Williwaw Engineering

August 4, 2015

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

Dear Luis,

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

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

- 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. See Attachment 1 for July 2015 Azura power performance data plots.

- Made minor improvements to the LabVIEW Azura user interface software on the host PC in Room 106:
    - Incorporated text messaging capability to send daily text messages indicating device operating state and further text messages whenever faults that disable device operation occur. Currently these text messages are sent to Terry Lettenmaier.
    - Modified software to automatically re-start after host PC – cRIO controller communication faults occur.

- Developed LabVIEW software to display 30 minute wave data and Azura average power data on the host PC in Room 106. This display is updated every 30 minutes and was integrated with the existing Azura CompactRIO user interface. See Attachment 2 for screen shots of this display.

- Developed LabVIEW software that displays Azura GPS position data from the NREL data system and provides a watch circle alarm with text messages to a list of recipients if the Azura moves outside of a specified mooring watch circle. This display is updated once every hour and is integrated with the existing Azura CompactRIO user interface on the host PC in Room 106. Presently data is displayed and analyzed with a delay of approximately two hours; NREL data improvements will ultimately reduce the delay to approximately one hour. See Attachment 2 for a screen shot of this display.

- Analyzed Azura float angle data using MATLAB to produce plots of 30 minute average float angle data for the deployment period. This data indicates that the Azura hull is very slowly settling in the water and was ballasted correctly in mid-July, with the Azura float angle, on average, very close to zero degrees (float horizontal, or

perpendicular to the hull). See Attachment 3 for 30 minute average float angle data plots.

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 July 2015

Attachment 2: Screen shots of Azura 30 minute data and watch circle data displays

Attachment 3: Azura 30 minute average float angle data plots

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Attachment 1

Azura power performance data plots for July 2015

Azura Power Performance – July 2015

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Summary

- Plots of July 2015 data only are shown on Slides 2-8
- Plots of cumulative data for the entire deployment period June-July 2015 are shown on Slides 9-15
- Azura was operated (output connected to grid) for approximately 737 hours in July (approximately 99% of month)
- Device was operated throughout July cycling between six different constant hydraulic motor displacement settings
    - Settings changed every 30 minutes
    - Constant displacement control is the simplest method possible and is expected to be useful for comparison to computer model results.

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Azura Power Performance
Monthly Data July 2015

Azura Power Performance – July 2015

Data samples collected

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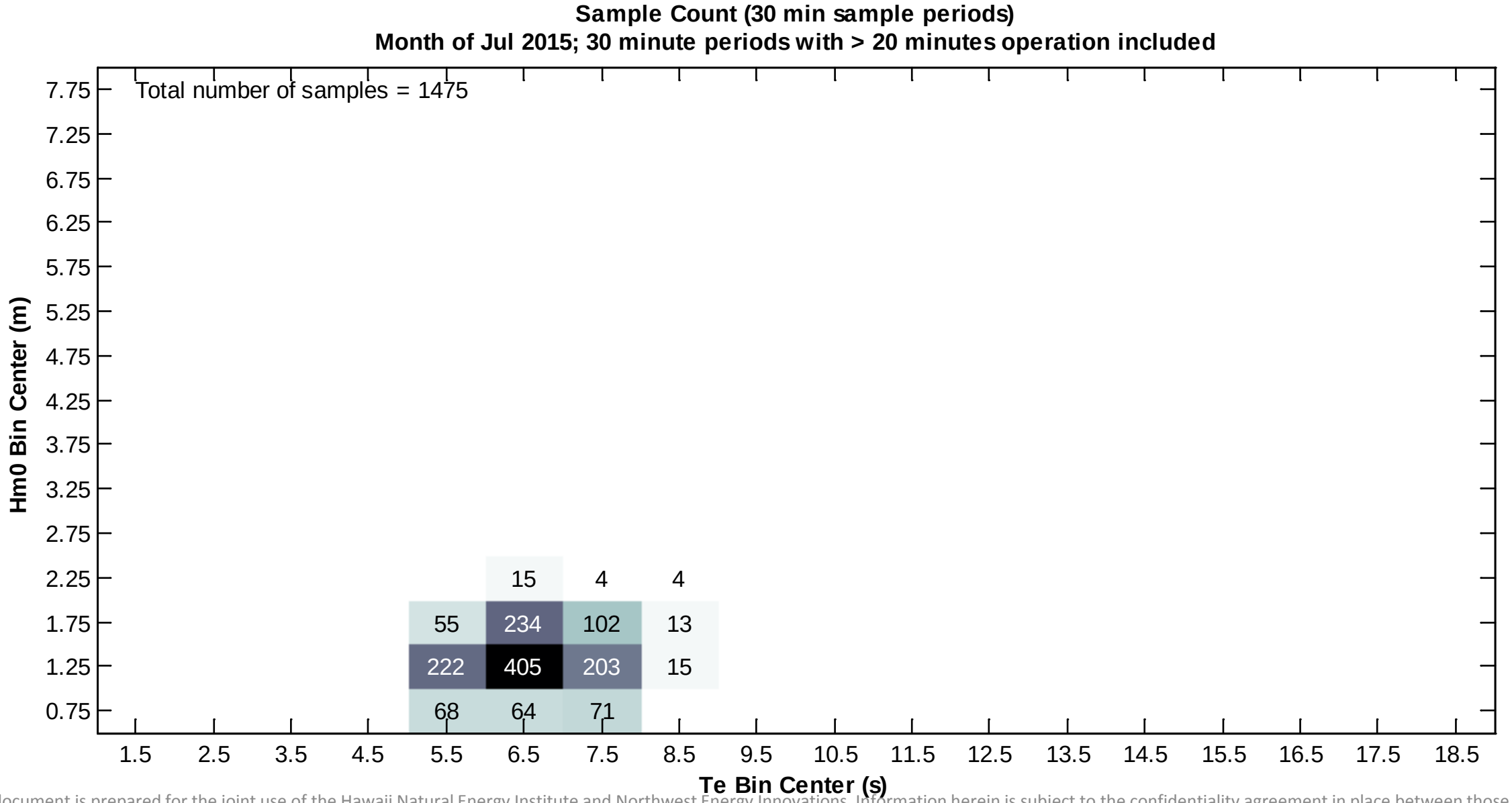

