance stresses O&M challenges.

PUGET SOUND ENERGY

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Dependencies: Yes

Dependencies comment: Ability to serve West Kitsap growing load

Escalation Included: No, escalation has not been included.

Total Estimated Costs: $122,660,000

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
Capital	W_R.10059.05.01.01	E Submarine Cable - Mercer Island	$ -	$ 500,000	$ 8,500,000	$ 6,000,000	$ 12,875,000	$ 5,700,000

Incremental O&M: No

Qualitative Benefits:

The primary benefit is reliability, preventing future load shedding or overload conditions and prolonged outages. Additionally, this program will eliminate environmental damage due to oil leaks either from cables or the bonding boxes.

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	$ -	$ -	$ -	$ -	$ -	$ 5,000,000	$ -	$ 40,500,000	$ 45,500,000

Risk Summary:

Project risk includes significant permitting complexities with various types of submarine construction and thus providing adequate project planning is imperative. The challenges with the Vashon resiliency project timing offers possible opportunities and mitigation as well.

Benefit risk is minimized as it is realized when completed.

System risk if there is further delay means customers face increased interruptions due to submarine cable repair downtime in the event of a failure. Manufacturers do not provide spares for this type so it will not be possible to carry out future cable repairs in the event of another failure. The risk to environmental damage increases with the longer these cables exist in Puget Sound and Lake Washington. Doing only repairs when needed, puts the remaining cable integrity at risk during the repair stage as it must be maneuvered and raised which adds stress to the fragile cable, meaning the cable could break apart at multiple locations during this process.

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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
2023 Cycle 1	Updated with current business plan information	3/15/2023

PUGET SOUND ENERGY

Grid Modernization: Submarine Cable

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

SUBMARINE CABLE REPLACEMENT

ENERGY TYPE: ELECTRIC

1. SHORT DESCRIPTION

The Submarine Cable Replacement plan is a reliability initiative to proactively replace Puget Sound Energy's (PSE) transmission and distribution submarine cables based on condition assessments or cable performance and repair history. These cables can fail for various reasons influenced by their age, physical characteristics and the surrounding environment, and are spread over multiple locations in the PSE service territory. The transmission cables are self-contained fluid filled cables (SCFF). The response to each failure circumstance is unique, can be expensive, and is typically more time consuming than repair of any other type of electrical system failure.

2. BACKGROUND

PSE began installing distribution submarine cables in 1916 starting from the Enatai neighborhood in Bellevue, to Mercer Island. Transmission submarine cables were introduced into PSE's system in 1960 from Enatai cable station on the mainland to Barnabie cable station on Mercer Island. Then in 1962 with an additional transmission cable submarine crossing was installed from South Des Moines to Robinson Point cable station on Vashon Island, continuing on with a second crossing, Command Point-Cove, running between Vashon Island and the Kitsap Peninsula. In 1964, a second submarine crossing, Quendall-Flood, was installed to south Mercer Island from Renton.These older generation transmission submarine cables, which use fluid filled insulation methods, or SCFF cables, have created challenges with repairs and may pose an environmental risk should a catastrophic failure occur. PSE has a documented history over many years of making repairs to submarine cables. These require extensive outages to locate failures and then raise cables above the water's surface to carry out splicing or repair of localized damage to the cable armor. Utilities around the United States have used SCFF cables from as early as the 1920s. Utilties ranging from the East Coast, Midwest, West Coast, and even as close as the Grand Coulee Dam, have replaced these SCFF cables due to an increase in leaks, failures, corrosion, and other issues associated with these cables. SCFF cable systems require highly specialized personnel to monitor, operate, troubleshoot, and repair. The new industry trend is to use extruded solid dielectric cable systems, such as cross-linked polyethylene (XLPE) and ethylene propylene rubber (EPR), for submarine crossings since these cables contain no fluid and overall operation and maintenance procedures are relatively similar to typical distribution cable systems. With stringent cable manufacturing control and testing, these newer cable technologies have a low failure rate.

