CGSN Standard and High Power Surface Buoy Recovery Procedure

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Template 3101-00023 Version 1-00

Revision History

Version	Description	Originator	Approver	Release Date
0-01	Initial Draft	S. White		
0-02	Updates from discussions with J. Kemp	S. White, M. Palanza		
1-00	Initial release	S. White	P. Matthias	2014-08-19
1-01	Updates from comments from: OOI Task 2 OSHA Report_082614	M. Palanza	P. Matthias	2014-10-24

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1.0 Scope & Purpose

The procedure describes the recovery and handling procedures of Standard and High Power Surface Moorings deployed at OOI Global, Coastal Pioneer and Coastal Endurance Arrays.

The purpose is to specify safe handling procedures to deal with the possibility of hydrogen gas accumulation within the buoy well. Hydrogen gas mixtures in air are combustible in concentrations of 4% to 75% by volume. This procedure is based on similar procedures developed for the Nation Data Buoy Center (NDBC) (Health and Safety Instruction H.12.001)

2.0 Roles & Responsibilities

The Marine Operators in the OMCs have a responsibility to monitor and control the operations of the moorings during deployments, and to provide status information to the recovery personnel at sea.

The recovery personal at sea have the responsibility to safely recover the mooring. The CGSN Mooring Operations Lead and the Chief Scientist have joint responsibility (in consultation with the ship's Master) to determine the best, safest course of action given the situation.

3.0 Materials required

- 1 Handheld hydrogen gas sensors: RKI Eagle 2
- Q size cylinders of nitrogen gas with pressure regulator (at least one cylinder per surface buoy, and 2 spares)
- 1/2" ID Flexible tubing (length dependent on deck configuration, see Section 6.1))

4.0 Reference Documents

NDBC Health and Safety Instruction H.12.001

3701-00387 J-Box, Well Instrument Connector Panel Assembly

3701-00127 Surface Buoy Well Purge Hose Adapter Assembly

5.0 Definitions & Acronyms

LEL – Lower Explosive Limit (percent by volume in air)

NDBC – National Data Buoy Center

OOI – Ocean Observatories Initiative

OMC – Operations & Management Component

PSC – Power System Controller

6.0 Procedure

The procedure for recovering and handling Surface Buoys will depend on the state of the buoy, whether it is active, inactive, or unknown. Each of those scenarios are presented in the sections below.

WARNING – Personnel should stand clear of the top of the buoy well (area above the hatch) and the bottom of the buoy well. No approach should be made into this area until the buoy well environment has been verified. Only the minimal number of personnel required to complete a task should be in the vicinity of the buoy.

WARNING – No power tools or ignition sources of any kind should be used in the vicinity of the Surface Buoy.

6.1. Operational Monitoring:

During normal operations, surface mooring Hydrogen levels will be monitored and logged daily.

6.1.1. Monitoring:

On a daily basis a trained operator will log onto: http://cgsn-omc.whoi.edu/oms

Determine Hydrogen Level:

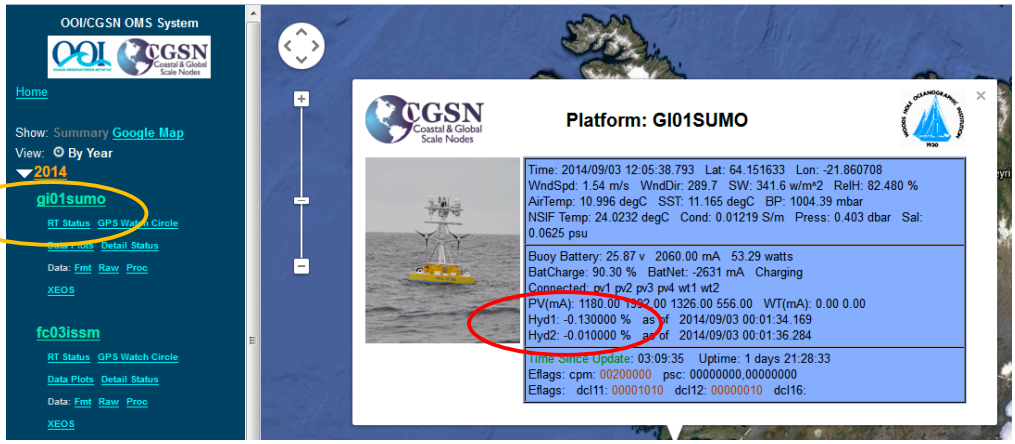

Figure 1: Buoy Real Time Status

6.1.2. Log Hydrogen Value

6.1.3. If value is greater than 25%:

6.1.3.1. Initiate Power System Override Procedure

6.1.3.2. Alert: Paul Matthias, CGSN Chief Engineer
Sheri White, CGSN Systems Engineer
Matthew Palanza, CGSN Lead Electrical Engineer

