Williwaw Engineering

July 6, 2015

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Subject: June 2015 Monthly Report – RCUH P.O. #Z10066105

Dear Luis,

The following constitutes my monthly report for the subject agreement for services associated with June 2015.

Work Completed under Task 3: Support HNEI in Device Performance Data Collection Throughout Development:

- Following the Azura deployment at the end of May (at-sea installation work was completed on May 30), worked on-site at Room 106, Battery French (MCBH) from June 1-14 in order to commission onshore data and power conversion equipment and closely monitor initial operation of the device. Specific tasks performed during that period are listed below:
  - Powered-up onshore power conversion equipment and checked for proper operation with Azura.
  - Oversaw Hawaiian Electric Company (HECO) inspection of NWEI grid interconnection equipment and corrected minor deficiencies noted during the inspection.
  - Installed a remote controlled relay that can be used to remotely reboot host PC in Room 106.
  - Checked out NWEI data collection from onshore and offshore NWEI CompactRIO (cRIO) controllers.
  - Installed a NI-9467 GPS module in the onshore NWEI cRIO controller to provide time-synching of NWEI data. This required installation of an antenna outside the west entrance to bunker. This replaces functionality of a GPS module in the offshore controller which did not function after the Azura deployment (most likely due to antenna failure during deployment).
  - Made onshore and offshore NWEI cRIO software modifications to implement time-synching via onshore GPS module.
  - Implemented half-hourly cycling between six alternate control settings in offshore cRIO software to assess effect of alternate control settings on output power.
  - In addition, participated in a walk-down of the high-voltage electrical switchgear equipment for the new WETS deep water berths with HNEI, MCBH, and NAVFAC staff.
  - Implemented improved logging of offshore control settings in offshore cRIO software.

- The following work was performed remotely during the second half of June after returning from Hawaii:

- Monitored the device regularly via remote connection to the NWEI host PC in Room 106, Battery French. Downloaded data from PC as necessary, maintained log file, and updated device control settings when necessary.
- Developed MATLAB routine to plot NWEI 10 Hz device data.
- Modified NWEI offshore cRIO software to improve time synching of data to onshore GPS time.
- Developed MATLAB routine to plot NREL data for device float angle together with NWEI float angle data in order to verify time synching between NREL and NWEI data recordings.
- Developed MATLAB routine to plot NREL data for heave of device hull.
- Modified LabVIEW routine to add onshore power data to monthly data files of 30 minute power performance data.
- Developed MATLAB code to plot device power matrices from monthly 30 minute average power data.

See Attachment 1 for power performance data plots, Attachment 2 for NWEI vs NREL float angle data plots, and Attachment 3 for plots of NREL heave data.

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

Sincerely,

Terry Lettenmaier

Attachment 1: Azura power performance data plots for June 2015

Attachment 2: Plots of NWEI and NREL data recordings for Azura float angle

Attachment 3: Plots of NREL hull heave data

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Attachment 1

Azura power performance data plots for June 2015

Azura Power Performance – June 2015

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Summary

- At-sea installation of Azura was completed on May 30 and device operation began on June 1
- Azura was operated (output connected to grid) for 575 hours in June (approximately 80% of month)
- Prior to June 26 issue of HECO permission to operate letter, device was shut down when not frequently monitored
- Device was not operated for maximum power output during month of June
    - Data was collected through most of month while cycling between alternate control settings on 30 minute basis
    - The goal was to collect data to assess control settings and compare with device modeling results
- Plots on following pages are for power measured at dc output (connection to umbilical cable) on board the device

