

**EXH. PKW-17C  
DOCKETS UE-19 \_\_\_/UG-19 \_\_\_  
2019 PSE GENERAL RATE CASE  
WITNESS: PAUL K. WETHERBEE**

**BEFORE THE  
WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION**

**WASHINGTON UTILITIES AND  
TRANSPORTATION COMMISSION,**

**Complainant,**

**v.**

**PUGET SOUND ENERGY,**

**Respondent.**

**Docket UE-19 \_\_\_  
Docket UG-19 \_\_\_**

**SIXTEENTH EXHIBIT (CONFIDENTIAL) TO THE  
PREFILED DIRECT TESTIMONY OF**

**PAUL K. WETHERBEE**

**ON BEHALF OF PUGET SOUND ENERGY**

**REDACTED  
VERSION**

**JUNE 20, 2019**

# Methodology for Determining Variable Operation & Maintenance (VOM) Expense

PROJECT SUMMARY  
PUGET SOUND ENERGY

## Introduction

Production plant variable operating cost calculations have been performed for years in support of economic plant dispatch, outage management, and to support various operational decisions. Previously, actual plant costs recorded in the SAP enterprise accounting platform were extracted on an ad hoc basis, determined to be variable costs or not, and averaged over a three-year rolling period to determine plant-specific costs.

With PSE's participation in the California Independent System Operator's (CAISO) Energy Imbalance Market<sup>1</sup> (EIM), and major changes implemented in 2017 to PSE's SAP enterprise accounting platform<sup>2</sup>, a project to review and update the VOM methodology and calculation procedure was initiated.

Various stakeholders were consulted, including the Generation, Energy Trading, Power Cost, Accounting, and Asset Management teams. These stakeholders participated in collaborative project activities (e.g., meetings, workshops, analyses, review, and consultation) assuring the widest range of perspectives and expertise was applied to the design of the new procedures.

The project performed an assessment of the current VOM methodology, calculations, and resources; designed revised procedures as needed to support future operations, developed new assumptions and semi-automated data updates to facilitate consistency across the plant fleets, and documented changes to data sources or procedures that resulted in a revised VOM.

## Goals for new methodology

The project conducted a current-state assessment of the Energy Operations' VOM methodology and calculation process and recommended improvements as generally described below:

1. Design of uniform and consistent data definitions, data sourcing, process work flows, and documentation to support internal and external plant operations.
2. Development of semi-automated data extract and filtering methods, plant specific VOM calculations, revision/change procedures, and a pre-implementation approval workflow.
3. Provide internal publication of the VOM updates by plant with access controlled to selected recipient groups.

## Phased Approach

This project reviewed and refined VOM calculation source data and means and methods to (i) provide accurate and consistent plant dispatch costs for multiple operational missions, (ii) utilize gas-fired generation spark spread opportunities to reduce power cost with least-cost dispatch strategies in the day-ahead market and CAISO EIM, (iii) reduce reliance on the CAISO cost

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<sup>1</sup> The California Independent System Operator Energy Imbalance Market is a real-time energy supply market offering electricity generation and transmission services and automatically balances demand every 15 minutes and dispatching power plants to meet demand every 5 minutes with the lowest cost energy. PSE entered the EIM on October 1, 2016.

<sup>2</sup> The Financial Transparency Improvement Program is an enterprise-wide initiative designed to improve, simplify, and standardize financial data, processes, tools, and methods that help run the business. It enables better collective financial management across the enterprise by improving financial leadership, delivering transparent financial information, and distributing accountability for financial results.

methodologies that may not reflect the regulated utility business model, and (iv) improve VOM process documentation, approvals, and governance.

## **Cost Category Definitions**

All expenditures needed for the safe and reliable operation of electric generation facilities can be broken into multiple categories: fixed costs, variable costs, capital costs, fuel cost, etc. The respective definitions of these costs can be subject to interpretation, and considerable time was spent gaining team consensus as to which costs were included for VOM purposes, and which were not included. The final definitions are summarized below:

### **Costs Categories Included in VOM**

Variable costs are those expenditures that fluctuate with plant production. Some variable costs increase at a constant rate relative to plant output, such as consumables, raw water supplies, or fees tied to plant electrical production. Some variable operations costs may not respond in a linear manner with plant production, such as contract fees and incentive payments, even though they change based on energy production

#### **VARIABLE OPERATIONS COST**

Variable operations costs include costs incurred to operate production facilities (outside of normal stand-by conditions) when a plant is being prepared to start, starting up, increasing or decreasing output, in steady state operation, shutting down, or being secured after shutdown until normal stand-by conditions are achieved. Variable operations costs do not include the costs of any maintenance activities, nor the cost of straight-time labor.

