
PNNL New Jersey WindSentinel

Monthly Report #1 November 2015



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1.0 INTRODUCTION

Ocean Tech Services, LLC (OTS) has been contracted by the Pacific Northwest National Laboratories (PNNL) to operate and maintain a WindSentinel (AXYS Technologies, Inc.) floating LIDAR (Light Detection and Ranging) buoy system off the coast of Atlantic City, New Jersey.

This monthly report for November 2015 describes the operational performance, daily remote monitoring, inspection visits, and service and maintenance performed on the WindSentinel during the reporting period.

2.0 SUMMARY

This monthly report covers the period from November 4, 2015 (the date the buoy was deployed at the project site) through December 7, 2015 (the date of the first monthly inspection). Overall, there were no observed issues and the system remained onsite, reporting data throughout the reporting period. All power systems, meteorological and oceanographic monitoring sensors, positioning and communication equipment were fully operational. An inspection trip was performed on December 7, 2015 and no concerns were identified during the visit.

3.0 PERFORMANCE MONITORING

The WindSentinel was remotely monitored by OTS personnel via the AXYS SmartWeb online tool on a daily basis to ensure proper system performance and continuous data collection. Data parameters that were observed include buoy position, bilge water monitors, sensor function and failures, data logger and communications status, and power system function. These areas are discussed in the following sections. A Daily Monitoring Log Sheet outlining daily observations is provided in Appendix A.

3.1 Location, Hull and Mooring System

The WindSentinel remained on location throughout the reporting period. No water intrusion was detected by the water level sensors (WLS) in each of the four compartments, which indicated that there were no hull leaks during the reporting period. The above water condition of the hull was visually inspected during the monthly visit on December 7. No damage or other issues were observed.

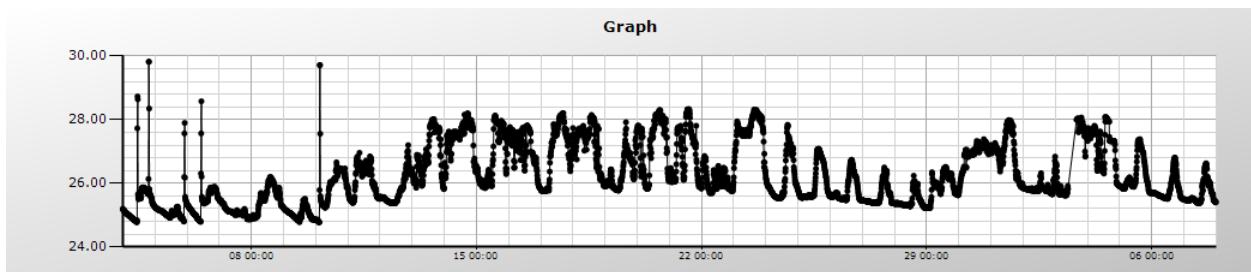
3.2 Power Systems

All power systems on the buoy were operational throughout the reporting period. The battery bank remained in good health maintaining an average voltage of 26.25 Volts (ranging between 24.8 Volts, the voltage threshold at which the generator would turn on, and 28.9 Volts, the voltage level reached by a generator charging event). As the renewable sources (wind and solar) provided the majority of the charging to the system's battery bank, the generator ran only four times for a combined 127 minutes throughout the reporting period. One of the four starts was remotely triggered on the day of the deployment by an OTS technician as a function test. Fuel and oil levels remained steady throughout the reporting period. There were no observed failures or damage to any of the power sources.

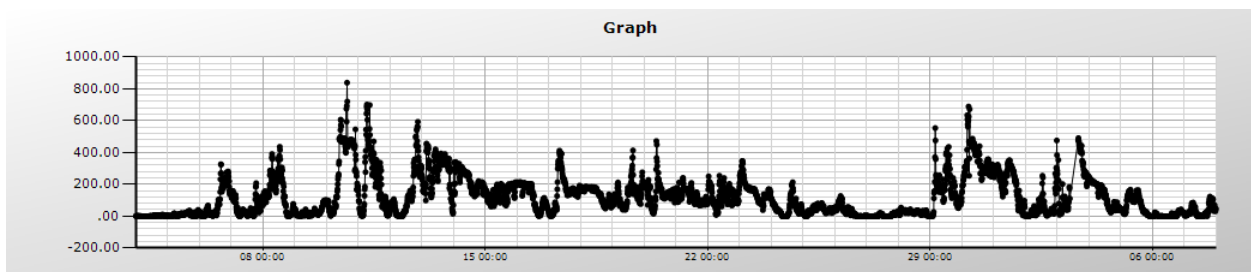
The table below shows the status and statistics on the various power systems. Note that for this reporting period, "Previous Month Value" is the recorded value from the day of deployment.

