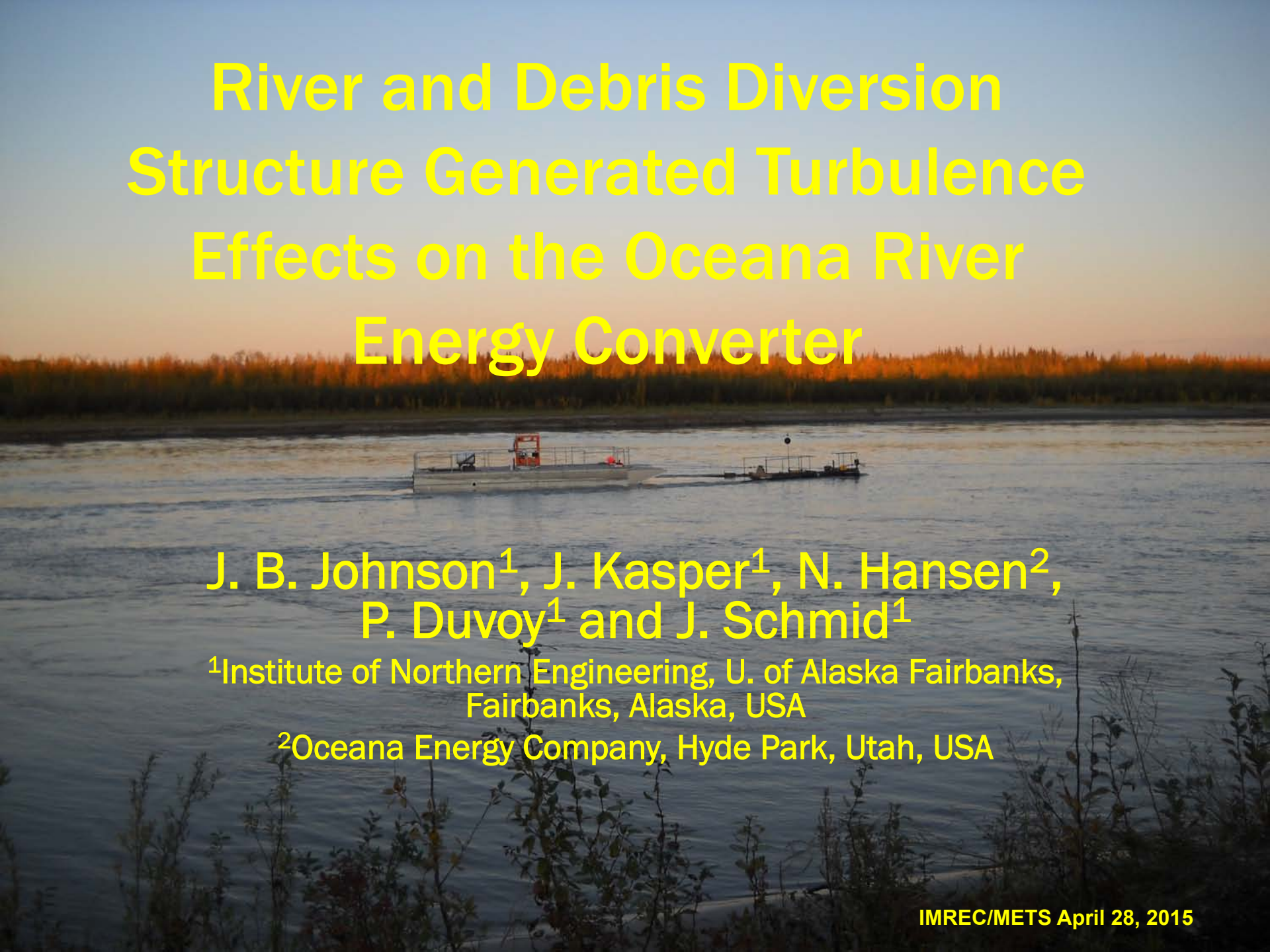
River and Debris Diversion Structure Generated Turbulence Effects on the Oceana River Energy Converter



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IMREC/METS April 28, 2015

Outline

- Alaska Hydrokinetic Energy Research Center (AHERC) overview
- Debris hazards and mitigation
- Oceana river energy converter (REC) testing
- Natural river turbulence
- River debris diversion device generated turbulence
- Effect of turbulence on Oceana power output

