Cruise Plan
Irminger Array Third Deployment
R/V *Neil Armstrong* Cruise AR 07-01
30 June-28 July 2016

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Coastal and Global Scale Nodes
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0-01	Draft	G. Tupper	
0-02	Formatting updates and edits	S. White	
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1.0 Introduction

1.1. Overview

This cruise is the third 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-3) 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 September 2015, 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 a fresh set of moorings before recovering this second set in order to obtain overlapping 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. There are two ancillary activities planned during this cruise. The first ancillary task will be the redeploy the CP02PMCI-00006 Mooring at the Pioneer Array. The second task will be to deploy Sound Source Mooring #13 for the NSF funded OSNAP project at 56.6° North Latitude and 41.0° West Longitude. Both of these ancillary tasks shall not interfere with the schedule and operations of the Irminger 3 cruise.

1.2. Operating Area

The cruise track is shown in Figure 1-3. The cruise is on RV *Neil Armstrong* and identified as AR 07-01. 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 steams to Reykjavik, Iceland. Mooring site locations and water depths are provided in Appendix A.

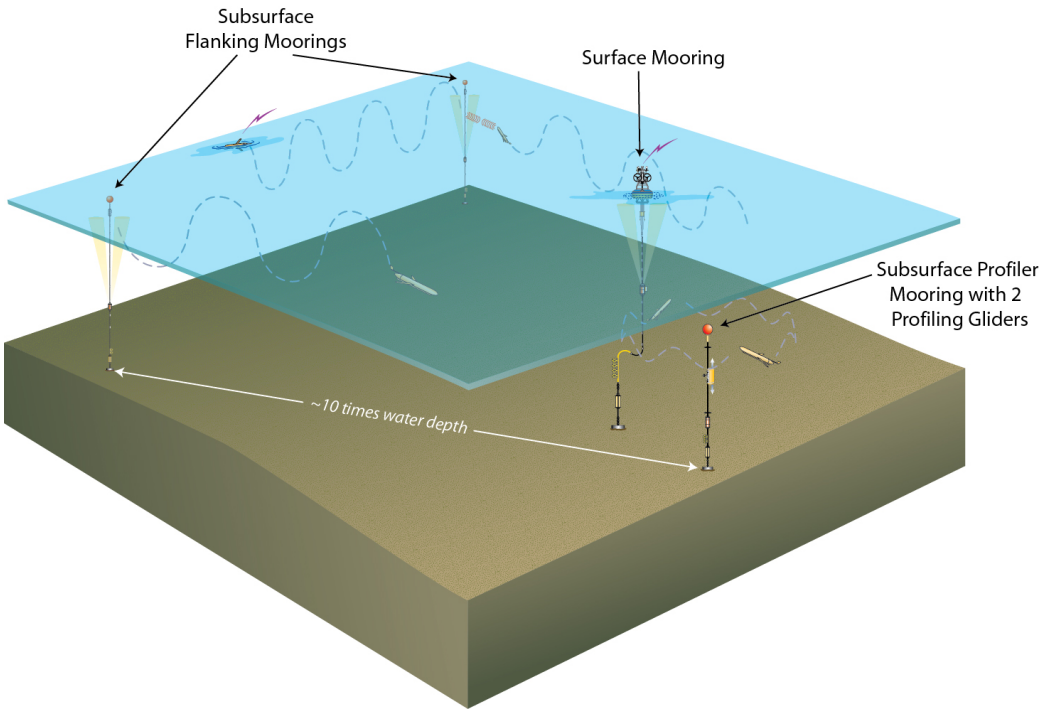

Figure 1-1 Schematic drawing of the Irminger Sea Global Node.

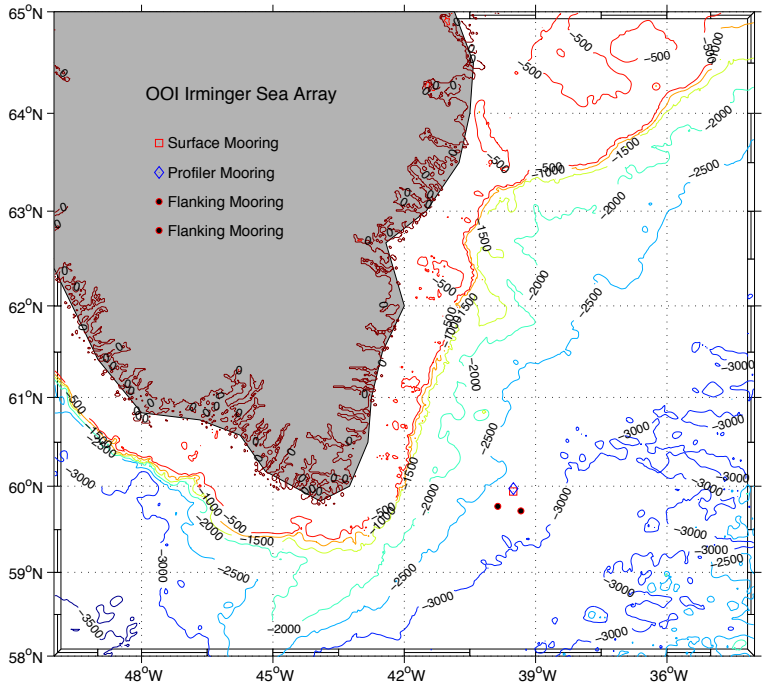

Figure 1-2 Irminger Sea Array mooring site locations.