POWER SYSTEMS STATUS AND STATISTICS		
Parameter	Previous Month Value	Reporting Month Value
Battery Bank Voltage Status	OK	OK
Turbine Charging Status	OK	OK
Solar Panels Charging Status	OK	OK
Generator Charging Status	OK	OK
Engine Start Count	170	174
Failed Engine Start Count	17	17
Engine Stall Count	68	68
Engine Operating Hours & Mins	210 hrs, 59 mins (12,659 mins)	213 hrs, 6 mins (12,786 mins)
Fuel level	88 %	88 %
Oil Level	100 %	100 %

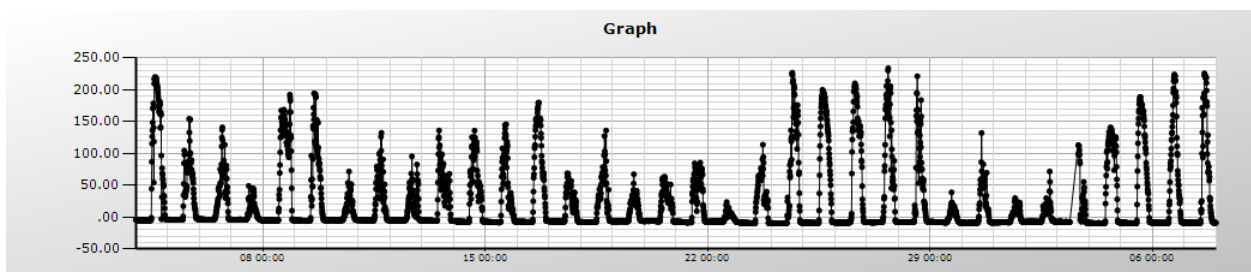
The plot below shows the system's average battery voltage for the duration of the reporting period. Note that the voltage spikes in the first quarter of the plot are results of generator charging. The last time the engine ran was six days after deployment, so the renewable charging sources have been maintaining solid battery voltage for most of the deployment so far.



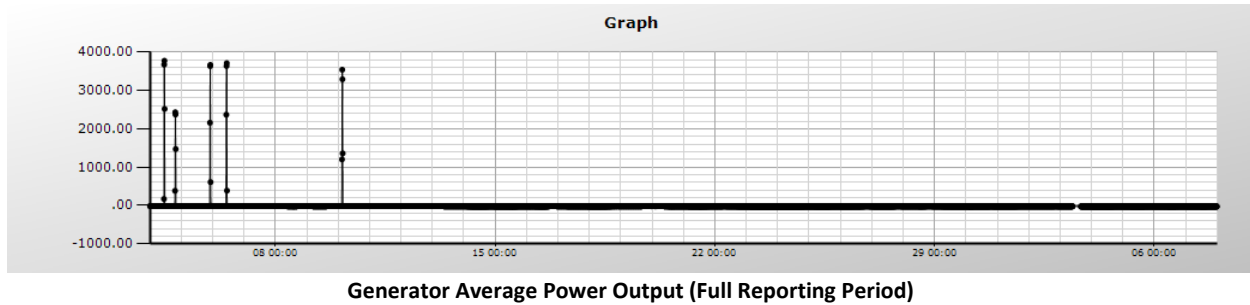
Average Battery Voltage (Full Reporting Period)



Turbine Average Power Output (Full Reporting Period)



Solar Panels Average Power Output (Full Reporting Period)



3.3 Data Logging and Transmission

Data collected by the WindSentinel’s WatchMan500 data loggers (a primary system, a secondary system, and a separate system for the TRIAXYS wave sensor) were successfully recorded to each of their respective Compact Flash (CF) cards. Additionally, data were transmitted to PNNL’s data archives via cellular telemetry (AT&T). The table below shows the available free space on each of the CF cards at the beginning (11/4/15 17:00 GMT) and end (12/7/15 23:50 GMT) of the reporting period. Note that for this reporting period, “Previous Month Value” is the recorded value from the day of deployment.

COMPACT FLASH CARD STATUS		
Parameter	Previous Month Value	Reporting Month Value
WM500 1 CF Card Free Space	15,162 MB	13,252 MB
WM500 2 CF Card Free Space	15,257 MB	14,988 MB
TRIAXYS CF Card Free Space	7,606 MB	7,380 MB

