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Wire Following Profiler Specification

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1.0 Scope

This document describes the specification requirements for wire following profilers. The specification describes the physical, functional and electrical characteristics of wire following profilers. The Coastal and Global Scale Nodes of the Ocean Observatories Initiative require two types of wire-following profilers. Except when otherwise noted, the specifications represent threshold values for both types of profilers. Unique characteristics for a specific profiler are identified as required.

2.0 Purpose

The purpose of this specification is to provide the requirements for the wire following profilers for use in the Ocean Observatories Initiative (OOI).

Moored profilers are one of the primary measurement tools used in the Coastal and Global Scale Nodes (CGSN) to obtain time series of the vertical profile of important variables in the oceans. In general, moored profilers consist of a suite of sensors that are raised and lowered through the water column on a regular basis. Tradeoffs between sensor power consumption, profiling range and speed, and profiling interval suggest that several different profiling technologies be employed on the CGSN. A wire following profiler is a platform which propels itself along the length of the mooring line holding the oceanographic mooring in place. This is in distinction to a winched profiler which uses a winch at a fixed depth to raise and lower a sensor package through the water column.

The moored profilers will be used to collect high resolution vertical profiles of water column properties on a regular basis and telemeter these data to shore. Their data will help fill in the space between fixed sensors located on moorings and on the bottom. Data will be transferred to shore in near real time. Commands from shore allow alteration of the sampling activities to optimize scientific return within power, bandwidth, and budgetary constraints.

The two types of wire following profiler used in OOI differ in their scientific mission and their area of deployment. The Coastal wire following profiler is deployed in coastal regimes with water depths up to 500 meters. The Global wire following profiler is deployed in the open ocean far from shore in waters as deep as 5200 meters. The Coastal profilers are maintained every 7 months. The Global profilers are maintained every 13 months and have a different scientific payload than the Coastal profilers.

3.0 Reference

3.1 Reference Documents

The specifications of the wire following profilers system are derived from the requirements listed in the OOI requirement module and based on the end item use defined in the Final Network Design (FND) 1101-00000 (available upon request).
Coastal Wire Following Profiler Interface Control Document (TBS) – to define mechanical and communications interface.

Global Wire Following Profiler Interface Control Document (TBS) – to define mechanical and communications interface.

The following White Papers describe the site characteristics and environmental conditions of the coastal and global deployment sites (available on request):
Coastal Arrays

- CGSN Site Characterization: Pioneer Array (3204-00007)
- CGSN Site Characterization: Endurance Array (3205-00007)

Global Arrays

- CGSN Site Characterization: Southern Ocean Array (3201-00007)
- CGSN Site Characterization: Irminger Sea Array (3202-00007)
- CGSN Site Characterization: Station Papa Array (3203-00007)
- CGSN Site Characterization: Argentine Basin Array (3206-00007)

3.2 General Definitions

Certificate of Compliance – a certificate provided by the manufacturer stating that the unit is compliant with the requirements in the specification, has passed testing with records maintained by QA/QC at the vendor, and contains materials as agreed at the design reviews.

Deployment Interval – The period between launch and recovery.

Mission – An operational task, defined by a mission plan, during which the vehicle is active and sampling.

Mission Plan – A set of vehicle and sensor commands defining vehicle trajectory and sampling protocols; mission parameters include but are not limited to profiling depth, speed, sensors active and sensor sampling rates, data compaction and selection for telemetry to shore.

Operate – Correctly performing designed functionality.

Shore station – In the context of these specifications, observatory management center(s) used to command and control profilers during a deployment through the use of bi-directional satellite communications (Iridium). The profilers will communicate with the shore station via the surface piercing or near-surface buoys.

Survive – Experience an event without major loss of hardware. System may experience loss of functionality requiring repair to return to normal mode functionality.

Sustain – Experience an event (environmental extreme or condition) without permanent loss of normal mode functionality. System may experience reduction of functionality during event.

4.0 Specifications

Note: Specifications are assigned unique identifications specific to this document. Specifications tied directly to wire following profilers requirements maintained in the database are followed by the requirement number in square brackets, e.g., [L4-CG-PR-RQ-167]. The requirement number is intended for internal OOI use.

4.1 Manufacturing Requirements

MANU-001: To the greatest extent practical, all infrastructure of the wire following profilers shall be compatible with applicable national and international standards, including those of the IEEE, ANSI, and IEC.