Transmission Submarine Cables

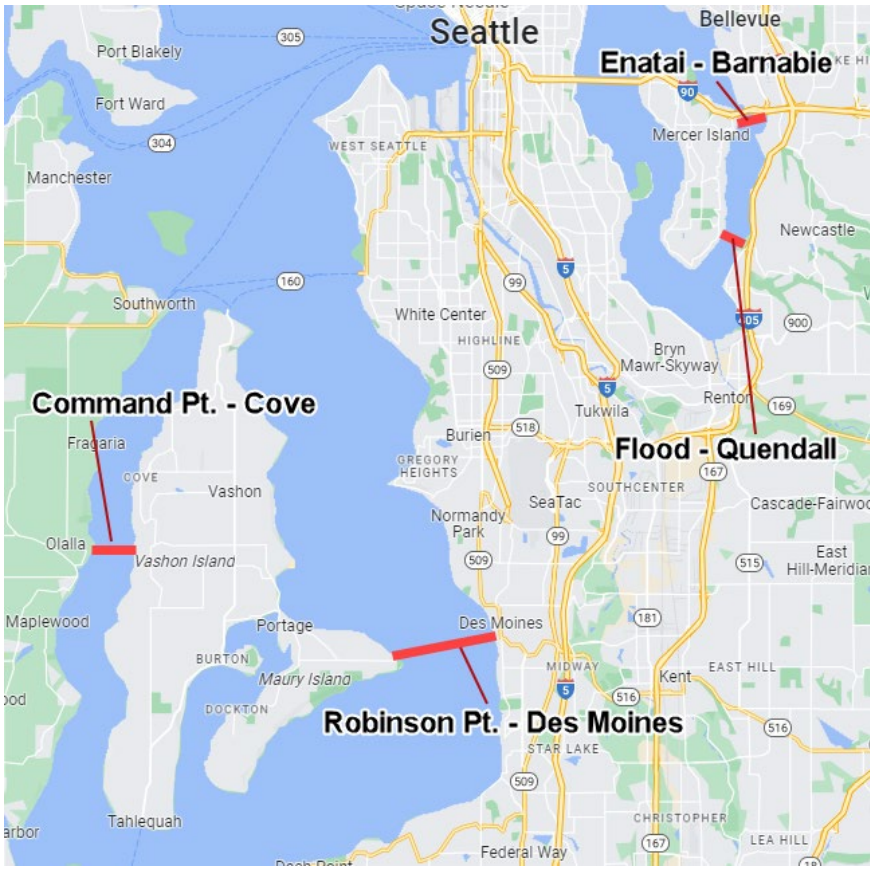
Table 1 shows a list of current transmission submarine cables in service. There are 3 or 4 submarine cable runs between each station. Marine crossings with 4 cable runs have the

added benefit of redundancy. If one cable in the run fails the fourth, or spare, cable can be utilized to maintain service. These cables are all beyond industry design life expectancy of 40 years. From an economic lifecycle point of view, the cables have passed their design life and are fully depreciated. The cable locations are displayed in Figure 1. The Vashon Island crossings serve 6,977 customers. The Mercer Island crossings serve 10,937 customers.

Table 1: Transmission Submarine Cables

Transmission Submarine Cables					
Station-Station	**Cable Type**	**Length (miles)**	**Runs/Phases**	**Year Installed**	**Cable Age (yrs)**
South Des Moines-Robinson Point	115-kV 600-kcmil Cu, SCFF	2.681	4	1962	59
Command-Cove	115-kV 600-kcmil Cu, SCFF	1.175	4	1962	59
Quendall-Flood	115-kV 600-kcmil Cu, SCFF	0.606	3	1964	57
Barnabie-Enatai	115-kV 600-kcmil Cu, SCFF	0.321	4	1960	61
Total Cable Miles		18.526			
Total Faults & Repairs		65			

Figure 1: Transmission Submarine Cable Crossings



Distribution Submarine Cables

There are less than 3,000 distribution customers being energized or backed up by distribution submarine cables. Table 2 lists distribution submarine cable crossings, the amount of customers fed from each crossing, and if there are alternative power supply sources available if an outage occurs on the submarine cable.

