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Cruise Plan
Irminger Array 4 Deployment
R/V Neil Armstrong Cruise AR21
28 July – 30 August 2017

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Coastal and Global Scale Nodes
Ocean Observatories Initiative
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1.0 Introduction

1.1. Overview

This cruise is the fourth cruise to the Irminger Sea Global Node of the National Science Foundation's Ocean Observatories Initiative (OOI; http://www.oceanobservatories.org). The Irminger Sea Global Node includes an array of four moorings (Figure 1-1) and a combination of patrol and profiling gliders deployed off the southeast tip of Greenland, close to 39°W, 60°N (Figure 1-2). The location is one characterized by strong air-sea interaction and winter-time water mass formation. It is also a location at an important location of the large-scale global thermohaline circulation where freshening of the water column has been observed, and the data from the array will contribute to improved understanding of the impact of climate variability and change on the physics, chemistry, and biology of the ocean. The combination of the moored array and the gliders will enable investigation of the role of processes at mesoscale and sub-mesoscale horizontal length scales. At the same time, the moored array and gliders will sample the full water column, from the sea floor to the sea surface and the surface mooring will provide unique new observations of surface meteorology and air-sea fluxes.

This Irminger Sea Global Node deployment cruise (Irminger-4) has the following primary objectives: deployment of a new Surface Mooring (GI01SUMO), deployment of a new Profiler Mooring (GI02HYPM), deployment of two new Flanking Moorings (GI03FLMA, GI03FLMB), deployment of new Irminger Sea mobile assets (GI05MOAS) with the deployment of gliders tasked to patrol within and around the moored array, recovery of the Surface Mooring, Profiler Mooring, and Flanking Moorings set in July 2016, and CTD casts with water sampling at both for instrument calibration and to further characterize the region of the mooring sites.

The intent is to deploy the fourth set of moorings before recovering the previously deployed third set of moorings. This is done to obtain data sets invaluable to the process of intercalibrating the moored instrumentation. Because of this and because the intent is to have future mooring operations to be conducted in close proximity to moorings in the water, the site locations for both the first and second deployments were identified during the bathymetric survey on the first cruise in September 2014.

1.2. Operating Area

The cruise track is shown in Figure 1-3. The cruise is on R/V *Neil Armstrong* and identified as AR21. Note: The cruise track is advisory in nature, meaning it's simply for displaying the distances involved for planning and timing of cruise operations. The actual courses and waypoints will be determined by the ship's officers. Navigation within the array will be directed by the Chief Scientist. The cruise originates in Woods Hole, MA and steams to the Irminger Sea array site, works there, and then returns to Woods Hole, MA. Mooring site locations and water depths are provided in Appendix A.

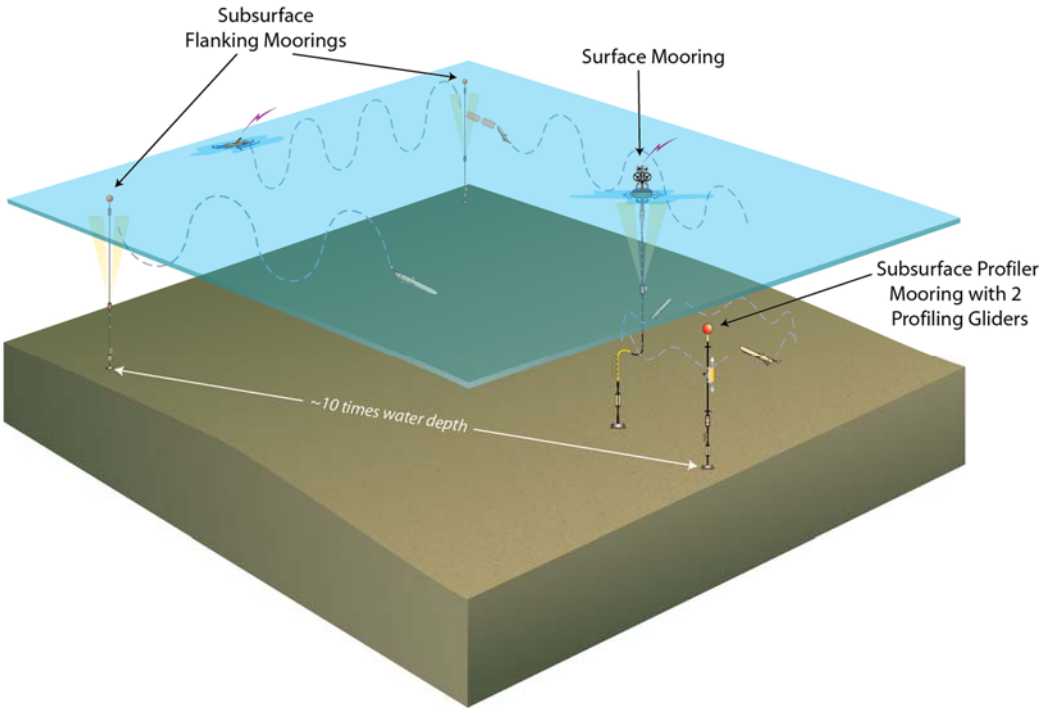

Figure 1-1 Schematic drawing of the Irminger Sea Global Node.

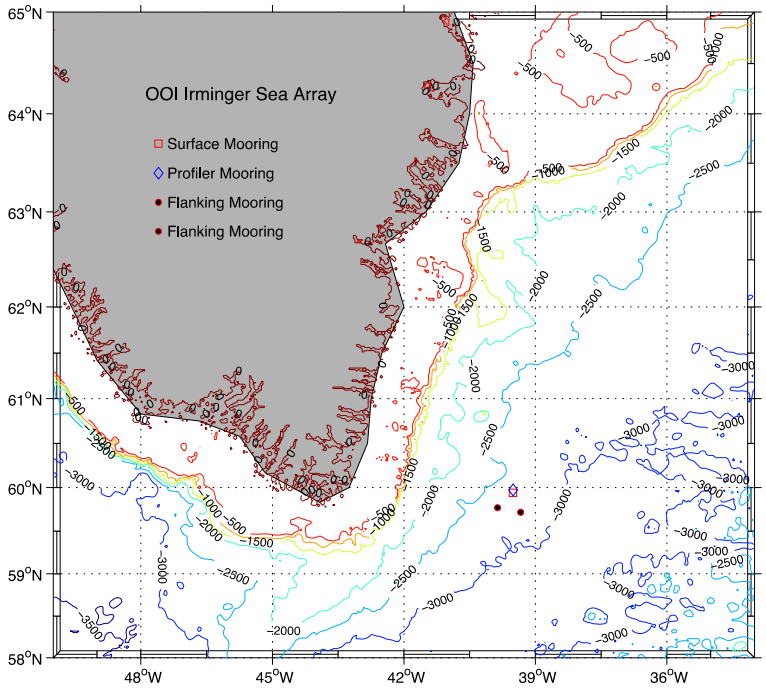

Figure 1-2 Irminger Sea Array mooring site locations.