Azura Power Performance – July 2015

Mean power matrix

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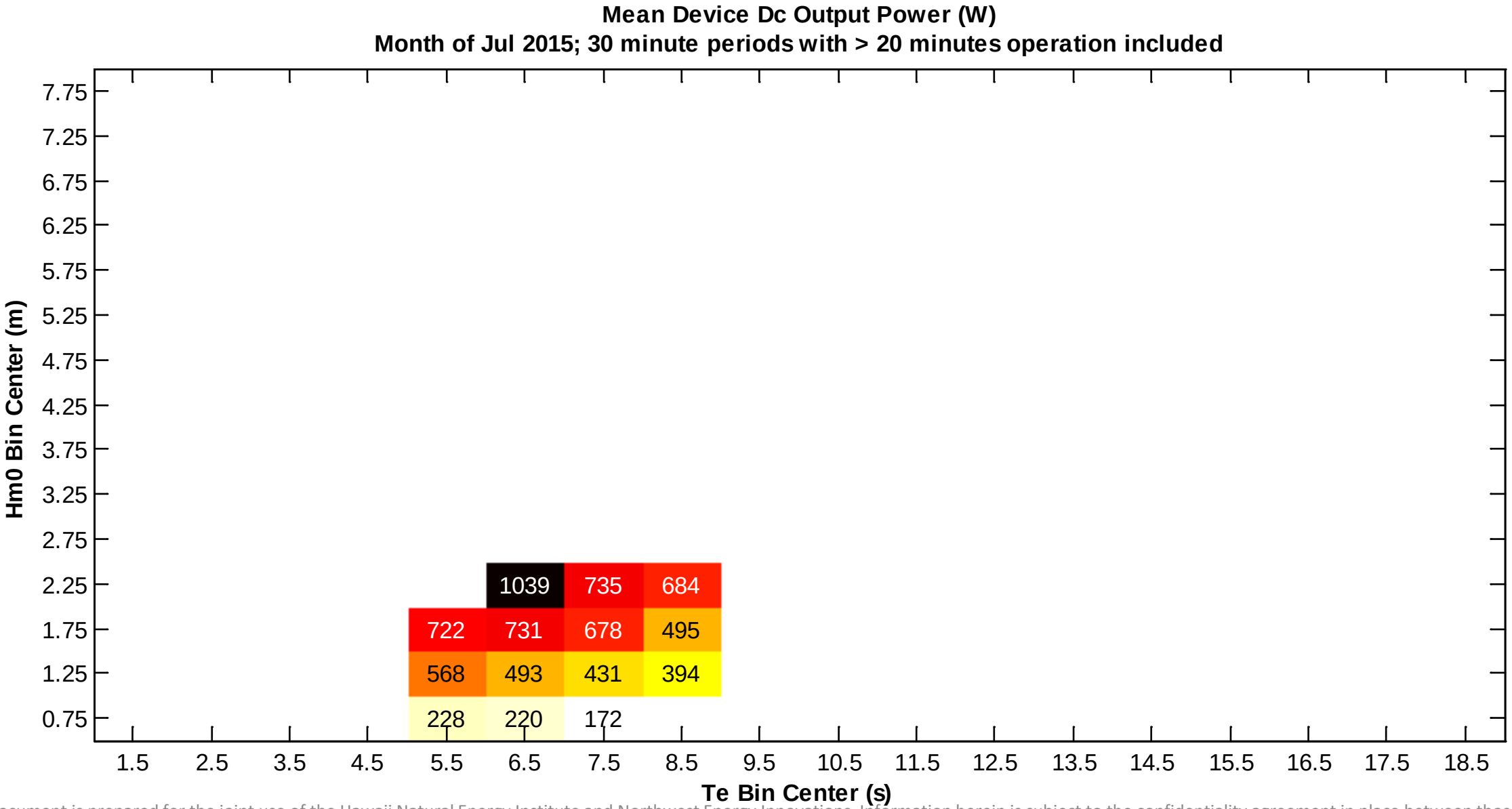

Azura Power Performance – July 2015

95th percentile power matrix

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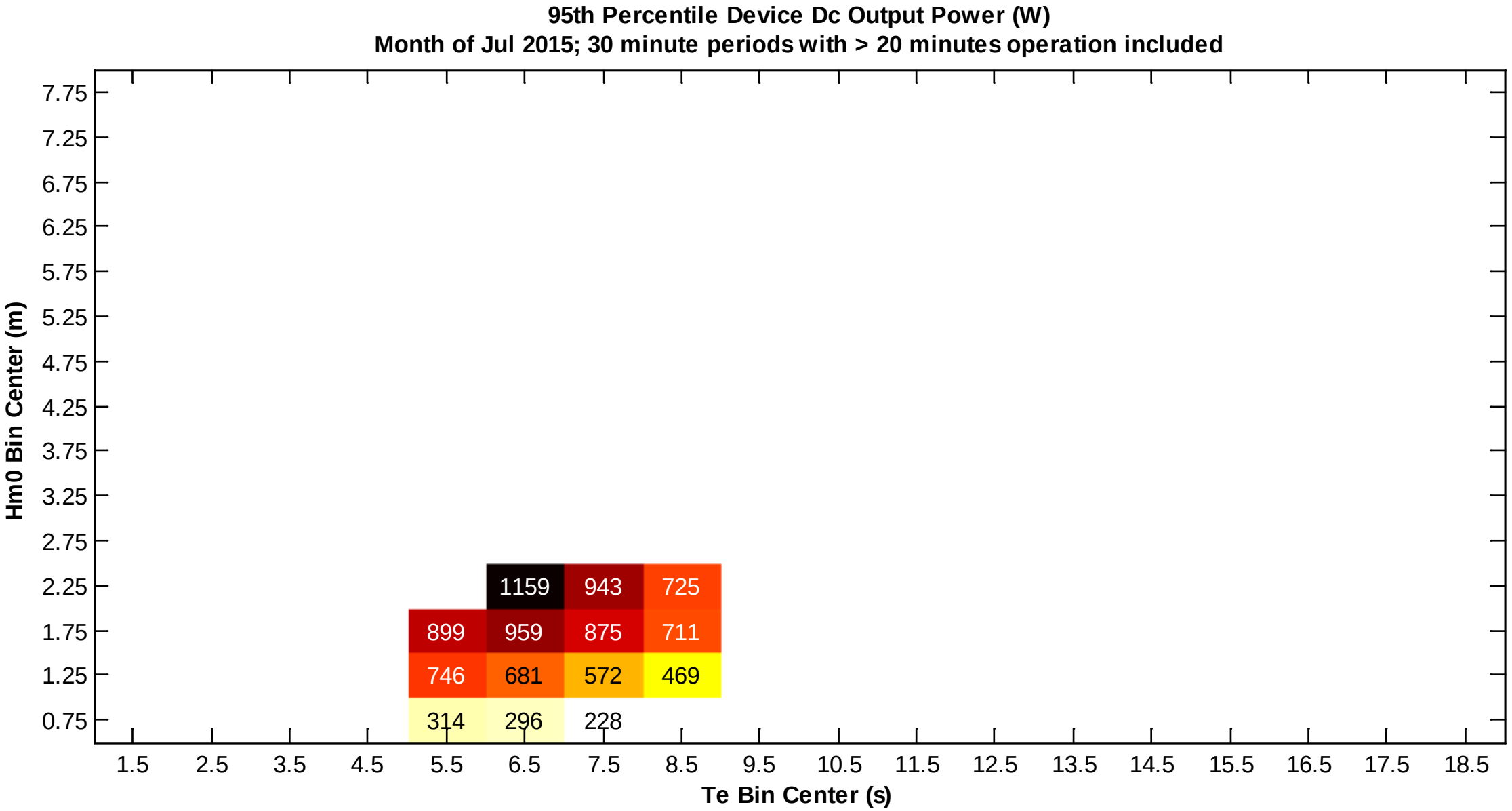