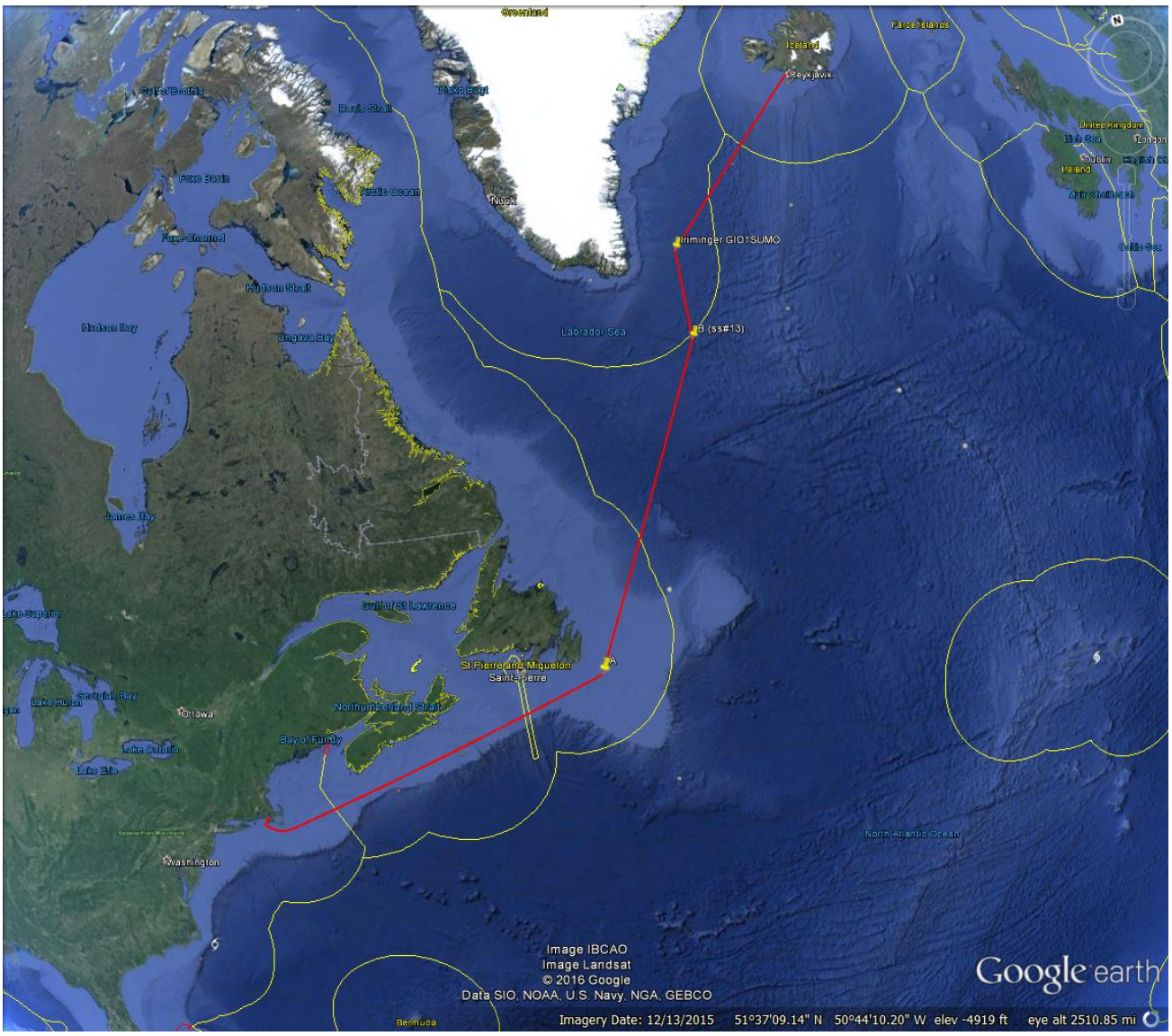

Figure 1-3 Cruise Track for A-07, starting in Woods Hole, ending in Reykjavik, Iceland.

2.0 Cruise Plan

2.1. Background

The Irminger Sea Global Node will be deployed in July, 2016 from R/V *Neil Armstrong* cruise No. AR 07-01, sailing from Woods Hole on June 30, 2016 and going in to Reykjavik, Iceland on July 28, 2016. 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 June 27-29.

For this cruise, four moorings will be deployed, as well as the two Open Ocean Gliders from the original array design to sample lateral scales of variability in and around the moored array, plus two Global Profiling Gliders 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).

An additional mooring will be launched on the way to the Irminger site. (Figure 1-3, Waypoint "B.") Amy Bower has asked that we deploy a much-needed sound source (Source No. 13) at 56.6 degrees N. and 41.00 degrees W. in an attempt to "save" the international OSNAP float program by adding more sound sources to the array. In Amy's words, "Very recent results indicate that acoustic ranges are even less than our original conservative estimates."

In a very recent development, the CP02PMCI Mooring, part of the Coastal Pioneer Array, will be deployed on the way out of Woods Hole at an approximate position of 40° 13.593' N., 70° 53.338' W.