Azura Power Performance – June 2015

Data samples collected

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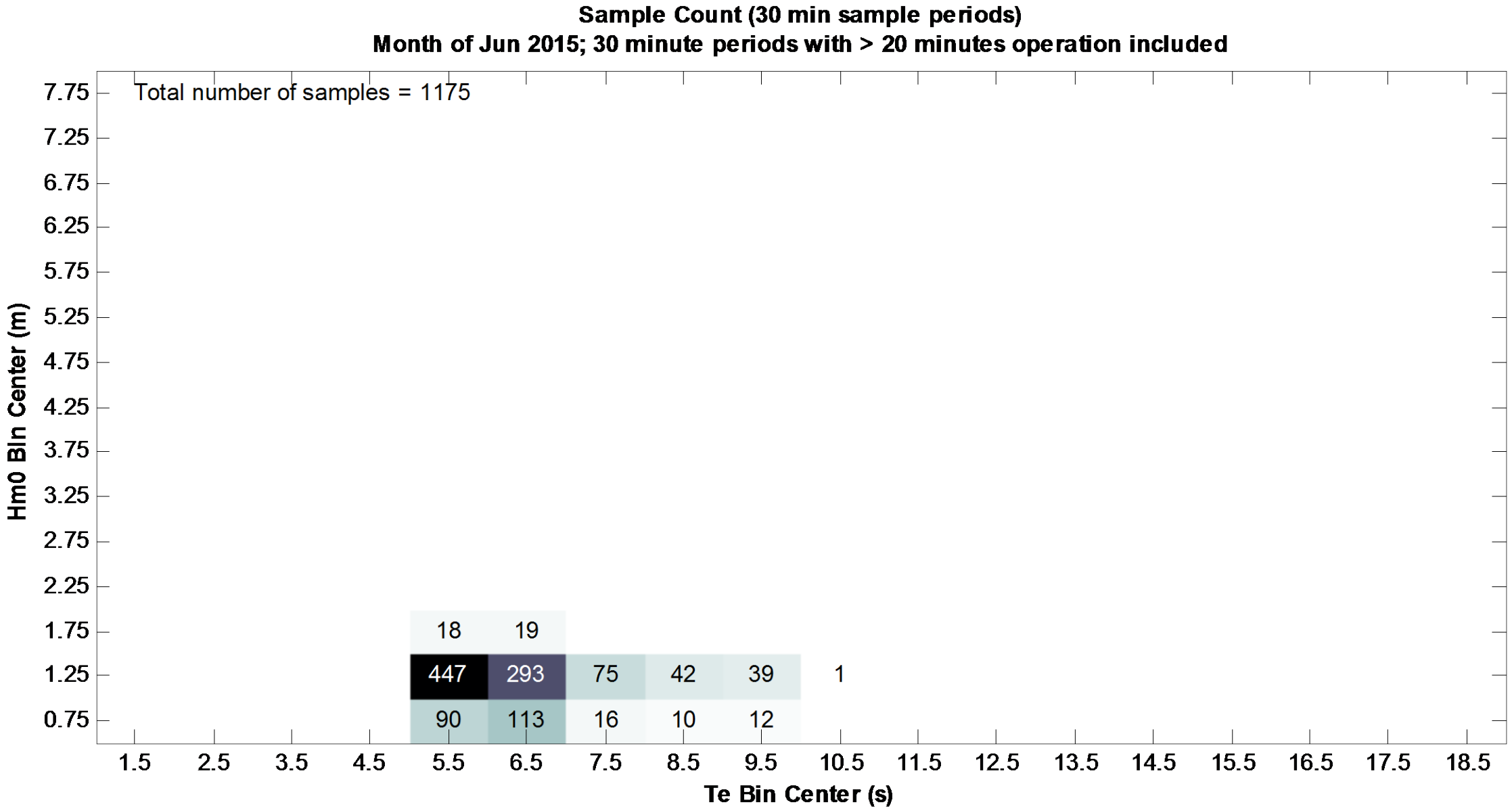