MANU-002: The materials used in construction of the profilers, sensors, and sensor mounts shall be chosen and treated in such a way as to reduce the levels of wear, corrosion and deterioration to allow multiple deployments of each unit. [L4-CG-PR-RQ-195]

MANU-003: All structural and electrical cables on a profiler deployed at depths shallower than 1000 m shall be protected from fish bite. [L4-CG-PR-RQ-181]

MANU-004: The Coastal wire following profilers shall be capable of sustaining a pressure of 600 decibars. [L4-CG-PR-RQ-228]

MANU-005: The Global wire following profilers shall be capable of sustaining a pressure of 6240 decibars. [L3-CG-RQ-433]

4.2 Performance Requirements

4.2.1 Operating Environment

OPEN-001: The Coastal wire following profiler shall be capable of profiling from a depth of 30m or less to a depth of 500m. [L4-CG-PR-RQ-222]

OPEN-002: The Global wire following profiler shall be capable of profiling from a depth of 200m or less to a depth of 5200m. [L4-CG-PR-RQ-150]

OPEN-003: The Coastal wire following profiler shall operate in conditions defined by the 10 year return period extreme waves, winds, currents, and tides per site characterizations at the Coastal Arrays. [L4-CG-PR-RQ-223]

OPEN-004: The Global wire following profiler shall operate in conditions defined by the 10 year return period extreme waves, winds, currents, and tides per site characterizations at the Global Arrays. [L4-CG-PR-RQ-292]

OPEN-005: The Coastal and Global wire following profilers shall sustain operations in conditions defined by the 30 year return period extreme waves, winds, currents, and tides. [L4-CG-PR-RQ-224] [L4-CG-PR-RQ-293]

OPEN-006: The Coastal and Global wire following profilers shall survive conditions defined by 100 year return period extreme waves, winds, currents, and tides. [L4-CG-PR-RQ-225][L4-CG-PR-RQ-294]

4.2.2 Power

POWR-001: The Coastal wire following Profiler shall be powered from an internal source which shall be sufficient to profile and sample all sensors four times per day with a 25 cm resolution for the entire maintenance interval. [L4-CG-PR-RQ-229]

POWR-002: The Global wire following Profiler shall be powered from an internal source which shall be sufficient to profile and sample all sensors two times per day with a 25 cm resolution for the entire maintenance interval. [L4-CG-PR-RQ-158]

POWR-003: The Global and Coastal profilers shall have the capability to reduce overall system functionality as power becomes limited or when directed by commands from the shore station via the buoy. [L4-CG-PR-RQ-203]

4.2.3 Communications

COMS-001: The Coastal wire following profiler shall include a bidirectional inductive telemetry system to communicate data and commands with a surface buoy on the same mooring. [L4-CG-PR-RQ-236]

COMS-002: The Global wire following profiler shall include a bidirectional inductive telemetry system to communicate data and commands with the global surface piercing profiler on the same mooring. [L4-CG-PR-RQ-174]

COMS-003: The profilers shall have the capability to turn off sensors or instruments that malfunction or when directed by commands from the shore station.[L4-CG-PR-RQ-204]

4.2.4 Sensor Payload

(See Section 5.0 for a list of sensors referred to in this section.)

SENS-001: The sensors are an integral part of the wire following profilers and shall be provided, installed and integrated with each delivered unit.

SENS-002: The Coastal and Global wire following profilers shall measure Conductivity, Temperature, and Depth (CTD). [L4-CG-PR-RQ-230][L4-CG-PR-RQ-159]

SENS-003: The Coastal and Global, wire following profilers shall measure Dissolved Oxygen (DO). [L4-CG-PR-RQ-231][L4-CG-PR-RQ-160]

SENS-004: The Coastal and Global wire following profilers shall measure Chlorophyll a Fluorescence, CDOM Fluorescence, and Optical Backscatter. [L4-CG-PR-RQ-232][L4-CG-PR-RQ-162]

SENS-005: The Coastal and Global, wire following profilers shall measure three axis point velocity. [L4-CG-PR-RQ-165]

SENS-006: The Coastal profiler shall measure Photosynthetically Active Radiation (PAR). [L4-CG-PR-RQ-234]

SENS-007: The Coastal and Global wire following profiler shall sample all sensors at least once in every 25 cm of vertical travel. [L4-CG-PR-RQ-235][L4-CG-PR-RQ-169]

4.2.5 Data Handling

DATA-001: The Coastal wire following profiler shall be capable transferring a subset of the data to shore using the inductive link to the buoy. [L4-CG-PR-RQ-237] [L4-CG-PR-RQ-174]

DATA-002: The Coastal and Global wire following Profiler shall contain a real time clock which can be synchronized to UTC with an accuracy of +/- 1 second via the inductive link to a GPS receiver located on the same mooring. [L4-CG-PR-RQ-238, L4-CG-PR-RQ-296]

DATA-003: The Coastal and Global wire following profilers shall stamp all data with the time of acquisition obtained from the real time clock. [L4-CG-PR-RQ-239][L4-CG-PR-RQ-297]

DATA-004: The Coastal and Global wire following profilers shall time-stamp and store all data from sensors in non-volatile memory. [L4-CG-PR-RQ-205]

DATA-005: The data storage subsystem shall have data storage capacity to store all of the engineering data and sensor data collected during the maintenance interval. [L4-CG-PR-RQ-207]

DATA-006: The data communication protocol shall employ an error detection/correction protocol. [L4-CG-PR-RQ-212]

4.2.6 Operations and Maintenance

OPSM-001: The Coastal and Global wire following profilers shall be capable of profiling along the mooring line anchoring a subsurface float to the bottom. [L4-CG-PR-RQ-221][L4-CG-PR-RQ-147]