Specific items included as variable operations costs are:

1. Raw water consumption;
2. Boiler chemicals;
3. Emission control system chemicals (e.g., ammonia);
4. Cooling tower chemicals;
5. Variable lease fees;
6. Variable license fees (if any);
7. Variable O&M supplier contract fees;
8. Purchased station service power in excess of offline consumption (for certain stations only, where station power is purchased from a third-party rather than generated by the plant); and
9. Labor for simple-cycle CT operations, if outside of normal work hours.

#### **VARIABLE MAINTENANCE COST**

Variable maintenance costs are incurred only as the result of plant operation or production. As the volume of production increases, wear and tear will also increase, and will the cost of restorative or corrective maintenance. Conversely, when there is less operation or production, variable maintenance costs will consequently decrease. Examples of variable maintenance

costs are corrective maintenance, certain overtime labor costs related to maintenance, and the cost of parts or materials used in corrective maintenance.

Costs incurred on production facilities for restoration of plant performance or function, including maintenance, repair, or replacements due to degradation resulting from incremental use are also included in Variable Maintenance.

Specific items included as variable maintenance costs are:

1. Labor (OT related to corrective maintenance events)
2. Predictive maintenance activities resulting from predictive monitoring, inspections, or testing
3. Corrective maintenance
4. Variable O&M service contract fees

#### ***Predictive Maintenance, PdM***

Predictive maintenance is work that is performed based on inspection results or predictive/condition monitoring findings to reduce the likelihood of functional failure. Predictive maintenance is performed when functional deterioration is identified in order to maintain performance and/or function.

Predictive maintenance is generally planned in advance so that necessary resources are available, equipment outages are forecast and approved, and replacement equipment (if needed) has been acquired or scheduled. Insofar as predictive maintenance is performed to correct known functional deterioration, it is considered a subset of Variable Maintenance Cost. The routine predictive monitoring that gives rise to predictive maintenance costs is not included as a Variable Cost.

#### ***Corrective Maintenance, CM***

Corrective maintenance is work that is performed to restore performance or function after a failure has occurred. Corrective maintenance is performed after the equipment has ceased performing and functioning properly, and may result in an unexpected outage. Corrective maintenance may be planned in advance, but is frequently initiated after functional failure has already occurred.

It is assumed that no corrective maintenance would be required if the plant had not been operational causing wear and tear. Consequently, Corrective Maintenance is considered a variable cost.

### **Costs Categories NOT Included in VOM**

#### **FIXED O&M COST**

Fixed operations and maintenance costs are those expenses that remain unchanged regardless of production or operation. Whether a facility is producing electricity or not certain preventive maintenance, contract, utility, and programmatic costs will continue to accrue independently of output. Examples of fixed costs are rent, employee straight time salaries, insurance, office supplies, etc. Although, fixed costs can change over a period of time, the change will not be related to production.

For this project, the cost of routine equipment inspections, monitoring, and planned maintenance activities were also considered to be a fixed cost insofar as such expenditures are part of good management practice to maintain operational availability of the equipment.

#### **PREVENTIVE MAINTENANCE, PM**

Preventive maintenance is work that is regularly performed based on pre-determined time intervals to reduce the likelihood of functional failure. Preventive maintenance is performed while the equipment is still performing and functioning properly to sustain performance and prevent unexpected failure. Preventive Maintenance is not included in the calculation of VOM.

Preventive maintenance is planned in advance so that any necessary resources are available, equipment outages are forecast and approved, and replacement equipment (if needed) has been acquired or scheduled.

#### **MAJOR MAINTENANCE**

"Major Maintenance" for the gas-fired turbine plants follows the requirements of WUTC Order No. 6 in UE-130617 issued in the 2013 PCORC Settlement Agreement. It includes the maintenance activity related to overhauls or upgrades to gas turbines or steam turbines and their associated generators for purposes of maintenance or modernization. The activity will follow a schedule set by the turbine or generator manufacturer, and may include testing as part of this activity. Major Maintenance does not apply to Hydro or Wind production plants, and is not included in the calculation of VOM for any plant facilities.

