



## Williwaw Engineering

February 9, 2016

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Subject: January 2016 Monthly Report – RCUH P.O. #Z10115098

Dear Luis,

The following constitutes my monthly report for the subject agreement for services associated with January 2016.

***Work Completed under Activity 1: “Provide technical and software support services to HNEI technical staff in programming data acquisition (DAS) controllers and analyzing data records in the following areas as assigned”:***

- Monitored the device regularly via remote connection to the NWEI host PC in Room 106, Battery French. Downloaded data from PC as necessary, and updated device control settings when necessary.
- Analyzed output power data to produce monthly power performance data plot; see Attachment 1 for results.
- Analyzed Azura float angle data using MATLAB to produce a plot of 30 minute average float angle data for the deployment period. The Azura has not settled in the water noticeably since the January 9 mooring repair.
- Plotted daily humidity sensor data for the cRIO enclosure and drybox on board the Azura. The results continue to show that the drybox, which is entirely sealed from the Azura hull, has maintained very low humidity throughout the deployment period while humidity has slowly increased inside the cRIO enclosure since the June deployment. See Attachment 3 for a plots of these results.
- Analyzed NREL mooring load cell data from before and after January 9 mooring repair to show effect of the change on mooring loads. See Attachment 4 for a plots of these results.

Please let me know if you have any questions or comments concerning this project.

Sincerely,

Terry Lettenmaier

Attachment 1: Azura power performance data plots

Attachment 2: Azura 30 minute average float angle data plots

Attachment 3: Azura cRIO enclosure and drybox humidity

Attachment 4: Azura mooring loads before and after AB mooring change

## **Attachment 1**

### **Azura power performance data plots**

## Summary

- The Waverider buoy was not deployed during the period Jan 1-12, 2016 so data is not available for that time period.
- The Azura AB float was re-installed on January 9 and the AB mooring riser shortened to keep the AB float below the surface and correct a mooring design problem discovered during the Azura deployment.
- January data on the following 3 slides shows Azura performance after AB float repair.
- For comparison, June-October data with AB float on the surface is shown on the last two slides.