OPSM-002: The Coastal and Global wire following profilers shall be recoverable and reusable following refurbishment and refueling. [L4-CG-PR-RQ-183]

OPSM-003: The Coastal and Global wire following profilers shall have the capability to monitor the orientation (attitude and heading) of the profiling body. [L4-CG-PR-RQ-335]

OPSM-004: The Coastal and Global wire following profilers shall have the capability to control and monitor the vertical velocity of the sensor package. [L4-CG-PR-RQ-199]

OPSM-005: The Coastal and Global wire following profilers shall have the capability to control and monitor the range of vertical motion of the sensor package. [L4-CG-PR-RQ-200]

OPSM-006: The sensors on a profiler shall be field-swappable without requiring the opening of the pressure housing. [L4-CG-PR-RQ-182]

OPSM-007: Science sensor replacement (with identical spares) shall require no modification to the profiler hardware or software. On board storage of instrument serial numbers and calibration coefficients is not construed as modification to profiler software. [L4-CG-PR-RQ-196]

OPSM-008: Science sensors shall be user-replaceable in the field with identical spare sensors. [L4-CG-GD-RQ-84]

OPSM-009: The designed maintenance and operation interval for the Coastal wire following profilers shall be seven months. [L4-CG-PR-RQ-226][L4-CG-PR-RQ-275]

OPSM-010: The designed maintenance and operation interval for the Global wire following profiler shall be thirteen months. [L4-CG-PR-RQ-152]

OPSM-011: The vendor shall supply operation manual(s) detailing operation, maintenance, handling, and shipping of the wire following profiler.

OPSM-012: The profiler shall have the capability to control and monitor the data acquisition and storage of sensor data. [L4-CG-PR-RQ-201]

OPSM-013: The profiler shall monitor the health of subsystems and record the time-stamped engineering data in non-volatile memory. [L4-CG-PR-RQ-206]

OPSM-014: All wire following profilers shall be deployable by UNLOS ships. [L4-CG-PR-RQ-308]

OPSM-015: The vendor shall provide a mission planning tool to provide estimates of energy usage as a function of sensor payload and sampling interval. [L4-CG-PR-RQ-184]

OPSM-016: The mission planning tool shall provide estimates of energy usage as a function of profiling speed, vertical profiling speed, current speed, and in situ water density. [L4-CG-PR-RQ-213]

OPSM-017: The mission planning tool shall provide estimates of the data storage needs as a function of sensor payload and sampling interval. [L4-CG-PR-RQ-214]

OPSM-018: The mission planning tool shall monitor the power usage of a deployed profiler and provide estimates of the capacity remaining. [L4-CG-PR-RQ-216]

OPSM-019: The mission planning tool shall monitor the data storage usage of a deployed profiler and provide estimates of the capacity remaining. [L4-CG-PR-RQ-217]

OPSM-020: The Coastal wire following profilers shall be capable of making 4 vertical water column profiles per day during its deployment interval. [L4-CG-PR-RQ-227][L4-CG-PR-RQ-246]

OPSM-021: The Global wire following profiler shall be capable of making 400 vertical water column profiles during its deployment interval. [L4-CG-PR-RQ-153]

OPSM-022: The Global wire following Profiler shall have the capability of performing no less than two profiles per day. [L4-CG-PR-RQ-295]

4.3 Quality Requirements

4.3.1 Manufacturing

QUAL-001: Wire following profilers shall be manufactured in accordance with the manufacturer's best practices. Records of quality assurance tests and inspections shall be available for review by the purchaser.

4.3.2 Certificate of Compliance

QUAL-002: A certificate of compliance shall be provided with each delivered unit. The certificate of compliance shall be supported with copies of the Factory Acceptance Test report and calibration records for each sensor following integration into the unit.

QUAL-003: (Reserved)

4.4 Identification and Traceability Requirements

4.4.1 Wire Following Profiler Marking

IDNT-001: Wire Following Profiler shall be marked indelibly on an exterior surface. Marking shall include:

- Manufacturer's part number
- Unit serial number
- CGSN part number as defined below:
  "P/N 3310-00003-00001" for the Coastal following profiler.
  "P/N 3310-00003-00002" for the Global following profiler.

4.4.2 Transportation Case Marking

IDNT-002: Wire Following Profiler transportation cases shall have external labels specifying safe handling precautions.

4.5 Handling, Packaging, Shipping, and Storage Requirements

4.5.1 Storage temperature

SHIP-001: Profilers shall be capable of being stored without damage or degradation between 0 F and 120 F for periods of up to 1 year.

4.5.2 Transportation environment

SHIP-002: The profiler in its transportation case must survive shipping conditions defined by ASTM D4169 truck assurance level 1.

4.5.3 Shipping

SHIP-003: Units shall be delivered with a reusable transportation case via commercial carrier to the address specified in the contract or purchase order.

5.0 Attachments

Wire Following Profiler Instrument List

Wire Following Profiler Test Verification Matrix (TBS)