Azura Power Performance – July 2015

Standard deviation of power matrix

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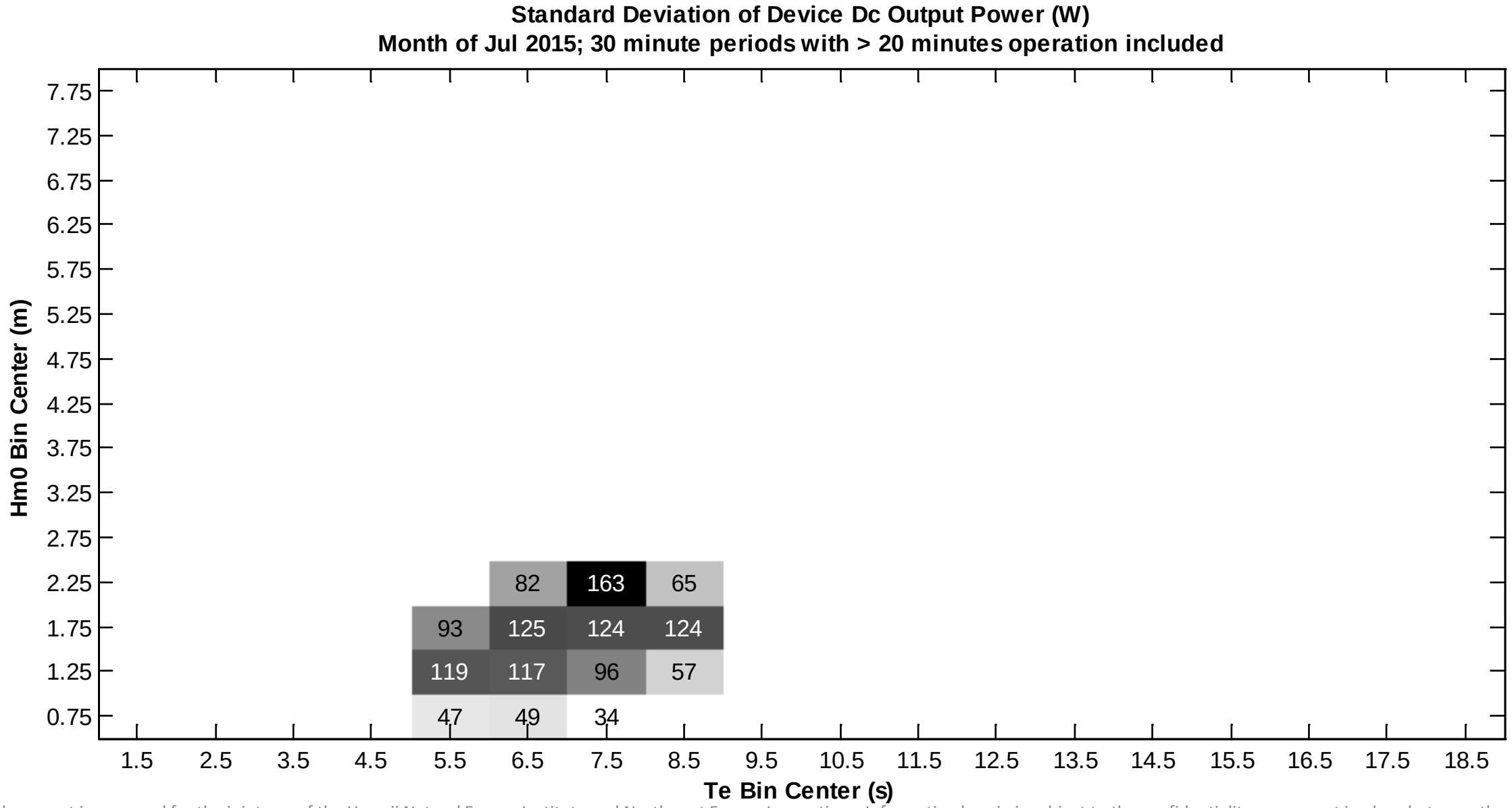

Azura Power Performance – July 2015

Mean capture length matrix

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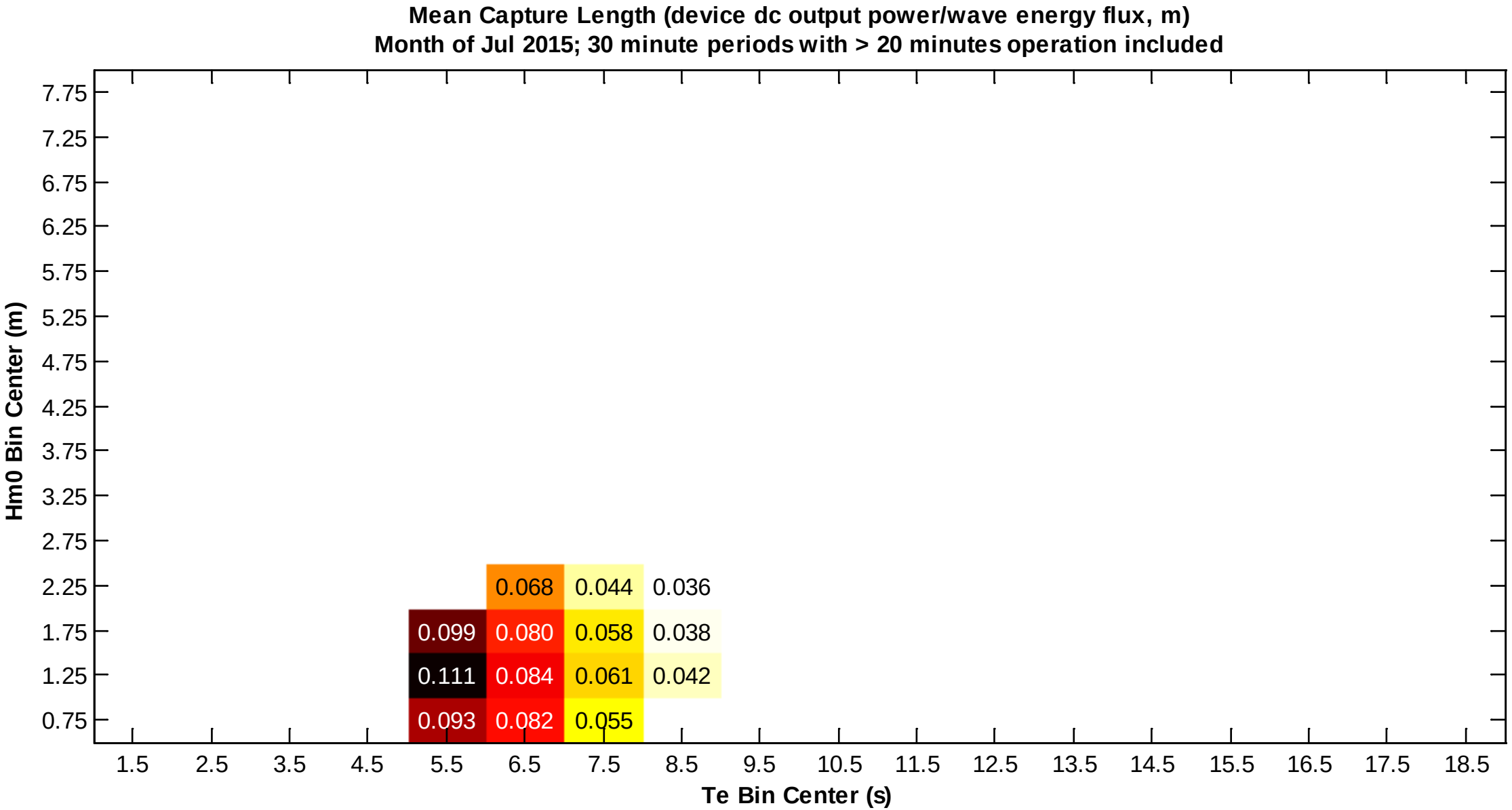