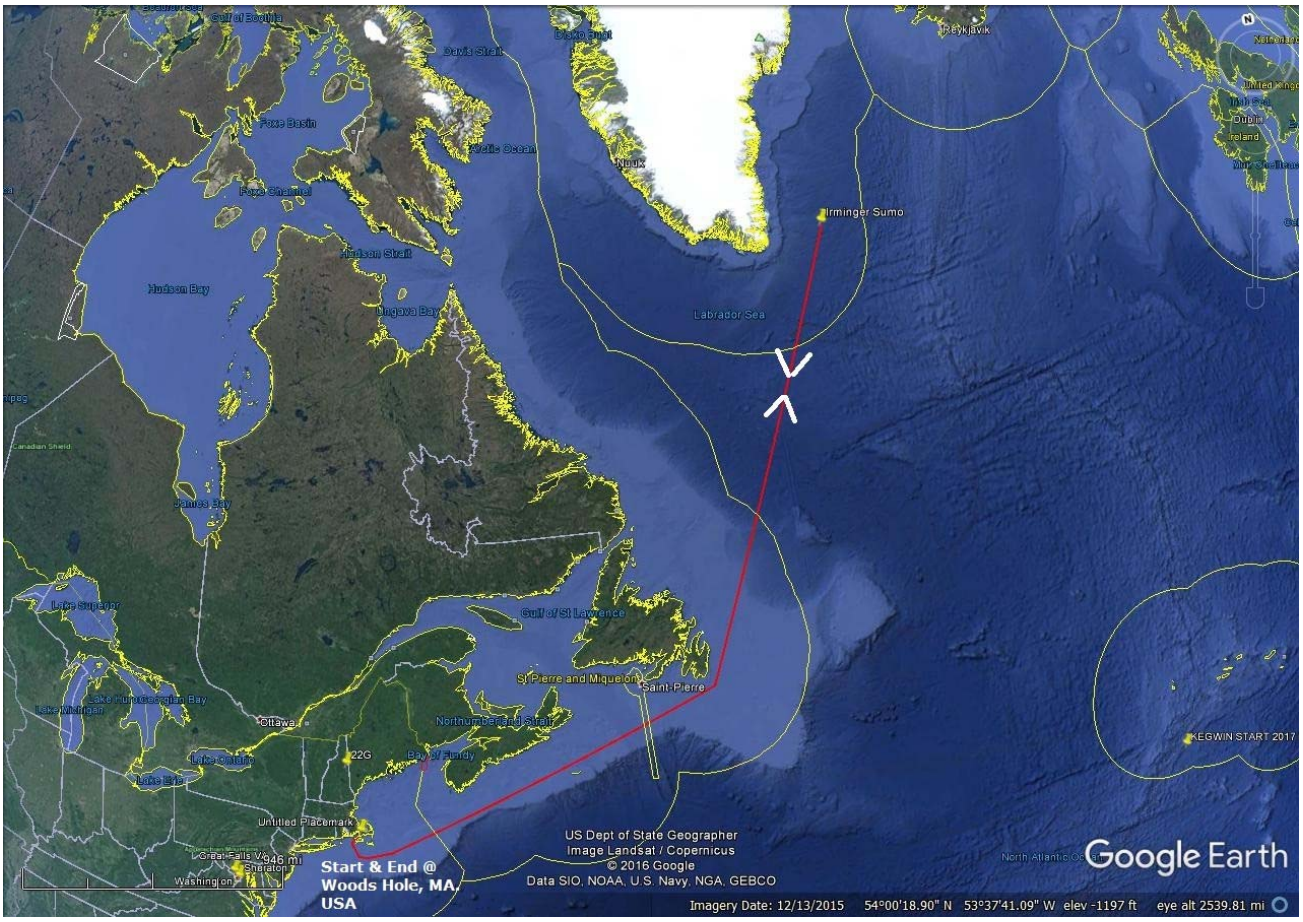

Figure 1-3 Cruise Track for AR21, starting in Woods Hole and returning to Woods Hole.

2.0 Cruise Plan

2.1. Background

The Irminger Sea Global Node will be deployed in August 2017 from R/V *Neil Armstrong* cruise No. AR21, sailing from Woods Hole on 28 July 2017 and returning to Woods Hole on 30 August 2017. Work will be done in Woods Hole prior to the cruise to prepare equipment. R/V *Neil Armstrong* will be in Woods Hole; loading for the Irminger Sea Global Node deployment cruise will occur on 25-27 July.

For this cruise, four moorings will be deployed, as well as two Open Ocean Gliders to sample lateral scales of variability in and around the moored array, plus one Global Profiling Glider operating in the vicinity of the Hybrid Profiler Mooring.

This year, the gliders will be launched before any moorings are recovered or deployed, for a couple of reasons. The first has to do with the possibility of mooring operations possibly interfering with the glider operations. The second is to get them in the water early in the cruise so their proper performance can be assessed prior to the mooring work. For these reasons, the gliders, after launch, will be restricted to a holding area, away from the mooring operations area until mooring operations are finished (Figure 2-1).

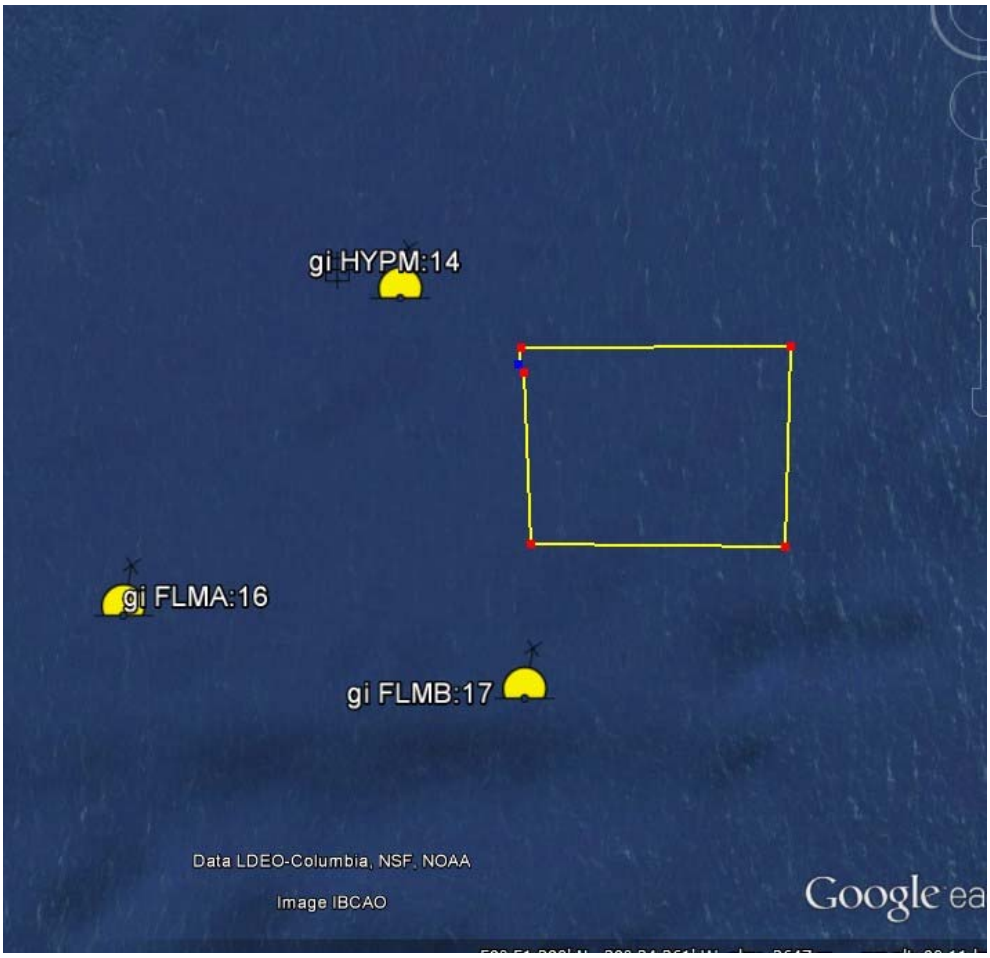

Figure 2-1 Location of Glider Box

The Irminger Sea Array of the OOI has been coordinated with other ongoing ocean research efforts. In December 2013, Bob Weller hosted a workshop in Boston focused on coordination of observing efforts in the Irminger Sea region. As a result of this, the locations of the OOI Irminger Sea Global Node moorings were discussed and finalized and the plan adopted to add additional deep single point velocity and CTD sensors to the two OOI Irminger flanking moorings. These sensors will be deployed again on this fourth cruise. The siting and the addition of these sensors enabled the OOI flanking moorings to sample consistently with and add to the observing effort of the Overturning in the Subpolar North Atlantic Program (OSNAP). Moorings from investigators at GEOMAR, Kiel, Germany and at the Royal Netherlands Institute for Sea Research (NIOZ) are located near the OOI Irminger Sea moored array.