# Azura Power Performance – January 13-31, 2016

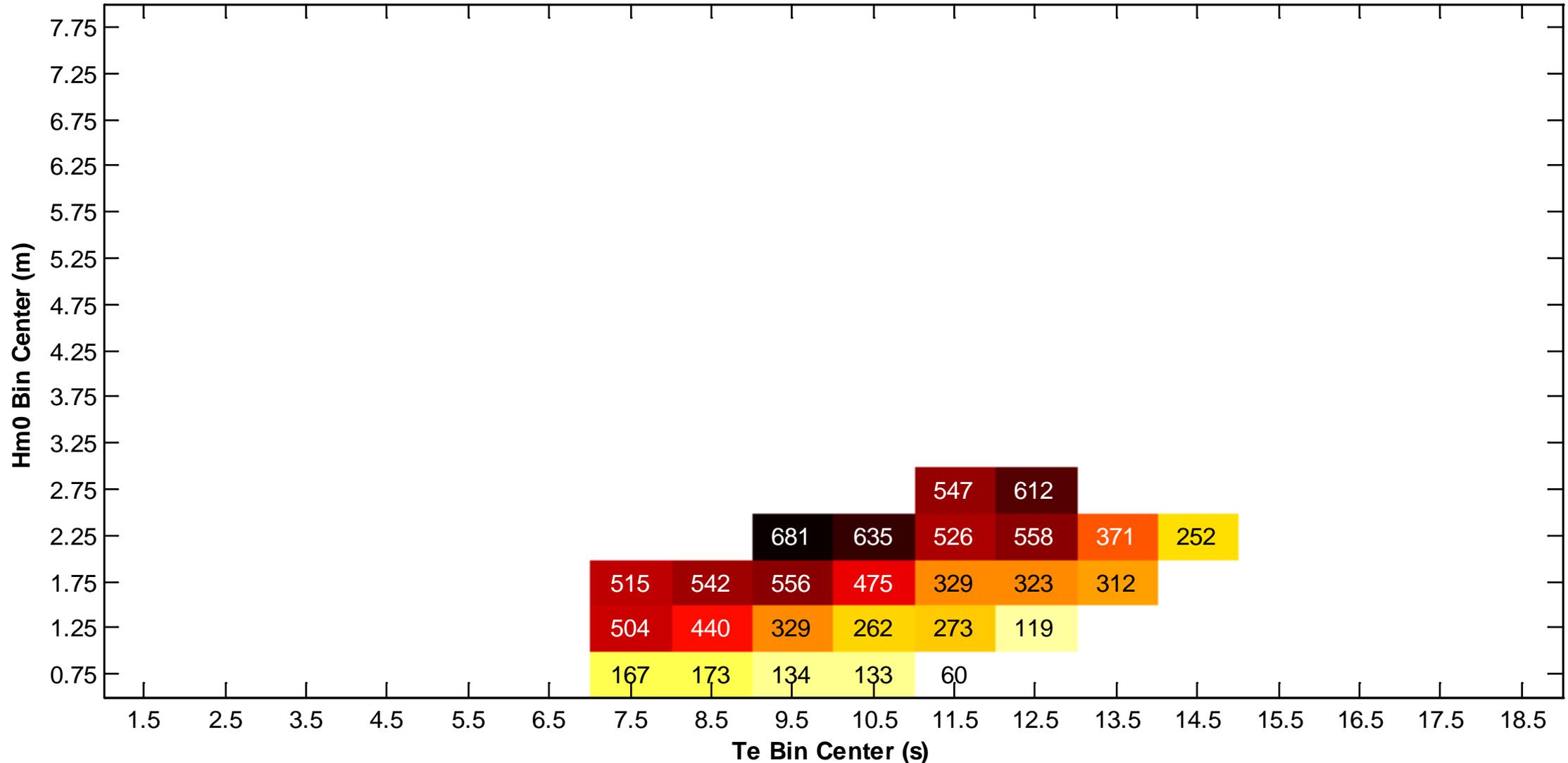


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95<sup>th</sup> percentile power matrix

95<sup>th</sup> Percentile Device Dc Output Power (W)

Data after AB float re-installed on Jan 9. 30 minute periods with > 20 minutes operation included



# Azura Power Performance – January 13-31, 2016

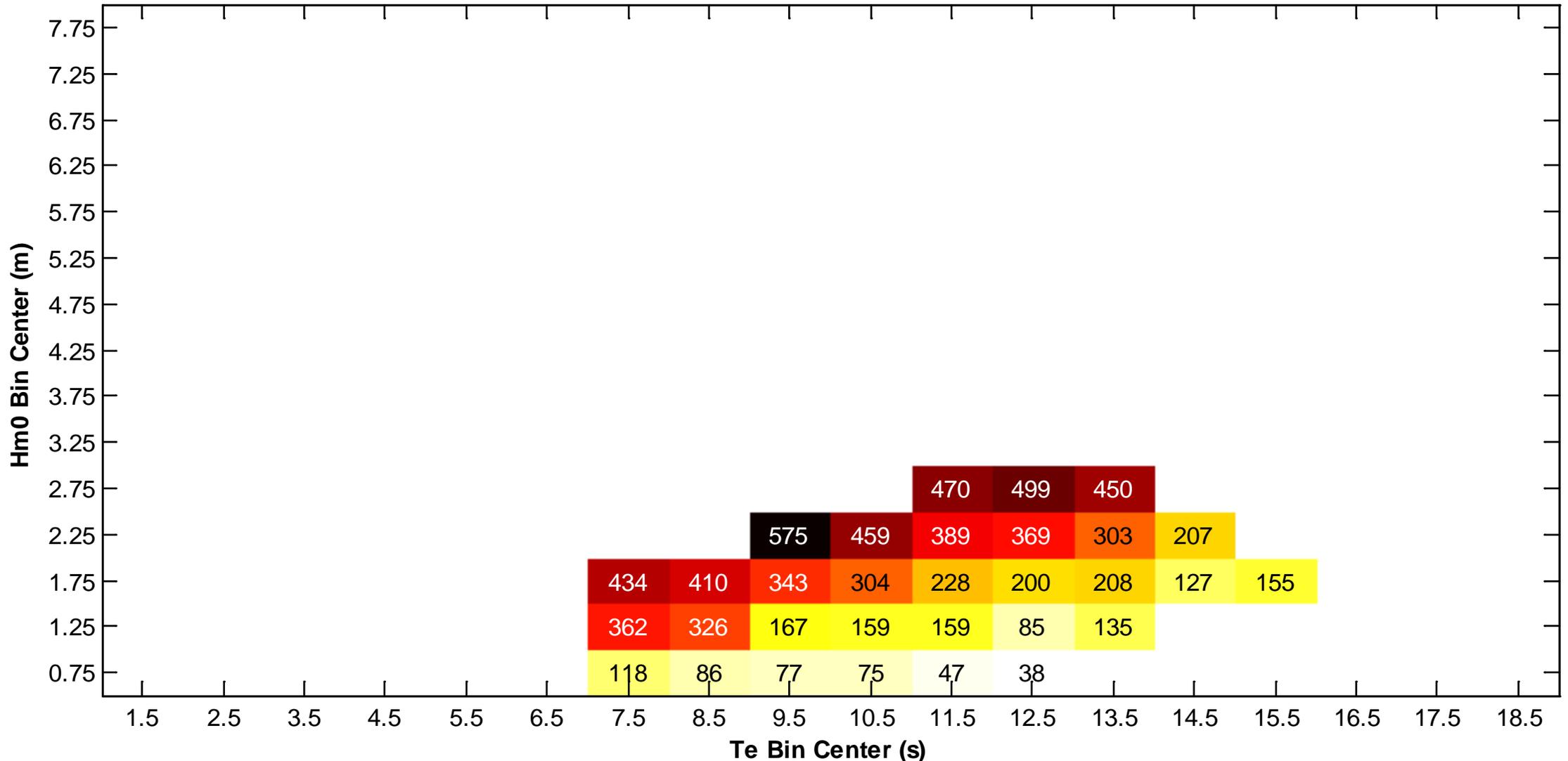


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Mean power matrix

Mean Device Dc Output Power (W)

