**BEFORE THE WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION**

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| WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION,<br>Complainant,<br>v.<br><br>PUGET SOUND PILOTS,<br>Respondent. | Docket TP- |

**TESTIMONY OF**

**M. SAMI KHAWAJA, Ph.D**

**ON BEHALF OF PUGET SOUND PILOTS**

**NOVEMBER 19, 2019**



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| | EXHIBIT LIST | |
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| **Exhibit No.** | **Description** | **Page Referenced** |
| SK-2 | Curriculum Vitae of Dr. M. Sami Khawaja | 1 |



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## I. IDENTIFICATION OF WITNESS

**Q: Would you please provide your name, employer and business address?**

**A:** My name is M. Sami Khawaja. I am a Senior Vice President with The Cadmus Group LLC located at 720 S.W. Washington, Suite 400, Portland, Oregon 97205.

**Q: Please describe your qualifications?**

**A:** I received a Ph.D. in Systems Science/Economics from Portland State University. Prior to my current position, I ran Cadmus' Energy Services Division with a staff of over 200 energy professionals. For the last 35 years, I have provided consulting services to utilities, local governments, state governments, and other organizations in the United States and other countries (Canada, Thailand, The Philippines, Jamaica, Jordan, and Libya). I also led a study of the economics of piloting in Oregon from 2002-2004. The study included both the Bar and the River Pilots Groups. A copy of my Curriculum Vitae is attached to my testimony as Exh. SK-2

**Q: What has been your experience with regulatory proceedings?**

**A:** I have been involved in studies in regulated environments for over three decades. My work has focused on assessment of impacts of various forms of market interventions. This has always included an assessment of the cost effectiveness analysis of various program delivery mechanisms. I teach, both as an adjunct professor and member of the Cadmus team, workshops throughout the country and internationally on issues related to economics of regulation. I have filed numerous testimonies throughout the country. I have appeared in front of Public Utilities Commissions in Oregon, Washington, Utah, and Indiana. I also testified in front of the Oregon Public Utilities Commission in the matter of economics of piloting in Oregon.

**Q: Have you testified at the UTC previously**? **In what capacity?**



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**A:** I have prepared testimonies on behalf of Avista Utilities. I also appeared in front of the Commission regarding the matter of the effectiveness of Avista's efficiency programs.

**Q: Would you please describe your past experience with pilotage groups or assessments or work therefor? Please describe your earlier study in general.**

**A:** My company, Quantec (now Cadmus), was selected by the Oregon Board of Maritime Pilots Pilot Transfer Review Team to conduct a cost-benefit study of different modes of transferring Bar Pilots onto ships entering and leaving the Columbia. The study was also designed to provide an assessment of: 1) The impact of pilotage rates on regional commerce, and 2) The workload associated with pilotage on the Columbia Bar and the Columbia River. Quantec was hired to develop a quantitative framework from which the Board could discuss various matters that had proved controversial between the stakeholder groups for years (including Columbia River Bar Pilots, the Columbia River Pilots, the Columbia River Steamship Operators Association and the Port of Portland).

## II. PURPOSE OF TESTIMONY IN THIS PROCEEDING

**Q: What are the topics your testimony will address?**

**A:** My testimony addresses: vessel forecast for 2020 (the rate year period) and assignments per pilot, accounting for fatigue and callbacks.

**Q: Would you please provide a description of Puget Sound Pilots' ("PSP") workload assessment in the rate year period and why that is important to pilotage ratemaking?**

**A:** Traditional regulated ratemaking requires the development of a revenue requirement (amount of money needed to meet regulated utility obligation to serve). The revenue requirement is conventionally determined through a rate case. Regulated utilities make the case for expenditures to be included in the rate base has been necessary to provide



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reliable service. Once the rate base amount is negotiated and approved, utilities are allowed to earn a rate of return on their rate base investments. The rate base along with the rate of return make up the revenue requirement. Sales level in rate year is projected. Rates are then determined by dividing revenue requirement by sales. The projected sales are synonymous with projected number of assignments in the case of pilotage rate setting. As such, the same approach can be followed for determining rates for pilotage groups with a couple of notable exceptions. In the case of pilotage, two *additional* components are necessary: 1) Distributive Net Income (DNI) for pilots, and 2) level of workload per pilot. All three inputs are needed for analysis of a test period. Once established, the rate-setting process involves simple multiplication and division. My role in this proceeding is limited to the total assignment forecast, an assessment of the level of work load per pilot, and endorsement of the methodology of setting rates for pilotage.