2.2. Overall Cruise Strategy

Preliminary assembly and testing was done at the Woods Hole Oceanographic Institution (WHOI). Final assembly and testing was done prior to loading on the R/V *Neil Armstrong*.

Two to three days before arrival at the Irminger Array, a test cast of the CTD will be done in international waters somewhere between Newfoundland and Greenland, where the water depth is greater than 1500 meters. The cast will serve as an initial test of the CTD's proper operation and also provide the ability to strap our acoustic releases to the CTD/rosette for operational

testing down to 1500 meters. More than one test cast will be required in order to test all of the releases.

The plan for the cruise this year will be to get the gliders safely launched and positioned in the "Glider Box", as described above. Once the gliders are launched and their operation checked, we will proceed with launching all four of the replacement moorings. Given the experience of the last two cruises to this area and our increasing familiarity with the winds and currents to be expected, we are cautiously optimistic that we will, in fact, accomplish the goal of having all 8 moorings in the water simultaneously. This will provide a crucial overlap period allowing the old and new mooring sensors to be measuring the same variables. With all moorings in place, testing and evaluation of the moored instrumentation, of the gliders, and of the acoustic communications between the gliders and the moorings would follow.

2.3. Staging and De-Staging

2.3.1. At WHOI, preparation, and staging

Initial phases of assembly, testing, and staging were done at the Woods Hole Oceanographic Institution (WHOI). Final assembly and testing is planned to be done in Woods Hole prior to loading on the R/V *Neil Armstrong*.

Loading will be done in Woods Hole 25 – 28 July 2017. Arrangements have been made for forklifts and a crane as needed as well as for transport from staging locations to the ship's berth. As part of the staging operation, it will be necessary to mount several antennas and run cables from these antennas to the main lab. Antenna mount locations and cable runs will be determined by consultation with the ship. A deck plan showing the location of major deck components is provided in Appendix C.

2.3.2. At WHOI, cruise wrap up and de-staging

De-staging and offloading of scientific equipment will occur in Woods Hole. The two demob days are 31 August and 1 September.

2.4. Cruise Objectives

In 2014 we carried out a bathymetric survey of the planned sites for the four Irminger Sea array moorings, looking at both the sites for the first deployment and for the second deployment. These two sites would then, for each mooring, be used in alternate years. The survey goal was to find anchor target sites for all moorings with alternates that allow establishment of the planned geometry of the array (Figure 2-22, Figure 2-33, and Figure 2-44) On servicing cruises the new surface mooring will be deployed before the old one is recovered, so two sites had to be identified.

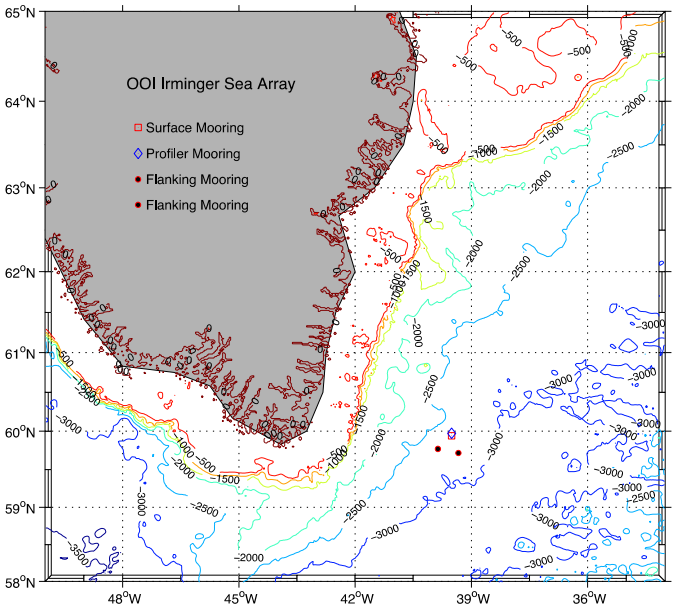

Figure 2-2 The location of the OOI Irminger Sea Array southeast of Greenland, in about 2,700 m of water. Bathymetry in all figures is Smith and Sandwell, in meters.

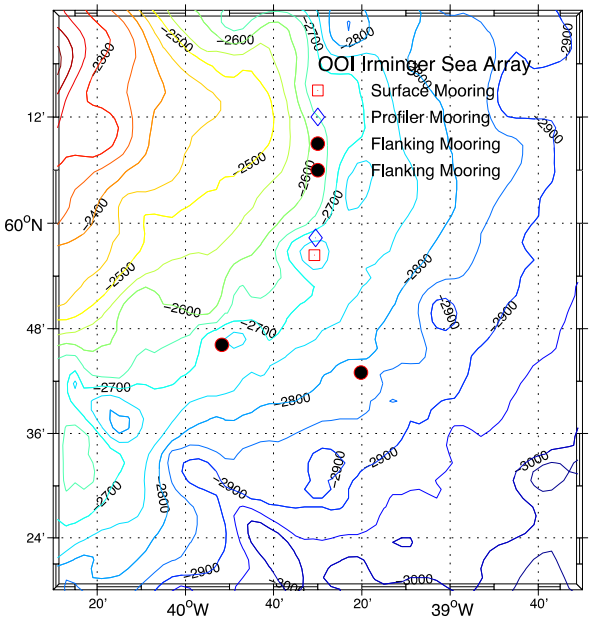

Figure 2-3 The OOI Irminger Sea Array as planned for deployment.

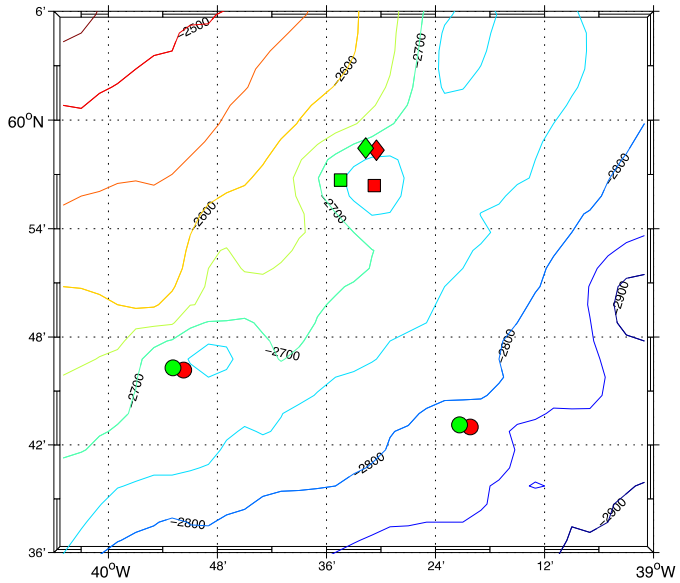

Figure 2-4 Blow up of OOI Irminger Sea Array.
Red symbols, defined as position "B" are the targeted initial and third deployment sites. Green, defined as position "A" are the targeted second and fourth deployment sites.