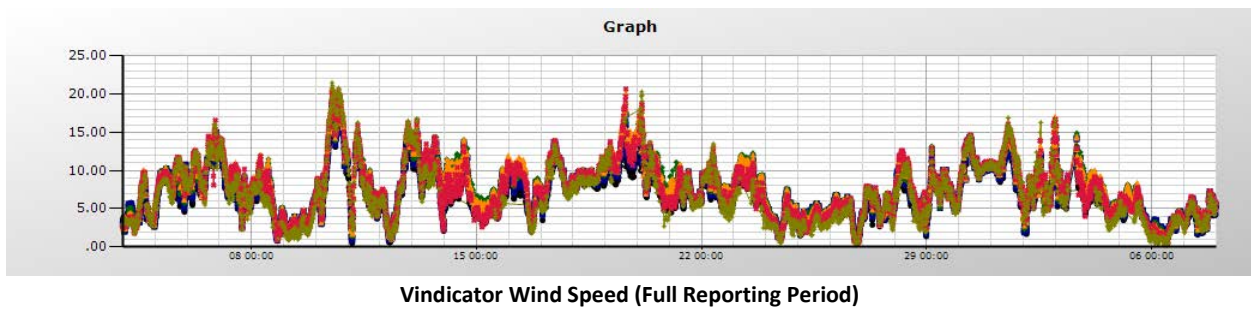
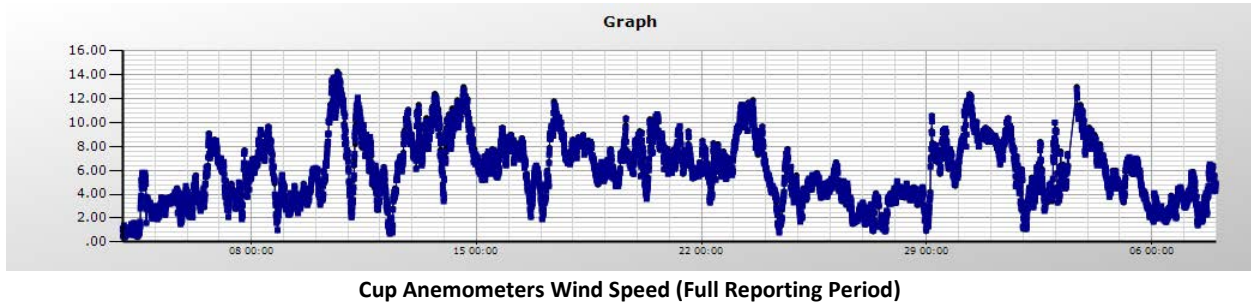
3.4 Meteorological and Oceanographic Sensors

During this reporting period there were no observed failures to any of the meteorological or oceanographic sensors. All sensors remained functional and reported valid data for the duration of the reporting period. The table below outlines the status of each meteorological and oceanographic sensors on the New Jersey WindSentinel.

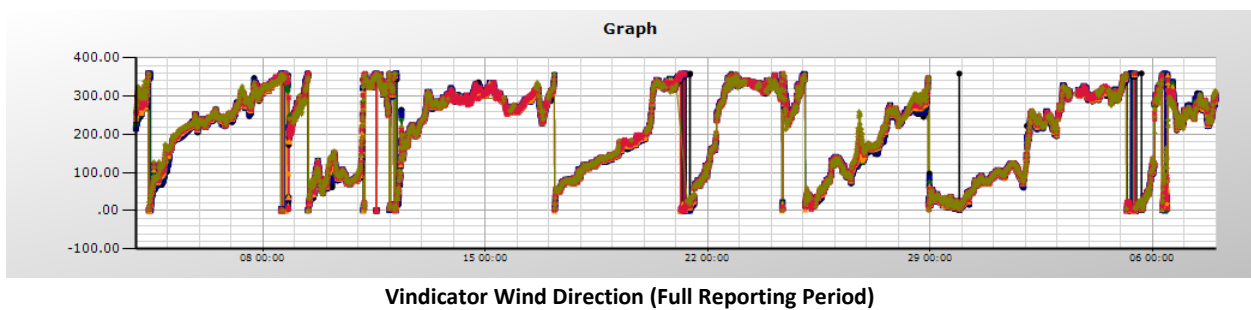
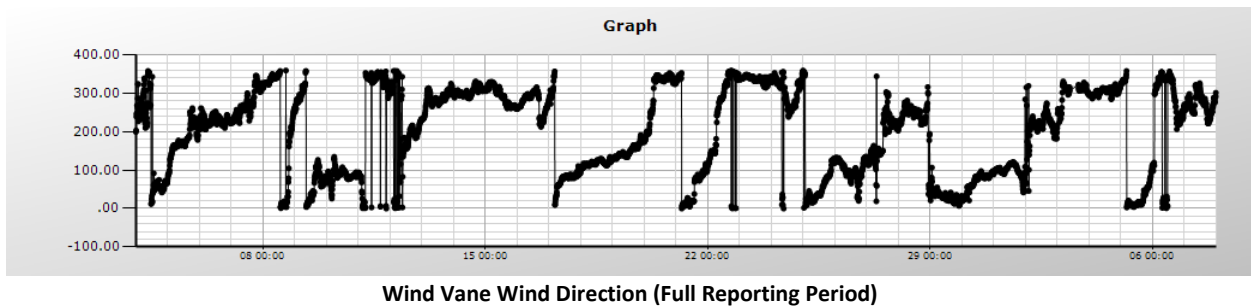
METOCEAN SENSORS STATUS		
Parameter	Status	Comments
LIDAR	Operational	Window manually cleaned during inspection
Anemometer 1	Operational	
Anemometer 2	Operational	
Wind Vane	Operational	
Air Temp. / Humidity Probe	Operational	
Pyranometer	Operational	
TRIAXYS Wave Sensor	Operational	
Sea Temp. Probe	Operational	
ADCP	Operational	
CTD	Operational	