## III. SUBSTANCE OF EXPERT OPINION

**Q: Please describe the approach followed for estimating total assignments for the test period.**

**A:** Recognizing that shipping traffic varies by year, we calculated forecast of total pilot assignments based on vessel traffic. To arrive at scenario predictions for relevant vessel traffic in the Puget Sound we utilized statistical regression models specific to vessel types. The explanatory variables we used in this forecast included: Macroeconomic indicator data from various sources, aggregated by the Federal Reserve Bank of St. Louis, Fuel pricing data from the Energy Information Administration, Data on global average container ship sizes from a container ship forecast study for the Port of Vancouver, traffic by vessel type, from 2005-2018, provided by the Puget Sound Pilots based on Marine Exchange arrivals, International Monetary Fund (IMF) macroeconomic



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forecasts for 2019 and 2020. We applied a separate regression model for each vessel type. The final set of explanatory variables included in the regression models were: Global average tanker size (C Ship Size), China's Gross Domestic Product (C-GDP), Japan's GDP (J-GDP), The United States' (U-GDP), price of No. 2 Diesel fuel at the port of Los Angeles, labor price for marine cargo handling, industrial production index of the United States, and total value of imports from to China by the US. Table 1 shows the vessel type and the selected (based on statistical testing) final explanatory variables for all vessel types. Table 2 shows the actual versus forecasted vessel traffic (2005 – 2020). As can be seen in the last column, the vessel models wereable to predict number of ships fairly accurately for the time period analyzed.

**Table 1: Predictor Variables by Vessel Type**

| Vessel Type | C Ship Size | C- GDP | J- GDP | U-GDP | No 2 Diesel | Cargo Labor | Ind. Prod. | US Imports - China |
|---|---|---|---|---|---|---|---|---|
| Bulk | | | | | | | | |
| Container | √ | √ | √ | √ | √ | √ | √ | √ |
| General | √ | √ | √ | √ | √ | √ | √ | √ |
| Other | | √ | √ | | | | | |
| Tanker | | √ | √ | √ | √ | | √ | √ |
| Passenger | | √ | √ | √ | √ | | √ | |
| Roll On-Roll Off | √ | | √ | √ | √ | √ | √ | |
| Tug | √ | √ | | | | | | |
| Vehicle | √ | √ | √ | √ | √ | √ | √ | |

**Table 2: Predicted vs Actual Vessels**

| Year | Actual No. of Ships | Predicted No. of Ships | % Difference |
|---|---|---|---|
| 2005 | **2,934** | **2,970** | 1.20% |
| 2006 | **2,994** | **2,961** | -1.10% |
| 2007 | **2,945** | **2,964** | 0.70% |
| 2008 | **2,968** | **2,942** | -0.90% |
| 2009 | **2,804** | **2,791** | -0.50% |
| 2010 | **2,666** | **2,685** | 0.70% |
| 2011 | **2,731** | **2,707** | -0.90% |
| 2012 | **2,717** | **2,757** | 1.50% |



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| | | | |
|---|---|---|---|
| 2013 | **2,719** | **2,724** | 0.20% |
| 2014 | **2,621** | **2,573** | -1.80% |
| 2015 | **2,484** | **2,524** | 1.60% |
| 2016 | **2,544** | **2,550** | 0.20% |
| 2017 | **2,504** | **2,469** | -1.40% |
| 2018 | **2,559** | **2,572** | 0.50% |
| **2020** | **Prediction** | **2,470** | |

**Q: Please describe the transition from vessel arrival forecast to assignment forecast.**

**A:** In order to determine the number of assignments expected in 2020, we first estimated the ratio of assignments per vessel based on 2018 data. As shows in Table 3, we started with number of vessels (row A) and number of assignments (row B) based on 2018 actual arrivals. The ratio of assignments per vessel is determined for each vessel type (row C). Our prediction of vessel arrival from Table 2 above (row D) is then used to predict number of assignments in 2020 (row E). Although we used 2018 assignments per vessel, we also analyzed other years to see if the result would be different. Generally, we found that this ratio was relatively stable across years.

**Table 3: Assignment/Vessel Type**

| | Factor | Bulk | Con-tainer | General | Other | Passen-ger | Roll-on Roll-off | Tankers | Vehicle | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| A | **2018 Vessels** (Actual) | 333 | 983 | 74 | 176 | 220 | 115 | 456 | 202 | **2,559** |
| B | **2018 Assignments** (Actual) | 1,132 | 2,427 | 196 | 175 | 461 | 238 | 2,205 | 496 | **7,330** |
| C | **2018 Assignments/Vessel** (B/C) | 3.40 | 2.47 | 2.65 | 0.99 | 2.10 | 2.07 | 4.84 | 2.46 | **2.86** |
| D | **2020 Vessel Prediction** | 333 | 964 | 80 | 157 | 201 | 107 | 388 | 240 | **2,470** |
| E | **2020 Assignment** (D*C) | 1,132 | 2,379 | 212 | 157 | 420 | 222 | 1,878 | 590 | **6,989** |