The primary objectives of the fourth Irminger Sea cruise are listed below. Nominal dates for these activities are given in the cruise timeline provided in Appendix A. Site locations are listed in Appendix B. As mentioned above, when the array is revisited, the new surface mooring ideally is deployed before the old is recovered due to deck space limitations and to allow overlapping data collection, so the strategy has been to define a set of alternate sites that are nearby (separated by safe working distance as defined by watch circles of the moorings) and preserve the array geometry. The mooring diagrams are shown in Appendix E – Mooring Drawings.

1) Deploy the Surface Mooring (GI01SUMO-00004)
2) Deploy the Hybrid Profiler Mooring (GI02HYPM-00004)
3) Deploy the Flanking Mooring A (GI03FLMA-00004)
4) Deploy the Flanking Mooring B (GI03FLMB-00004)
5) Recover the Flanking Mooring B (GI03FLMB-00003)
6) Recover the Flanking Mooring A (GI03FLMA-00003)
7) Recover the Hybrid Profiler Mooring (GI02HYPM-00003)
8) Recover the Surface Mooring (GI01SUMO-00003)
9) Deploy 2 Open Ocean Gliders to sample the field around the array and 1 Global Profiling Glider.
10) Conduct CTD casts with water sampling at the deployment/recovery sites
11) Carry out shipboard underway sampling in support of field calibration and validation of the platforms and sensors in the OOI Irminger Sea array.

There will be no ancillary activities during the Irminger 4 Deployment.

2.5. Cruise Plan

The R/V *Neil Armstrong* will depart from Woods Hole and transit to the Irminger Sea OOI Array region. A detailed timeline is provided in Appendix A – Cruise Timeline. To an extent, that timeline will need to be flexible and accommodate weather conditions that either make it difficult to do some of the work or present a window of opportunity to capitalize on favorable weather conditions by adjusting the order of the planned work. The most important objective is to get the new moorings launched and the old moorings recovered safely, so the weather will dictate when particular operations will occur.

For each new mooring, the following work is planned: 1) Assess currents, winds, and sea state and identify an initial point for the deployment of the top end of the mooring and a course to be followed toward; 2) Steam toward the anchor target site, paying out the mooring and attaching instruments; 3) Overshoot the anchor target by a fraction of the water depth to allow for fall back of the mooring and drop the anchor; 4) Allow mooring to settle and do 3 point acoustic survey to find coordinates of anchor; and 5) Carry out validation and verification of the function of the moored instrumentation. For all moorings, the acoustic releases will be lowered to 1,500 m, allowed to get cold (~30 minutes) and acoustic communication will verify their functionality prior to using them on the moorings. Set up for a deployment and staging of instrumentation will occur the day before deployment. The deployment will begin after breakfast and continue through the day.

For each mooring deployed in 2016 and recovered on this cruise, the following work is planned: 1) Assess functionality by telemetry and acoustic communication where possible, 2) Recover and document recovered condition, 3) Download data, and 4) Preliminary cleaning.

CTD profiling and water sampling: CTD profiles are needed to verify glider ballasting and provide data to validate moored instrumentations. Water samples will be collected and processed for moored and glider-borne instrument validation. A CTD will be done prior to glider deployment, in association with pre-deployment instrument calibration, and for validation of moored and glider-borne instrumentation.

Gliders: There are no gliders on site to be recovered. Two Open Ocean Gliders will be deployed to be used in the patrol mode around the array and also to acquire and retransmit data from the Flanking Moorings. One Global Profiling Glider will be deployed to profile in the vicinity of the Hybrid Profiler Mooring. As stated above, the gliders will be initially restricted to the "glider box." Glider deployment will be followed by functionality testing and testing of the acoustic data communications and relay. The shore pilot team will perform the majority of final checkouts via Iridium and will also provide the final green light indicating gliders are ready to be deployed. The time line for the glider deployments is as follows:

T_0: 0600 (or daylight): Gliders secured in carts on deck, clear sky view and green plug inserted (ON). Communication with shore-side pilots should be established through Jen Batryn and Steve Caldwell. Shore team will have two pilots available.

T_0+4 hours	Shore pilots complete pre-deployment checklist and signal ready for launch via satellite phone communication with deck ops lead. We should allow up to 4 hours to complete this task. The launches will be staggered and may take longer to complete.
T_0+4.5 hours	Once gliders are safely launched, the ship conducts a CTD in the general area, but positioned at least1 km away from glider location. The ship is not required to stay near the gliders during the subsequent dive testing phase.
T_0+16 hours	Each glider requires up to 12 hours to complete basic functional dive checks to their full rated depth of 1000 m. Each glider must first complete a dive to 500 m before attempting 1000 m. The gliders will remain in the "Glider Box" during their dive testing, subject to weather and currents. Gliders will complete ta set of progressively deeper test dives to 25,50,100, 250, 500, 750, and 1000 m.

Following the successful installation of the new Irminger-4 platforms, and with a green light from the R/V Armstrong, the gliders will be sent to the nearest mooring to begin acoustic testing and to begin patrol and profiling duties.

The Chief Scientist (CS) will execute the cruise according to the direction of the Program Manager (PM) in order to accomplish, to the extent practicable, programmatic and scientific objectives as described above. The ship's Master and the CS have the discretion to alter the order of operations as well as determine that some operations cannot be accomplished safely or effectively, based on conditions encountered at sea. The CS and PM have discussed tasks and responsibilities for the cruise, have reviewed likely at-sea failure modes and actions, have reviewed guiding principles for at-sea decision making, and have established communication pathways for both routine reporting (e.g. email) and emergency contact (e.g. satellite telephone).

The CS and PM will communicate frequently (typically daily by email) during the cruise to exchange status information and to assess the potential impact of at-sea decisions driven by weather or technical issues. Significant modifications to the cruise objectives (e.g. inability to deploy/recover a platform) will be communicated to the PM at the earliest opportunity. Changes to the cruise plan anticipated to have significant financial impacts (e.g. additional ship days) require approval from the PM prior to execution. Incidents involving injury or damaged/lost equipment will follow established Program protocols (UNOLS policies, OOI Incident Reporting Process). Anomalies, suspected failures, and confirmed failures will be handled according to the OOI Equipment Notification and Escalation Process.

2.6. Specific Cruise Operations

2.6.1. Release Tests

At a convenient time prior to deployment of the moorings, the science party will perform release tests. The release tests involve lowering multiple acoustic releases, to one or more depths between 1,500 m and the surface and held there while being interrogated acoustically. The science party will bring an acoustic transceiver than can be lowered over the rail with a cable run to the main lab and connected to a transceiver controller. Alternatively, the controller can be connected directly to a 12 kHz hull transducer on the R/V *Neil Armstrong*.

2.6.2. Mooring Operations

Mooring deployments and recoveries will be done in stages using the ship's crane and winches supplied by the science party. Science party personnel will be familiar with mooring deployment and recovery and will be capable of directing operations in cooperation with the ship's crew. Additional science personnel will assist with mooring operations, met watches, and other observation and data collection activities.