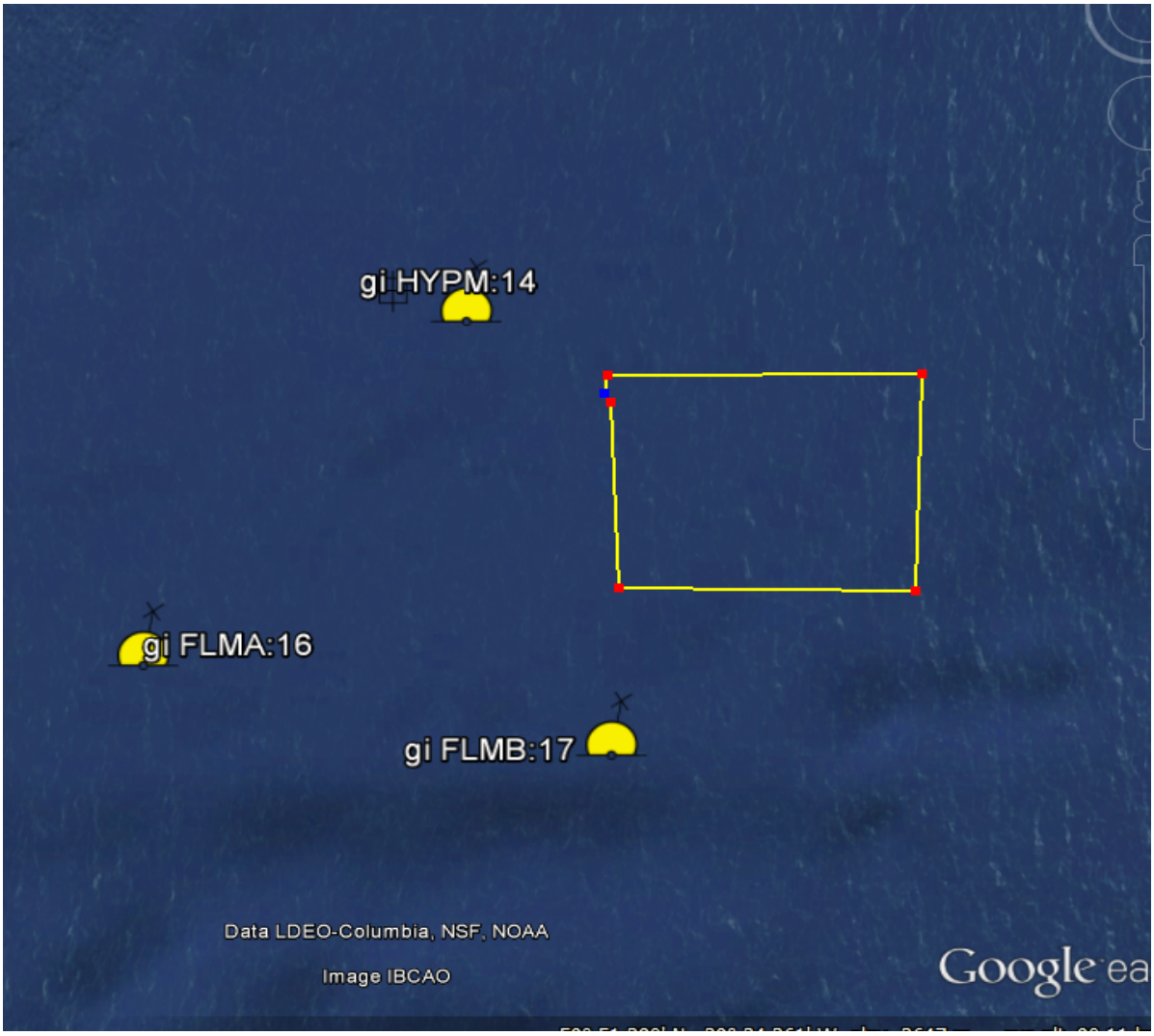

Figure 2-1 Location of Glider Box

The Irminger Sea Array of the OOI has been coordinated with other ongoing ocean research efforts. In December 2013, 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 third 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*.

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. In advance of mooring deployments, testing of acoustic releases and calibration of moored instrumentation by deployment on the CTD rosette would be carried out. An additional need for an early CTD cast is to provide data to verify the ballasting of the gliders prior to deployment.

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 June 27-29, 2016. 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. In Reykjavik cruise wrap up and de-staging

De-staging and offloading of scientific equipment will occur in Reykjavik at the end of the cruise as needed to make space for the subsequent cruise (OSNAP, Reykjavik to St. John's, Canada). Whatever is unloaded will be loaded into shipping containers for shipment back to Woods Hole. The project will make arrangements for a shore-side crane if needed for offloading in Woods Hole.

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 2-2, Figure 2-3, and Figure 2-4) On servicing cruises the new surface mooring will be deployed before the old one is recovered, so two sites had to be identified.

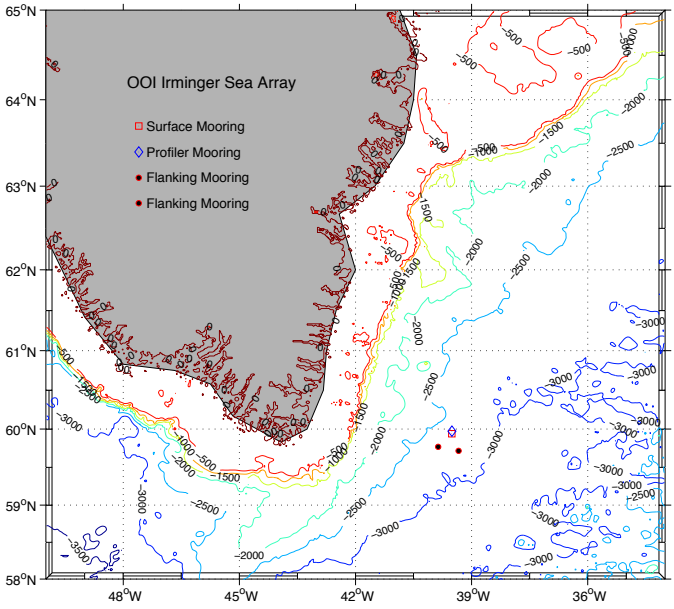

Figure 2-2 The location of the OOI Irminger Sea array southeast of Greenland, in about 2,700 m of water. Bathymetry in all figures is Smith and Sandwell, in meters.

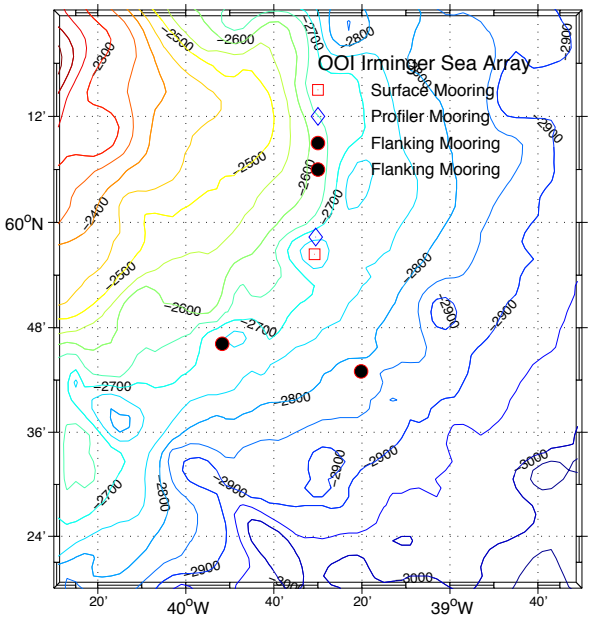

Figure 2-3 The OOI Irminger Sea Array as planned for deployment.