Data after AB float re-installed on Jan 9. 30 minute periods with > 20 minutes operation included



# Azura Power Performance – January 13-31, 2016

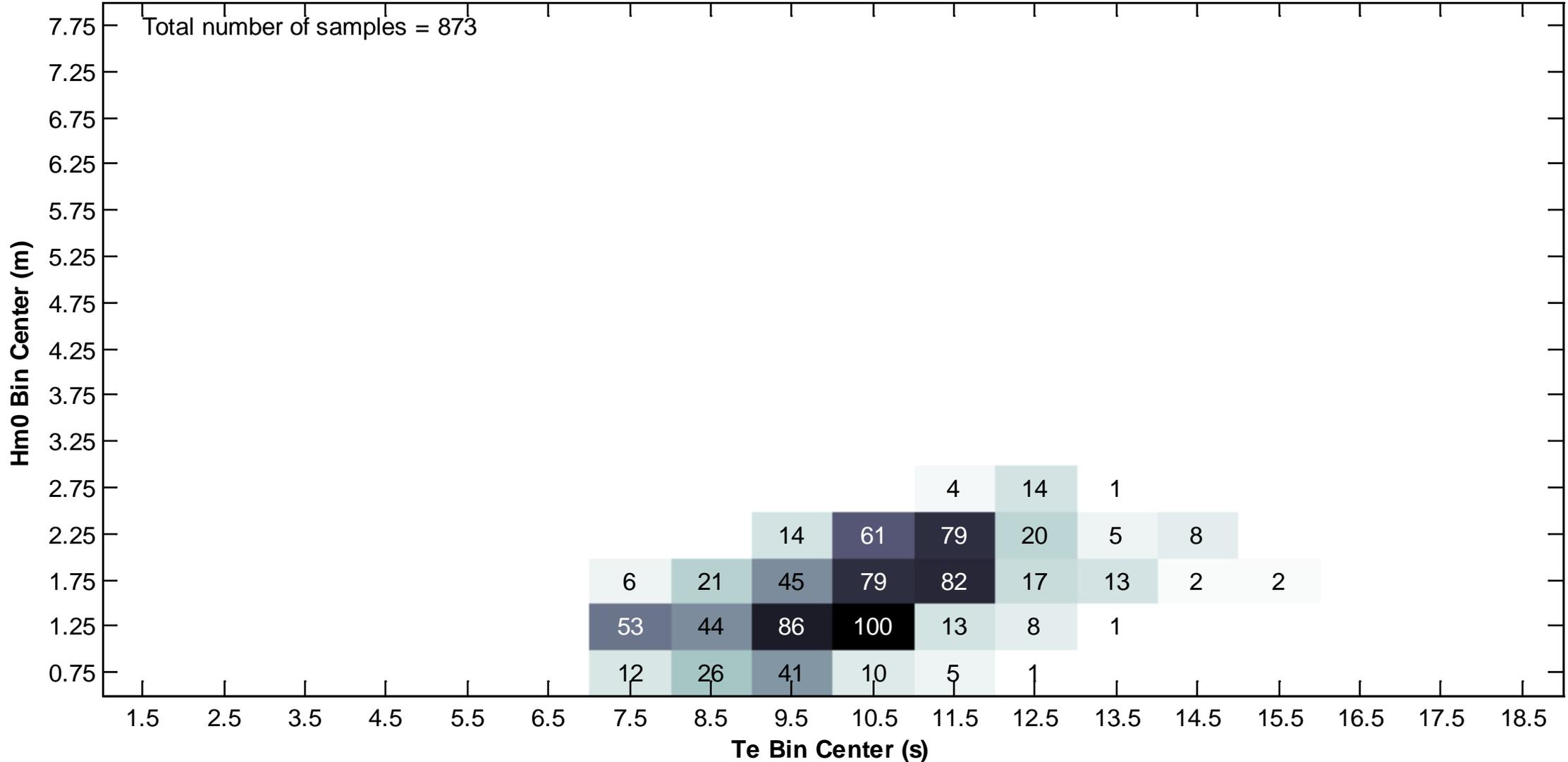


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Sample Count

Sample Count (30 min sample periods)

Data after AB float re-installed on Jan 9. 30 minute periods with > 20 minutes operation included