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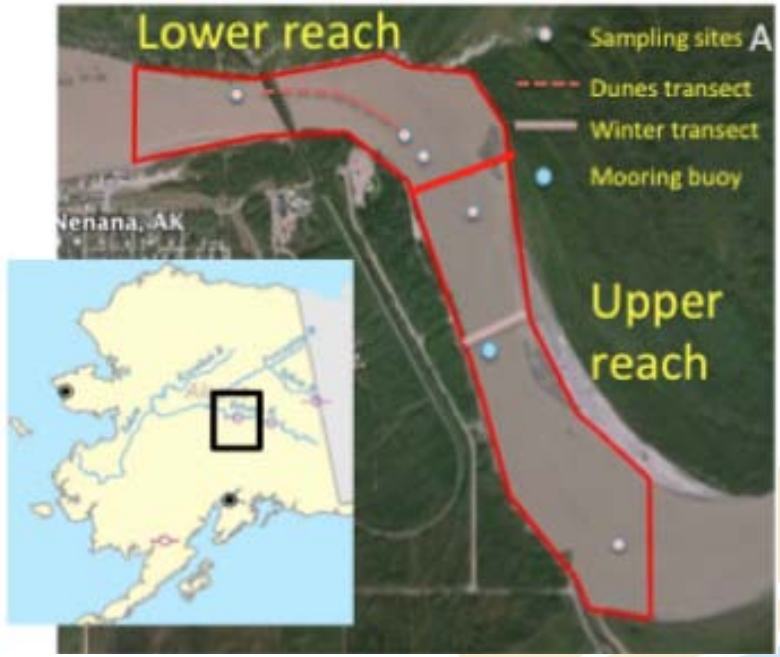
AHERC Overview

- Goal: Develop technology and methods to enable a sustainable hydrokinetic industry in Alaska

- Site characterization
  - Hydrodynamic measurement/ modeling
  - Baseline fish population studies
  - Debris
- Technology development and testing
  - River debris diversion platform (RDDP)
  - Debris modeling and mitigation
  - Mobile test barge
  - River energy Converter testing
    - Fish interaction monitoring
  - Infrastructure development
    - Anchoring, river energy converter (REC) deployment, operations and integration in remote communities with islanded grids



Tanana River Test Site (TRTS)

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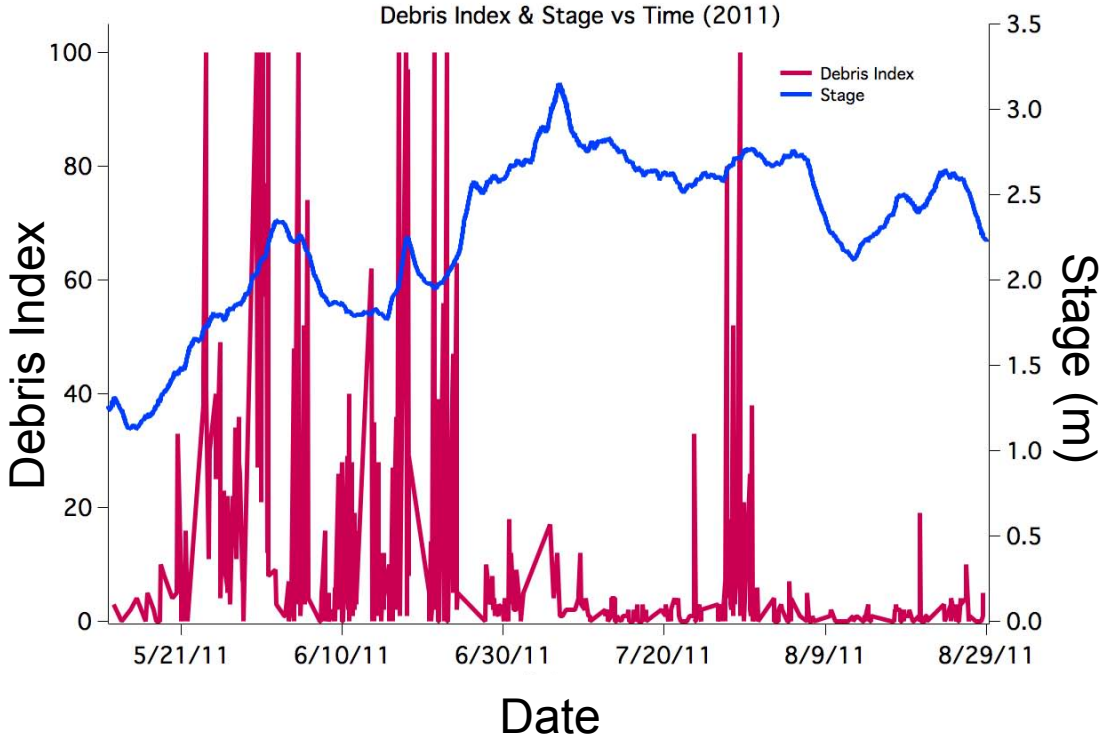
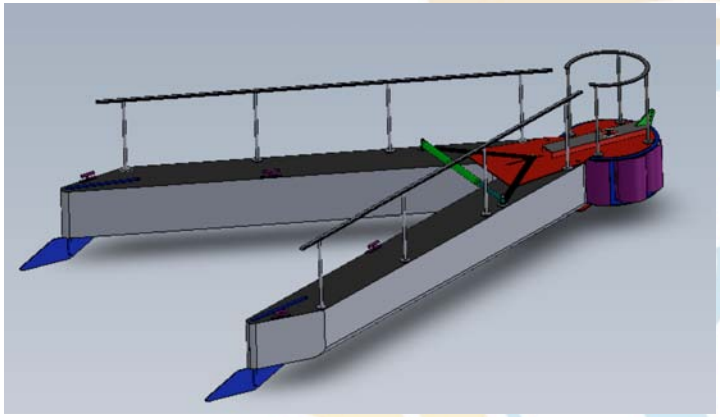
Debris Hazards and Mitigation