Azura Power Performance – June 2015

Mean power matrix

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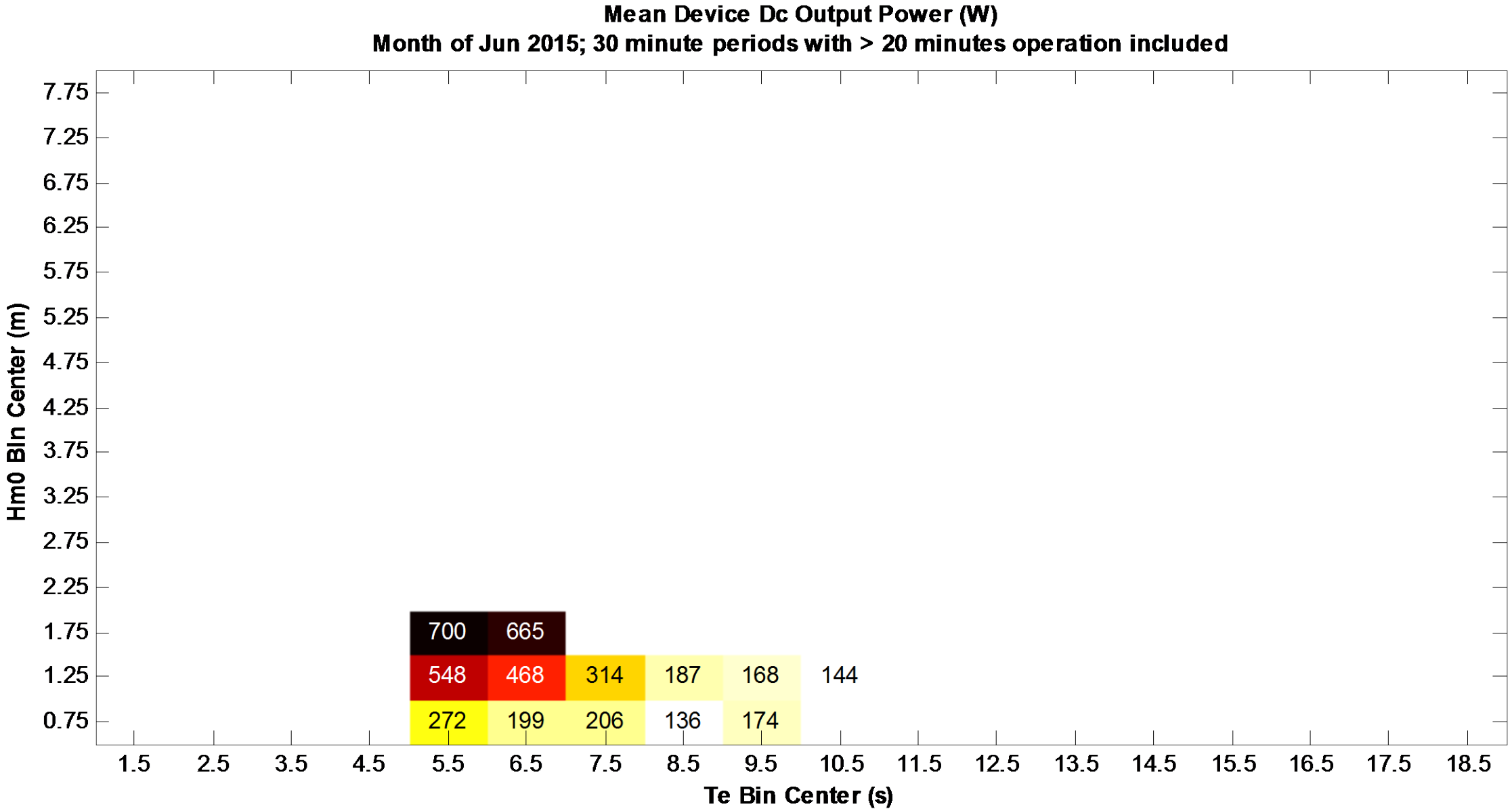

