

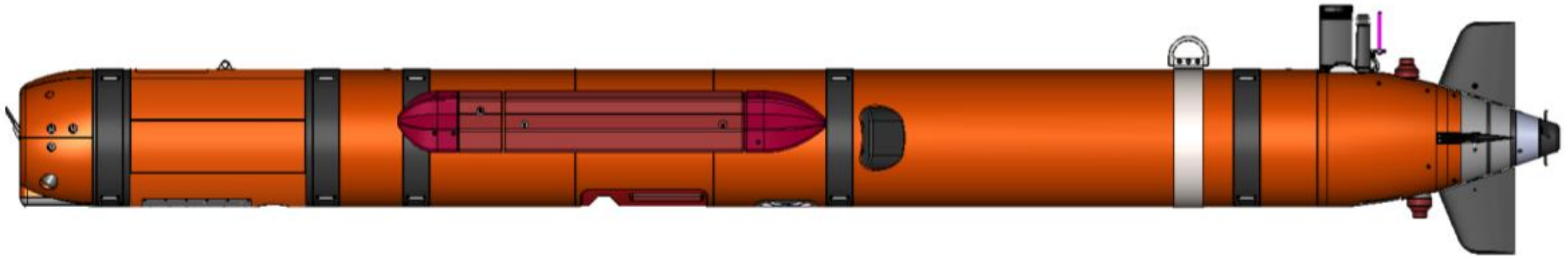
# IMR New Autonomous Underwater Vehicle



n+



# Munin+ Kongsberg Maritime



## Technical data

Length: 5.4 meter

Weight: 870 kg

Depth rating: 1500 meter

Survey speed: 3-4 knots

Battery capacity: 19.8 kWh, >24 hrs @ 3 knop

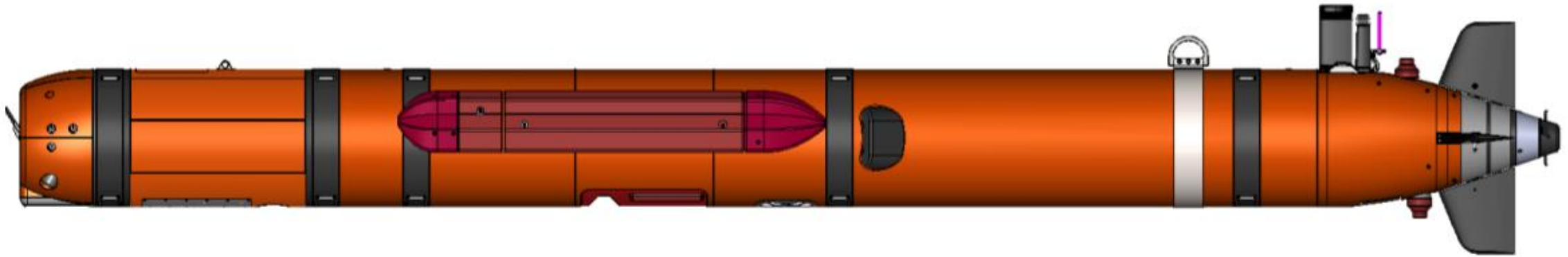
Charging time: 2 timer (0-90%)

## Payload sensors

- EM2040M – multibeam ekkosounder
- HISAS 2040 – High Interferometrisk Syntetisk Aperture Sonar
- Edgetech Sub-Bottom Profier (SBP)
- Cathx Ocean still picture camera



# Munin+



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E

D

C

B

A



# Munin+



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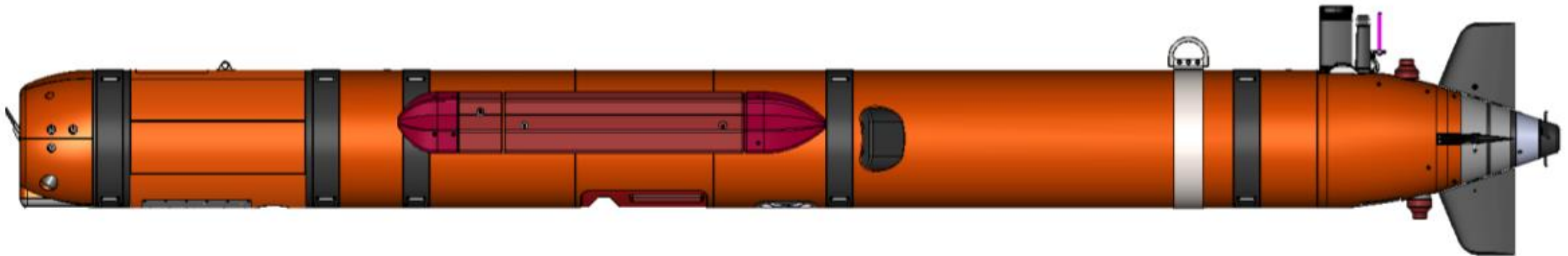
A