Tanana River stage & debris frequency vs. time



Debris interaction with REC infrastructure



River debris diversion platform

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Oceana Testing

- Oceana Energy Company conducted tests of their REC at the AHERC tests site (Reported at this conference)
- Additional tests to examine the effect of RDDP generated turbulence on Oceana REC power output were conducted with the turbine located at 14.5, 50 and 100 m downstream from the RDDP

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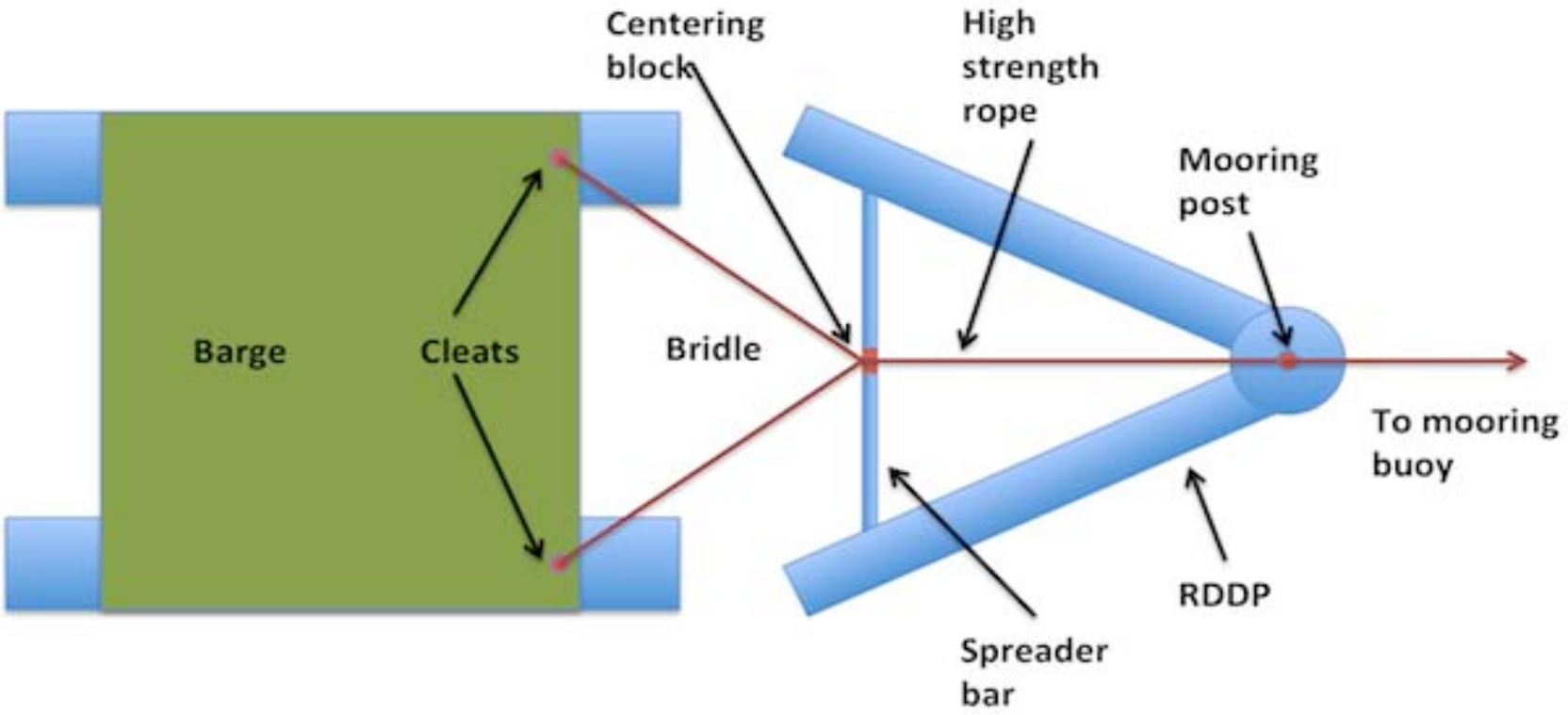
Oceana REC testing