# Azura Power Performance – June-October 2015

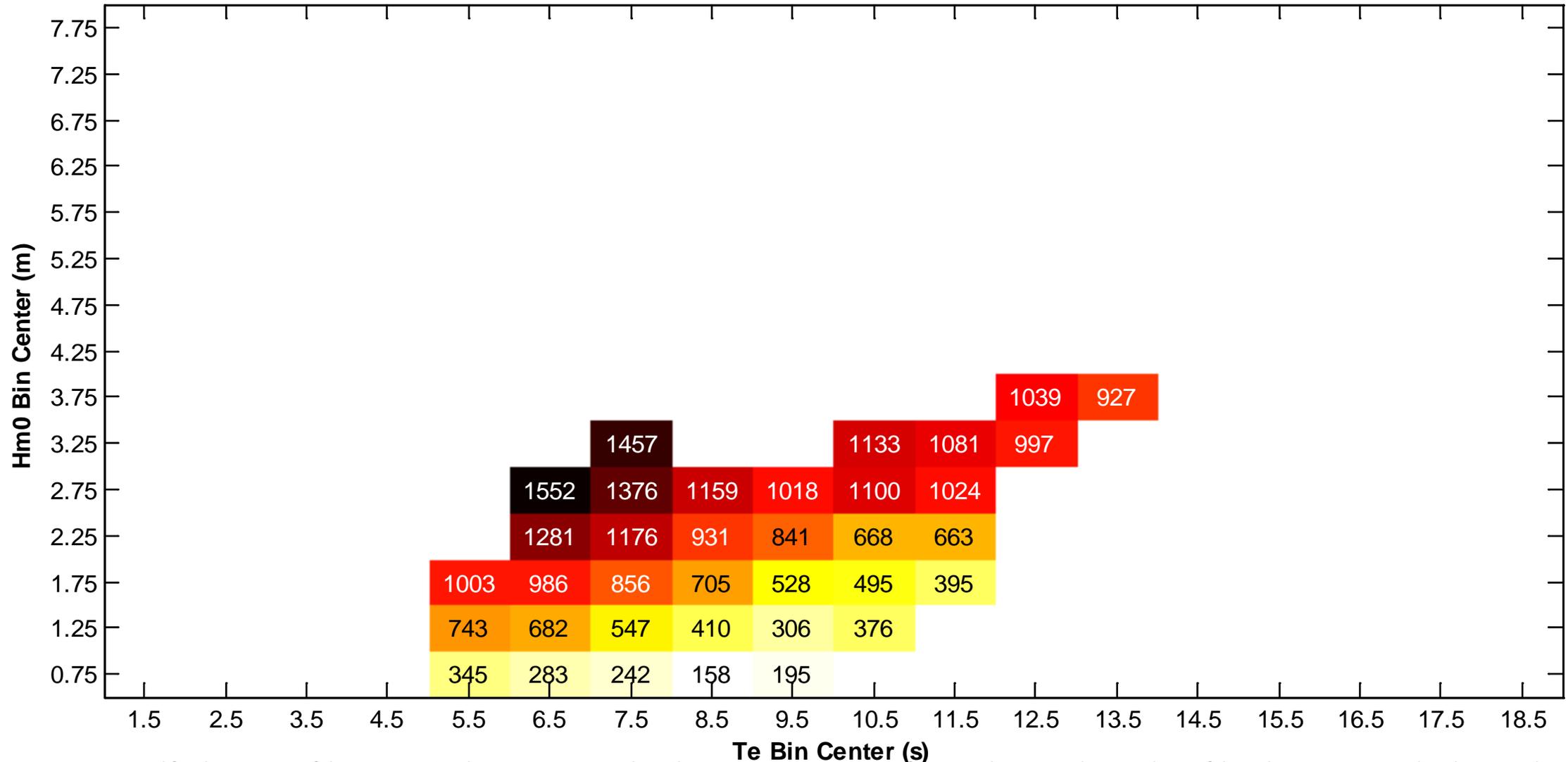


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95<sup>th</sup> percentile power matrix

95th Percentile Device Dc Output Power (W)

Cumulative data, months of Jun 2015 - Oct 2015; 30 minute periods with > 20 minutes operation included