## **A Tail section:**

The Tail section holds the **propulsion system**, Depth and CT sensors, **antennas** (RF, GPS, Iridium and WLAN), cNODE **acoustic link system**, Recovery strobe light, **Drop weight unit** and On/Off magnetic switch.



# Munin+



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## **B Energy section:**

The Energy section is a watertight section containing up to 12 **Battery modules** with internal electronics for charging and safety circuitry, with a communication link to the Battery control station (BCS). Buoyancy elements, **Trim weights and Trim bladders** can be installed on each side of the Energy section to adjust buoyancy of the AUV.



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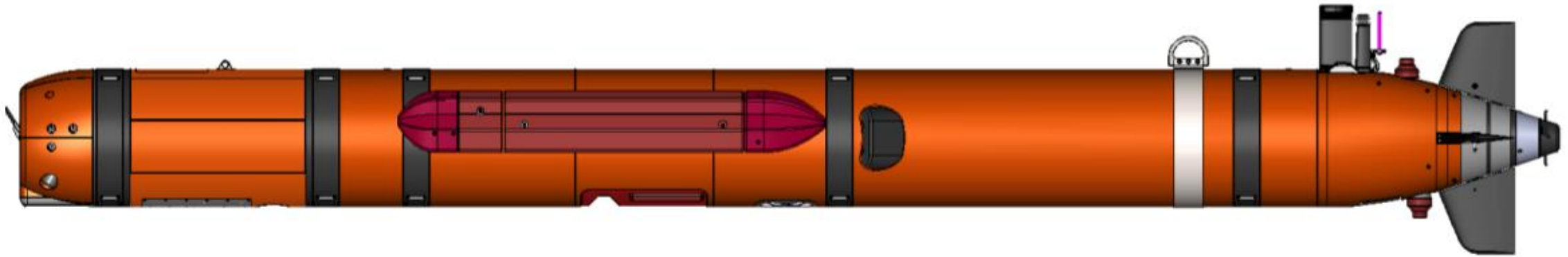
## **C Navigation/Payload section:**

The Navigation/Payload section is a watertight section containing the payload and control system electronics and processing units, Inertial measurement unit, Doppler velocity log, **EM 2040M** sonar head and **HISAS 2040** arrays.





# Munin+



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## **D Forward endcap section:**

The Forward endcap section is a watertight section containing electronics related to the LED panel and **Swappable NAS**. An On/Off magnetic switch is installed on the Forward endcap section.



# Munin+



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## **E Wet payload section:**

The Wet payload section supports the installation of various sensors and watertight equipment.