2.6.3. Glider Operations

Glider deployments (and recoveries if necessary) will be done using the ship's crane and handling equipment supplied by the science party. Science party personnel will be familiar with glider deployment and recovery and will be capable of directing operations in cooperation with the ship's crew during all phases of glider operations.

2.6.4. Anchor Surveys

Once the anchor has settled on the bottom, R/V *Neil Armstrong* will occupy three stations 0.3 to 1.5 nm from the anchor drop point in a triangular pattern. At each station, the slant range to the acoustic release will be determined. Ranging from three stations will allow the release position, and thus the mooring anchor position, to be determined by triangulation.

2.6.5. CTD casts

CTD casts will be conducted using the ship's 9-11 CTD sensors, 24 bottle rosette frame, and deck box. Sensors requested in addition to C,T,D are dissolved oxygen, chlorophyll fluorometer, transmissometer, and PAR. CTD operations will be supervised by shipboard SSSG technicians – the science party will supply line handlers and a lab operator. Water sampling and any on board analysis will be handled by the science party. Water samples and filtered samples will be preserved for analyses on shore.

2.6.6. Sensor Performance Evaluation

Sensor evaluation operations will be conducted at each mooring deployment site and glider deployment site. The primary means of evaluation of the three subsurface moorings will be CTD casts obtained at a position halfway between the old mooring and the newly-deployed mooring (approximately ½ mile from each of the moorings), as well as within similar proximity to the gliders. This assures the capability of data validation of the old vs. new moorings with one CTD cast. For validation of meteorological and sea surface variables measured by the surface moorings, the ship will establish and hold a position, with the bow into the wind, approximately 0.25 nm downwind of a surface buoy. This station will be held, and adjusted if necessary, while the science party evaluates data received from the buoy. A CTD cast will also be done during this time. During this period, the ship's underway data will be continuously recorded and the science party may make periodic observations with hand-held meteorological sensors. At a convenient time during the cruise, the ship may make a close approach to buoys to allow visual inspection, determination of the water line, and photographs.

2.6.7. Shipboard Underway Data

The ship's meteorological system will be used to continuously monitor weather conditions while underway and for evaluation of buoy meteorology during the intercomparison period. The ship's ADCP systems will be used to continuously measure the currents in the upper ocean while. Sea surface temperature and salinity will be recorded continuously, using the ship's thermosalinograph.

2.6.8. Small Boat Operations

The use of a work boat may be requested, at the discretion of the ship, for glider recovery or attending to unforeseen problems that would require physical access to a buoy tower. Expected duration of use is approximately 0.5 to 1.5 hr. Work boat operations would be within 0.5-1.0 nm of the ship.

2.7. Potential Restrictions

Small boat activities may be restricted by weather. In the case of a recovery operation, the ship will maneuver to the item to be retrieved and grappling lines and/or pick up poles will be used. Mooring activities may be restricted by severe weather or equipment failure. Severe weather would result in postponement until conditions eased. Failure of a given piece of Project equipment (e.g. winch, air tugger) can typically be compensated by use of an alternative approach. Failure of ship's equipment (e.g. electrical or hydraulic system) would result in postponement of operations until the failure was addressed. Deployment and recovery activities may be restricted by the presence of multiple fixed objects (e.g. fishing gear) in the deployment area or along the deployment/recovery track. If possible, operations will be delayed until conditions are more favorable (e.g. change in prevailing wind direction allowing deployment approach along a different, unobstructed course).

3.0 Appendixes

Appendix A – Cruise Timeline

Appendix B – Selected Waypoints and Maps

Appendix C – Deck Plan

Appendix D – Science Party

Appendix E – Mooring Drawings

Appendix A – Cruise Timeline

Cruise Plan

Note: - the cruise transits have been planned at 10 knots.
-This tentative schedule could vary due to weather and logistics
-Some overnight work will consist of having the ship drift over the HYPM mooring to compare the EK-80 with the ZPLSG instrument on the mooring.

Day -3 to -1	Jul 25-27	In Woods Hole, loading WHOI gear on board *R/V Neil Armstrong*
Day 1	Jul 28	Finish loading & depart Woods Hole @ 0830
Day 2 – 4	Jul 29-31	Transit towards Irminger Array position
Day 5	Aug 1(estimate)	Test CTD station in at least 1500 meters water depth, release tests
Day 6 – 9	Aug 2-5	Transit to Irminger Array “Glider Box”
Day 10	Aug 6	0800 Arrive “Glider Box”/Deploy Gliders/CTD
Day 11	Aug 7	Deploy GI01SUMO-00004 mooring, validate/verify/CTD halfway between old and new moorings, anchor survey
Day 12	Aug 8	Deploy GI02HYPM-00004 mooring, validate/verify/CTD halfway between old and new moorings, anchor survey/ Night ops- try to find mooring with EK-80. Also, drift over the HYPM mooring to compare the EK-80 with the ZPLSG instrument on the mooring.
Day 13	Aug 9	Deploy GI03FLMB-00004 mooring, validate/verify/CTD halfway between old and new moorings, anchor survey/Night ops-try to find mooring with EK-80
Day 14	Aug 10	Deploy GI03FLMA-00004 mooring, validate/verify/CTD halfway between old and new moorings, anchor survey/ Night ops-try to find mooring with EK-80
Day 15	Aug 11	Assess functionality of acoustic releases on the four old moorings
Day 16	Aug 12	Data downloads from the old profiler mooring, FLMA/B moorings
Day 17	Aug 13	Data downloads from new profiler mooring, FLMA/B moorings
Day 18	Aug 14	Data downloads from new profiler mooring, FLMA/B moorings
Day 19	Aug 15	Heave to ¼ mile downwind of old surface mooring for 24 hours for ship/buoy data comparisons
Day 20	Aug 16	Heave to ¼ mile downwind of new surface mooring for 24 hours for ship/buoy data comparisons

Day 21	Aug 17	Try to find old FLMA, FLMB, and HYPM moorings on EK-80
Day 22	Aug 18	Recover GI03FLMB-00003 mooring
Day 23	Aug 19	Recover GI03FLMA-00003 mooring
Day 24	Aug 20	Recover GI02HYPM-00003 mooring
Day 25	Aug 21	Recover GI01SUMO-00003 mooring
Day 26	Aug 22	Complete any final tasks in area
Day 27	Aug 23	Head for Woods Hole
Day 28 – 33	Aug 24-29	Transit
Day 34	Aug 30	Arrive in Woods Hole
Day 35-36	Aug 31-Sep 1	Demob

Appendix B – Selected Waypoints, Locations, and Transit Distances

From the deployment cruise in 2016 at Deployment Target B:

OOI Irminger Mooring Locations – Anchor Positions from Acoustic Survey July 2016

Mooring	Deployment Date/Time (UTC)	Latitude	Longitude	Depth (m)
GI01SUMO (Surface Mooring)	7/10/2016 17:44	59° 56.114' N (59.9341° N)	39° 27.914' W (39.4652° W)	2691
GI02HYPM (Profiler Mooring)	7/11/2016 14:29	59° 58.167' N (59.9695° N)	39° 29.314' W (39.4886° W)	2673
GI03FLMA (Flanking Mooring A)	7/12/2016 15:59	59° 46.063' N (59.7767° N)	39° 50.474' W (39.8412° W)	2696
GI03FLMB (Flanking Mooring B)	7/13/2016 15:49	59° 42.929' N (59.7155°N)	39° 19.549' W (39.3275° W)	2830

Note: 1488 m s^{-1} used for mean sound speed.