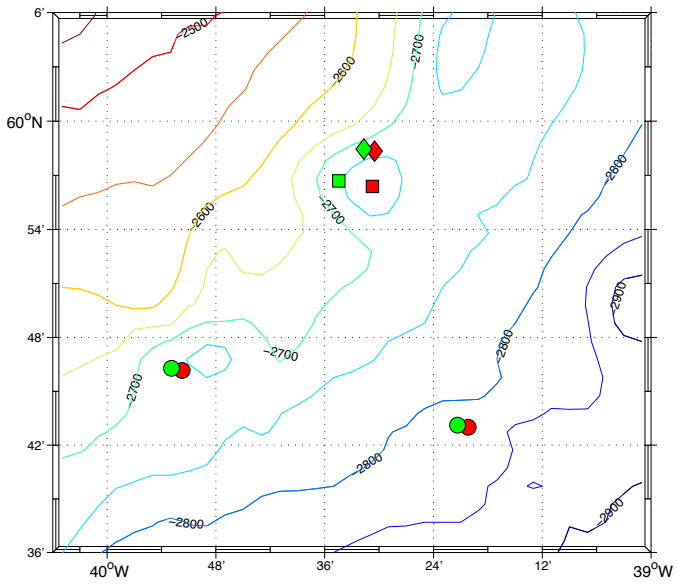

Figure 2-4 Blow up of OOI Irminger Sea Array.
Red symbols, defined as position "B" are the targeted initial and third deployment sites. Green, defined as position "A", are the targeted second deployment sites.

The primary objectives of the third 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.

1) Deploy four fresh OOI Irminger Sea Array moorings. 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 Surface Mooring diagram is shown in **Appendix E – Mooring Drawings**, as is the Profiler Mooring is shown. The diagrams for the two identical Flanking Moorings are also given in **Appendix E – Mooring Drawings**.
2) Recover the four moorings deployed in September 2015.
3) Deploy 2 Open Ocean Gliders to sample the field around the array, and 2 Global Profiling Glider.
4) Carry out shipboard sampling, including collection of water samples, in support of field calibration and validation of the platforms and sensors in the OOI Irminger Sea array.

The ancillary objectives of the Irminger 3 Deployment 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.

1) Deploy the CP02PMCI-000006 mooring in the Pioneer Array.
2) Deploy the OSNAP Sound Source Mooring #13.

2.5. Cruise Plan

The R/V *Neil Armstrong* will depart from Woods Hole and transit to the Irminger Sea OOI Array region, stopping first at the Pioneer site to deploy the CP02PMCI-00006 mooring, then at waypoint "B" to launch the Sound Source #13 mooring. 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.

For each new mooring, the following work is planned: 1) Verify the bottom depth and target region to identify as the anchor drop site; 2) 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; 3) Steam toward the anchor target site, paying out the mooring and attaching instruments; 4) Overshoot the anchor target by a fraction of the water depth to allow for fall back of the mooring and drop the anchor; 5) Allow mooring to settle and do 3 point acoustic survey to find coordinates of anchor; and 6) Carry out validation and verification of the function of the moored instrumentation. For the profiler and flanking moorings, prior to deployment, instrumentation will be deployed on the CTD rosette for final pre-deployment calibration. 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. Deployment will begin after breakfast and continue through the day.

For each mooring deployed in 2015 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. Two Global Profiling Gliders 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 Dan Bogorff. 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+10 hours	Each glider requires 3-6 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. We will attempt to keep the gliders on station, subject to weather and currents.

	Example dive time deltas:	50 and 100 m dives - 30 – 60 min
		500 m hold position– 2.5 hours
		1000 m hold position - requires up to 5 hours
T_0+12+ hours	CTD Cross-calibration dives with three gliders must be coordinated between ship and shore. Gliders will hold position or drift at a suitable distance from the vessel until CTD operations can commence. We will attempt concurrent dives.	

Post launch we will swim gliders to the nearest mooring and begin to test the acoustic comms.

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 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) or changes to the cruise plan anticipated to have significant financial impacts (e.g. additional ship days) will be communicated to the PM at the earliest opportunity. 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 with at each mooring deployment site and glider deployment site. The primary means of evaluation will be CTD casts obtained in near proximity (e.g. 0.25 nm) to the mooring or glider. For validation of meteorological and sea surface variables the ship will establish and hold a position, with bow into the wind, approximately 0.10 nm downwind of a buoy. This station will be held, and adjusted if necessary, while the science party evaluates data received from the buoy. During this period, the ships 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. Shipboard Multi-beam Bathymetry

Bathymetric surveys will be conducted at the Irminger Array mooring sites (**Appendix B – Selected Waypoints, Locations, and Transit Distances**) as needed to verify new deployment sites and strategies. Nominal waypoints for each survey will be provided to the bridge. Cruising speed, leg length, and leg spacing can be adjusted as needed to ensure adequate data overlap and good system performance. The results of the bathymetry survey will be displayed and interpreted immediately after the survey in order to confirm the suitability of the deployment site.

2.6.9. 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).

Appendices

Appendix A – Cruise Timeline

Appendix B – Selected Waypoints and Maps

Appendix C – Equipment Inventory and 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.

Day -3 to -1	Jun 27-29	In Woods Hole, loading WHOI gear on board *R/V Neil Armstrong*
Day 1	Jun 30	Depart Woods Hole 0800L, transit 90 miles south to site of Pioneer Mooring CP02PMCI (Approx. 40 N., 70.5 W.) 9 hours. Anticipate mooring finished by midnight.
Day 2	Jul 1	Transit to Sound Source 13 Position (Waypoint "B." 56.6° N., 41.0° W.)
Day 3	Jul 2	Transiting to S.S. 13
Day 4	Jul 3	Stop at 0900L, 6 hours, test releases, test CTD and rosette; watch weather; deepest cast is 1,500 m depth permitting
Day 5	Jul 4	Transiting to S.S. 13
Day 6	Jul 5	Transiting to S.S. 13, turn on underway sampling when in international waters; finish CTD and release tests if needed
Day 7	Jul 6	Transiting to S.S. 13
Day 8	Jul 7	Transiting to S.S. 13, arrive late, rig for mooring deployment Deploy S.S. 13
Day 9	Jul 8	Transiting to Irminger Sea Array Glider Box position
Day 10	Jul 9	Deploy gliders, validate and verify function, CTD
Day 11	Jul 10	Continue monitoring glider performance
Day 12	Jul 11	Deploy surface mooring, validate/verify/CTD Anchor survey
Day 13	Jul 12	Deploy profiler mooring, validate/verify/CTD Anchor survey
Day 14	Jul 13	Monitor surface mooring and profiler mooring operations
Day 15	Jul 14	Monitor surface mooring and profiler mooring operations
Day 16	Jul 15	Check on gliders
Day 17	Jul 16	Sit between two surface moorings, collect ship meteorology
Day 18	Jul 17	Ship versus surface buoys comparisons
Day 19	Jul 18	Ship versus surface buoys comparisons