6.2. Pre-Recovery Planning

Prior to recovery, the shipboard personnel should be informed of the safety issues associated with Surface Buoy recovery, and what areas must be kept clear during recovery and post-recovery operations. Given the location the buoy will be placed on deck, a suitable location shall be identified (protected from the buoy and weather) to locate the hydrogen sensing equipment and nitrogen cylinders. Flexible hosing needs to be of sufficient length to connect from the buoy on deck to the hydrogen monitoring location.

6.3. Mooring Recovery Scenarios

Active Mooring Scenario Assumptions

- The Surface Mooring is operational and status is being reported on schedule to the OMC.
- The Surface Mooring can be controlled from shore via satellite telemetry, and/or from the ship via line-of-sight telemetry
- Power System and hydrogen gas concentration data/status are normal.

Unknown Mooring Scenario Assumptions

- The Surface Mooring is in an unknown state.
- There are no communications with the mooring.
- No status information can be obtained from the mooring.
- The state of the Power System is unknown.

6.4. Pre-Recovery Actions

6.4.1. Active Mooring Scenario

- **Stop battery charging** – Marine Operators (on shore or at sea) will remotely command power generation processes to stop for a minimum of 48 hours, and a maximum of 72 hours prior to the planned recovery. This will prevent any further hydrogen generation from battery charging prior to recovery.

The Power System Controller (PSC) autonomy will be overridden via a PSC Override Procedure, appendix n.

- **Determine hydrogen gas concentration** – Details on hydrogen concentration within the buoy well, as measured by the hydrogen sensor mounted in the well, will be communicated to the recovery team at sea by the Marine Operators.

All surface moorings are equipped with two internal Hydrogen sensors. The Hydrogen sensors measure Hydrogen concentration between 0% and 100% Lower Explosive Limit.

Data is available remotely via the shore side command and control site, and locally by logging onto the buoy directly.