The two plots below show reported wind speeds from the two cup anemometers (top plot) and the Vindicator LIDAR (bottom plot). It is evident that the two cup anemometers are reporting the same

surface wind speeds and the LIDAR range gates typically show the same changes in wind speeds. Additionally, fluctuations in wind speeds at a given time match up well between the cup anemometer and the Vindicator LIDAR data.



The wind vane surface wind direction and the Vindicator LIDAR wind direction data also match up well throughout the reporting period, as shown in the plots below.

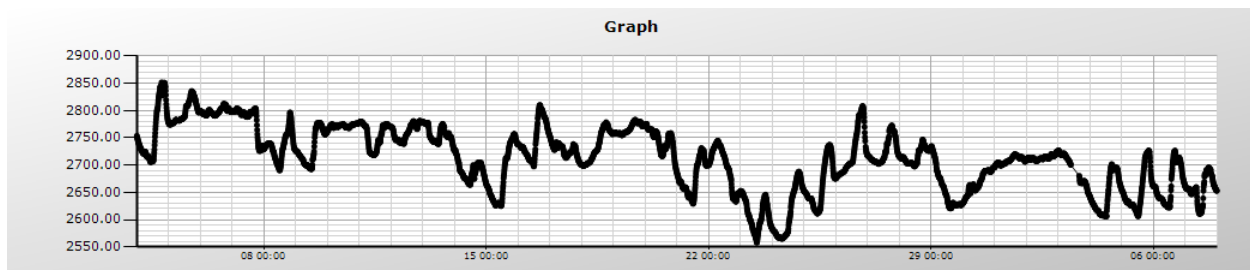


3.5 On-Board System Monitoring Equipment

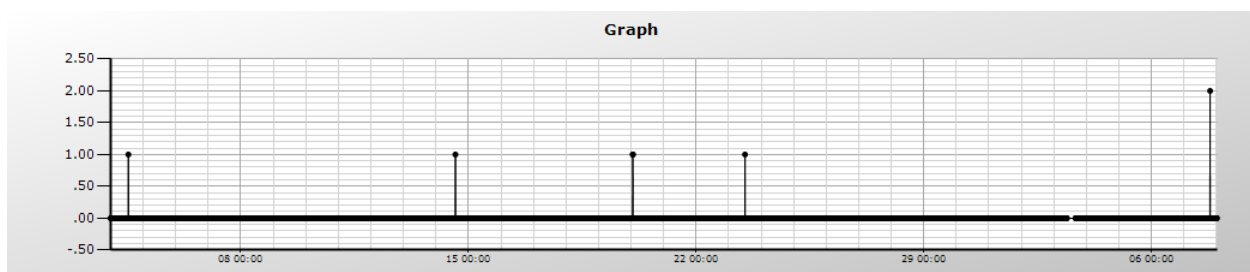
There were no observed failures or issues with any of the system monitoring equipment throughout the reporting period. The table below lists the various sensors and their status. Note that for this reporting period, "Previous Month Value" is the recorded value from the day of deployment.

ON-BOARD SYSTEM MONITORING EQUIPMENT STATUS		
Parameter	Previous Month Value	Reporting Month Value
WLS Compartment 1	3.5 V	3.5 V
WLS Compartment 2	3.5 V	3.5 V
WLS Compartment 3	3.5 V	3.5 V
WLS Compartment 4	3.5 V	3.5 V
Scuba Tank Air Pressure	2,834.27 psi	2,653.16 psi
Scuba Tank Pressure Sensor	OK	OK
LIDAR RLU Cleaning System	OK	OK
Engine Oil Pressure Sensor	OK	OK
Microstrain	OK	OK

The first plot below shows the reported air pressure from the LIDAR window pressurized air cleaning system for the duration of the reporting period. The second plot shows the LIDAR RLU cleaning event count. Note that the first cleaning event was triggered by OTS personnel on the day of the deployment, and the last two cleaning events were triggered by OTS personnel during the inspection on December 7.



LIDAR RLU Cleaning System Air Pressure (Full Reporting Period)



LIDAR RLU Cleaning Event Count (Full Reporting Period)

4.0 ALERT NOTIFICATIONS

The table below lists all alert notifications currently active for the New Jersey WindSentinel. Next to each alert are the number of alerts received during the reporting period, and any response or action taken following the alert.