Table 2: Distribution Submarine Cables

Distribution Submarine Cables				
Crossing Name	**Number of Customers**	**Year of Installation**	**Alternative Sources Available**	**Plan if cable fails**
Guemes Island	908	1977	NO	Replace
Silcox Island (American Lake)	31	1994	NO	Repair/Replace
Ben Ure Island	7	1984	NO	Repair/Replace
Blake Island	4	2000	NO	Repair/Replace
Lumni Island	1001	2002	NO	Repair if possible

				Replace if necessary
Black Lake	386	1994	YES	Repair/Replace
Enatai to Mercer Island *	0	1978	YES	Repair/Replace
Olympia Yacht Club *	0	2003	YES	Repair/Replace
Lake Tapps *	0	2013	YES	Repair/Replace
Lake City to Tilicom (American Lake) *	0	1982	YES	Repair/Replace/ Retire/Remove Cost Dependent
Port Gamble Bay	453	1980	YES	Retire/Remove
Fragaria to Cove *	0	1957	YES	Retire /Remove
Fragaria to Cove *	0	1959	YES	Retire /Remove
Bangor to Coyle (Hood Canal)	17	1980	NO	Retire (Jefferson County PUD)
Salsbury to Shine (Hood Canal) *	0	1999	NO	Retire (Jefferson County PUD)

*Not primary feed for distribution load in the area

Submarine Cable Failure Procedure

When dealing with a submarine cable failure, there are four steps PSE follows:

1. Collect Information
2. Locate the Failure
3. Assess the Damage
4. Make Repairs, Replace the Cable, or Abandon It

PSE has some spare cable and accessories on hand to replace short segments of distribution cables or splices. However, there is not enough spare cable to fully replace the transmission submarine cables. There is only enough spare transmission cable available to carry out repairs and add splices.

There are three replacement/repair methods available to install submarine cable:

1. Floating Method
2. Messenger Method
3. Submarine Cable-Laying Vessel

These methods present challenges such as complications during wind, high current, and installation within deep crossings. They can also be complex and costly construction with long lead times to procure materials, and difficult to back up. Most of the time, these cable repairs are viewed as non-emergency work and are required to go through the appropriate

permitting process. As the cable ages, it requires more repairs and replacements compared to newly installed cable. If the cable is the only feed to customers on an island, PSE installs and operates a portable generator until the cable is restored.

Transmission Cables Failure and Repair History

There have been roughly 65 faults and repairs documented up to September 2023 amongst submarine transmission cables. The repairs are primarily required due to issues of the lead sheath and armor wires that cover the conductor, or due to hydraulic leaks. In some locations, the armor wires are severely corroded and the lead sheath carrying the circulating current can become fatigued over time. Multiple planned and emergent repairs have also been carried out on the bonding boxes for cable terminations at cable stations since their initial installation.

From 2014 to 2016, PSE repaired multiple dielectric fluid leaks at bonding boxes, which increased repair costs because these were completed as unplanned emergent repairs. PSE proactively replaced bonding boxes after these incidents to avoid leaks and prevent potential environmental risks. The planned and unplanned repairs of bonding boxes ranged from $250,000 to $700,000 per incident.

In 2021, the most recent leaks investigated for the Barnabie-Enatai transmission line involved 5 new leaks within 5 years of the last repair that this line segment had seen in 2016. Throughout the repair process, a team of subject matter experts provided oversight and input to develop and execute the remediation plan. Given the age of these transmission submarine cables, and increases in unplanned repairs, continuous maintenance is not sustainable for long term reliability.