**Q: How did you approach calculating assignments for pilots?**

**A:** Fundamentally, economic analysis leading to optimal decisions relies on the use of marginal analysis, or an examination of the additional benefit of an activity compared to the additional cost incurred by the same activity. The marginal benefit of adding a pilot, is increased safety, decreased callbacks, and decreased vessel delays. The marginal cost is the income of the added pilot. In 2018, the number of callbacks represented 15% of



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total assignments. This level of callbacks represents time where pilots are called from their off-duty time to work. Callbacks occur when there is insufficient staffing of on-watch pilots. The purpose of these callbacks is to avoid ship delay. Callbacks, however, are not ideal as they represent time pilots are working while off duty and may create situations of pilot fatigue, an important safety consideration. Additionally, this trend implicates the need for additional licensed pilots in order to avoid the unpredictable expansion of the callback calculation accrual. They are also not ideal as they create a liability on the association books.

**Q: How did you specifically go about this analysis?**

**A:** The primary basis of our analysis was the data set cleaned by NASA for "Puget Sound Pilot Fatigue Study Report" for assignments from 10/17-9/2018 (analysis year). These data had jobs or assignment detail which combined multiple harbor shifts conducted by a single pilot into a single assignment from a working perspective and split cruise ship moves (inbound and outbound by the same pilot) into two assignments. The first step in our process was to create a time series for each pilot indicating their current activity. Each row of the NASA data set corresponded to an assignment and contained various details about each of those assignments.

**Q: Then what steps did you take?**

**A:** With all data in hand, we then simulated a reduction in callbacks by creating "hypothetical pilots on shift." We ran this simulation once for each number of the hypothetical pilots tested (e.g., once for 1 pilot, once for 2 pilots, etc.). Consistent with the calculation of historic working pilots (see below), we converted those assignments from pilots who did a relatively low number of jobs (< 20) to callbacks to avoid overcounting the number of working pilots. Table 4 shows the scenario results of adding



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one additional pilot on watch. In the analysis year, only 18% of days had zero callbacks, with an average of 3.3 callbacks per day for a total of 1,188 callbacks. The simulation result shows that that adding one additional pilot on-watch from the base year leads to a reduction of 373 callbacks (i.e., 1,188-815) and adding two pilots on-watch reduces another 295 callbacks.

**Table 4: Scenarios of Additional On-Watch Pilots**

| **Additional On-Watch Pilot** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
|---|---|---|---|---|---|---|---|---|---|---|
| **Resulting % Days with 0 Callbacks** | 18% | 33% | 48% | 64% | 77% | 89% | 96% | 98% | 99% | 100% |
| **Average Callbacks* per Day** | 3.3 | 2.2 | 1.4 | 0.8 | 0.4 | 0.2 | 0.1 | 0.0 | 0.0 | 0 |
| **Total Callbacks*** | 1,188 | 815 | 520 | 288 | 145 | 63 | 22 | 10 | 4 | 0 |
| **Marginal Reduction in Callbacks** | | 373 | 295 | 232 | 143 | 82 | 41 | 12 | 6 | 4 |

** Combines multiple harbor shifts and round-trip cruise jobs*

The following figure shows the relationship between the portion of days with zero callbacks and the number of additional pilots on watch. It shows that the marginal benefit of adding pilots (i.e., reduction in call backs) has a positive slope (as you add pilots, number of days with zero callbacks also increase). Around 5 pilots however, the slope, while still positive, decreases (i.e., diminishing returns set in). As mentioned above, the marginal cost of addition of a pilot is the income earned by the pilot. The marginal benefit of adding a pilot is avoiding a call back. However, this cost is unknown. Ideally, we would resort to the traditional economic approach of marginal analysis. However, without complete data, we resorted to a close method of adding pilots up to the point where diminishing returns set in at five pilots on watch. Furthermore, at this staffing level, the number of days with zero callbacks is expected to be 89% which appears to be reasonable as compared to staffing for peak demand and avoiding any callbacks or any potential ship delays. Puget Sound Pilots are willing to use callbacks to not overtax the system with too many pilots.