ALERT NOTIFICATIONS LIST		
Alert Type	# Received	Response/Date (if applicable)
Off-Position (watch circle)	0	
WM500 Primary CF Card Error Count	0	
WM500 Secondary CF Card Error Count	0	
TRIAXYS CF Card Error Count	0	
Minimum WM500 Primary System Voltage	0	
WM500 Primary Inactivity – 30 mins	0	
Average Battery Voltage	0	
Low Fuel Level	0	
Low Oil Level	0	
Low Oil Pressure	0	
Generator Coolant Temperature	0	
Generator Maintenance Required	0	
Water Intrusion, Compartment 1	0	
Water Intrusion, Compartment 2	0	
Water Intrusion, Compartment 3	0	
Water Intrusion, Compartment 4	0	

5.0 EMERGENCY TRIPS AND RECOVERIES

There were no emergency issues or recoveries during the reporting period.

6.0 MONTHLY INSPECTION

The first monthly inspection of the New Jersey WindSentinel was performed on the afternoon of December 7, 2015. One OTS technician traveled to the buoy from Brigantine, NJ on the SeaTow vessel *Tide Runner*. Forecasted conditions on the day of the inspection were for winds SW 5-10 knots and seas 2-3 feet, but actual conditions onsite were variable W winds 10-12 knots and seas in the 2.5-5 feet range.

Conditions allowed for the OTS technician to board the WindSentinel and perform all topside inspections, which included inspecting the solar panels, turbine, masts, railings, and all topside equipment for damage; checking the turbine junction box for water intrusion; examining the LIDAR RLU pressurized air cleaning system and gauges; examining the Vindicator RLU windows, function testing the cleaning system, and manually cleaning the windows; ensuring that all compartment hatches were securely fastened; ensuring the moonpool was intact; function testing the navigation light; and checking all cabling and connections for secureness. Conditions did not allow for inspections of the compartment interiors, and the moonpool was not raised during this inspection.

The completed Inspection Checklist and photographs from the inspection are provided in Appendix B. A picture of the buoy on the day of the inspection is provided below.



The WindSentinel on the day of inspection

7.0 PROBLEMS ENCOUNTERED AND RESPONSE

During the reporting period it was observed that the quantity of data transmitted through the IP modem was far above what was expected. During pre-deployment preparations, AXYS evaluated the sampling scheme and determined that the monthly transmitted data volume would be approximately 1GB. When setting up the modem service account, OTS subscribed to a 5GB per month plan. An evaluation of the modem activity log shows that the data volume transmitted was actually around 15GB. This has resulted in overage charges from the service provider. On November 30, 2015 OTS informed PNNL of the excessive data transmission issue and has requested that AXYS, PNNL and OTS convene to identify the cause of, and repair of this problem.

8.0 PLANS FOR NEXT REPORTING PERIOD

During the December – January reporting period, OTS will continue daily monitoring of systems performance, and conduct an onsite inspection of the WindSentinel system. A monthly maintenance report describing the system performance and all maintenance activities will be provided to PNNL during mid-January.



APPENDIX A

DAILY MONITORING

LOG SHEET

DATE	POSITION	HULL	POWER	MET.	OCEAN.	PRESSURE	COMMS.	COMMENTS
11/29/2015	✓	✓	✓	✓	✓	✓	✓	
11/30/2015	✓	✓	✓	✓	✓	✓	✓	
12/1/2015	✓	✓	✓	✓	✓	✓	✓	
12/2/2015	✓	✓	✓	✓	✓	✓	✓	
12/3/2015	✓	✓	✓	✓	✓	✓	✓	
12/4/2015	✓	✓	✓	✓	✓	✓	✓	Observed slight data gap
12/5/2015	✓	✓	✓	✓	✓	✓	✓	
12/6/2015	✓	✓	✓	✓	✓	✓	✓	
12/7/2015	✓	✓	✓	✓	✓	✓	✓	2 LIDAR cleaning events (triggered during inspection)



APPENDIX B

MONTHLY INSPECTION CHECKLIST & PHOTOGRAPHS

PNNL New Jersey WindSentinel (130)

MONTHLY INSPECTION TRIP CHECKLIST

#1

DECEMBER 7, 2015

VESSEL: TIDE RUNNER (AC SEALTAW)