Port of origin: Woods Hole, MA, USA (41.5236° N, 70.6721° W)
(41° 31.4153' N, 70° 40.3268' W)

Center OOI Irminger Array: (59.82°N, 39.58°W) (59° 49.2' N, 39° 34.8' W)

Irminger Surface Mooring Deployment Target A: (59.9449° N, 39.5742° W)
(59° 56.694'N, 39° 34.452'W)

Irminger Surface Mooring Deployment Target B: (59.9344° N, 39.4685° W)
(59° 56.064'N, 39° 28.110'W)

Irminger Profiler Mooring Deployment Target A: (59.9743° N, 39.5280° W)
(59° 58.458'N, 39° 31.680'W)

Irminger Profiler Mooring Deployment Target B: (59.9704° N, 39.4888° W)
(59° 58.224'N, 39° 29.328'W)

Irminger Flanking Mooring A Deployment Target A: (59.7714° N, 39.8816° W)
(59° 46.284'N, 39° 52.896'W)

Irminger Flanking Mooring A Deployment Target B: (59.7674° N, 39.8426° W)
(59° 46.044'N, 39° 50.556'W)

Irminger Flanking Mooring B Deployment Target A: (59.7186° N, 39.3557° W)
(59° 43.116'N, 39° 21.342'W)

Irminger Flanking Mooring B Deployment Target B: (59.7147° N, 39.3168° W)
(59° 42.882'N, 39° 19.008W)

Nominal waypoints used to calculate distance to and from Irminger Array (Note: these are not directive, simply convenient positions to calculate rough distances)

1. Woods Hole 41° 31.4153' N, 70° 39.79' W
2. Southeast of Cape Cod 41° 30'N, 69° 30' W
3. Southeast of Newfoundland 45° 00' N, 50° 00' W
4. Irminger Array center: 59° 49.2' N, 39° 34.8' W

Transit distances:

Woods Hole to WP 2	52 nm	sum
WP2 to WP3	875 nm	927 nm
WP3 to Array :	965 nm	1,892 nm
Array to Woods Hole	1,892 nm	3784 nm

Distances in and around array:

Array perimeter: 60 nm

Array sides: Surface to Flanking A – 14.0 nm
Surface to Flanking B – 14.0 nm
Flanking A to Flanking B – 16.3 nm

Glider Box (Roughly square box 8-10 nmi on a side)

Upper left corner	59 55.60' N, 39 18.0' W
Lower right corner	59 47.50' N, 38 56.50' W

Appendix C – Equipment Inventory and Deck Plan

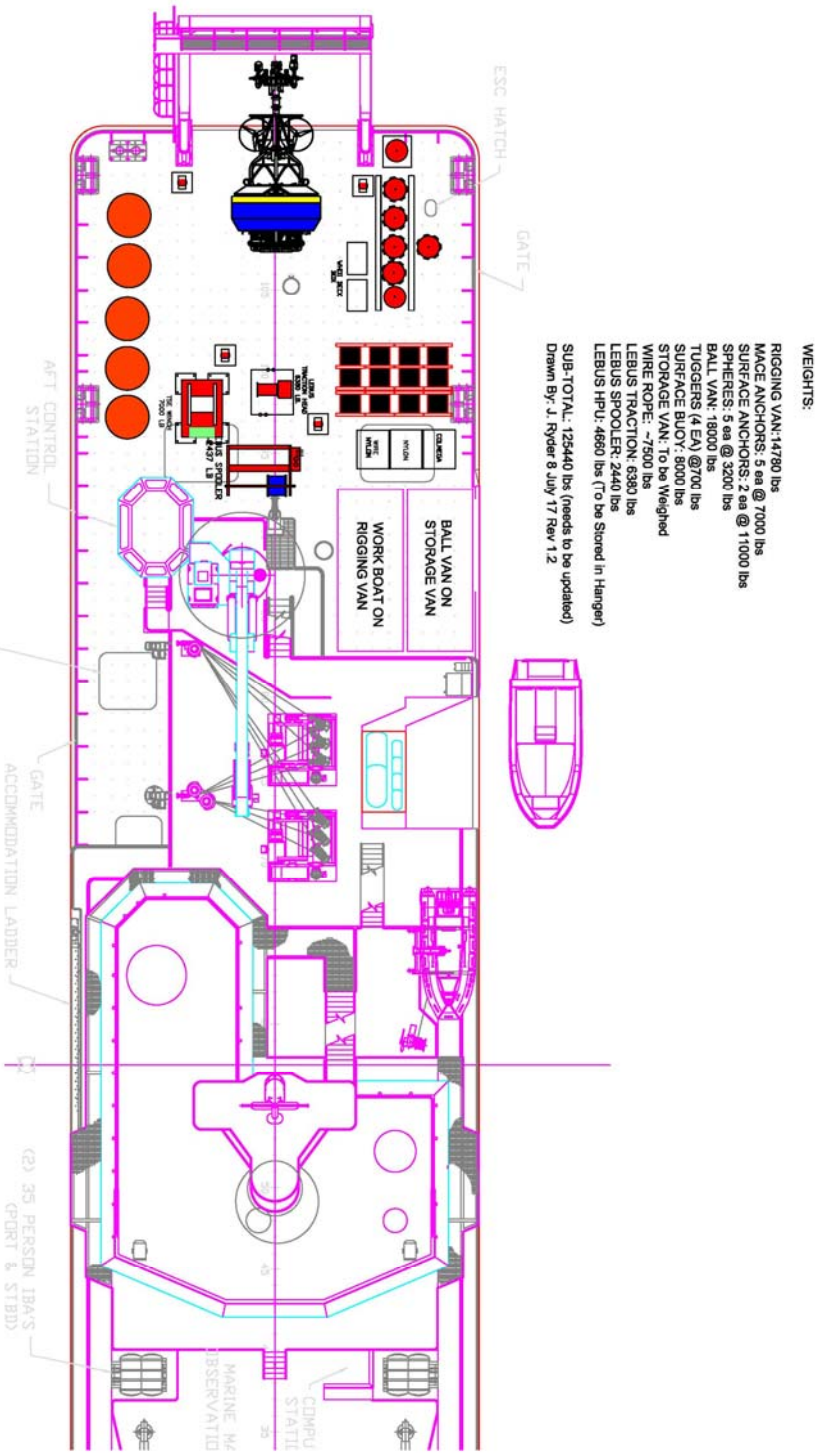

Figure 3-1 Deck layout for the major components associated with Irminger-4 operations. Proposed locations of major deck elements are shown. Estimates weights of major deck components are also documented in a table.