Azura Power Performance – July 2015

Standard deviation of capture length matrix

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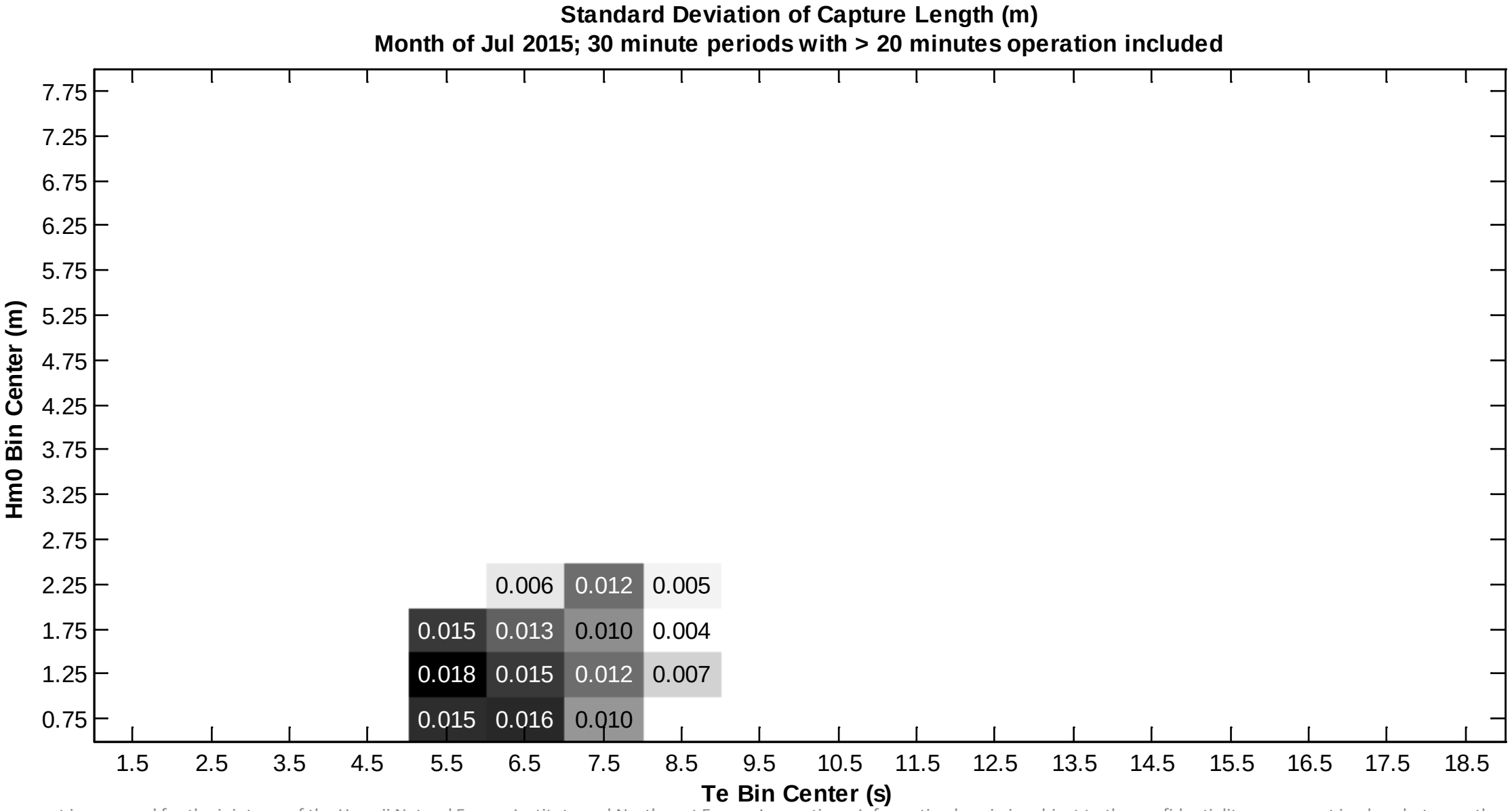

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Azura Power Performance
Cumulative Data June and July 2015

Azura Power Performance – June & July 2015

Data samples collected

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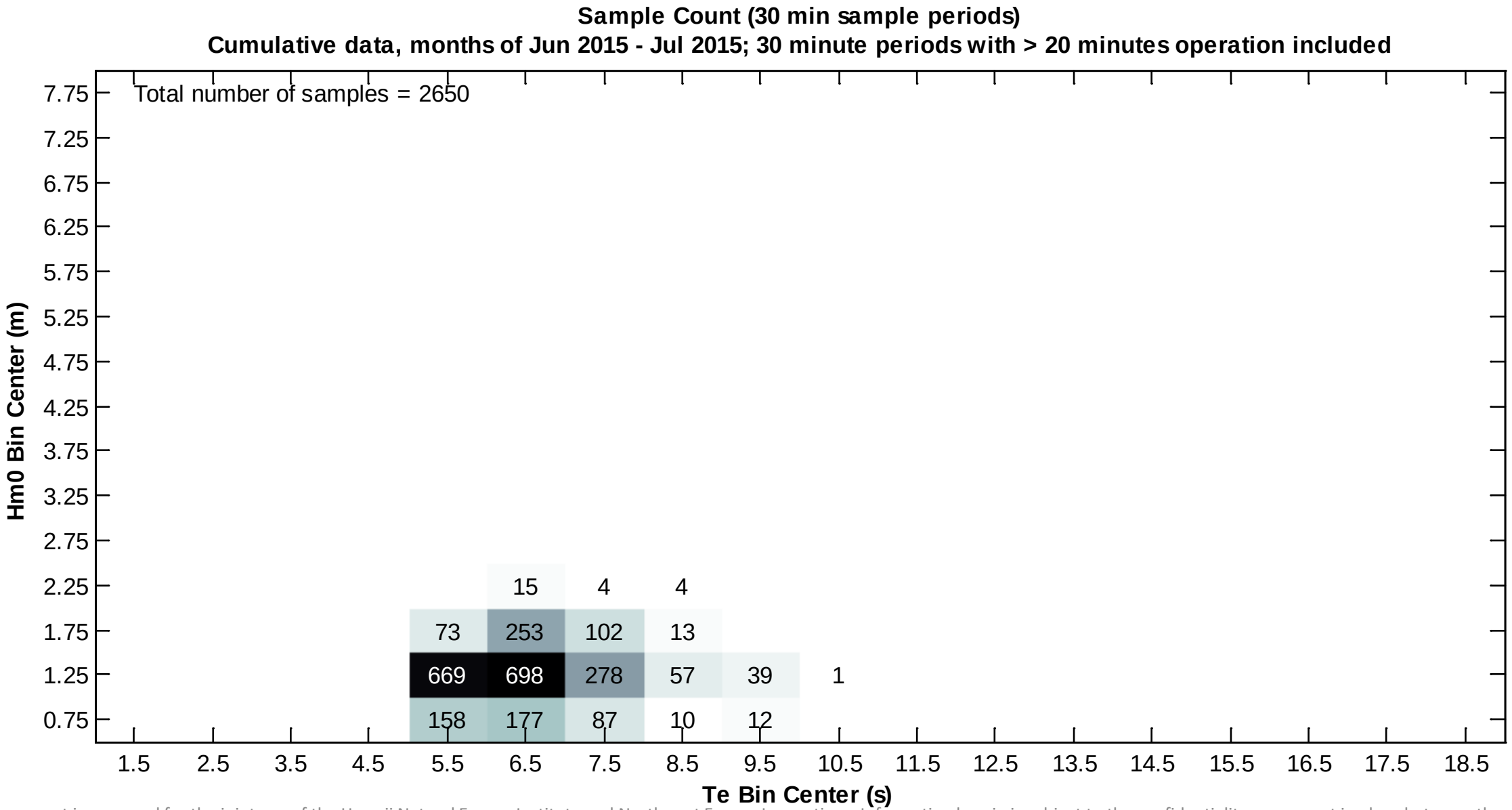