- Edgetech **Sub-Bottom Profier** (SBP)
- Cathx Ocean **stillbildekamera**





# Munin+



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## **F Nose section:**

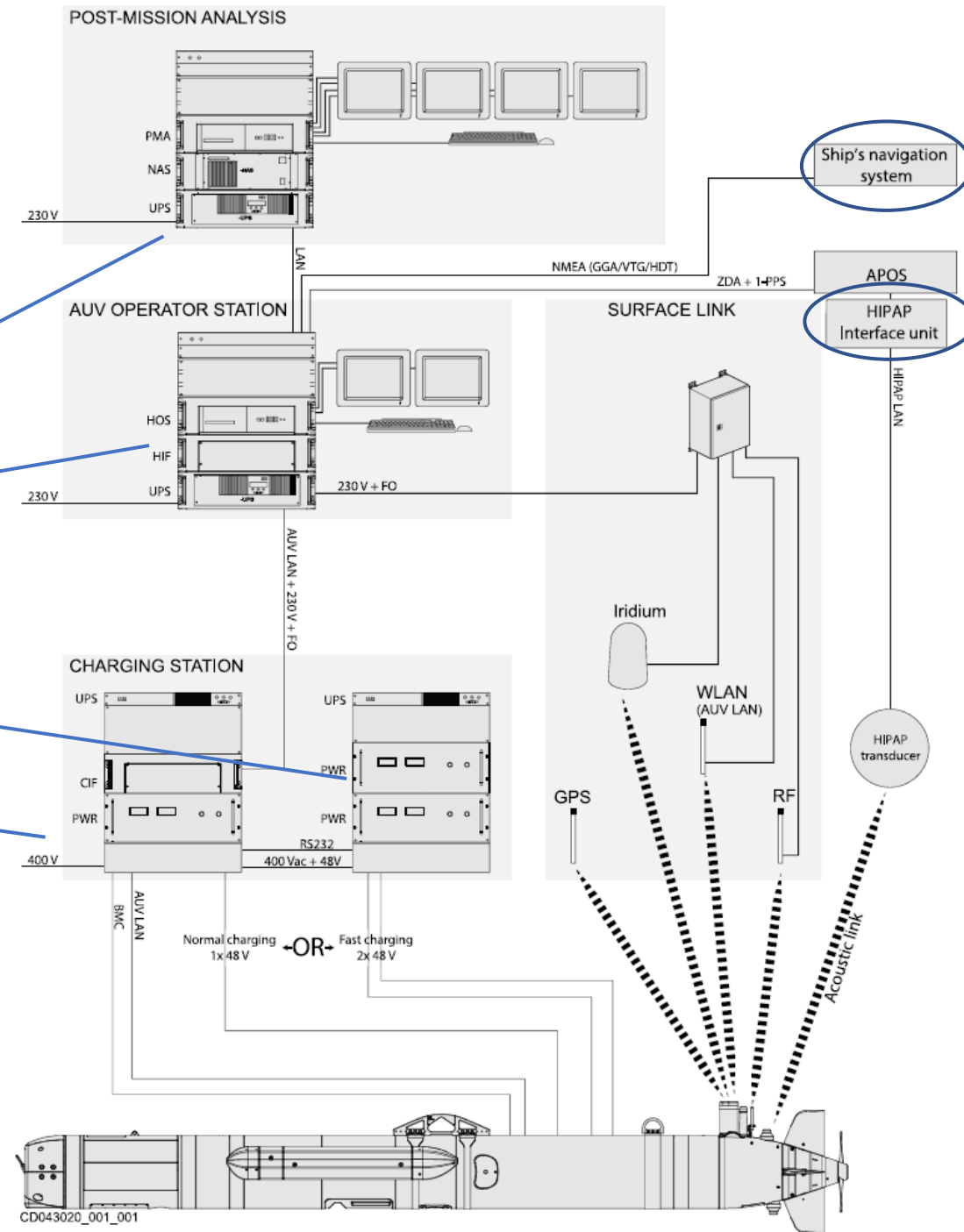
The Nose section holds units required for **vehicle recovery** (Lifting bail, Drop nose), collision avoidance sensors (**Forward looking sonars**), data download port and the **LED panel** for the Underwater camera.