# Azura Power Performance – June-October 2015

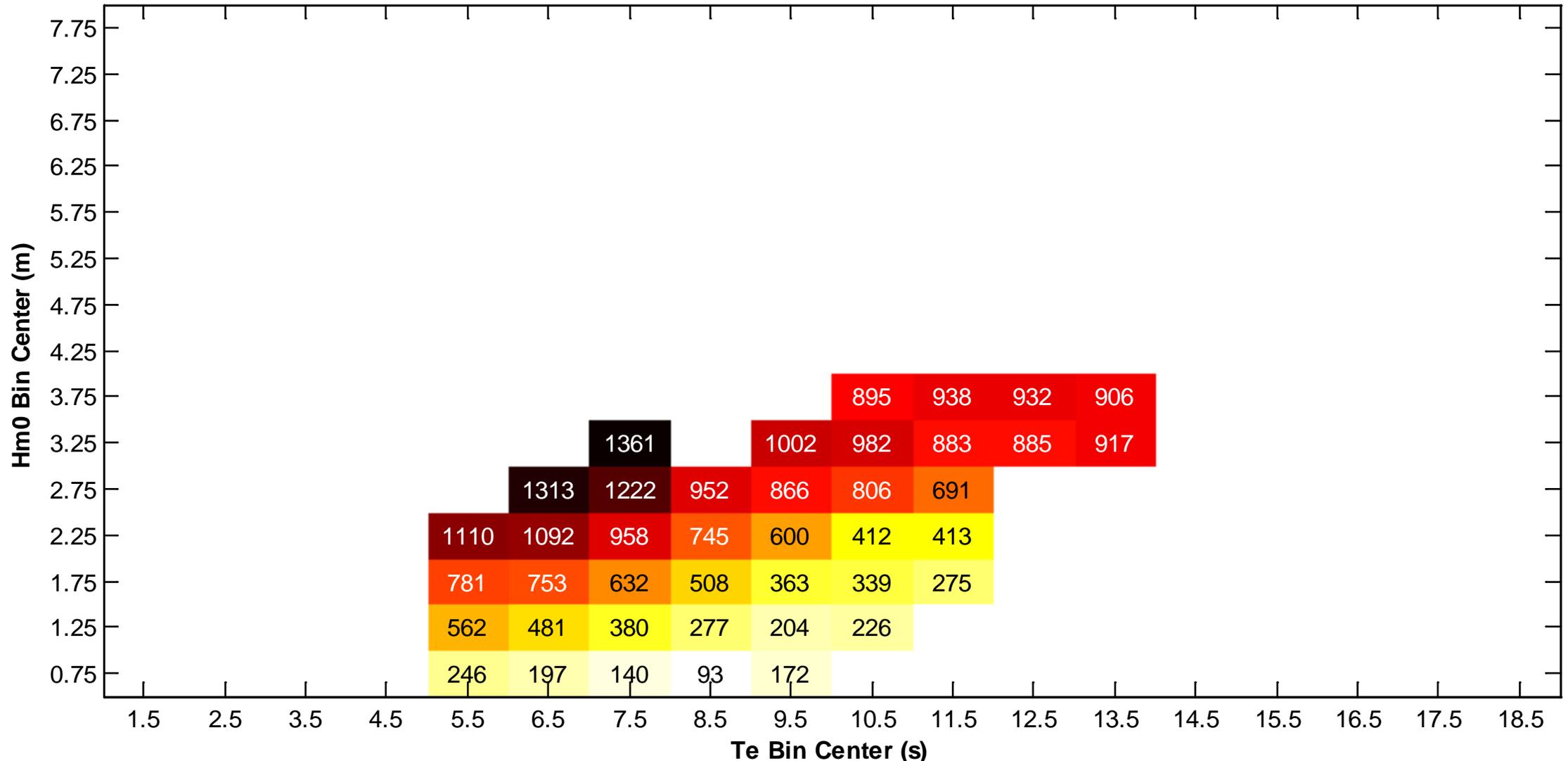


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Mean power matrix

Mean Device Dc Output Power (W)

Cumulative data, months of Jun 2015 - Oct 2015; 30 minute periods with > 20 minutes operation included



## **Attachment 2**

**Azura 30 minute average float angle data plots**

## Summary

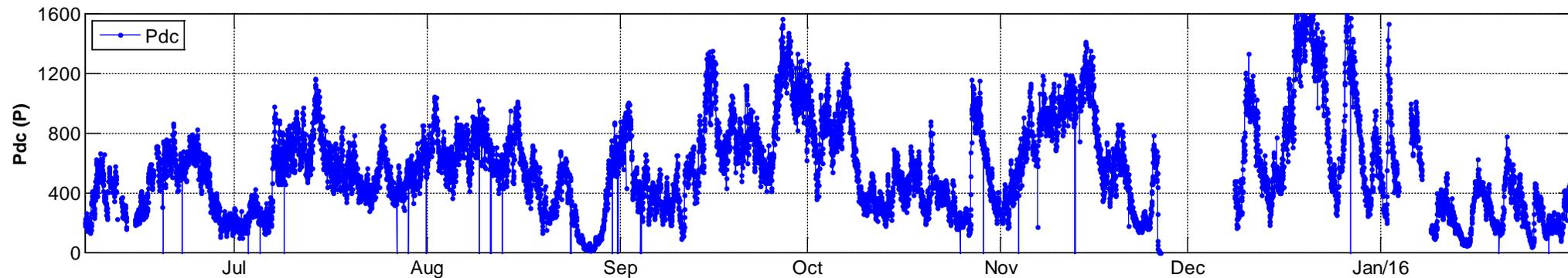
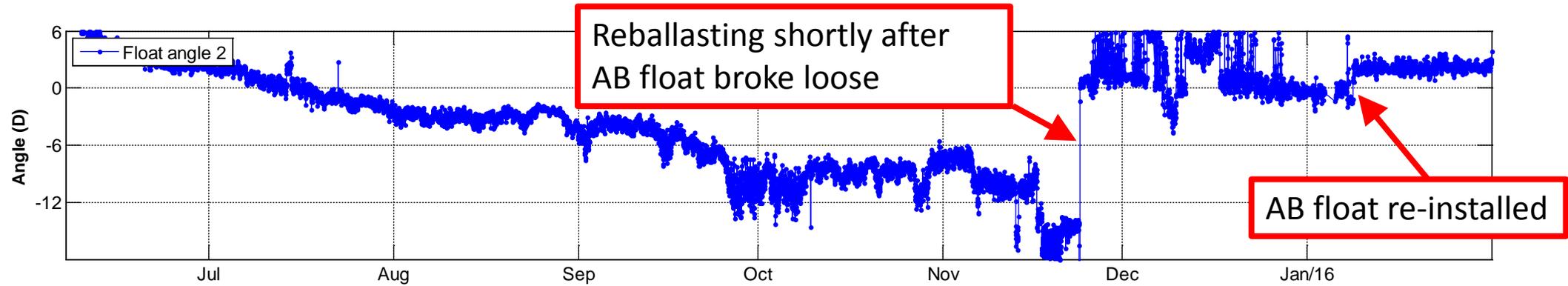
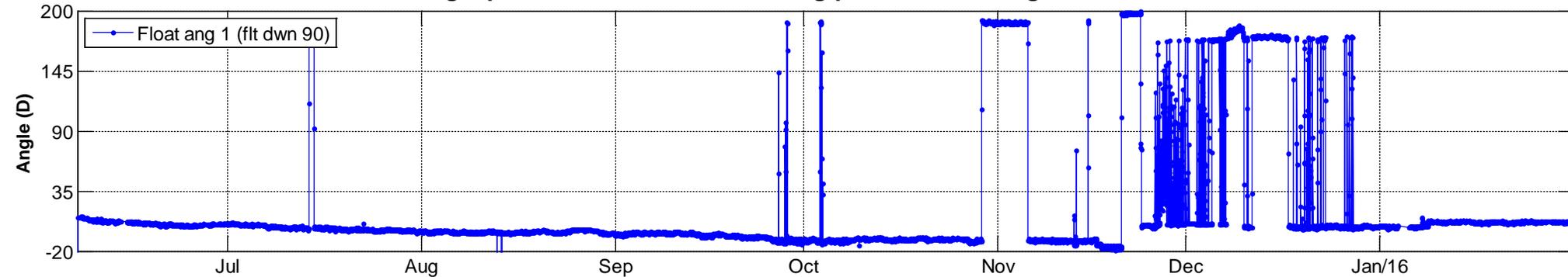
- See Slide 2 for plot of June 2015 – Jan 2016 data
- Average float angle has been steady near zero angle since the AB subsurface float was re-installed on January 9.