Azura Power Performance – June & July 2015

Mean power matrix

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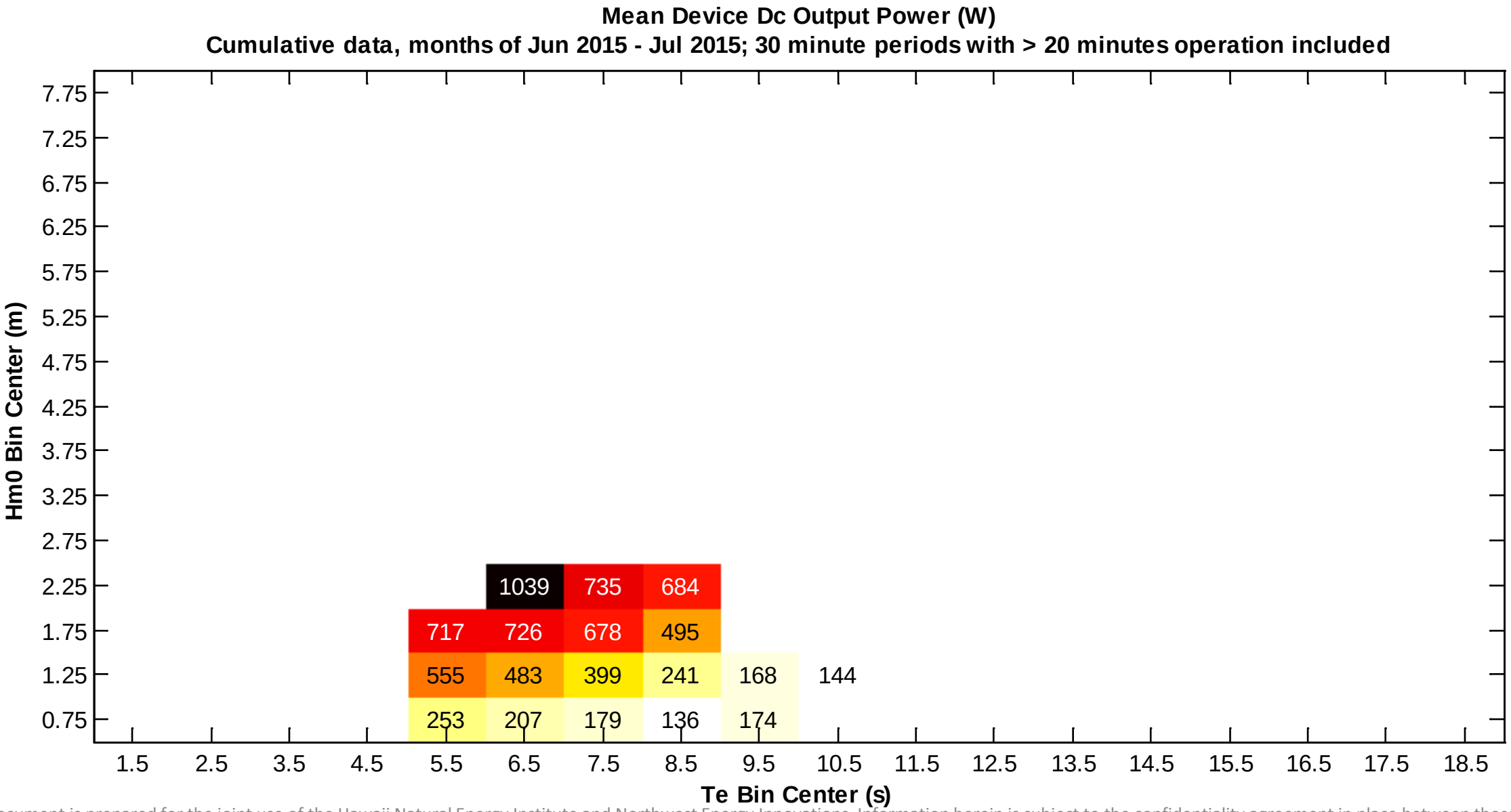

Azura Power Performance – June & July 2015

95th percentile power matrix

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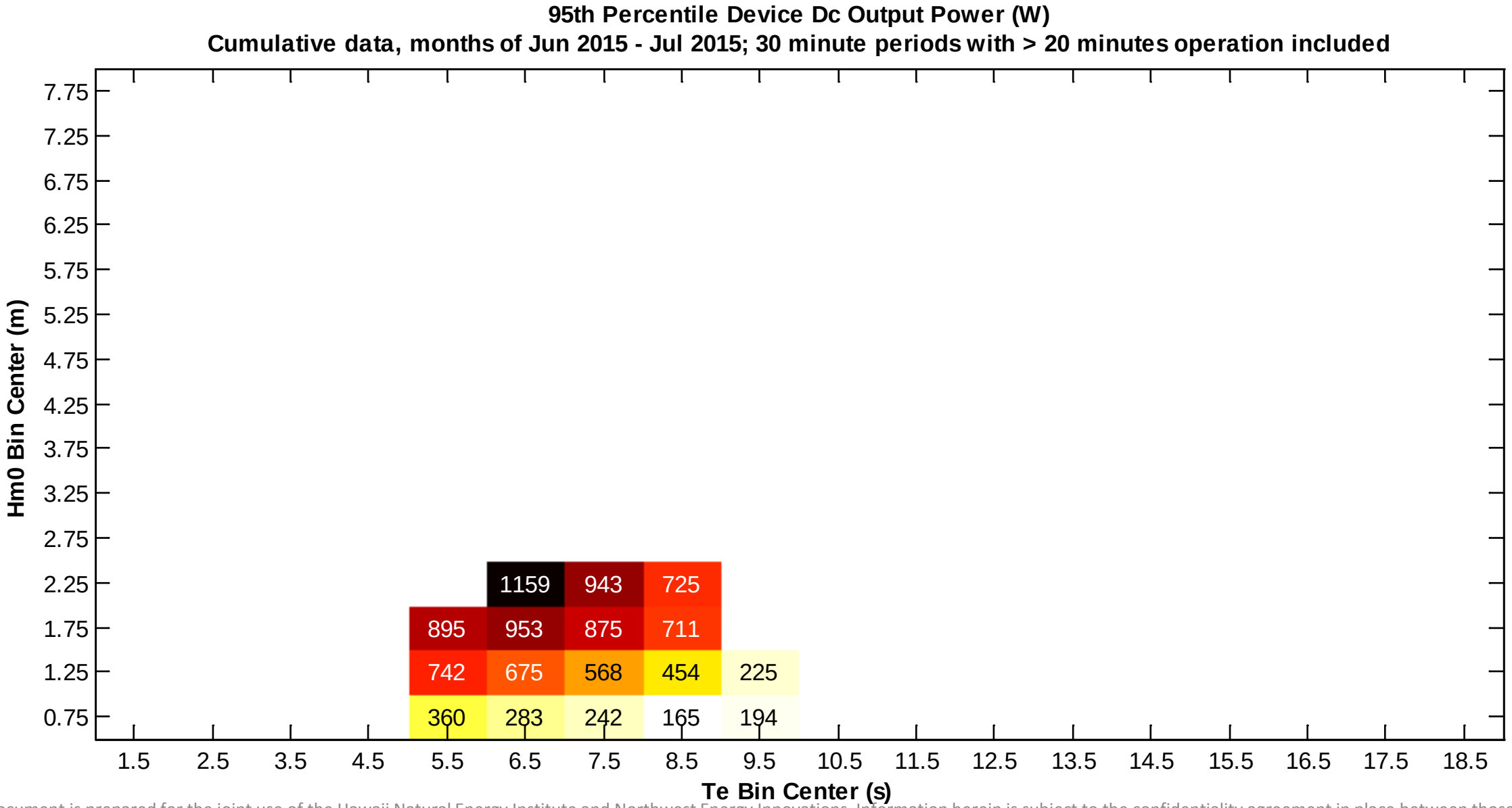