#### **CAPITAL REPLACEMENT AND BETTERMENTS**

Expenditures for the purchase, construction, and replacement of full Units of Property<sup>3</sup>, or the significant betterment of full Units of Property may be funded with capital. Capital expenditures are treated separately from operations and maintenance expense for accounting purposes, and are not included in the calculation of VOM for any plant facilities.

#### **FUEL COST**

Fuel costs include the total cost of fuel delivered to the production facilities as purchased from an offsite fuel supplier. While fuel costs are certainly variable with the production of electricity, they are captured and evaluated separately from O&M costs for dispatch purposes. As a result, fuel costs are not included in the calculation of VOM.

#### **Other Cost Considerations for VOM**

As noted previously, VOM costs are those that increase or decrease in relation to increased or decreased operations of the production plant. In reviewing plant work order costs for categorization, additional filtering is required to separate direct generation costs from those costs related to balance of plant or other plant facilities not directly connected to the production of electrical energy.

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<sup>3</sup> Units of Property ("UOP"), also known as Retirement Units in FERC, are "those items of plant which, when retired, with or without replacement, are accounted for by crediting the book cost to the appropriate plant account in which included." Electric and gas units of property are found in the PSE Electric and Gas Units of Property Manuals. Existing assets will be retired / replaced in accordance with the current Units of Property Manuals.

## **PRODUCTION VS. NON-PRODUCTION EQUIPMENT**

A power plant is a complex facility to operate and maintain for safe and reliable operations. Some parts of the facility are directly associated with the production of electricity, such as turbines, generators, boilers, fuel tanks, controls, and the like. Other parts of the facility are indirectly associated with the production of electricity, such as office buildings, grounds, public-access facilities, and/or site security. For this project, only variable expenditures directly related to the production of electricity are included in the VOM calculation. Other expenditures for non-production equipment are specifically excluded from the calculation, whether fixed or variable in nature.

Production equipment includes onsite or offsite plant equipment and systems used to produce electricity, or equipment and systems directly supporting the production of electricity.

## **CONSUMABLES**

Consumables consist of small parts or goods that are used for common operations or maintenance activities. The cost of consumables for corrective maintenance is included in the calculation of VOM, however, the cost of consumables for preventive maintenance, predictive monitoring, or planned maintenance is not included in VOM.

## **Data Sources & Extracts**

Plant cost data is extracted from SAP enterprise accounting using a new query purpose-built for plant O&M by the Information Technology – Business Warehouse team. The old transaction was rendered inoperative by accounting systems changes and improvements that eliminated “order groups” that the old transaction relied upon. The new query returns all plant O&M expenditures for a specified period, organized by date, plant, and order number. The extract is pre-formatted for Excel, simplifying import to the VOM dataset.

Plant Operations posts work order expenditures using an existing practice for the application of order types and Maintenance Activity Type (MAT) codes. Much of this cost categorization is already supplied via the SAP work management system, but there is some optionality for the application of MAT codes. Pre-categorization of costs into the new VOM cost category definitions facilitates the speed and accuracy of later data filtering and analysis, and reduces the need for manual filtering of indeterminate work order costs.

The dataset holds all plant operations and maintenance work orders from 2015 to present, and is designed to allow rapid updates when new data is added to the data set, or to perform what-if analyses for differing periods of interest. The period can be expanded to encompass all available data, or shrink to periods as short as one month. This “moving window” approach to VOM calculation is one of the most powerful and valuable enhancements in the new VOM methodology.

## **Calculations & Filtering**

Within the dataset, operations and maintenance costs are filtered using Maintenance Notifications, Equipment Hierarchy, and MAT codes to determine VOM applicability. These key indicators attached to the SAP work order header are used to group costs into fixed or variable

categories. Some costs are indeterminate after this initial filtering, and are reviewed/grouped manually based on work descriptions or consultation with plant staff.

From its definition as a fixed cost, straight-time labor is removed from VOM expenditures, although certain overtime labor costs remain when associated with corrective maintenance activities.

Access to the VOM calculation dataset is controlled and password protected. Changes to the data set are performed once per quarter and validated during the update. Thereafter, the data is not changed unless there was an allocation or accounting change made to SAP systems or for error correction purposes. Occasional issues will arise with the formulas or cell references, but these are reviewed and corrected within the Asset Management group.