Day 20	Jul 19	Check on gliders
Day 21	Jul 20	Deploy Flanking Mooring A validate/verify/CTD Anchor survey
Day 22	Jul 21	Deploy Flanking Mooring B validate/verify/CTD Anchor survey
Day 23	Jul 22	Go to Flanking Moorings, check function, get intercomparison data
Day 24	Jul 23	Recover Flanking Moorings A and B
Day 25	Jul 24	Recover Profiler mooring
Day 26	Jul 25	Recover Surface mooring
Day 27	Jul 26	Transit to Reykjavik, packing for unload, clean labs/rooms
Day 28	Jul 27	Transit to Reykjavik
Day 29	Jul 28	Arrive Reykjavik
Day 30	July 29	Unload and demob
Day 31	July 30	Continue unload and demob, load shipping containers.
Day 32	July 31	Finish demob, shipping

Appendix B – Selected Waypoints, Locations, and Transit Distances

From the deployment cruise in 2015 at Deployment Target A:

OOI Irminger Mooring Locations – Anchor Positions from Acoustic Survey August 2015

Mooring	Deployment Date/Time (UTC)	Latitude	Longitude	Depth (m)
GI01SUMO (Surface Mooring)	8/15/2015 19:22	59° 56.615' N (59.9436° N)	39° 34.423' W (39.5737° W)	2657
GI02HYPM (Profiler Mooring)	8/16/2015 22:59	59° 58.365' N (59.9728° N)	39° 31.490' W (39.5248° W)	2668
GI03FLMA (Flanking Mooring A)	8/18/2015 23:47	59° 46.240' N (59.7707° N)	39° 52.806' W (39.8801° W)	2689
GI03FLMB (Flanking Mooring B)	8/21/2015 17:11	59° 43.094' N (59.7182°N)	39° 21.217' W (39.3536° W)	2812

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)

Port for end of cruise: Reykjavik, Iceland (64.13° N, 21.82° W)
(64° 7.8'N, 21° 49.2' W)

Way points:

Woods Hole	41° 31.4153' N, 70° 39.79' W
Nominal Pioneer CP02PMCI	40° 13.593' N, 70° 53.338' W
WPA, nominal waypoint:	46° N, 52° W
WPB Sound Source 13	56° 36' N, 41° W
WP4, enter Greenland waters:	56° 26' 55.6" N, 42° 57' 00.8"
Irminger Array center:	59° 49.2' N, 39° 34.8' W
Reykjavik, Iceland	64° 09.438' N, 21° 55.987' W

Transit distances:

Woods Hole to Pioneer	90 nm	sum
Pioneer to WP A	885 nm	975 nm
WPA to S.S. 13:	756 nm	1,731 nm
S.S. 13 to Array:	190 nm	1,921 nm
Irminger Array to Reykjavik:	561 nm	2,482 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

Appendix C – Equipment Inventory and Deck Plan

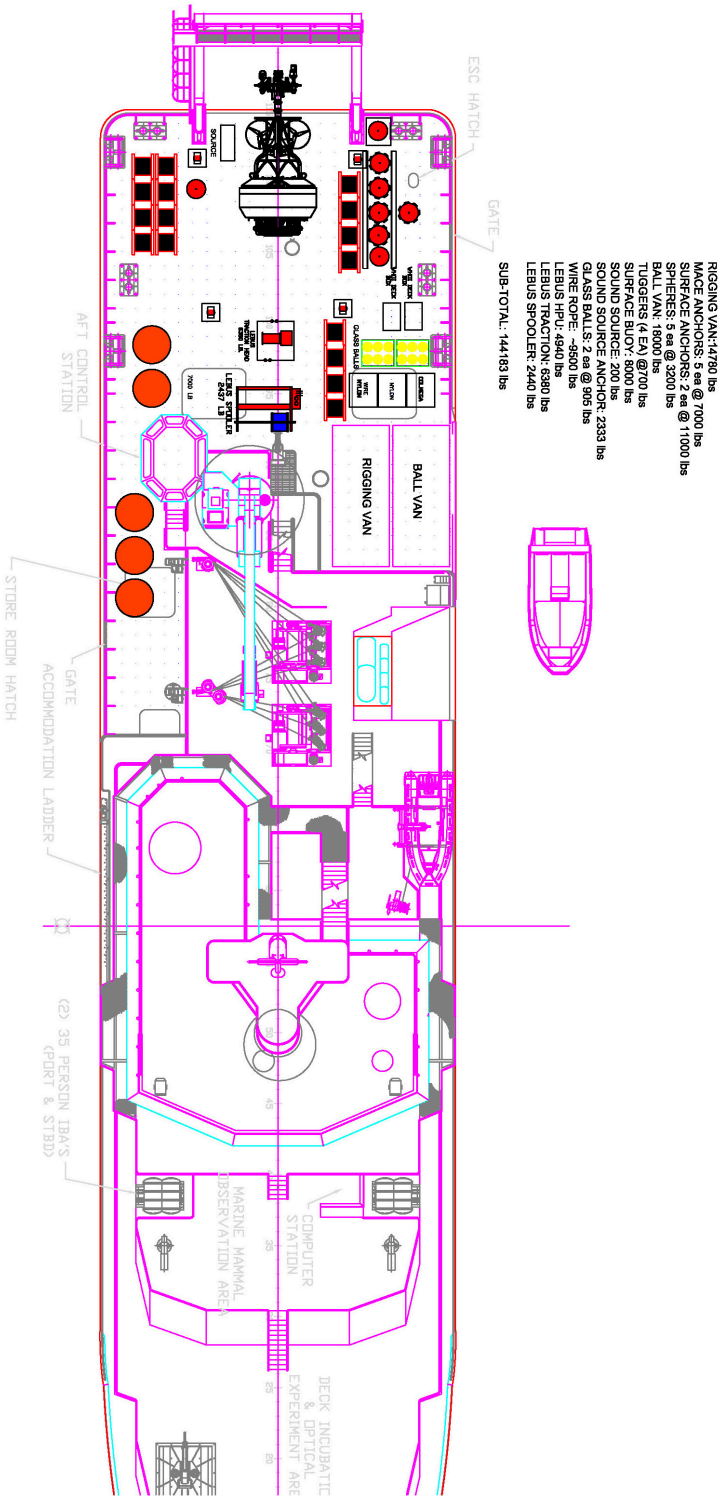

Figure C-1 Deck layout for the major components associated with Irminger-3 operations. Proposed locations of major deck elements are shown. Estimates weights of major deck components are also documented in a table.