Azura Power Performance – June & July 2015

Standard deviation of power matrix

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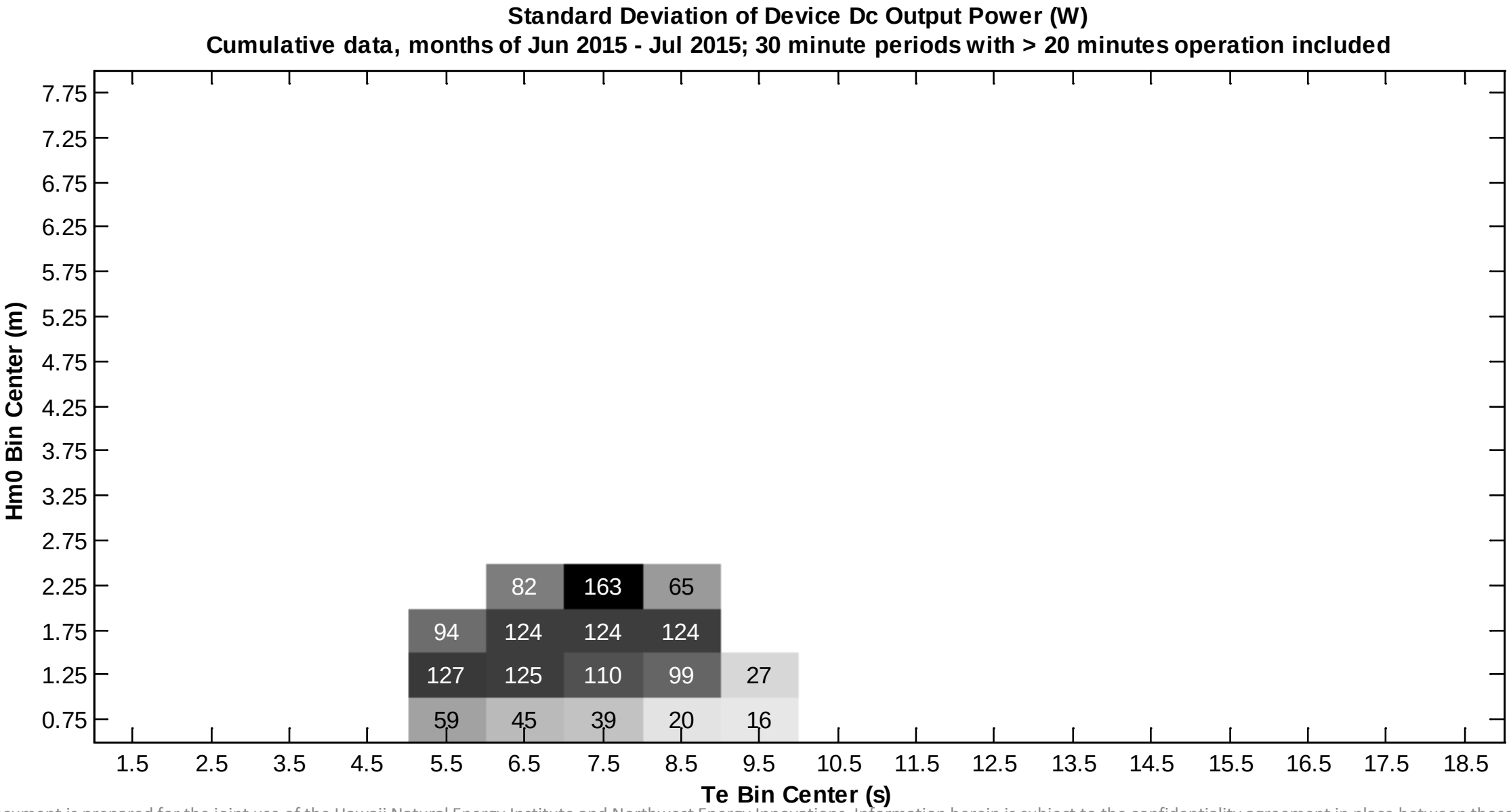

Azura Power Performance – June & July 2015

Mean capture length matrix

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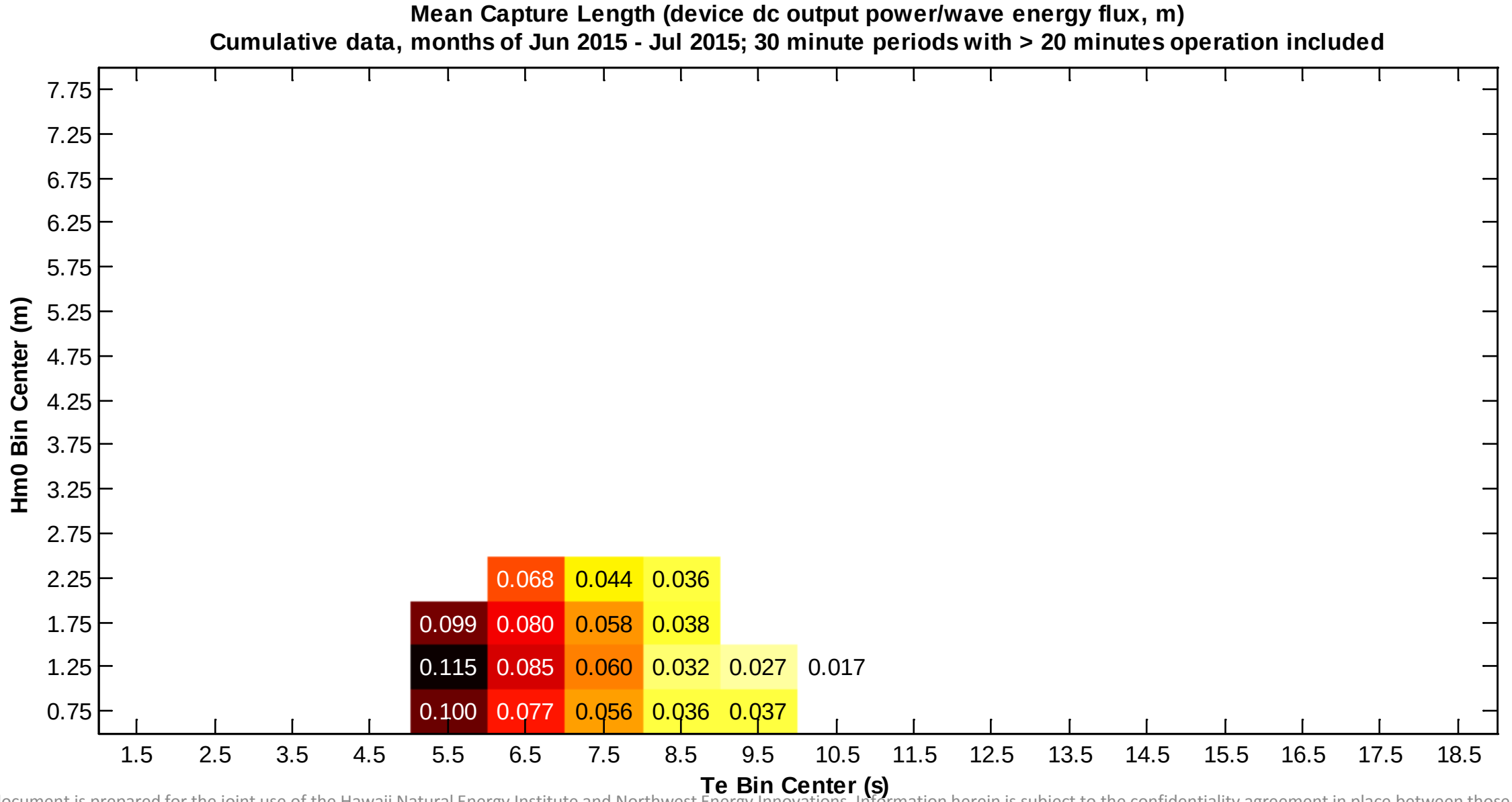