Appendix E – Mooring Drawings

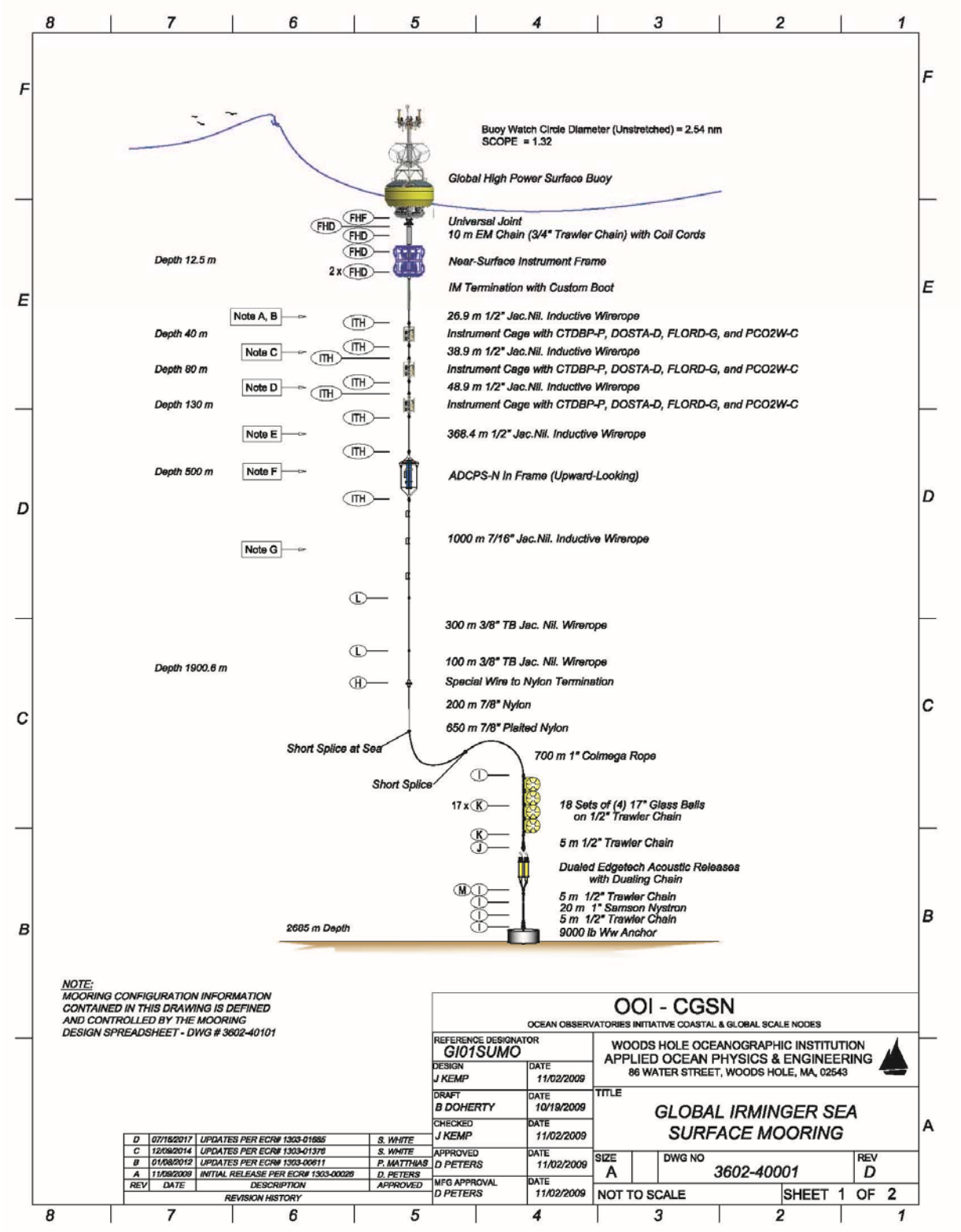

Figure 3-2 Irminger Sea Surface Mooring (GI01SUMO)