Additionally, areas served by the submarine cables have seen an increase in demand and there is risk of overloading remaining cables if the island was to lose a feed. If there is an overload, it would require load shed, resulting in prolonged outages and lengthy restoration times. Presently very few companies are capable of manufacturing SCFF cable systems. Overall, the cost of any type of repair will likely increase over time as these cables are no longer industry standard, and finding replacement parts and skilled labor will become even more challenging. Due to these risks, it is recommended PSE take a proactive approach and plan for replacement of submarine cables with new cable designs, while the current cables are still operational.

Distribution Cables Failure and Repair History

Regional Planning evaluates the distribution cables based on loading and feeds available to determine if cables should be replaced or repaired in future events. Condition assessments may be performed to determine remaining life of cables based on cable loading history and previous repairs. Distribution cables have 66 failures documented with a histroy of splice failures, anchor strikes, ferroresonance, armor corrossion, and pothead failure. The most recent distribution submarine cable replacement was for Lummi Island in 2021 with a $1,443,675 cost. There are new submarine cable technologies for fresh and salt water in use industry wide which PSE will explore as part of replacement planning.

For the currently operational distribution cables, there are cables identified for retirement once they fail. This approach is effective as these distribution cables are no longer needed for the area based on additional infrastructure added throughout the years. The cable conditions for distribution crossings have unknowns and the plan is to perform condition assessments on the lines that are identified to be replaced or repaired, in order to learn more about the estimated remaining life of these cables. Based on the infomration gathered, PSE will be able to develop a more economical replacement plan.

Design Life and Condition Monitoring

A study was completed for Vashon Island's 115 kV submarine cables by Power Delivery Consultants, Inc. on March 2021. Remaining useful life calculations based on cable operating conditions and loading history have aged the cables to an average of 72 years, placing them near or at end-of-life. A similar study was conducted for the Mercer Island fresh water submarine cables by PDC consultants in October 2022. Remaining useful life calculations based on cable conditions and loading history have aged the cables to an average of 60 years, placing them near or at end of design life. For Mercer Island, if the cables in one of the crossings fails and cannot be repaired, the Island loses redundancy and will rely on one feed for the entire Island for a potentially long outage lasting over multiple months while a replacement project is designed, permitted, and constructed with trained crews capable of installing submarine cables.

The cables continue to age beyond their design life due to a significant number of leaks, third party anchor strikes, abnormal loading during fault events, armor wire corrosion, lead alloy sheath fatigue, cable abrasions, aging splices, and aging fluid fittings. SCFF cables are no longer industry standard resulting in a delay for repair work which lengthens unplanned outages beyond that of regular underground cable work.

Based on the urgent needs, testing and monitoring the submarine cables will provide information that helps inform on the remaining years of useful life, while we plan for replacement. Electrical testing detects existing defects and cable performance, however this testing equipment and ability is not available within PSE. Cost estimates from PDC consultants for testing the Vashon Island 115kV submarine cable are outlined in Table 4 below.

Table 3: Condition Monitoring Tasks, Costs, and Estimated Duration

Assessment Task	**Contractor Cost Estimate Range**	**Estimated Testing Duration**
Marine Surveys	$120,000-$150,000	2-4 Weeks (not including processing, reports and mapping)
ROV Survey	$120,000-$150,000	3-5 Weeks

Dissipation Factor Testing	$170,000-$225,000	1 Week (Line outage required)
Line Resonance Analysis	$40,000-$60,000	1 Week (Line outage required)
Asessment of Mechanical Concerns	$45,000-$65,000	-
Total	**$495,000-$650,000**	

3. BUSINESS NEED

This plan targets the improvement of reliability, aging infrastructure, and a reduction of outages due to risk of submarine cable related failures. PSE's electrical system consists of 18 circuit miles of submarine transmission cables and 35 circuit miles of submarine distribution cables. Necessitated by growing loads and increasing dependency on the electrical delivery system for clean energy transformation, PSE needs to strengthen the transmission system that serves the Kitsap peninsula and Mercer Island and provide increased reliability of service to its customers.