INSPECTION PARAMETER		COMMENT
SEA AND WEATHER CONDITIONS ON SITE		
Swell heights:		23', slight chop
Wind speed and direction:		SSW 5-10 kts; intransigent 15 kts
Precipitation:		NO
Do conditions allow for boarding the buoy:		YES
Do conditions allow for raising and servicing the moonpool and equipment:		N/A
Do conditions allow for opening the hatches:		NO
VISUAL INSPECTION FROM SERVICE VESSEL		
Buoy on location:		YES
Visual damage to hull:		NO
Signs of vessel/other collision:		NO
Vinyl lettering and signage intact:		YES
All rubber bumpers intact:		YES
All railings intact:		YES
Solar panels intact: Any damage:		YES/NO
Turbine intact on mast: Spinning upon arrival:		YES / YES
Additional Comments	• Turbine spinning nicely • occasional surges and wind gusts, slight water/spray coming over bow - did not want to risk water entering compartments...	
TOPSIDE (ON BUOY)		
Turbine junction box securely mounted to mast:		YES
Radar reflector intact and securely mounted to mast:		YES
Port aft mast intact and upright:		YES
Starboard aft mast intact and upright:		YES
Heater hose attached to generator exhaust pipe:		YES
Foremast intact and upright:		YES
Cup anemometers rotating freely:		YES, both
Wind vane moving with wind direction changes:		YES
Navigation light operational:		YES
All other sensors and ancillary equipment on the foremast intact and securely mounted:		YES
LIDAR RLU intact and securely mounted:		YES
LIDAR RLU cleaning system operational:		YES
LIDAR RLU windows manually cleaned:		YES
What are air pressure levels on the 2 air tanks: (should be around 3,000 psi)		~2700, 2100
What is air pressure level on the low pressure side of manual regulator: (should be around 150 psi)		~150

What is air pressure level on the high pressure side of manual regulator: (should be around 3,000 psi)	~2100
All balls in the compartment vents move freely:	YES
Any damage to deck of buoy:	NO
All hatches securely closed at arrival:	YES
Additional Comments	
MOONPOOL	
Moonpool intact and secure to hull:	YES
Was the Moonpool raised:	NO
ADCP and CTD securely mounted to moonpool cage:	
Zinc anodes % remaining:	
Level of biofouling on ADCP, CTD and moonpool rack: (light, moderate, extreme)	
ADCP, CTD and moonpool rack cleaned:	
Zinc oxide applied to ADCP transducer:	
Additional Comments	NOT RAISED ON FIRST MONTHLY INSPECTION
COMPARTMENT 1	
Was the hatch opened: Compartment entered:	NO/NO
All gases within the allowable levels (were threshold alarms triggered by the gas detector):	
Any damage to the hatch seal:	
Any water pooling in the bilge:	
Any noticeable water intrusion: If so, from where:	
All cables neatly coiled and secured:	
All WM500 external connections OK:	
WM500 Primary and WM500 Secondary units dry inside: Desiccant packs dry:	
LIDAR BLU LED's green:	
LIDAR BLU cables securely connected:	
LIDAR ECU intact:	
LIDAR ECU wiper fluid level: (full, half, almost empty)	
AIS unit intact and cables connected:	
Additional Comments	
COMPARTMENT 2	
Was the hatch opened: Compartment entered:	NO/NO
All gases within the allowable levels (were threshold alarms triggered by the gas detector):	
Any damage to the hatch seal:	

Any water pooling in the bilge:	
Any noticeable water intrusion: If so, from where:	
Batteries securely mounted:	
Battery cables condition OK, securely connected:	
PDU securely closed:	
Control switches on outside of PDU in proper position:	
Any breakers open inside PDU:	
Desiccant pack inside PDU dry:	
Additional Comments	
COMPARTMENT 3	
Was the hatch opened: Compartment entered:	NO/NO
All gases within the allowable levels (were threshold alarms triggered by the gas detector):	
Any damage to the hatch seal:	
Any water pooling in the bilge:	
Any noticeable water intrusion? If so, from where:	
Fuel tank securely connected to hull:	
All fluid lines securely connected:	
Ground cable securely connected:	
Additional Comments	
COMPARTMENT 4	
Was the hatch opened: Compartment entered:	NO/NO
All gases within the allowable levels (were threshold alarms triggered by the gas detector):	
Any damage to the hatch seal:	
Any water pooling in the bilge:	
Any noticeable water intrusion: If so, from where:	
Any signs of fluid leaks (oil, coolant, fuel, etc.):	
If so, leak points identified: Where:	
If so, leaks cleaned up with sorbent pads and properly disposed of:	
Generator/alternator serpentine belt OK:	
Water pump V-groove belt OK:	
Oil level and condition OK on dipstick:	
Coolant level OK:	
Any signs of damage to generator:	
All fuel lines securely connected:	
Fuel valves in ON position:	
All cable connections on Enermatic Controller secure:	