Azura Power Performance – June 2015

95th percentile power matrix

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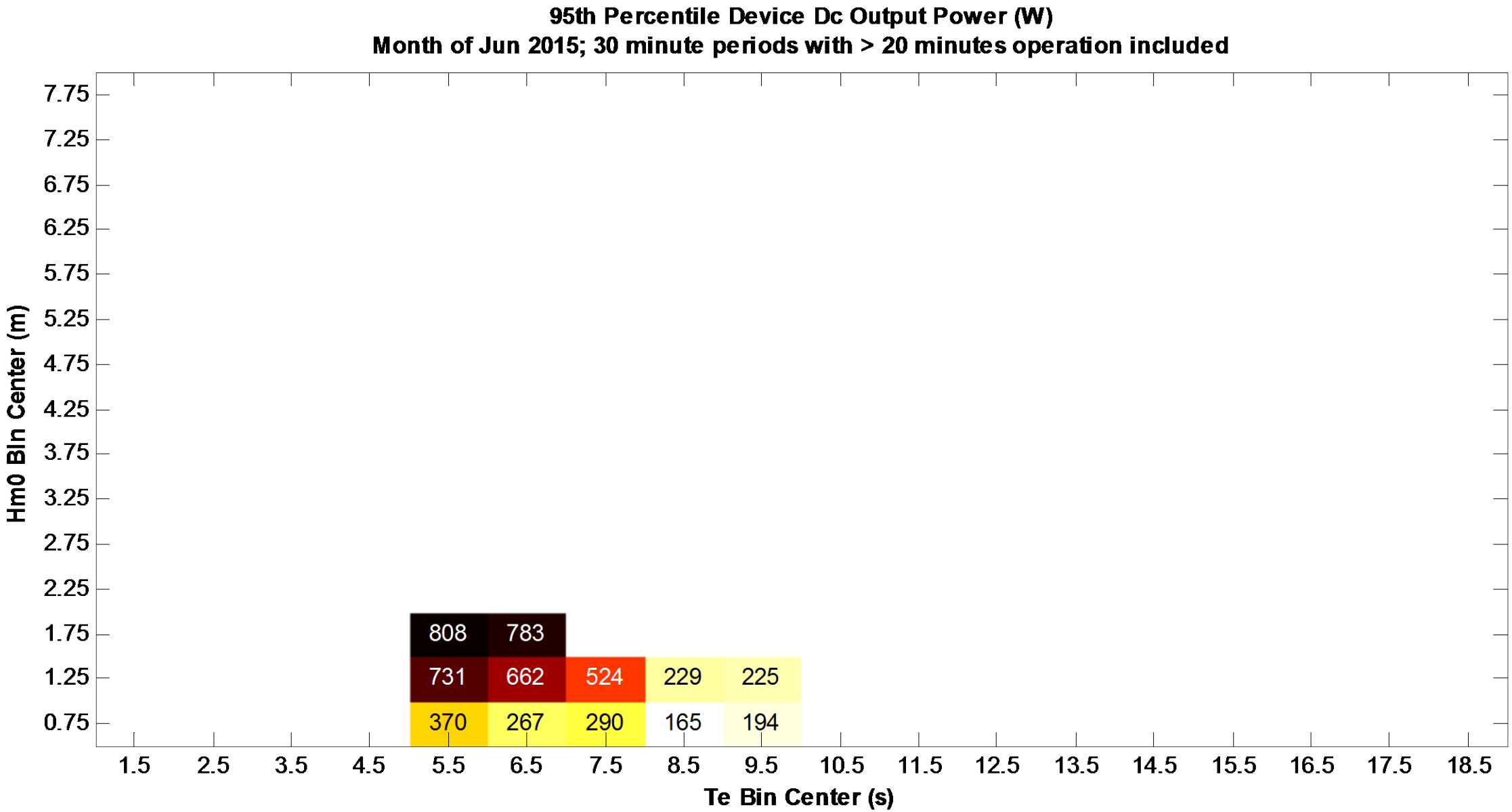