## Azura 30 min average float angle data through Jan 2016



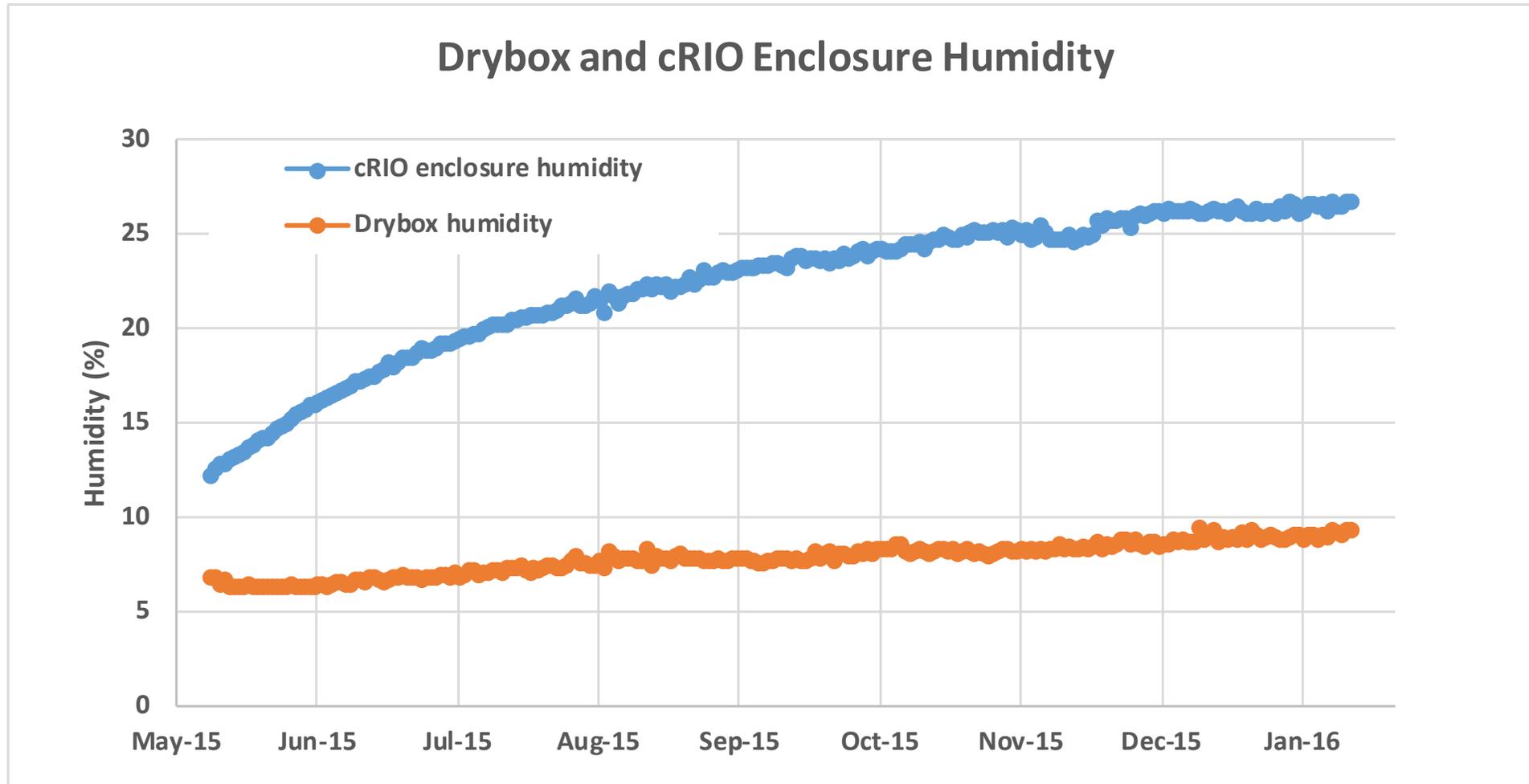
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Float angle plots from file NWEI 30m avg power w float angle 201506 to 201601.txt