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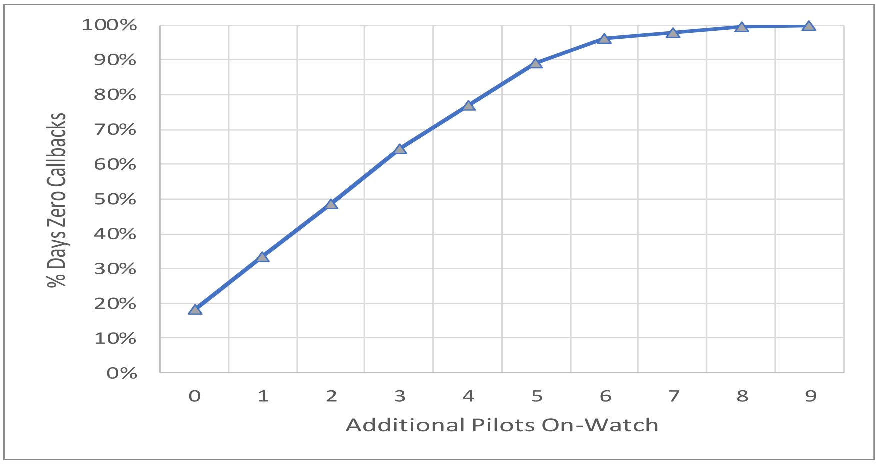
**Figure 1: Relationship of Days with Callbacks vs Additional On-Watch Pilots**




**Q: How do you estimate number of pilots needed from number of pilots on watch?**

**A:** According to the PSP, for every pilot on watch, an additional 1.2 pilots are needed. This value represents the fact that the Puget Sound Pilots have 11 watch groups, one of which is on earned time off each two-week period. Therefore, to add five pilots on watch requires 11 full-time working pilots (5*2.2). We then added these pilots to the number of working pilots in the analysis year. Across the course of a year, pilots are hired, retire or go on medical leave. As noted above, to avoid overcounting pilots, we removed the pilots with a low number of jobs (< 20) from the data set, which represented administrative and pilots on major medical. We calculated number of unique working pilots based on the median monthly level: 49 working pilots at any point in the analysis year. To calculate total full-time working pilots, we also added NASA study's estimate of 2 additional pilots required to account for fatigue. The sum of these components results in 62 working pilots in the analysis period. The ratio of total 2018 assignments (7,330) and total working pilots results in the recommended number of assignments per working pilot of 118.



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**Table 5: Assignments per Working Pilot**

| | | |
|---|---|---|
| A | **Working Pilots** | 49 |
| B | **Additional Full-time Pilots** (5*2.2) | 11 |
| C | **Additional Pilots for Fatigue, NASA** | 2 |
| D | **Total Full Time Working Pilots** (A+B+C) | 62 |
| E | **2018 Assignments** (Table 3) | 7,330 |
| F | **Assignments / Working Pilot** (E/F) | 118 |

To adjust this analysis period to 2020 pilots, we first divided the forecast of number of 2020 assignments (6,989 see Table 3 above) by the number of assignments per working pilot. In addition to working pilots, the Puget Sound Pilots have non-working pilots. To add administrative pilots and average number of pilots on medical leave, we added 2 and 0.5 pilots, respectively. In 2018, the Pilots had an average of 1 pilot on major medical on a daily basis. Yet, this average was higher than the 10-year average of 0.5 pilots, so we used that value.

**Table 6: Total 2020 Pilots**

| | | |
|---|---|---|
| A | **Assignments / Working Pilot** (Table 5, F) | 118 |
| B | **2020 Assignments** | 6,989 |
| C | **2020 Working Pilots** (B/A) | 58.6 |
| D | **Average Annual Pilots on Major Medical** | 0.5 |
| E | **Administrative Pilots** | 2 |
| F | **2020 Total Pilots** (C+D+E) | 61.6 |

In summary, we recommend that the pilots are staffed at a level of 61.6 pilots for 2020, with an average assignments per working pilot of 118.

**Q: Finally, can you address the recommendation by which you suggest the Commission set rates in this proceeding?**

**A:** Yes. As mentioned above, traditional rate making involves estimation of cost of service (cost of meeting obligation to serve) and a rate of return. The total of the two forms the revenue requirement. This amount is what is considered sufficient analogously to compensate utilities for their investment, i.e., an amount that would attract investment in the utility delivery structure. Similarly, for rate setting for pilots, the approach needs to



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compensate pilots at rates comparable to industry averages and at levels that will continue to attract qualified pilots to the Puget Sound. I am thus endorsing a methodology for setting the revenue requirement that seeks to generate revenue sufficient to fund at a competitive level the greater of the number of licensed pilots, or the number of FTE pilots necessary to perform the projected vessel assignments, based on a comparison of the available workload (vessel traffic projection) to the work each pilot is expected to perform while on-duty. Notably, this model would ensure sufficient funding for the number of actual licensed pilots at a minimum, and compensates for off-duty worked performed when  licensed pilots perform more work than the share of an FTE pilot. Thus, the methodology that best accomplishes the goals of ratemaking for pilots is one that seeks to generate a distributive net income per pilot that is competitive with other pilot groups, multiplied by the greater of the number actual licensed pilots or the number of FTE pilots needed. This approach is what I recommend the Commission adopt.

**Q: Does this conclude your testimony for now?**

**A:** Yes it does.



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