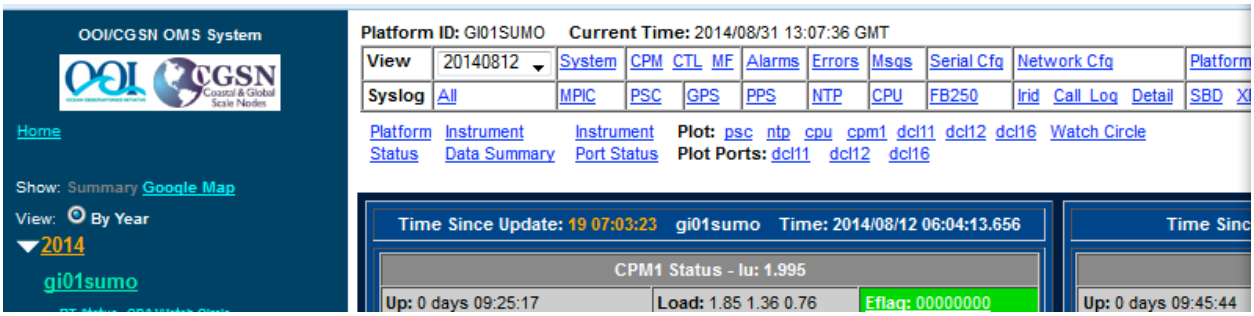

Figure 2: Detail of Command and Control Interface

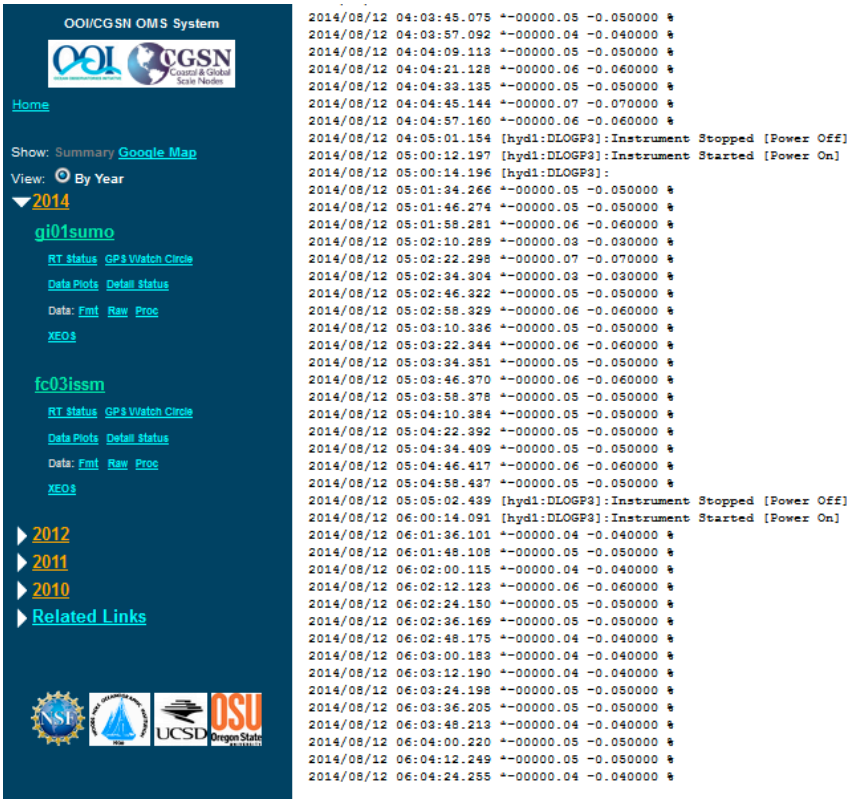

Figure 3: Hydrogen Sensor Data

6.4.2. Unknown Mooring Scenario

- **Visual inspection** – The ship will pass as close as possible to the mooring such that a visual inspection can be made.
  - Mechanically secure wind turbines
    - If possible a small boat operation will be considered to mechanically secure the wind turbine blades.
  - Inspect vent valves for any signs of blockage.
    - If possible clear any blockage

6.5. Recovery Actions

WARNING – Personnel should stand clear of the top of the buoy well (area above the hatch) and the bottom of the buoy well. No approach should be made into this area until the buoy well environment has been verified. Only the

minimal number of personnel required to complete a task should be in the vicinity of the buoy.

WARNING – No power tools or ignition sources of any kind should be used in the vicinity of the Surface Buoy.

NOTE – Once the buoy is on deck in a ~45% orientation, the buoy vent valves act as one way check valves. Atmosphere can be actively pumped out, but passive ventilation is prevented.

1. **Recover Surface Buoy** –

Figure 4: ESD Ground Strap

   A. Surface Moorings will nominally be recovered buoy first, with the buoy being brought aboard on the starboard side of the ship.
   B. Connect ESD ground strap to instrument well grounding strap prior to touching the ship.
   C. Connect ESD ground strap to ship.
   D. Once the buoy is brought on deck, minimal tie-downs will be applied to the sides of the buoy as needed given the sea state conditions.

2. **Measure hydrogen concentration of buoy well** –
   A. Connect a long section of flexible tubing to the vent port on the Instrument J-box Panel and to the hydrogen sensor in a protected location on deck.
      1) If the LEL reading is less than 10% proceed to Step 4.
      2) If the LEL reading is greater than 10% proceed to Step 3.
3. **Purge the buoy well with nitrogen** –

Figure 5: Nitrogen Tank, Regulator and Flexible Tubing

Figure 6: Eagle 2 Gas Analyzer

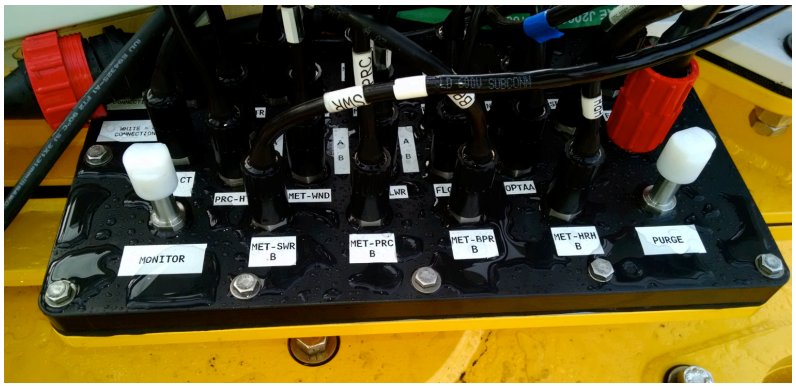

Figure 7: Monitor and Purge Ports

A. Connect a long section of flexible tubing to the vent purge port on the Instrument J-box Panel and to a cylinder of nitrogen gas.
B. Flush the well with 2-4 psi of nitrogen until the hydrogen sensor records less than 10% LEL.