Normal Test Configuration



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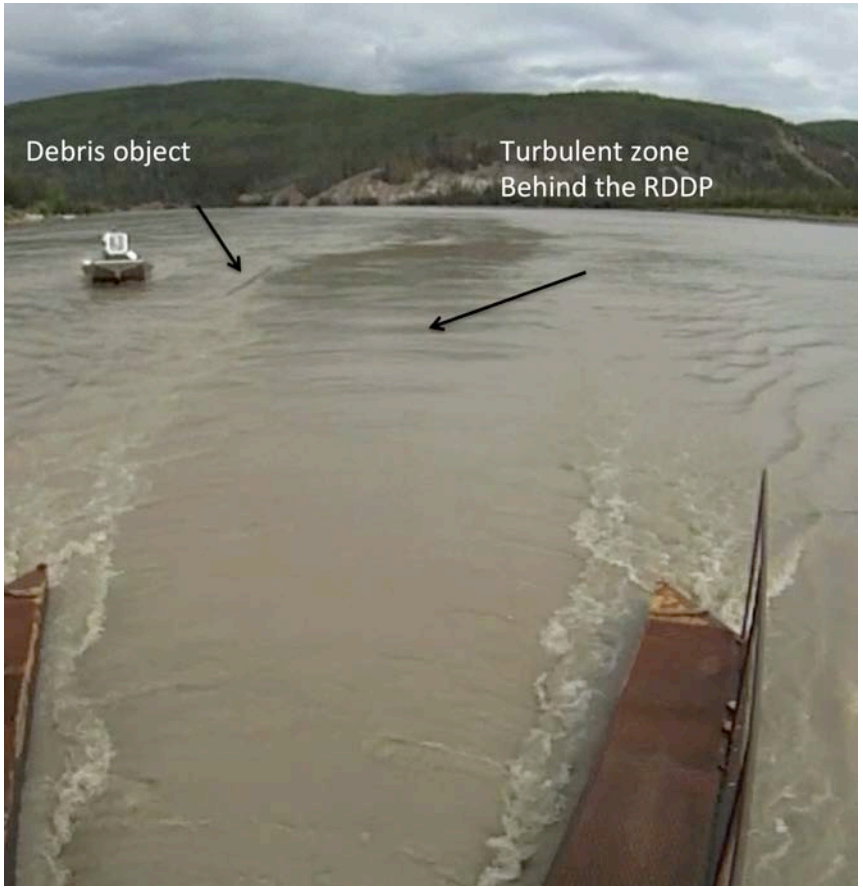
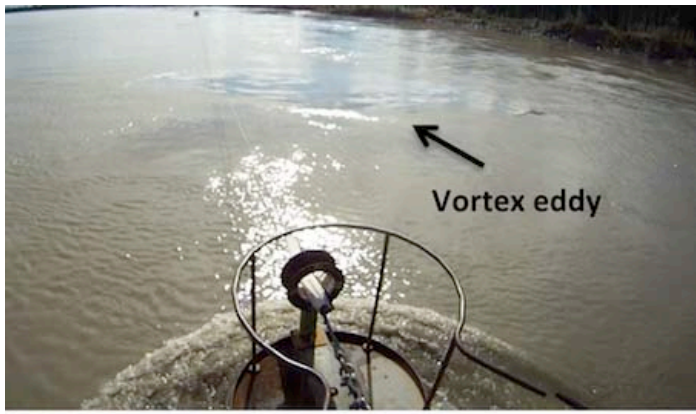
Sources Of Turbulence