## **Attachment 3**

**Azura cRIO enclosure and drybox humidity plots**



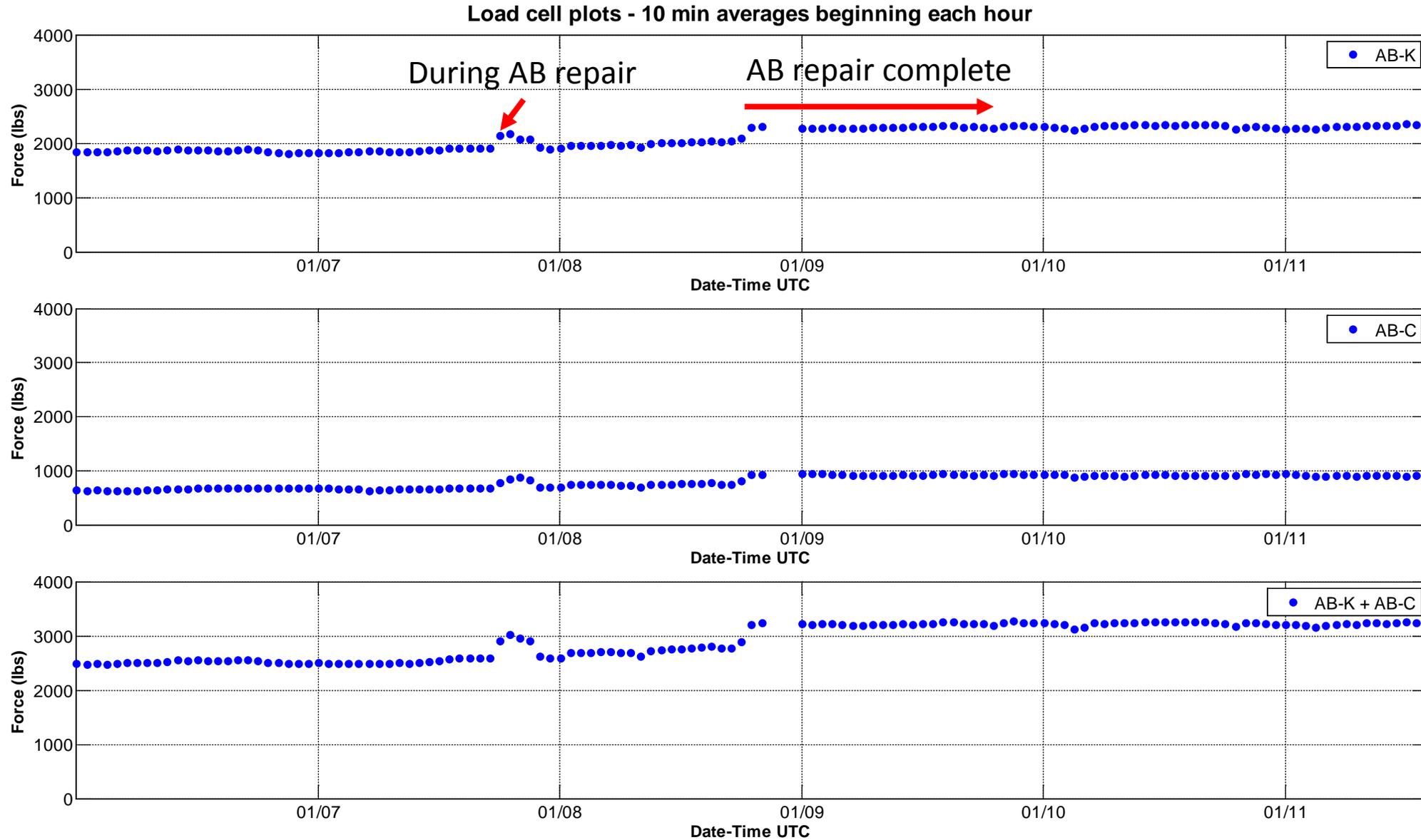
## **Attachment 4**

**Azura mooring loads before and after AB mooring change**

## Summary

- The Azura mooring as initially installed in late May 2015 had incorrect mooring lengths so that the AB subsurface float was on the surface.
- In November the AB float broke loose so that in December and early January, mooring tension was provided by weight of AB mooring line and “fish plate” normally connecting AB float.
- On January 9, the AB float was re-installed and the AB riser was shortened. After this change the AB float was below the surface.
- See following slide showing change in pre-tension of mooring system when AB float was re-installed. Pre-tension slightly increased. Data is from NREL AB mooring leg load cells.
- See the last two slides comparing dynamic loads with AB float in final position below surface to October data with AB float on surface. Dynamic loads are significantly decreased with AB float below surface. Data is from NREL AB mooring leg load cells.