Additional Comments	
WHAT ADDITIONAL MAINTENANCE TASKS WERE PERFORMED?	
1	LOTS OF PICTURES
2	OPENED TURBINE JUNCTION BOX, INSPECTED.
3	
4	
5	
6	
7	
8	
COMMENTS OR NOTES FOR THE NEXT MONTHLY INSPECTION OR MAINTENANCE TRIP	
1	RAISE / CLEAN MOONPOOL SENSORS
2	
3	
4	
5	
6	
7	
8	
ADDITIONAL COMMENTS OR NOTES	
• BIOFOULING / GROWTH ON HULL AT / BELOW WATER LINE BEGINNING	

Date: 12/7/15

OTS Representative Name: BENJAMIN RIKER

OTS Representative Signature: Bu RL



Inspection Photographs



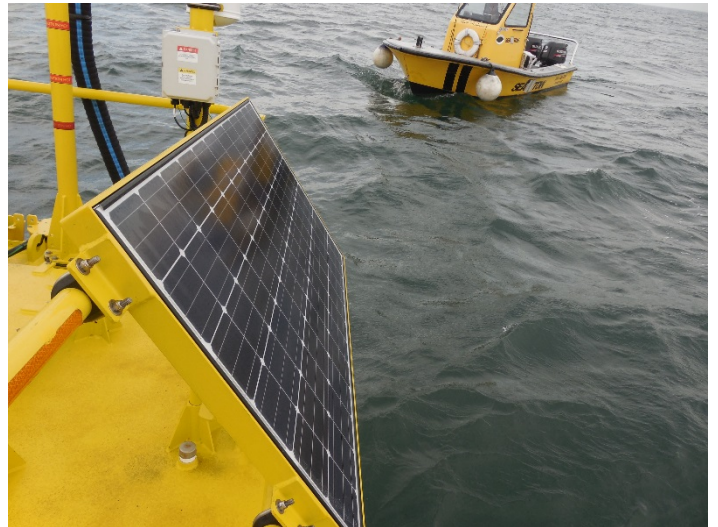
WindSentinel and conditions at arrival



Turbine



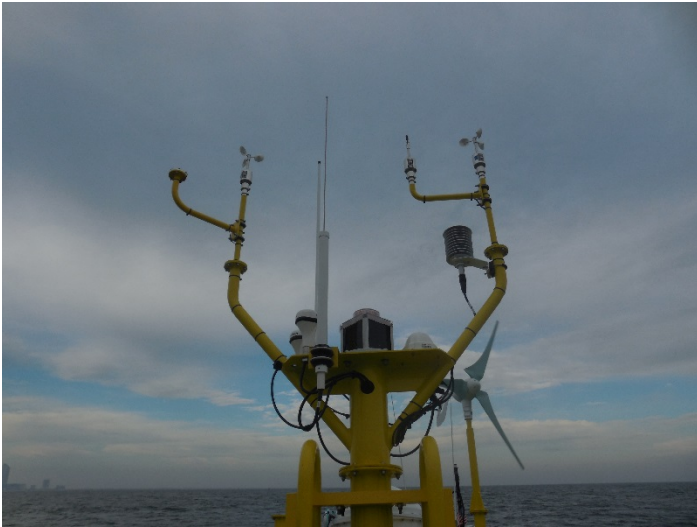
Starboard solar panel