Appendix D – Science Party

There will be 12 participants in the science party and two WHOI Shipboard Scientific Services (SSSG) technicians.

Scientific Party

Name	Employer	email	Responsibility
George Tupper	WHOI	gtupper@whoi.edu	Chief Scientist
John Kemp	WHOI	jkemp@whoi.edu	Ops and deck lead
Sheri White	WHOI	swhite@whoi.edu	Documentation Lead, Instruments Lead
Greg Yonkoske	WHOI	greg_yonkoske@raytheon.com	Surface Mooring
Leah Houghton	WHOI	lhoughton@whoi.edu	Documentation Assist
Dave Wellwood	WHOI	dwellwood@whoi.edu	CTD/water sampling
James Kuo	WHOI	jkuo@whoi.edu	Subsurface Lead
Jennifer Batryn	WHOI	jbatryn@whoi.edu	Gliders, Instruments
Brad Guerrero	WHOI	Bc_guerrrero@raytheon.com	Subsurface Assist
Chris Basque	WHOI	cbasque@whoi.edu	Deck Ops Team
Mike Williams	WHOI	mwilliams@whoi.edu	Deck Ops Team
Emma Theriault	Guest Investigator	theriaultemma@gmail.com	Documentation Assist

Roles and responsibilities:

Overall conduct of the science party and cruise: Tupper, Chief Scientist

Overall logistics and deck operations lead: Kemp

Safety (MSDS) and Shipping Document Coordination: Kemp

WHOI Surface Mooring: Yonkoske

WHOI Subsurface Moorings: Kuo

WHOI Instrumentation: White, Batryn

WHOI Gliders: Batryn

CTD/Water Sampling: Wellwood

Bathymetry: Tupper, White

Mooring team (winch, deck): Kemp, Basque, Williams

Anchor survey: Kemp, Tupper, White

Cruise Documentation: White, Tupper, Theriault, Houghton

Appendix E – Mooring Drawings

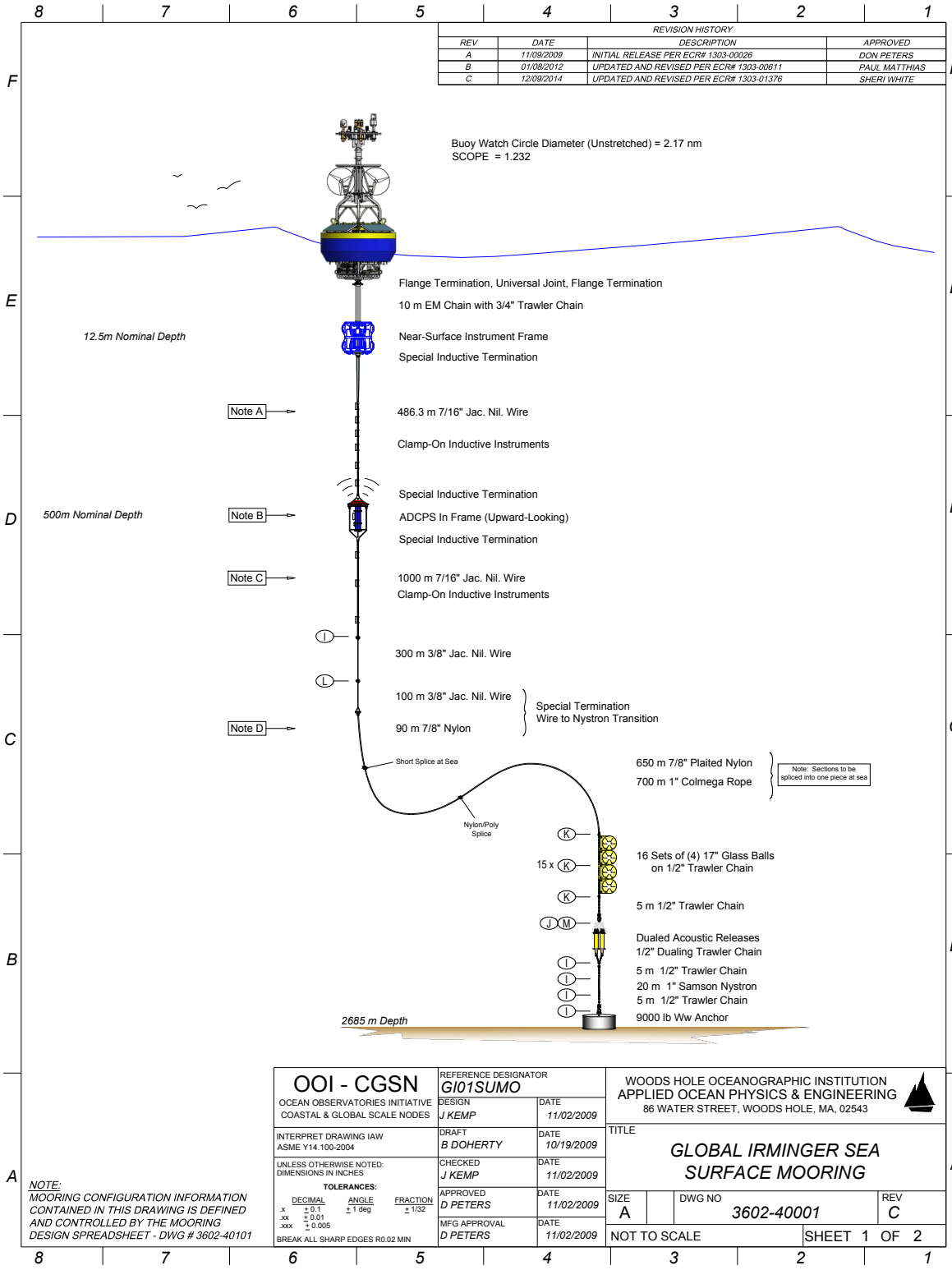

Figure E-1 Irminger Sea Surface Mooring (GI01SUMO)