Azura Power Performance – June 2015

Standard deviation of power matrix

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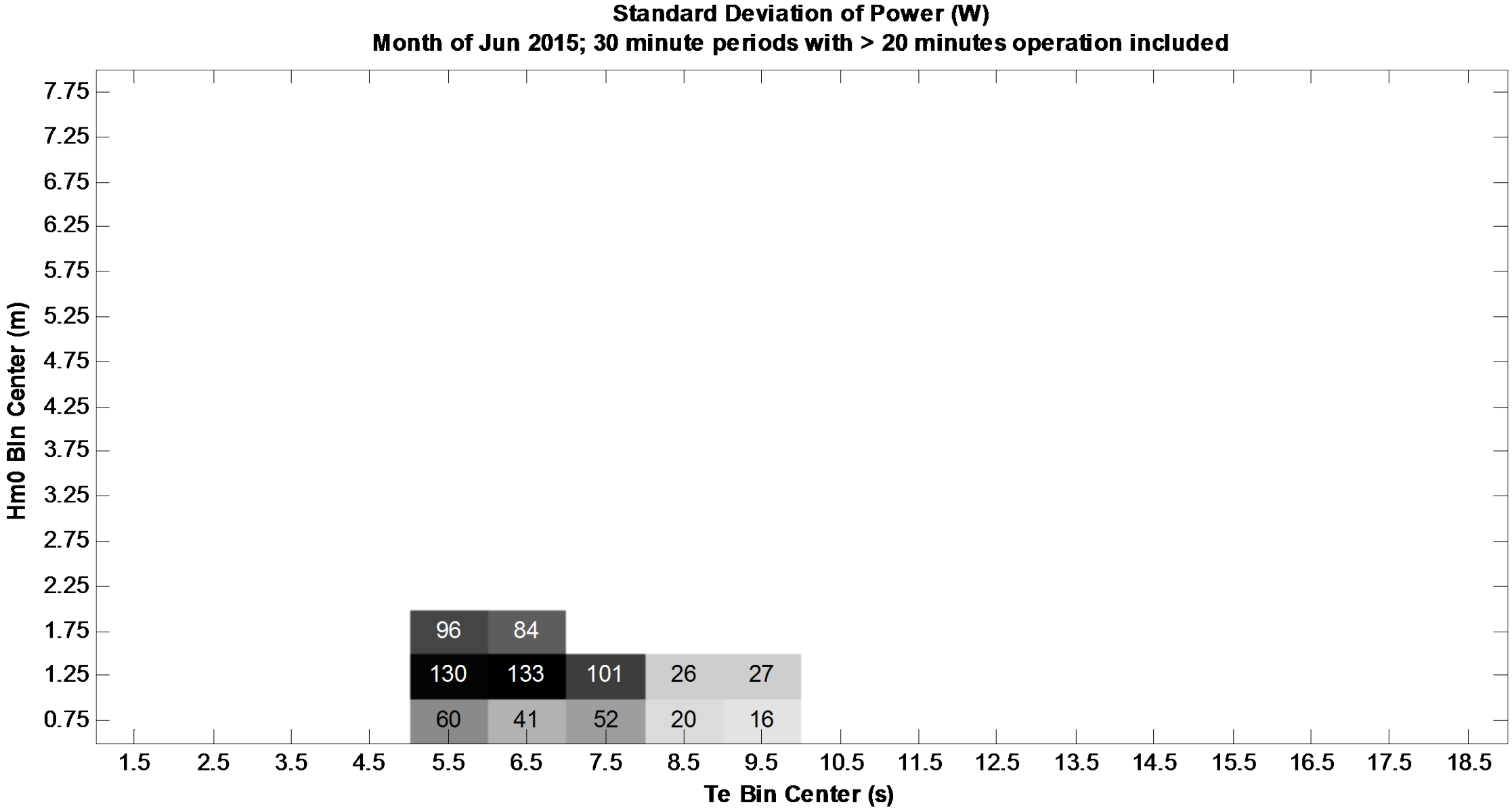