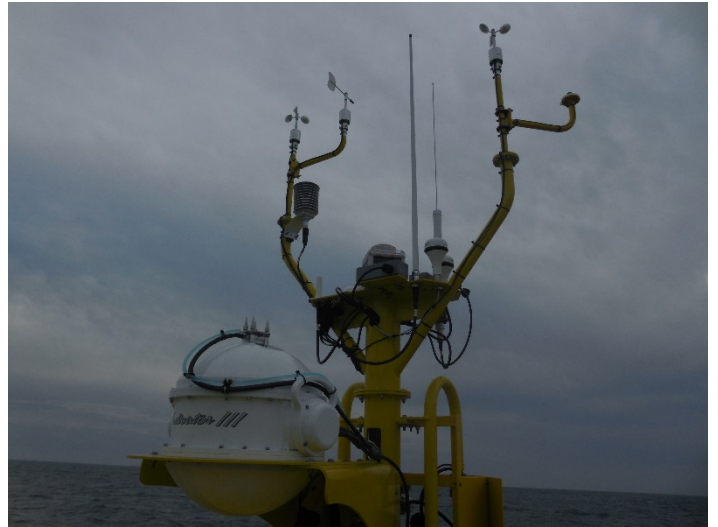
Port solar panel



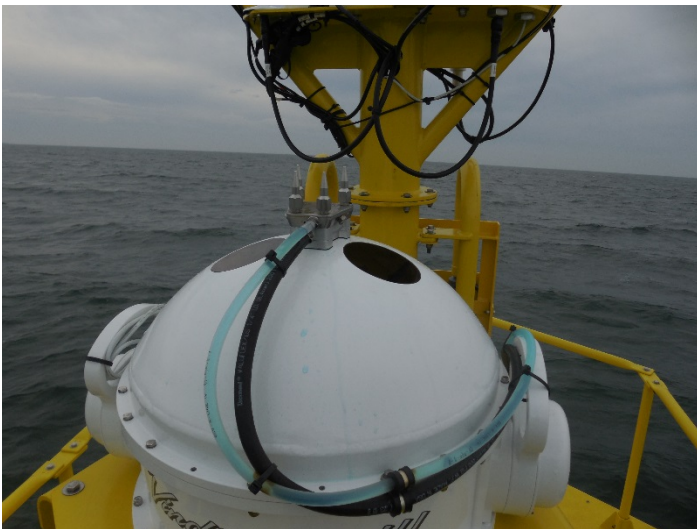
Inspection Photographs



Foremast, forward side



Foremast, aft side



Vindicator RLU



Pressurized air system



Inspection Photographs



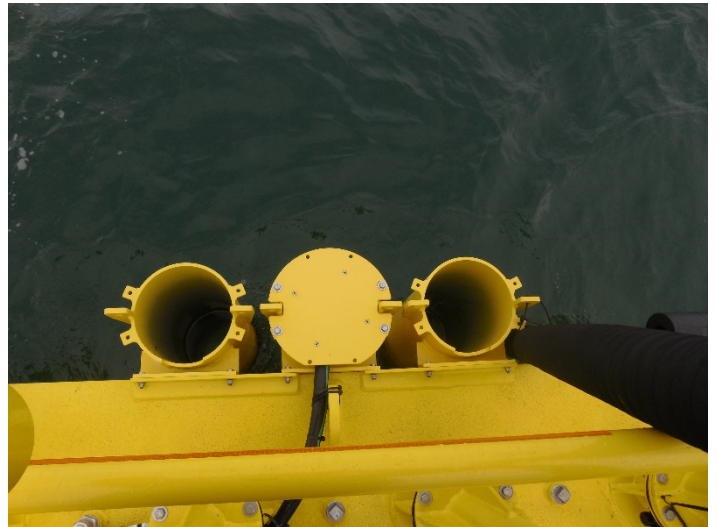
Starboard air tank pressure level



Port air tank pressure level



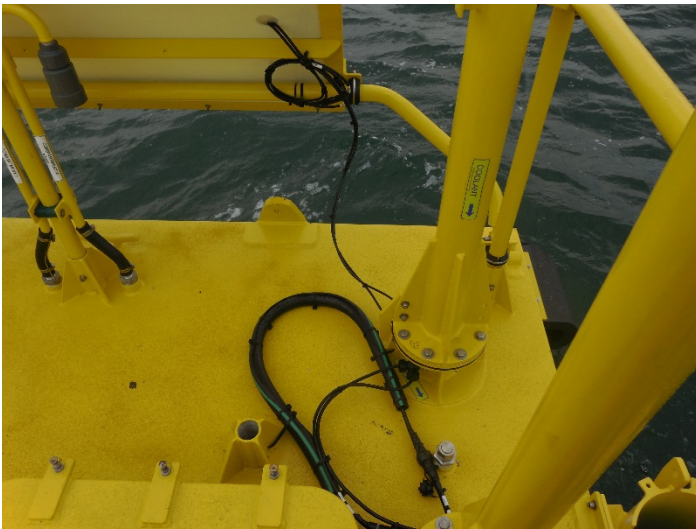
High and low pressure gauges



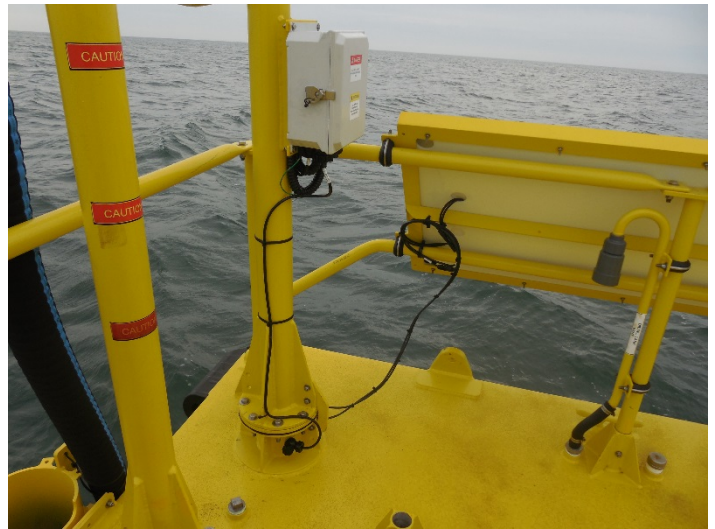
Moonpool



Inspection Photographs



Starboard solar panel and moonpool cables



Port solar panel and turbine cables



Bow eye and hull biofouling



WindSentinel stern