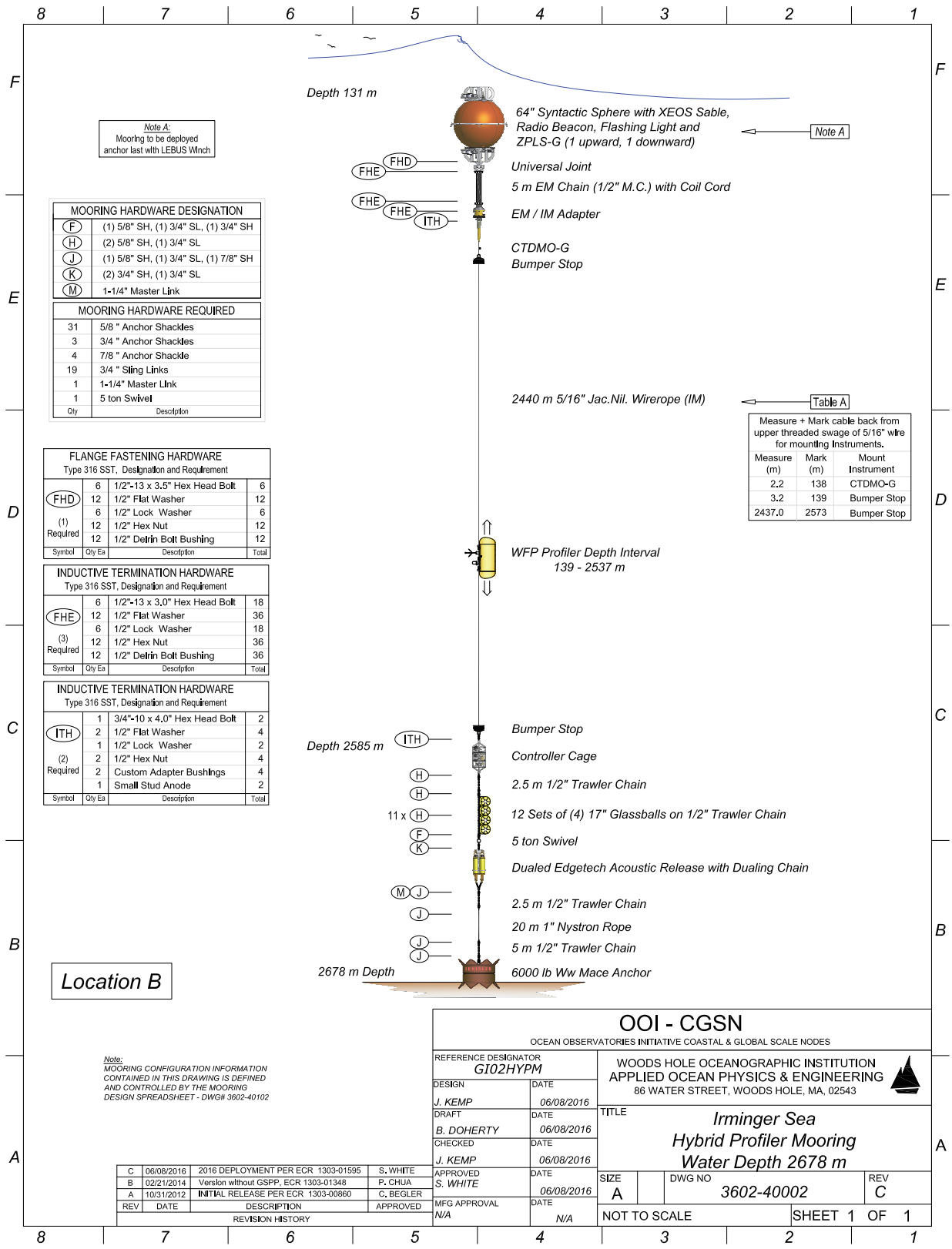

Figure E-2 Irminger Sea Profiler Mooring (GI02HYPM)