As the infrastructure ages, failures have become more frequent in the last ten years. Even though PSE proactively replaced all bonding boxes, terminations are subject to lightning strikes, vibrations, and earthquakes and cable splices are subject to fail and leak.

Leak location, fault assessment and oil containment are very time-consuming and challenging, even with a remotely operated vehicle (ROV). It is possible that with aging infrastructure, the in-service components, such as immersion reservoirs, oil gages, alarm systems, and spare parts, such as cable and splices, may not be replaceable or usable. Based on past failure evaluation, the cable armor has been determined to be severely corroded. Due to the corrosion, it is difficult to repair the cable and for some of the cables, they cannot be used for their full rated capacity. Through replacement of the oil filled cables with new submarine cable technology, PSE will be able to provide a safe, reliable service to the region and its customers and reduce emergency repair costs on an annual basis.

3.1. NEED DRIVERS

Grid Modernization

Reliability –Replacing aging submarine cable with new submarine cable technology improves system and customer reliability and eliminates the aging infrastructure outages and repairs. This supports Grid modernization efforts by improving the reliability of the new infrastructure and cable configuration.

Safety – Modernization of the PSE submarine system protects the public and employees from stray voltage concerns. Corrosion can create small pits of the splice box and grey oxide that forms on the cables both in and offshore of the splice can deteriorate the armor.

Resiliency – The PSE submarine cable system was built over many years and is aging and unreliable. These cables need to be resilient to provide quality service to a growing load demand, especially in Kitsap. Modernizing PSE's aging infrastructure will harden and protect the submarine cable system and bring it up to latest standards which supports and enables future Grid modernization plans. Optimized submarine cable design and configuration with redundancy built in, will reinforce power supply and improve PSE's ability to restore power faster as needed.

Capacity – Replacement and installation of new submarine cables allows for improved design and construction, which facilitates increased capacity for customers and reliability with additional circuit loading.

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 5 for a brief description of the CBIs that address equity and the applicable benefits for the Submarine Cable Replacement program. 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 4: 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	Yes
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 program addresses aging infrastructure of submarine cables and 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, essentially ensure 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 first submarine transmission cable was installed in 1960 and this system consists of 18 circuit miles of submarine transmission cables and 35 circuit miles of distribution cables.

Final design configuration has not been determined for cable replacement projects, so the cost will depend on type of cable and construction method. The project cost will be estimated more precisely once design is finalized. However, for a planning level estimate to replace submarine cables for Mercer Island, the cost could range from $26 million to $37 million. For Vashon submarine cables, it could range from $53 million to $89 million. This cost range consists of cable materials and installation, but it does not include cable station rebuild or engineering, project management, site surveys, field supervision, and overheads required to complete the design and construction.

4.2. PROPOSED COMPLETION DATE

The planning needs and solutions documents are being developed and as they are signed off for project initiation the process of investigation, engineering and replacement of approximately 18 transmission submarine cable miles will be performed in the next 5 to 10 years with an estimated starting date in 2024.

The Vashon Island transmission submarine cables needs and solutions documents were approved in 2022 as part of the solution for the Kitsap Initiation study. The Mercer Island transmission submarine cables needs and solutions documents have been approved in 2023.

Once the submarine transmission cables have been replaced, PSE will begin planning the replacement of existing submarine distribution cables which are smaller and do not have the same cable station needs or impact on system reliability.

4.3. BENEFITS

The submarine cable replacement plan will improve current and future system reliability for Vashon Island, Mercer Island, and the Kitsap area. Upgrading this aging infrastructure will eliminate the possibility of environmental damage due to fluid leaks either from cables or the bonding boxes. There are 18 transmission cable miles to be reviewed and engineered for replacement. Replacing aging cables ensures our system is resilient to deterioration and provides long term stability in electric service to the region. Being proactive in this approach will allow PSE to replace the cables while the full aging submarine cable system is still servicable, minimizing risk of overload or load shedding scenarios.