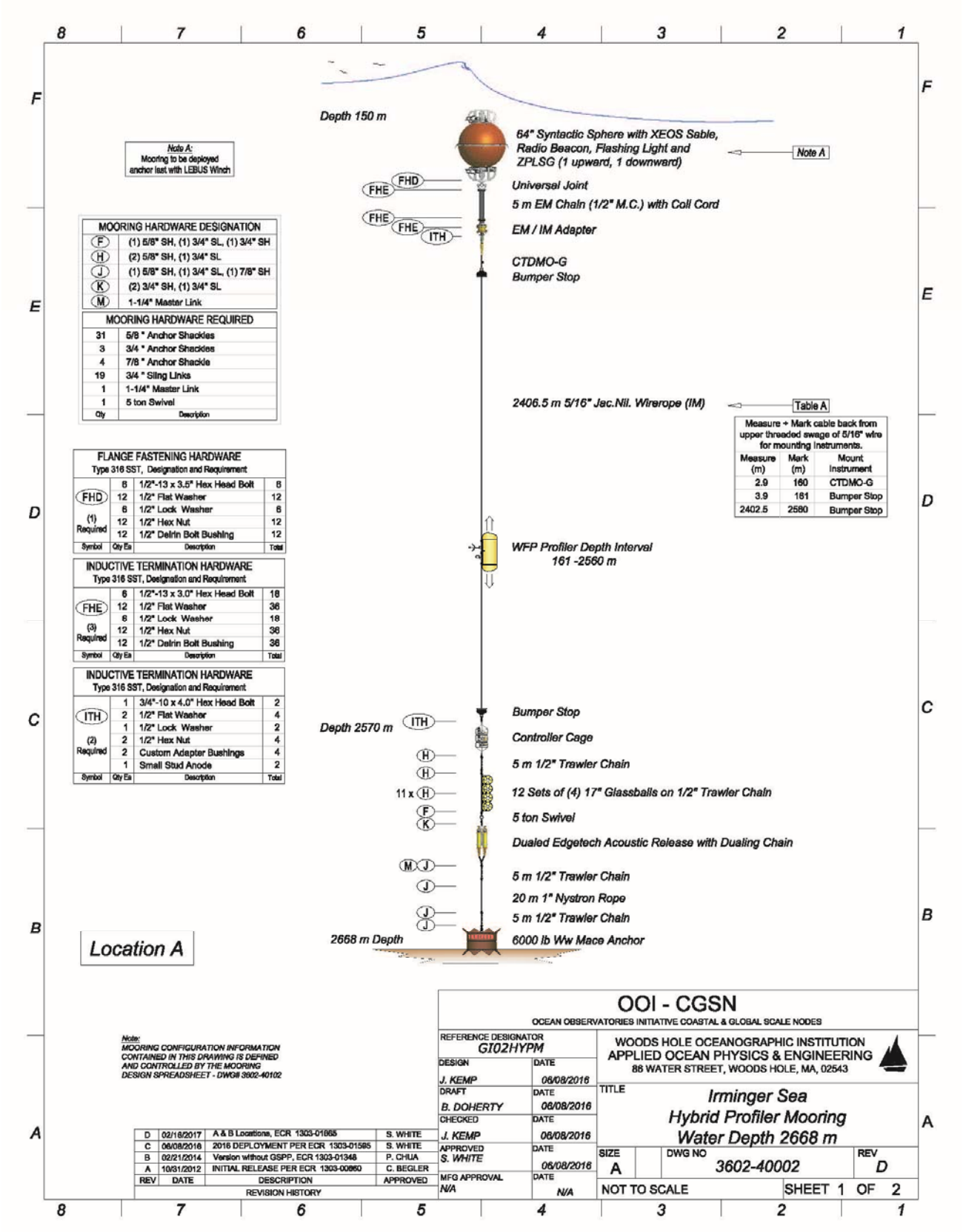

Figure 3-3 Irminger Sea Profiler Mooring (GI02HYPM) – Target Water Depth 2668 m

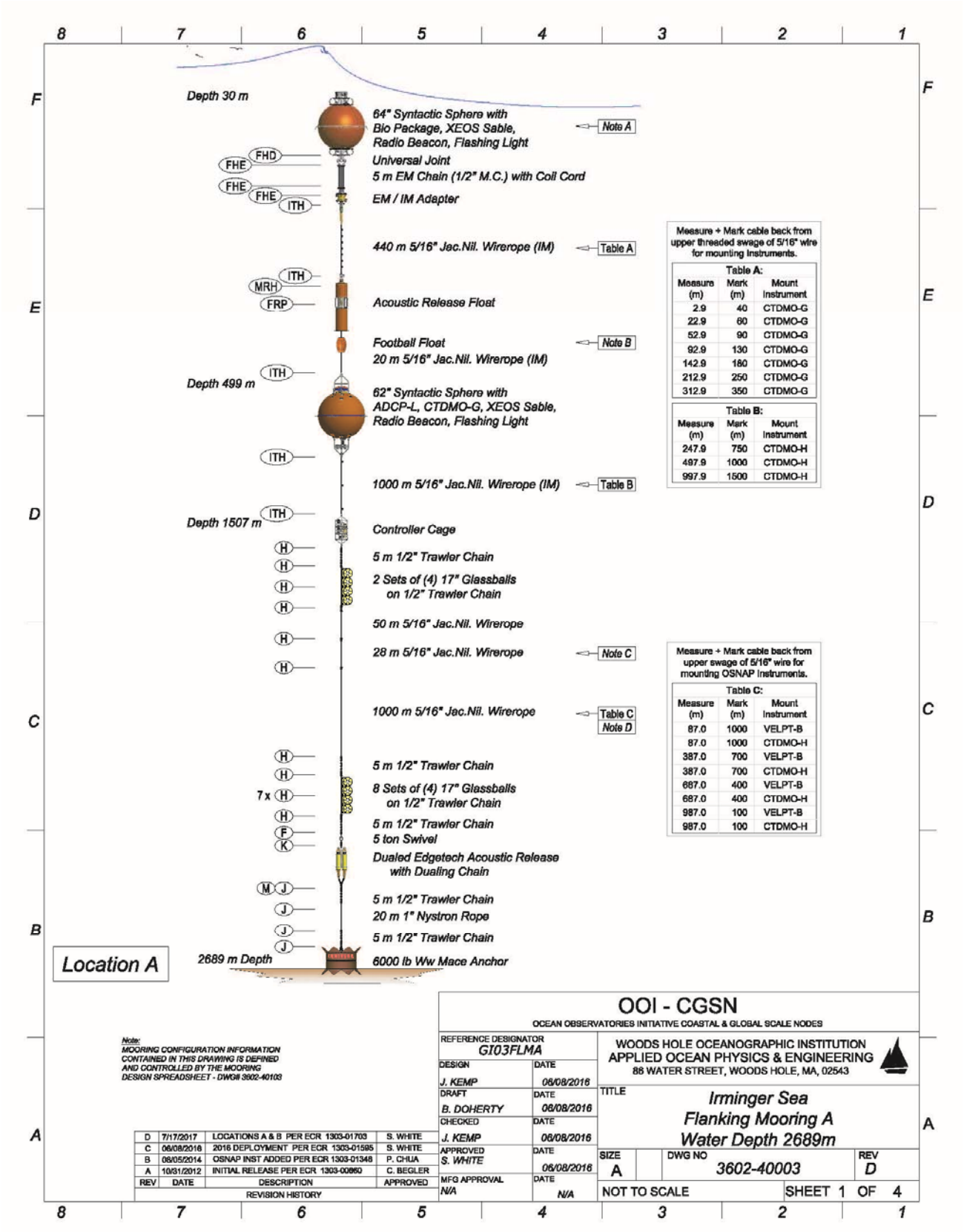

Figure 3-4 Irminger Sea Flanking Mooring A (GI03FLMA) – Target Water Depth 2689 m

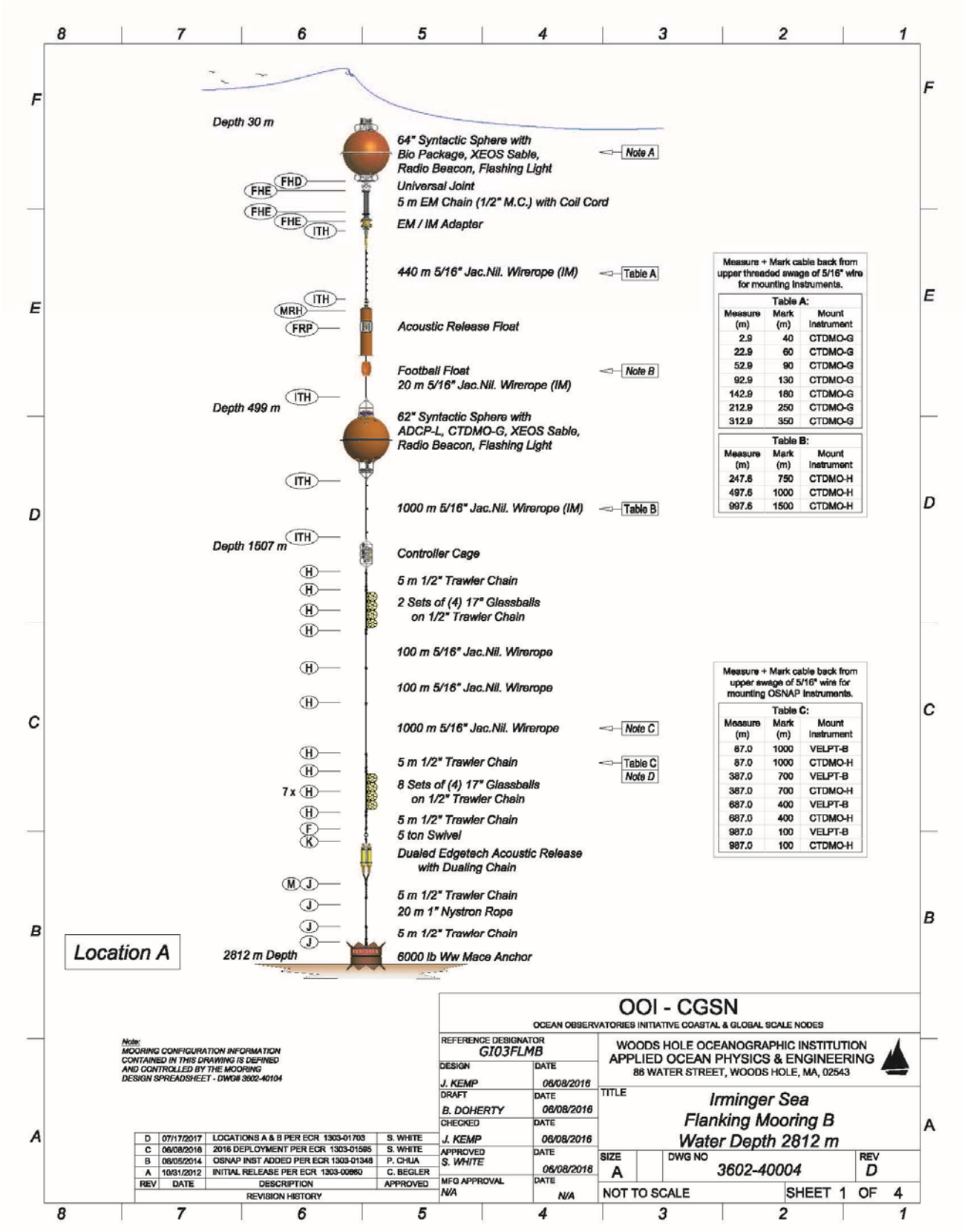

Figure 3-5 Irminger Sea Flanking Mooring B (GI03FLMB) – Target Water Depth 2812 m