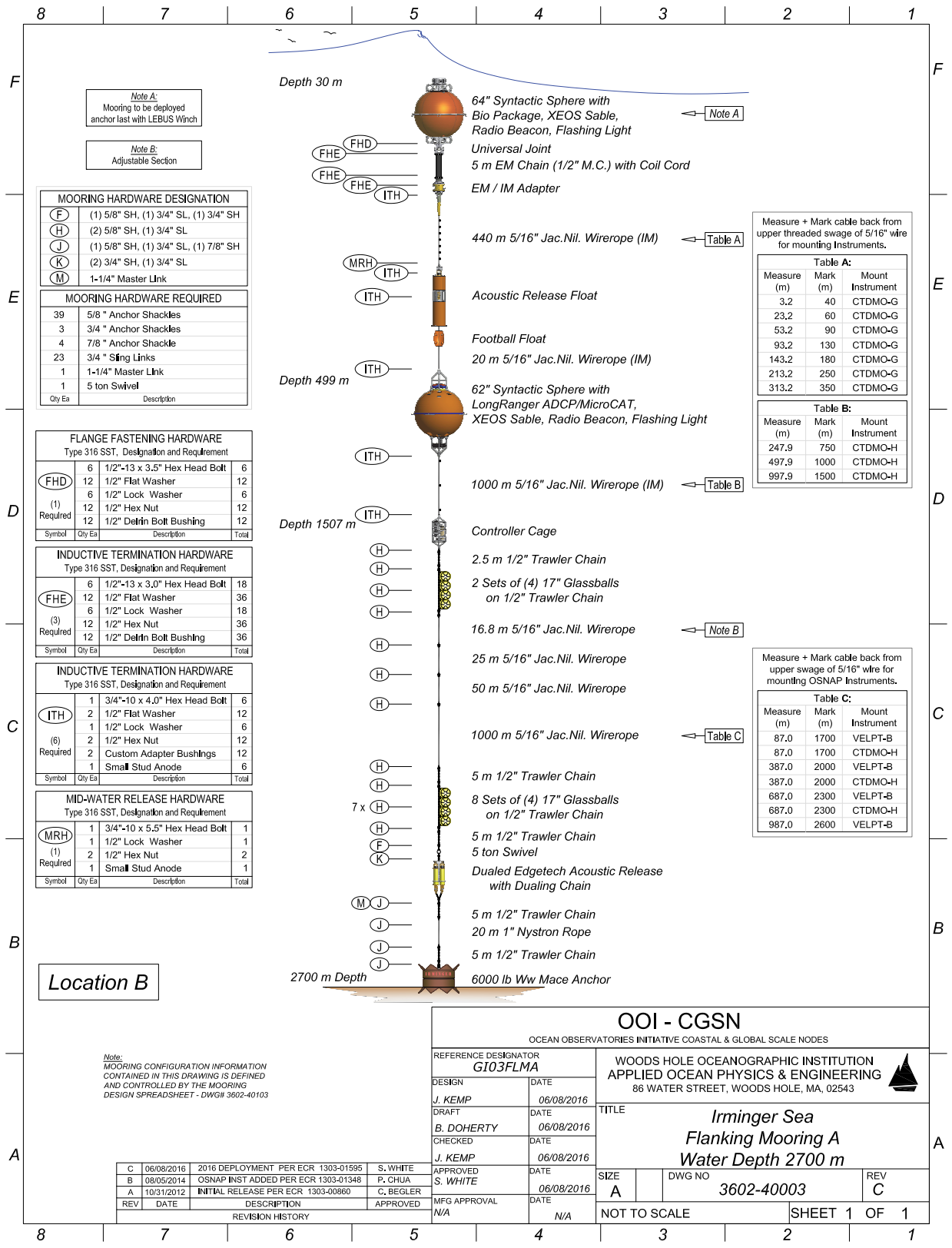

Figure E-3 Irminger Sea Flanking Mooring A (GI03FLMA)

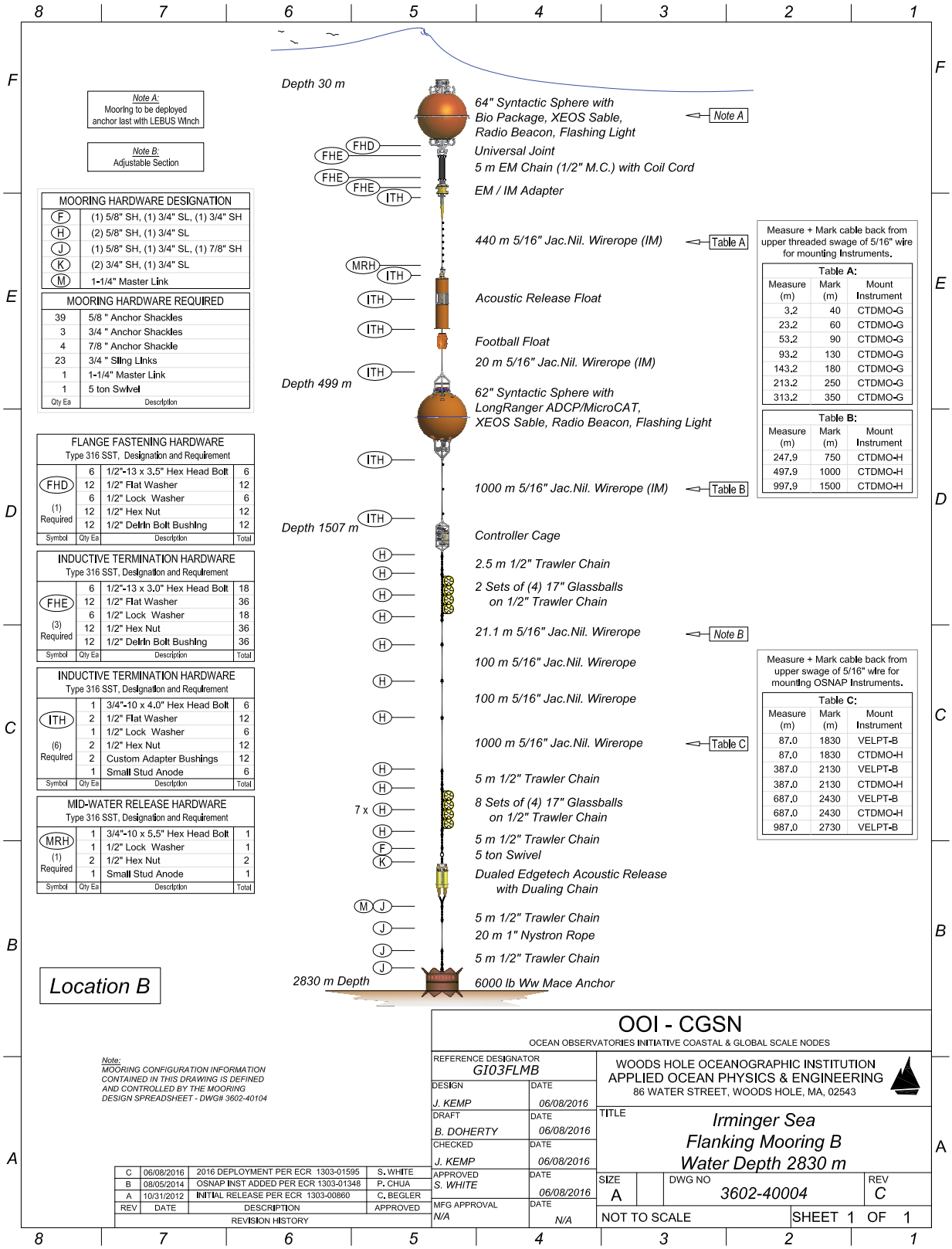

Figure E-4 Irminger Sea Flanking Mooring B (GI03FLMB)