4.4. INVESTMENT DECISION BENEFITS

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

- Outage Concern
- Stakeholder Perception
- Environmental Impact
- Operation and Maintenance Cost Avoided
- Contribution to Strategy

The iDOT benefits review for the years 2022 through 2026 cover mostly engineering development, permitting and some cable station upgrades, and do not include submarine cable replacement until 2027. Capital costs are high level estimates until cable design and construction costs are finalized.

Assumptions include average O&M cable repair costs since 2014. Outage concerns based on both submarine cables failing at Vashon Island, with a 12-hour impact before energizing spare phase if repairs are not possible. Outage concerns are not based on actual outage history since there are redundancy measures in place in the event of a single cable failure, they are based on worst case scenario of both crossings failing. For Mercer Island the assumption is both submarine cable feeds to the island failing with an 8-hour impact before energizing the spare phase.

Table **6**: Summary of Plan Benefits, Population and iDOT B/C Score

	Total Projects (Cable Miles)	**Total Budget[2] ($M)**	**All-In CMI Saved (Million)**	**iDOT B/C Score**
2024-2028	**3.7[2]**	**34.4**	**10.5**	**0.56**

[1] B/C ratio uses NPV of benefits and budgets

[2] The budget for 2024-2025 covers engineering and construction plan development for Mercer Island. The total budget shown also includes estimated construction costs anticipated in 2027 and onwards.

5. ALTERNATIVES

5.1. SOLUTION ALTERNATIVES

No Action – Without a submarine cable replacement plan, PSE would face increased interruptions due to submarine cable repair downtime in the event of a failure. This increases customer dissatisfaction and emergency repair expenses annually. Manufacturers are not able to provide spare material for this type of cable so it will not be

possible to carry out future cable repairs in the event of successive failures. The risk to environmental damage increases the longer these cables remain in the operating environment of Puget Sound and Lake Washington. Doing only repairs when needed puts the remaining cable integrity at risk because it must be maneuvered and raised during each repair which adds stress to the fragile cable, increasing likelihood the cable could break apart at multiple locations during this process.

5.2. FUNDING ALTERNATIVES

Increase Funding from Proposed – increased funding for the submarine cable replacement plan would allow PSE to start prioritizing, developing, engineering, and permitting both transmission and distribution replacement projects. Accelerated replacement would reduce O&M emergency repair costs and provide earlier improvement to system reliability from an operational perspective.

Decrease Funding from Proposed –Decreased funding would delay the opportunity to replace existing crossings while they are still fully functioning and in service, adding to reliability risks if crossings become unservicable before replacment projects are comleted. Decreased funding automatically translates into additional maintenance costs on cables and at the bonding boxes in each cable station. Without timely implementation of a replacement plan, the risk of failure will increasinly become greater.

6. PLAN DOCUMENT HISTORY

The current version of the project summary supersedes all previous versions.

Date	Reason(s) for Update	Summary of Significant Change(s)	Modified By
4/1/2021	Initial plan	Initial Document – Summarize Historical Plans	Puneet Janda
12/1/2021	Additional information	Incorporate additional submarine cable failure details	Puneet Janda
10/10/2023	Added information	Added details of PDC report for Mercer Island and cable construction requirements	Vidushi Raina
12/5/2023	2024 MYRP Update	Reformatted tables, iDOT section to align with the other business plans	Krista Malmgren

7. SUPPORTING DOCUMENTATION

Document Name
PSE SUBMARINE CABLE REFERENCE BOOK
CONDITION ASSESSMENT OF PSE'S 115-KV SELF-CONTAINED FLUID-FILLED (SCFF) CABLE SYSTEMS
VASHON ISLAND 115 KV SUBMARINE CABLES PHASE 1 CONDITIONAL ASSESSMENT REPORT
PDC COMMENTS ON PSE VASHON CABLES 8-3-2020
MERCER ISLAND 115 KV SUBMARINE CABLES CONDITION ASSESSMENT REPORT