# Munin+ Top side rack

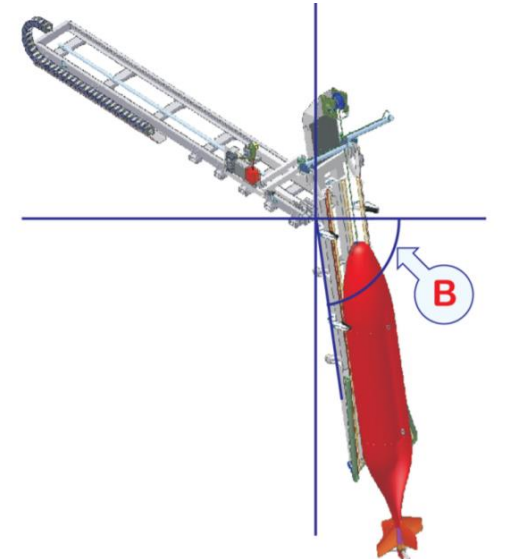
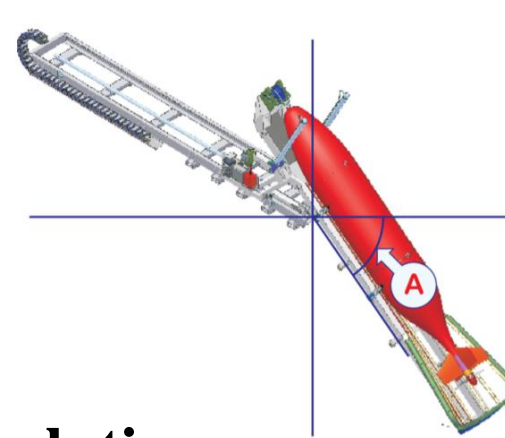
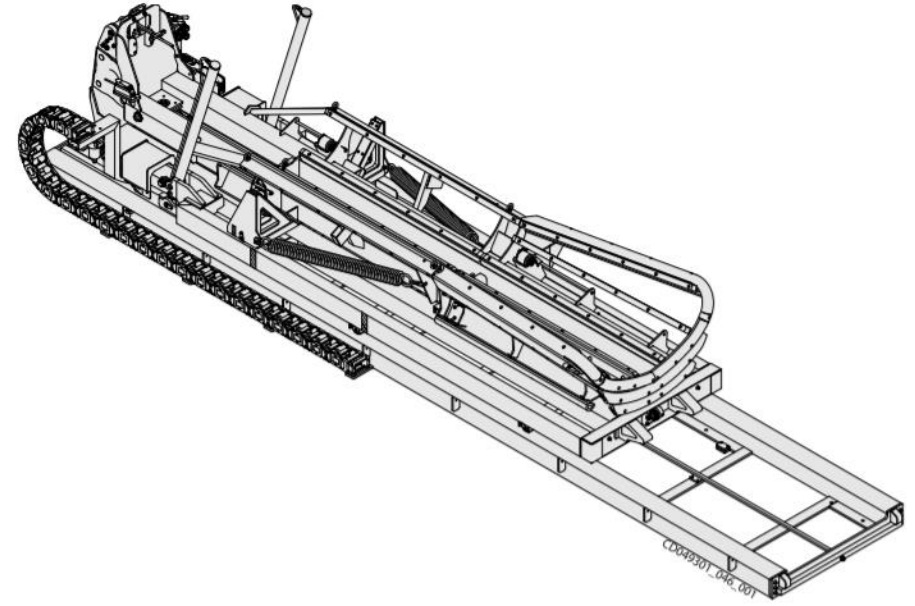