Azura Power Performance – June 2015

Mean capture length matrix

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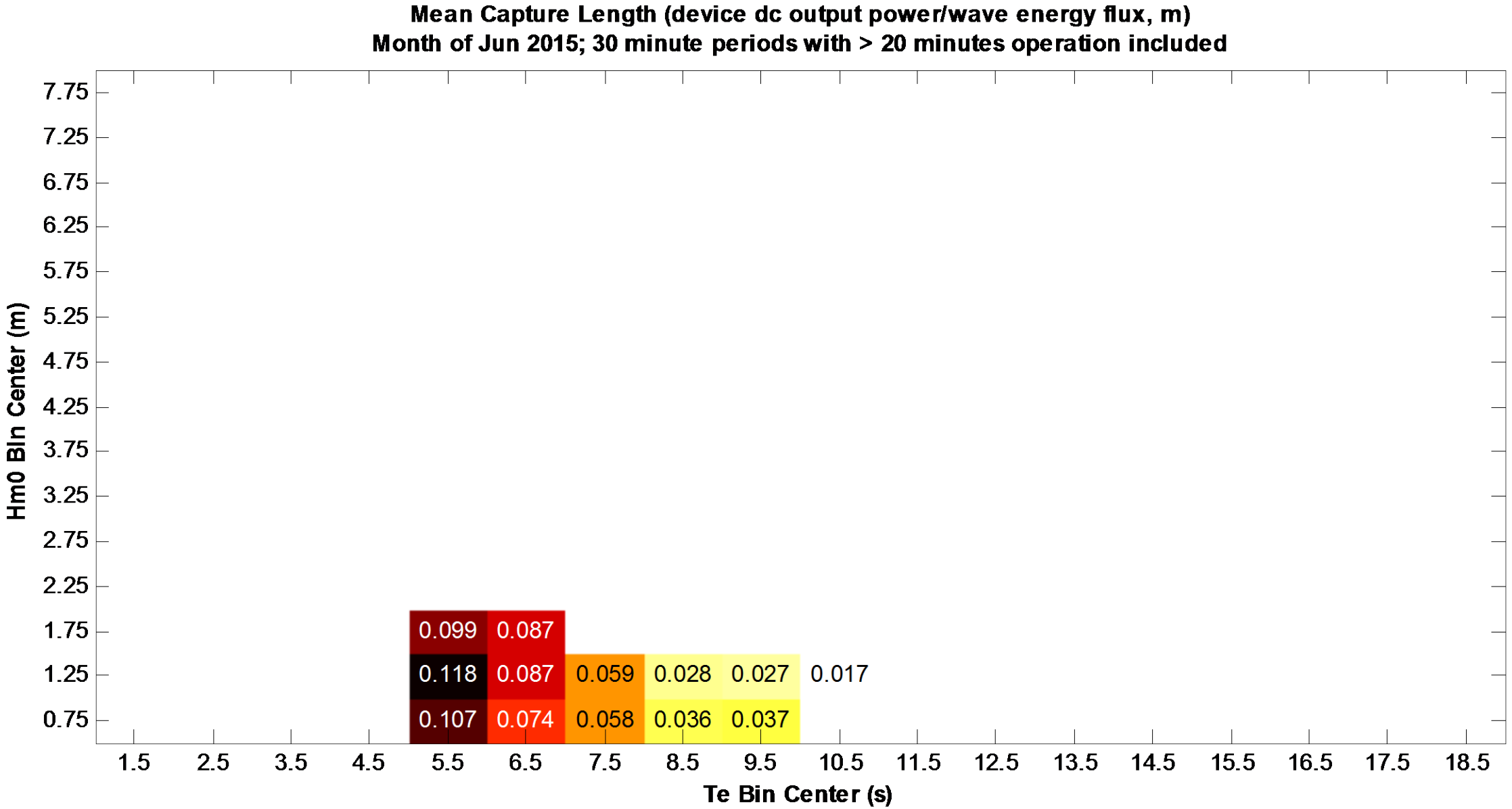