Azura Power Performance – June & July 2015

Standard deviation of capture length matrix

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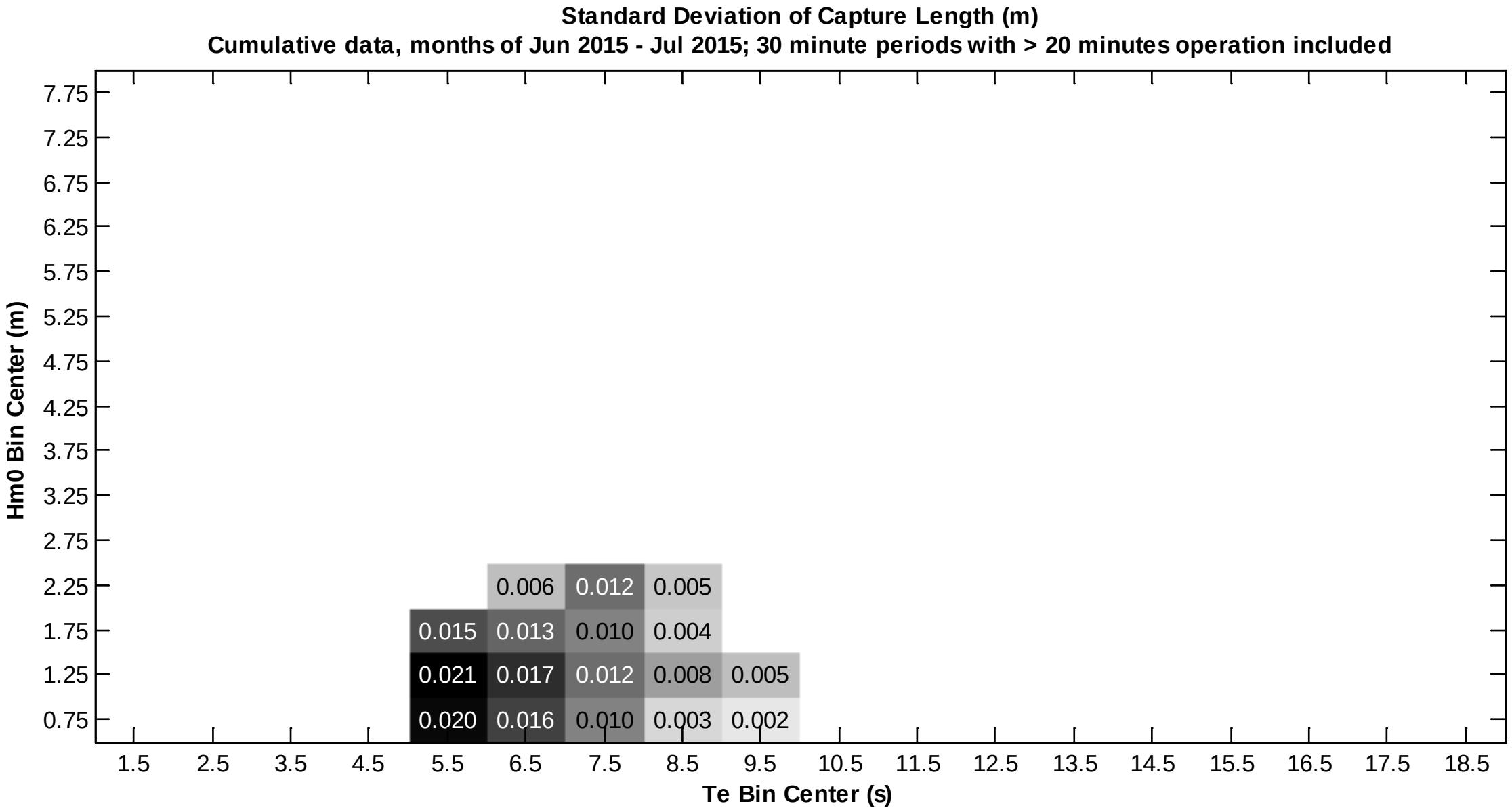

Attachment 2

Screen shots of Azura 30 minute data and watch circle data displays

30 min data display screen of Azura host PC user interface

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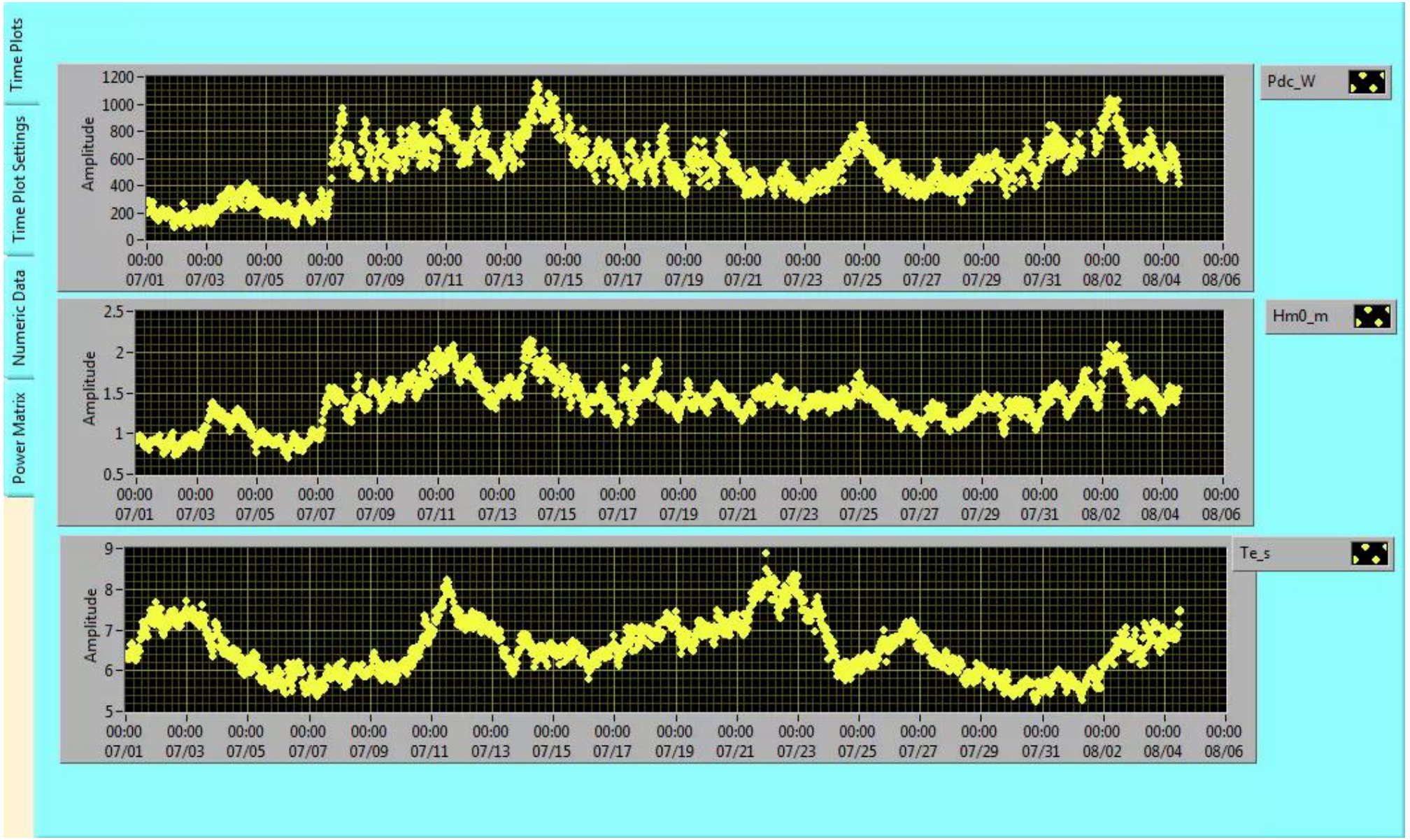