**Control container**





# Stinger for launch and recovery



**Crane solution**  
to be evaluated





# Testing of Munin+ on a small boat





# Testing of Munin+ and the stinger onboard «Hydrograf». Launch over the side.



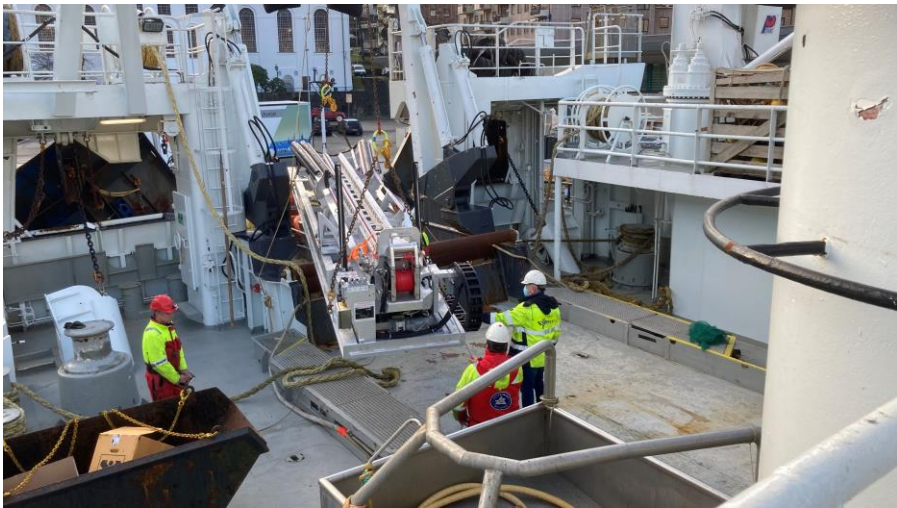
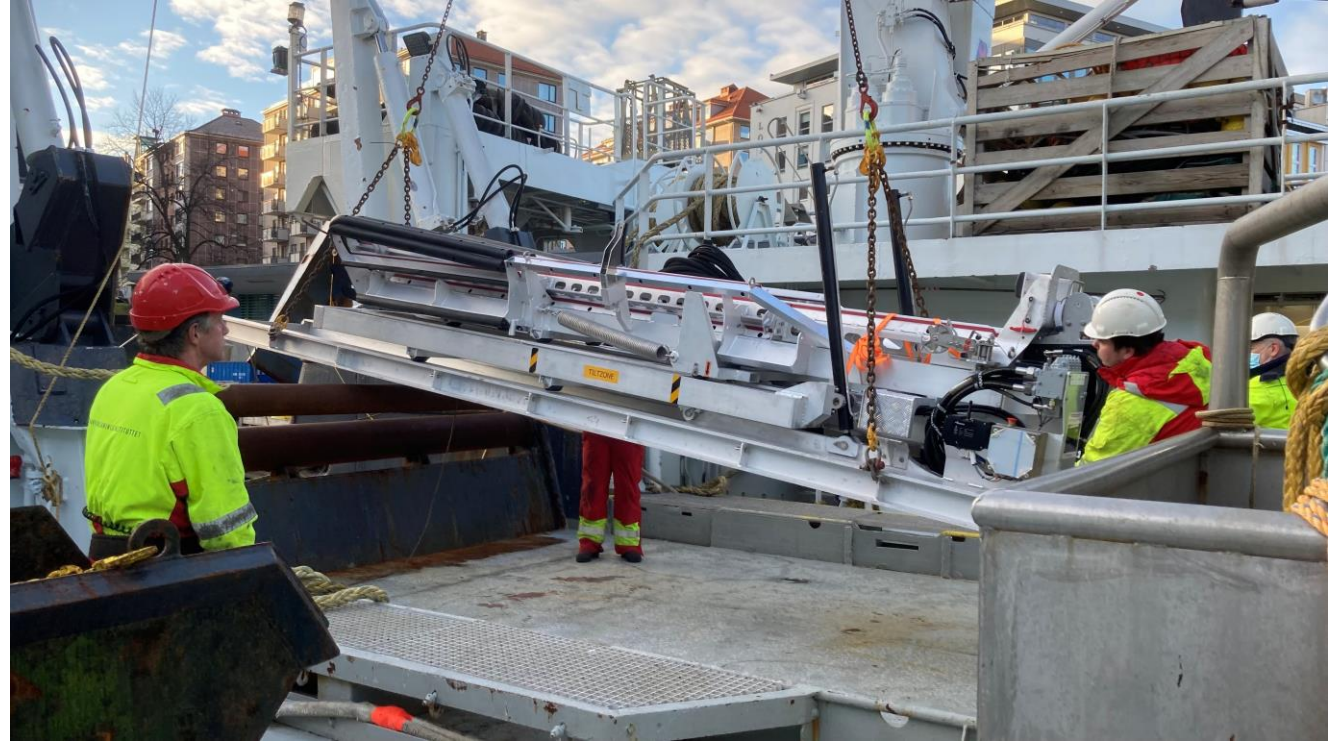


