Exh. IC-___X
Docket TP-190976
Witness: Ivan Carlson

BEFORE THE WASHINGTON

UTILITIES AND TRANSPORTATION COMMISSION

WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION, Complainant, v. PUGET SOUND PILOTS, Respondent.	**DOCKET TP-190976**

CROSS-EXHIBIT FOR

Ivan Carlson

PSP Callback Subbing Methodology

August 7, 2019

To:	Puget Sound Pilots
From:	Jon Koliner and Lauren Gage, Apex Analytics
Subject:	Methodology for Calculating Needed Pilots
Date:	October 10th, 2019

In order to calculate the impact of hiring additional pilots on the total callbacks for the Puget Sound Pilots, we processed the NASA "Job Details" data set. The primary impetus for using this data set is that it had jobs and travel resolved at the minute-level, which allowed the analysis team to see which jobs overlapped with each other. In order to accurately determined the number of jobs additional pilots could cover, we needed to be able to see how many were required at each point in time.

Generating Interval Data

Each row of the NASA Job Details data set corresponded to one or multiple (multi-harbor shift) jobs and contained:

- Pilot identifier
- Job type
  - E.g callback, reposition, meeting, standard job…
- Time travel started
- Time job started
- Time job ended
- Time pilot "checked in"
  - The time that the pilot returned to base

For each pilot in the data set, we took the following steps:

1. Extract all jobs, sorted by start time
2. Create a time series documenting for this pilot, at five minute intervals:
   - Type of job they are currently doing (includes "None")

The result of this conversion was a time series for each pilot indicating their current activity, at the five minute level. This time series could also be analyzed by the time point, with each time point now having information about which pilots were doing jobs, and what kind. From this data set, we could summarize number of unique pilots working per day, number of unique pilots working callbacks per day, and the maximum number of callbacks at any time during each day, among other things.

Callback Reduction Analysis

With data on all pilots at the five minute level, we could now simulate a reduction in callbacks by creating "hypothetical pilots on shift." We ran this simulation once for each number of hypothetical pilots tested (e.g. once for 1 pilot, once for 2 pilots, etc.). The simulation took the following steps:

- For pilots who did a low number of jobs (< 20), convert all jobs to callbacks (assume we are "pulling" these pilots from our base available pilots, resulting in higher callbacks)
- At each time point, get the pilots currently performing callback jobs
- If the number of callbacks is less than or equal to the number of hypothetical additional pilots on shift, remove all callbacks
  - i.e. set any pilot's "current job" to "None" instead of a callback
- If the number of callbacks is greater than the number of hypothetical additional pilots on shift, remove callbacks from a number of pilots equal to the hypothetical additions
  - Chosen alphabetically to ensure consistency across the time series (not useful for calculating the impacts on *specific* current pilots across the year but useful in aggregate)

Using this revised data set, we once again calculated unique pilots working per day, unique callback jobs per day, and maximum callback jobs at once each day. These new simulated data sets show the impact of adding hypothetical additional pilots.

Calculating Total Unique Pilots

Across the course of a year, some pilots retire or go on leave and others begin work for Puget Sound Pilots. For those reasons, the number of unique pilots working in a year is an overestimate for the standing number of working pilots. However, the number of unique pilots doing jobs in a given day is an underestimate because of vacations or pilots who are not on shift. Therefore, we decided to calculate the median number of unique pilots at the monthly level. Before doing this, we removed the pilots with a low number of jobs (< 20) from the data set. That resulted in an estimate of **49 pilots** as standing staff at any point in time in the NASA data (10/2017 – 9/2018).

To arrive at an estimate for total number of needed pilots, we took the following steps, starting at the **49 pilot** estimate for pilots needed during the NASA study period.

- Add additional pilots for:
  - Covering more callbacks, as detailed above **(1-9 pilots, variable)**
  - Removing fatigue conditions, as detailed in the NASA study **(2 pilots)**

This resulting value is *the number of <u>working</u> pilots to cover the NASA study period, assuming callbacks and fatigue were reduced to recommended levels.* Then:

- Take the ratio of pilots working to vessel traffic

- Multiply by predicted vessel traffic for 2020 according to our vessel analysis
- Add in 2 pilots for administrative tasks (President and Vice President, who should not be covering jobs in the ideal case)
- Add in 1 pilot to represent the average of 1 pilot on medical leave at any point in time during the NASA study period.

The resulting estimate is the total number of required pilots to cover jobs and administrative tasks in 2020 while following recommendations to reduce callbacks and fatigue, and allowing for an average of one FTE on medical leave.