# Plots of load cell 10 min averages



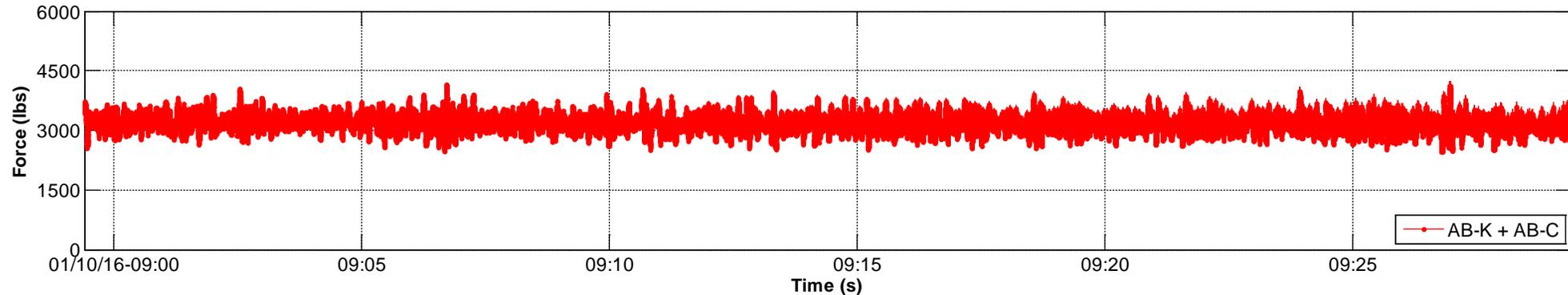
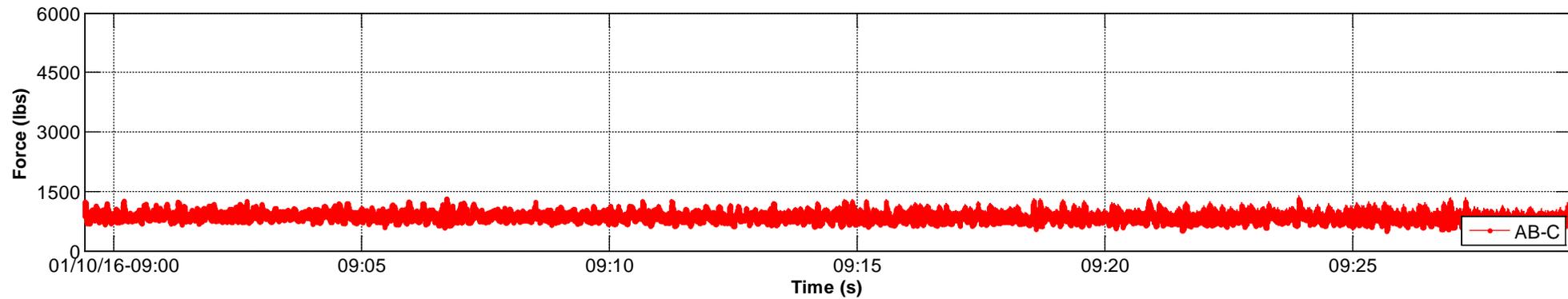
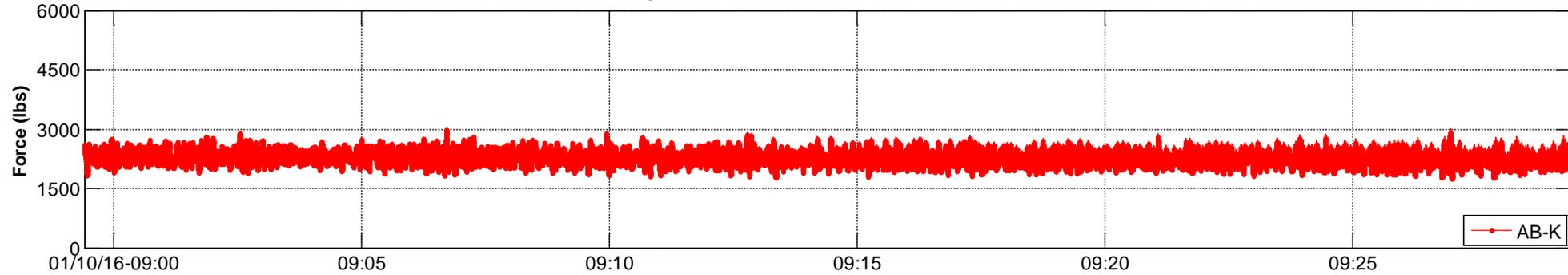
# Mooring load cell plots after AB repair Jan 10, 9:00 UTC



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$H_s = 2.8 \text{ m}$ ,  $T_p = 14.3 \text{ s}$

Load cell plots from file 10 9 0 2016 LoadCell.tdms



## Mooring load cell plots AB float on surface Oct 29, 0:00 UTC



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$$H_s = 2.8 \text{ m}, T_p = 15.4 \text{ s}$$

Load cell plots from file 302 0 0 2015 LoadCell.tdms