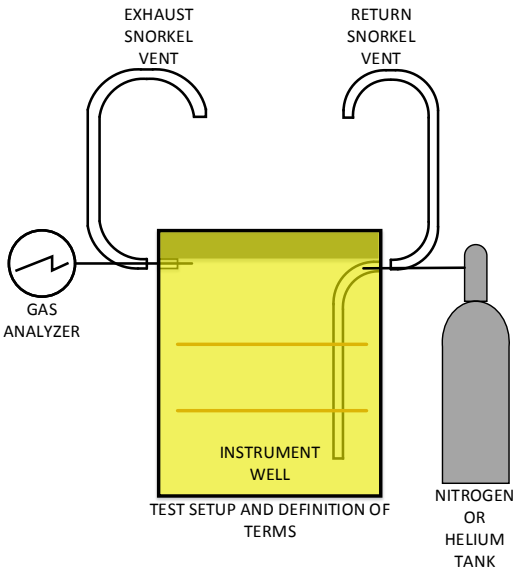

Figure 8: Instrument well purge procedure setup

4. **Insert magnet to shut down buoy** –
   A. Secure a magnet on the J-Box Status panel to shut down the Surface Buoy.
   B. Remove high power interlock jumper if installed.
5. **Secure the buoy on deck** –
   A. Apply tie-down straps as needed to secure the buoy on deck.

Once the buoy is on deck, purged and secured, mooring recovering operations can continue. The surface buoy should continue to be monitored using the hydrogen sensor and flushed as needed with nitrogen.

6.6. Shipboard/transit Actions

Following mooring recovery, transit times will vary depending on the Array location. Coastal Pioneer cruises will like return to port within a day or two of recovery. Global cruises may have several days of transit time. To secure the buoy for transit and ensure adequate flushing of the buoy well, the following actions will be performed.

1. **Disconnect Batteries** –
   A. Following mooring recovery, once the buoy has been purged and is secure, the buoy hatch will be opened
      1) Remove connector P5 on the Power System Controller.
   B. The well should be allowed to vent in this configuration for at least 15 minutes (weather dependent), and then secured for transit.
2. **Venting of buoy well** –
   A. Remove vent valves from the tower assembly to enable venting of the well during transit.
   B. Hydrogen measurements should be made at Monitor port daily.

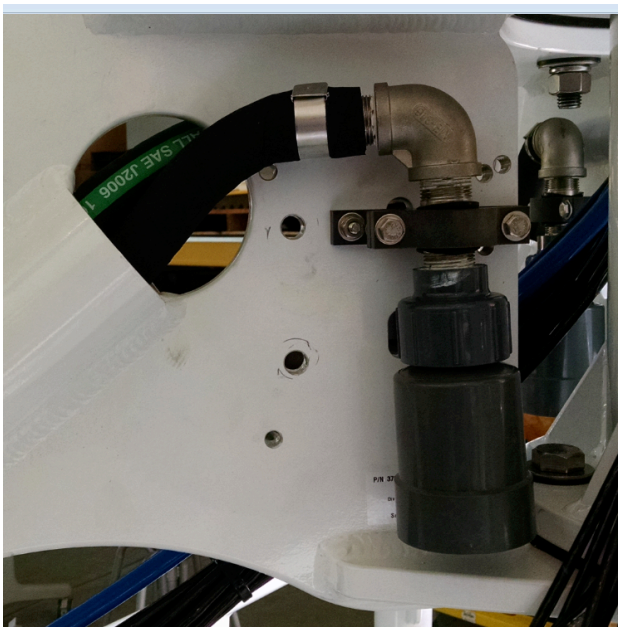

Figure 9: Vent Valve to be removed

7.0 Records

All measurement readings and procedures followed will be recorded in the mooring recovery log.

8.0 Attachments

None.