

**EXH. CAK-7
DOCKETS UE-170033/UG-170034
2017 PSE GENERAL RATE CASE
WITNESS: CATHERINE A. KOCH**

**BEFORE THE
WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION**

**WASHINGTON UTILITIES AND
TRANSPORTATION COMMISSION,**

Complainant,

v.

PUGET SOUND ENERGY,

Respondent.

**Docket UE-170033
Docket UG-170034**

**THIRD EXHIBIT (NONCONFIDENTIAL) TO THE
PREFILED REBUTTAL TESTIMONY OF**

CATHERINE A. KOCH

ON BEHALF OF PUGET SOUND ENERGY

AUGUST 9, 2017

BEFORE THE WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION

**Dockets UE-170033 and UG-170034
Puget Sound Energy
2017 General Rate Case**

ICNU DATA REQUEST NO. 024

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Please provide the following with respect to the Ardmore Substation:

- a. Total cost;
- b. Of the total cost, please separately identify whether any of this cost includes the cost to decommission the Interlaken Substation and/or relocate transmission or distribution lines from the Interlaken Substation to the Ardmore Substation;
- c. A complete description of the need for the substation;
- d. The in-service date;
- e. The transmission voltage of the substation;
- f. The number of transformers within the substation;
- g. The percentage of the total cost that is allocated to each rate schedule; and
- h. If any of the total cost is allocated to Schedule 40, please identify the percentage that is allocated to each customer on Schedule 40 without identifying the customer by name.

Response:

Puget Sound Energy ("PSE") provides the following in response to subparts a-h relative to Ardmore Substation.

- a. The total cost of the Ardmore Substation Project, including the substation, transmission lines and property acquisitions, was \$39,539,381. This figure represents the un-depreciated cost to construct the project, and is not a net book value.

- b. The total cost for the Ardmore Substation Project does not include the cost to decommission the Interlaken Substation.

Of the total cost for the Ardmore Substation, \$1,439,399 is associated with transmission work and \$9,005,260 is associated with distribution work. The removal costs of the respective transmission line tap serving the Interlaken Substation and distribution lines are included in these costs but were not tracked separately.

- c. The Ardmore Substation Project was needed to support local capacity and reliability needs of the Northeast Bellevue – Southeast Redmond area served by the Sammamish-Kenilworth-Lakeside transmission line. Prior to the Ardmore Substation Project, this transmission line served six substations including both the Interlaken and Lake Hills Substations which were on radial transmission feeds.

The drivers for the Ardmore Substation Project included both capacity limitations of the existing substation transformers and a reliability limitation with the existing transmission line. Regarding the capacity limits, projected growth in 2008-2010 was expected to exceed the summer substation transformer capacity of 27 MVA per transformer. Projected growth on the transmission line was expected to approach the 150 MVA level requiring a third transmission line. Serving six substations already caused reliability limitations for the transmission line. More details are included below:

Substation Capacity:

The immediate driver of the Ardmore Substation Project was the need for additional substation capacity. Commercial and industrial load growth in the area was projected to load multiple substations over their capacity. Key to this analysis was the ability of each substation to be taken off-line without requiring customer outages.

It was projected in 2007 that the load growth over the next two years (2008-2009) would push substation transformer loading over the level where a substation transformer outage could be picked up by neighboring substations. In particular, the summer loading was a concern, when the overload capacity of the 25 MVA transformers was only 27 MVA rather than the 33 MVA of winter.

The substations of concern in the Ardmore area were Kenilworth, Evergreen (with two transformers), and Interlaken. These substations served almost 9,000 customers and 83% of the load was commercial. The four substation transformers near Ardmore were loaded during the summer at 91%.

The high temperature alarm at the Kenilworth, Evergreen Bank #1, and Interlaken Substations went off multiple times during the summers between 2006 and 2009. In 2009, when a heat wave pushed loading past the projected 2009 summer levels, the substation transformers at the Interlaken, Kenilworth and Evergreen Substations were near or over the summer emergency load limit, requiring that load be shifted to adjacent substations proactively to prevent equipment failure. Fortunately, PSE did not experience a transformer outage during this time, when the capacity was not available to pick up adjacent substation loads.