Watch circle alarm screen of Azura host PC user interface

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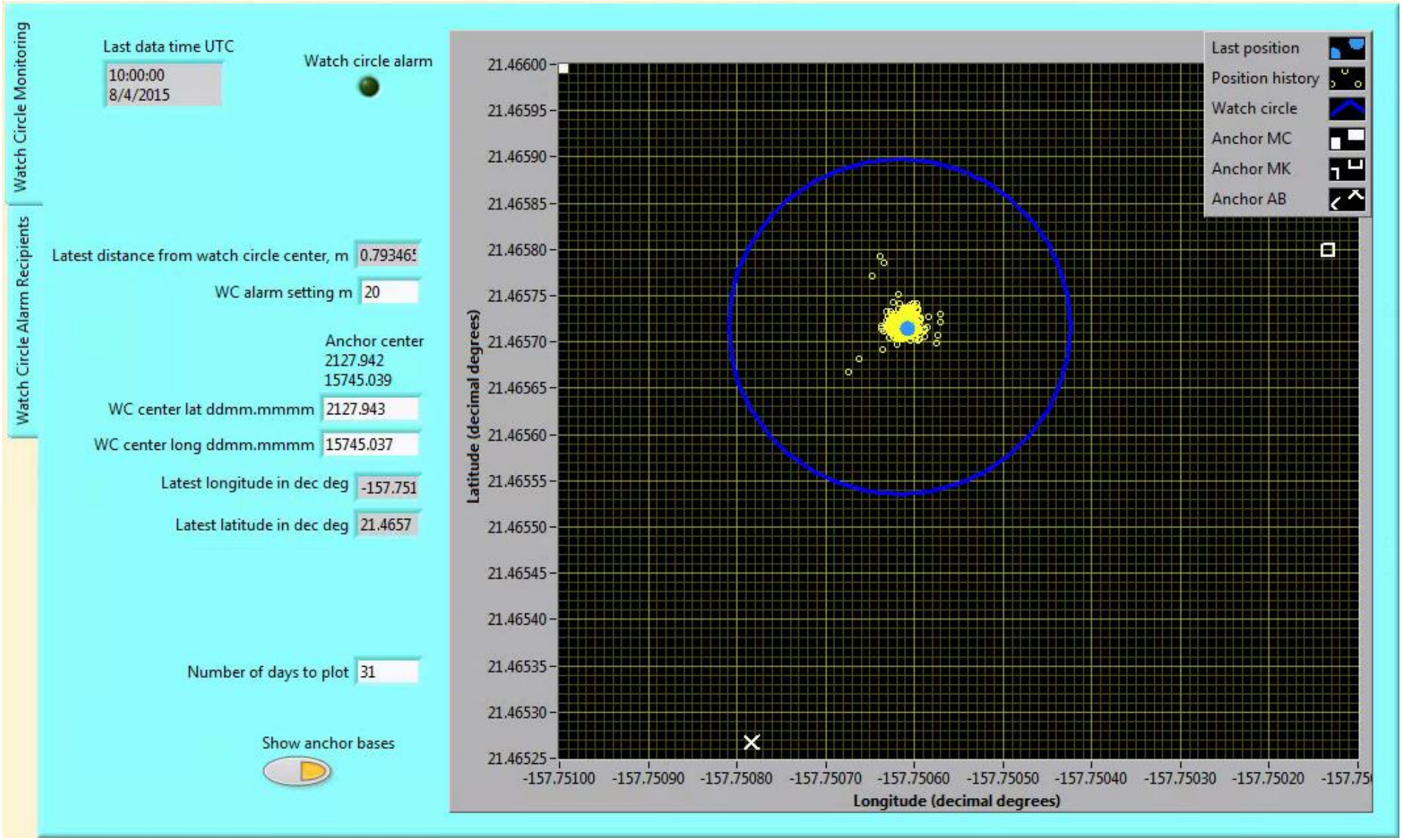

Attachment 3

Plots of Azura 30 minute average float angle data

Azura 30 minute average float angle data

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Summary

- Two float sensors are being used; Sensor 1 has 0- 360 range and Sensor 2 0-180 range on both sides of hull
- Float went from onshore to offshore side and back on July 14. Data from both sides was used to zero sensor by assuming that average angle relative to hull was same on both sides
- Sheet 2 shows data around July 14
- Sheet 3 shows data for entire deployment period. Data indicates that the hull is slowly losing buoyancy.

30 min average float angle data July 12-18

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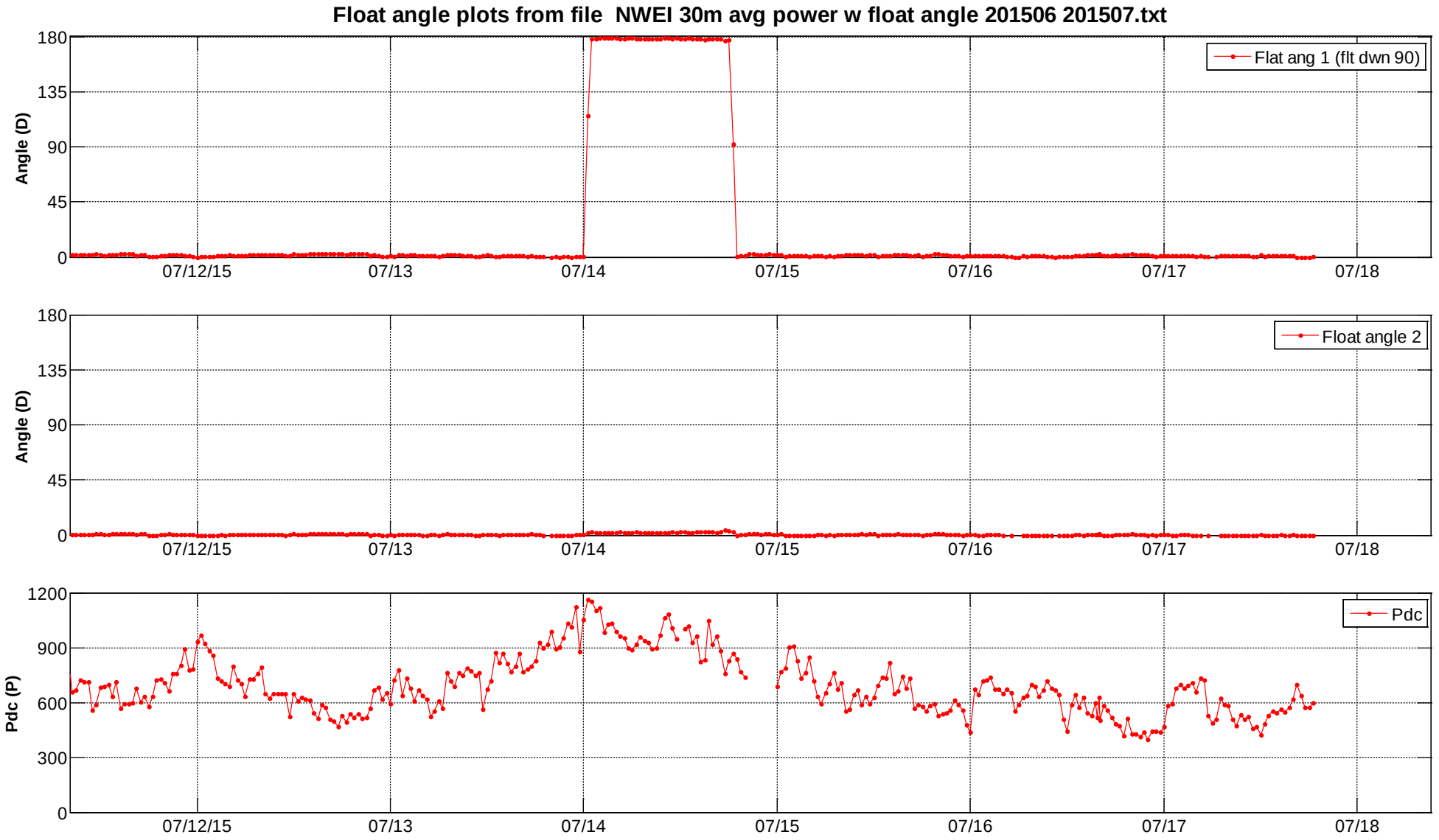

Float switched sides on July 14

Data with float on opposite sides of hull was used to determine zero offset for sensor

30 min average float angle data entire deployment

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