Azura Power Performance – June 2015

Standard deviation of capture length matrix

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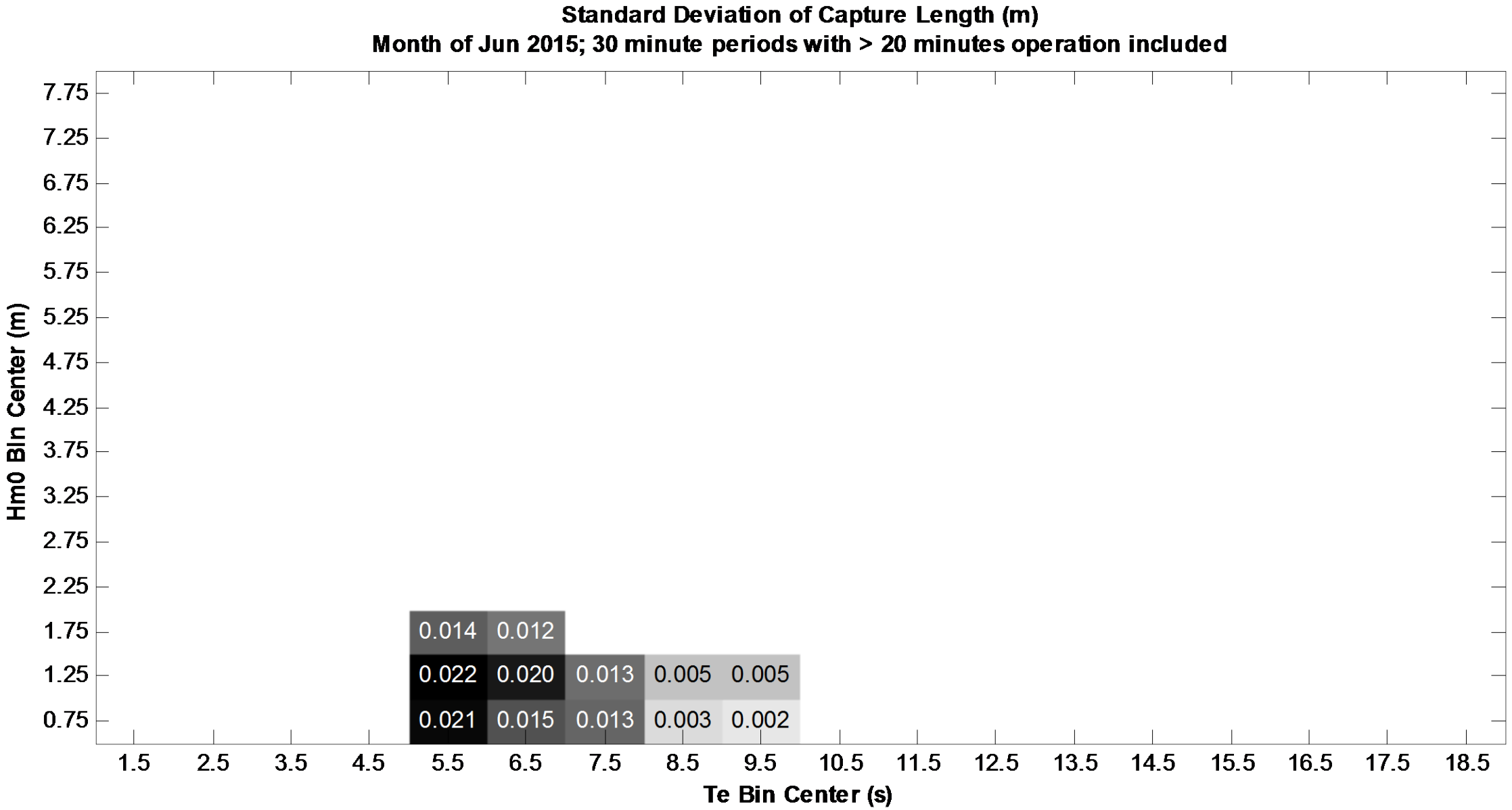
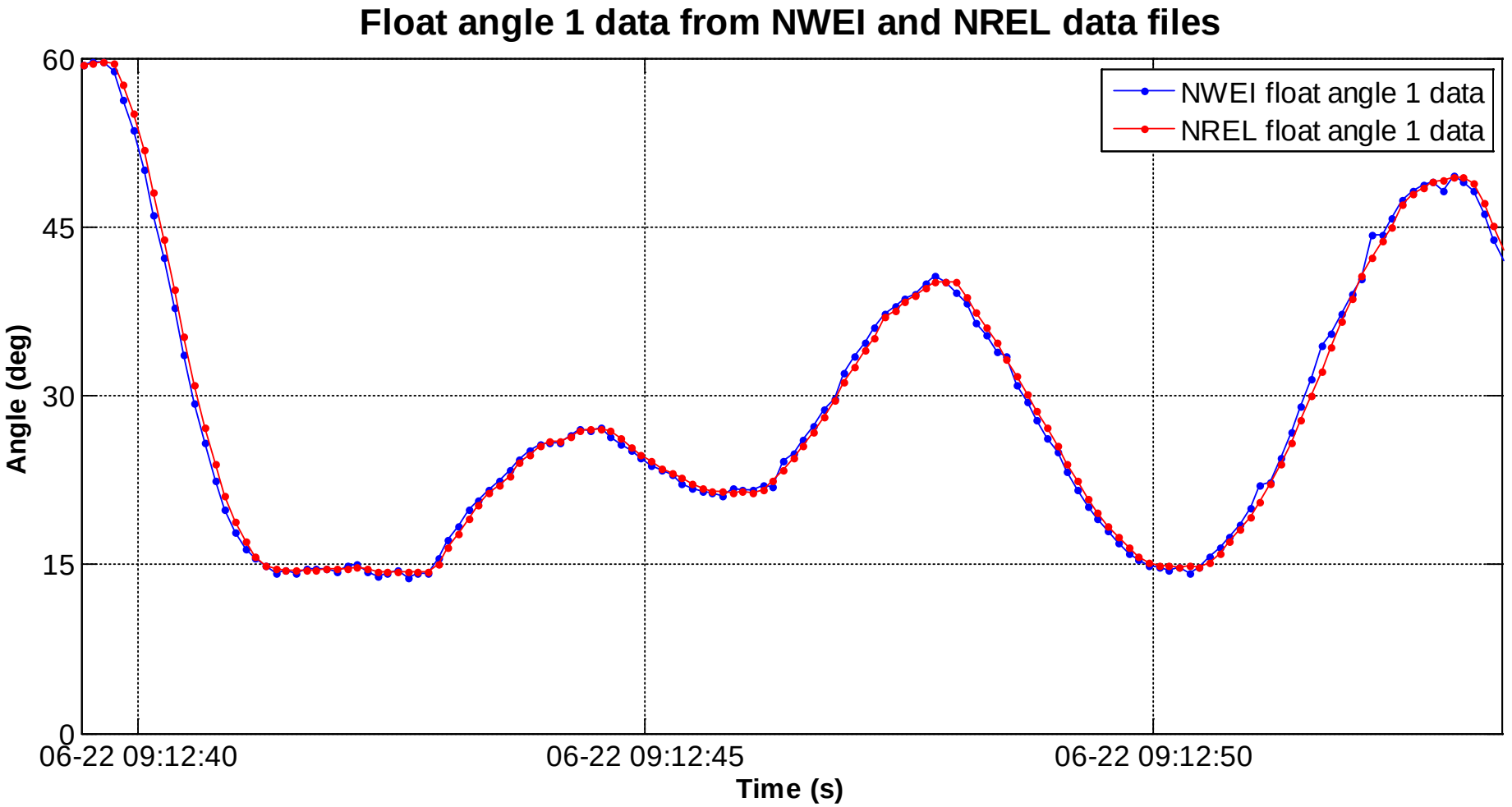


Attachment 2

Plots of NWEI and NREL data recordings for Azura float angle

NWEI and NREL data time synch check

- The same float analog float angle sensor input is connected to both NREL and NWEI cRIO controllers
- Both NREL and NWEI data is plotted together below to show time difference between the two controllers
- There is a small shift of approximately 40 ms between the two plots in the data below
- The same relative timing will occur for all data recorded by the NWEI and NREL data systems



Attachment 3

Plots of NREL hull heave data

NREL hull heave data check

- NREL installed a six-degree of motion sensor on the Azura hull; validity of this data had not been checked
- This data is recorded in a serial string that requires decoding in order to plot and check validity of data
- Below is a sample plot of the heave data recorded from this sensor together with NWEI float angle data
- The data plots indicate that the heave data is valid