Part of the challenge in transferring load between substations in this highly commercial area was that load could not be shifted in small increments. Each switching point served at least 2 MVA, so that shifting between substations required that the substation picking up the load would need to be loaded well below nameplate. This was not easily achievable in the Ardmore area, where most neighboring substations were loaded near nameplate.

Transmission Reliability:

The Sammamish-Kenilworth-Lakeside transmission line also had several reliability challenges. Numerous substations were added to the line over the years so that it could not use automatic switching to automatically restore all of the substations in case of a transmission fault. Therefore, restoration by supervisory control from PSE's operations center or restoration following a field patrol of the line were required. Two of the six substations were served radially and could not be restored until repaired if the fault happened on the radial section feeding the substation. And in the event of a transmission fault occurring on part of the transmission line while another section of the line was switched out for planned work, such as a road widening project or a pole replacement, up to 22,000 customers were at risk of outage.

Due to the high loading and multiple industrial, commercial, single-family and multi-family residential customers on the Sammamish-Kenilworth-Lakeside transmission line, the line operated normally open for several years at the Kenilworth Substation. As a result, the area was effectively served by two radial transmission lines. While this protected customers north of the Kenilworth Substation from exposure to faults south of the Kenilworth Substation, it limited reliability options for customers south of the Kenilworth Substation.

The substations on the Lakeside-Kenilworth section of this line were the Midlakes, Interlaken, and Lake Hills Substations. Both the Interlaken and Lake Hills Substations were on radial taps of the transmission line and therefore could not be automatically switched to another source in case of a problem on the transmission line.

In 2005, the Sammamish-Kenilworth-Lakeside 115 kV transmission line peaked at 132 MVA in the winter and 122 MVA in the summer. By 2007, the line was the most heavily loaded 115 kV transmission line in PSE's service area for summer peak at 143 MVA, with 43% of the load being commercial.

New commercial development planned for 2008-2010 in the Northeast Bellevue — Southeast Redmond (Ardmore) area was projected to increase load on this transmission line 10 MVA by 2010. The projected peak load level was beyond the 100-150 MVA range requiring a third line to accommodate PSE's need to schedule outages and to perform maintenance and construct system expansion projects, while complying with the North American Electric Reliability Corporation and Western Electricity Coordinating Council standards and meeting customer service expectations.

The new Ardmore Substation was designed with circuit breakers for transmission reliability. This enabled PSE to restore most substations on the transmission line using automatic switching for most transmission faults. With the Interlaken Substation being removed and its customers now served by the Ardmore Substation, the radial transmission line to Interlaken was no longer a reliability problem. The only substation remaining radially fed out of Ardmore was the Lake Hills Substation, 1.5 miles away. The feed to the Lake Hills Substation was moved to its own bus position in the new substation rather than being tapped mid-line on the transmission line between Ardmore and Kenilworth. This improved reliability for both the Lake Hills and Kenilworth Substations, while preparing for a future transmission line to tie the Lake Hills Substation to the rest of the transmission system.

Distribution Reliability:

With the heavy summer loading on the area substation transformers, it had been necessary to shift load between substations to avoid transformer overloads. This was difficult due to the large customer loads. Shifting a small number of customers resulted in a large load shift between circuits. Capacity available to pick up adjacent circuits or transformers was also extremely limited in summer, which could lead to extended outages if equipment failures or other outages had occurred on a hot summer day. PSE accelerated preventive testing and maintenance to reduce the likelihood of outages until a permanent solution could be implemented. It was necessary to avoid planned substation maintenance outages during peak summer or winter months to prevent overloading transformers at nearby substations.

- d. The Ardmore Substation was placed in-service on June 6, 2012. The second and third transmission lines were connected to the 115 kV bus on June 30, 2014.
- e. The transmission voltage of the Ardmore Substation is 115 kV.

- f. There are two transformers within the Ardmore Substation.
- g. The table below contains the percentage of the Ardmore Substation Project cost that is allocated to each rate schedule in PSE's cost of service, rate spread and rate design studies.

Schedule	Ardmore Substation Project Allocation
7	19.7%
24	10.2%
25	13.4%
26	4.0%
31, 35 & 43	6.7%
40 Customer 1	37.5%
40 Customer 2	7.7%
46 & 49	0.6%
Transportation	0.0%
50-59	0.1%
Firm Resale	0.0%
Total	100.0%

- h. The table in part g above lists the percentage of the Ardmore Substation Project that is allocated to each customer served on Schedule 40.