RDDP generated turbulence





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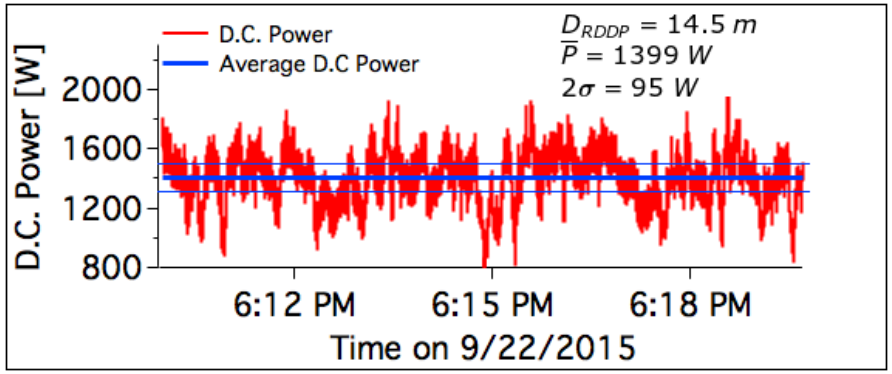
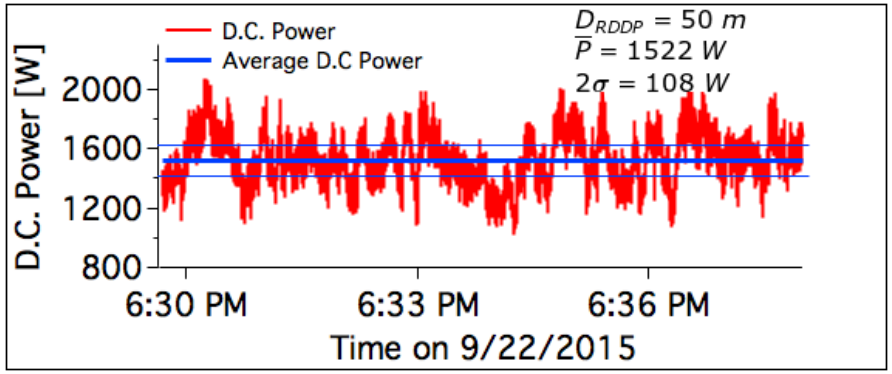
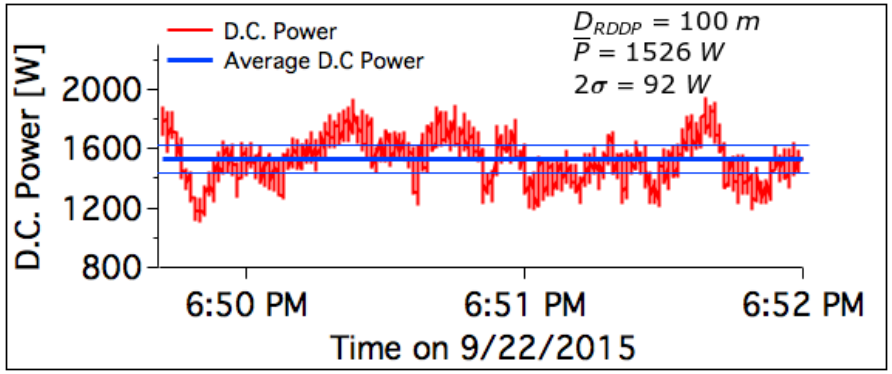
Natural river turbulence

Turbulence effects on Power Output







D_{RDDP} (m)	$\overline{V}$ (m/s)	$\overline{P}$ (W)	$2\sigma_{\overline{P}}/\overline{P}$ (%)	$\Delta\overline{P}/\overline{P}_{100}$ (%)
14.5	1.65	1399	6.8	-8.3
50	1.65	1522	7.1	-0.3
100	1.65	1526	6.0	–

$$\Delta\overline{P}/\overline{P}_{100} = \left| \left(\overline{P}_{D_{RDDP}} - \overline{P}_{100} \right) / \overline{P}_{100} \right|$$

Summary and Conclusions

- The RDDP effectively protects floating platforms from river surface debris
- Maximum protection from debris requires the floating platform be connect to the RDDP using a bridal mooring system
- Natural river turbulence produced a 2σ power output variation of 6% for the Oceana REC
- RDDP generated turbulence reduced Oceana REC mean power by 8.3% at 14.3 m from the RDDP and by 0.3% at 50 m from the RDDP
- Improving RDDP hydrodynamic design may reduce the magnitude of RDDP generated turbulence

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