## **VOM Approval**

Asset Management extracts cost data for the prior quarter from SAP enterprise accounting and performs all data filtering and categorization. After the initial draft categorization and internal quality checks of the VOM calculation, quarterly work order costs, plant production figures, and draft VOM updates are sent to the responsible plant managers for their review and check.

The responsible plant managers receive the initial draft categorization and VOM calculation from Asset Management and review for accuracy and completeness. A data form showing the updated numbers compared to the last iteration is provided, as are the new orders on which the refreshed VOM is based. Since VOM updates are performed on a quarterly basis, the number of work orders to review and check is not onerous.

Once the plant managers have been given the opportunity to review and check the latest work orders and draft VOM update, Asset Management makes any appropriate revisions and provides a draft of the VOM update to senior plant management for final review.

At the same time as senior plant management is reviewing the draft VOM update, senior energy supply management also gets a copy for review. Both plant and supply management then discuss the VOM update, recommend any final changes, then approve the draft to final-status and allow the update to be posted and operationalized.

## **VOM Submittal Form**

The approved VOM update submittal form is published to an internal PSE SharePoint site, itself with controlled access. These published updates represent the official VOM cost by plant to be used for operational analysis and dispatch.

## **PHONETIC LETTER REVISIONS**

It is anticipated that VOM updates will be issued on a quarterly basis only, unless market conditions, plant run profiles, or operational costs encounter a rapid change of substantive magnitude. These official updates may be preceded by drafts for internal data quality review, review by senior management, sensitivity testing, etc. making revision tracking tedious and creating the potential to operationalize updates before they are finalized. As a result, all updates to VOM will be published to an internal SharePoint site using a phonetic letter revision



code to denote updates. Such revisions are easier to track than a traditional date/time stamp on the update (e.g., 5/3/2018 8:23:47 AM) and will evolve a shorthand such as, "Are we using the Golf revision or the Hotel revision?"

VOM Summary  
BRAVO

Designated information is confidential per WAC 480-07-160  
Designated information is confidential per protective order in  
Docket [insert docket number for case submittal]

FINAL

PLANT VARIABLE OPERATIONS AND MAINTENANCE COST UPDATE	
Dataset: VOM Workbook_Sept2018.xlsx	

1. Variable Operations and Maintenance (VOM) Calculated Costs are linked to "VOM Results" output tab within the VOM_WorkOrder_Classification workbook.
2. Updated cells outlined in red.

VOM CHANGE DESCRIPTION AND IMPACT					
Version No.	Description & Impact	Prepared By	Reviewed By	Distribution Date	Effective Date
ALPHA	First issue under new procedure, incorporates VOM cost and production on 3-year rolling average	Bennett	St.Clair	7/25/18	TBD
BRAVO	Incorporates monthly O&M actuals from June, July, August, & September, revisions to Wind contract allocation to VOM, and changes in SCCT maintenance allocation to VOM.	Bennett	St.Clair	12/21/18	TBD

**COST BY PLANT**

VOM updates are provided by plant on the submittal form showing the last current value and the update for easy comparison of the change. In addition, the submittal form includes a brief explanation of major changes in the update, period service hours and capacity factor, cost by period service hour, and total period VOM expenditures. Depending on the mission for plant dispatch (market operations, reliability operations, spinning reserve, load following, etc.) an appropriate plant VOM can be compared to available alternatives.

VOM Summary		PLANT VARIABLE OPERATIONS AND MAINTENANCE COSTS						
BRAVO		Current VOM (\$/MWh)	Updated VOM (\$/MWh)	Updated VOM (\$/Service Hr)	VOM Period Expenditures (\$)	VOM Period Production (MWh)	VOM Period Service Hours (Hrs)	VOM Period Capacity Factor (%)
Goldendale	Combined Cycle	\$						
Mint Farm	Combined Cycle	\$						
Ferndale (2x1)	Combined Cycle	\$						
Sumas	Combined Cycle	\$						
Encogen (3x1)	Combined Cycle	\$						
Fredonia 1&2	Simple Cycle	\$						
Fredonia 3&4	Simple Cycle	\$						
Fredrickson 1&2	Simple Cycle	\$						
Whitehorn 2&3	Simple Cycle	\$						
Snoqualmie	Hydro	\$						
Upper Baker	Hydro	\$						
Lower Baker	Hydro	\$						
Hopkins Ridge	Wind	\$						
Lower Snake River	Wind	\$						
Wild Horse	Wind	\$						

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