# Control container





# Testing of Munin+ and the stinger onboard «Johan Hjort». Launch via trawl gate



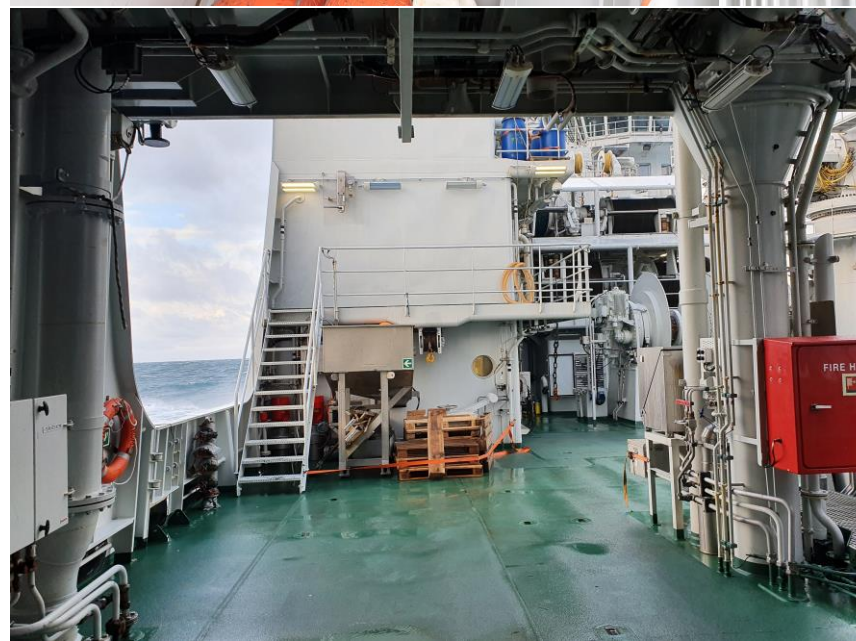


# Testing of Munin+ and stinger onboard «G.O.Sars». Launch at the stern





# Plan for Testing of Munin+ and the stinger onboard «Kronprins Haakon»



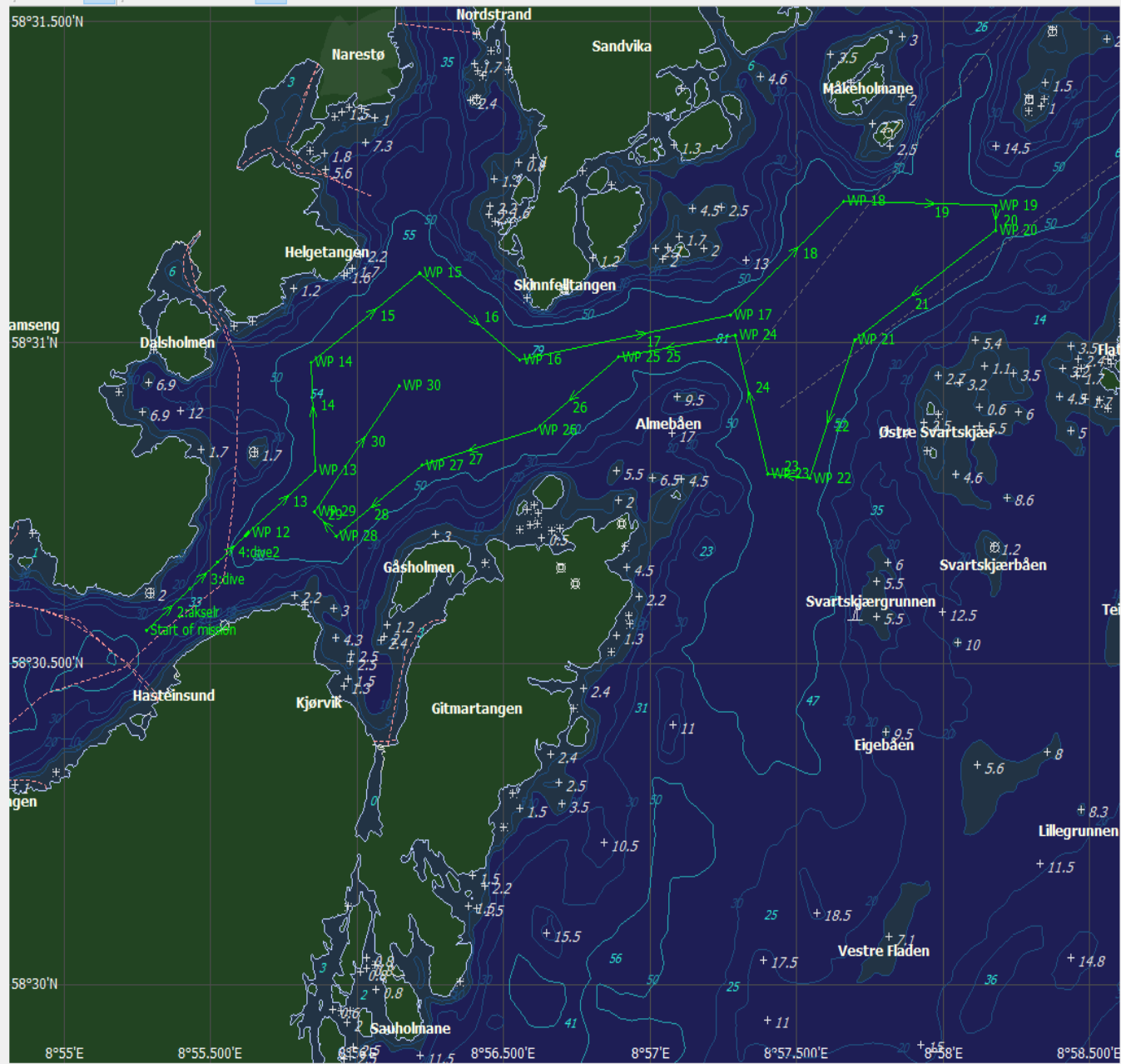
# Munin+ Mission planning SW

AUV (1) New Vehicle Commands

Mission Plan

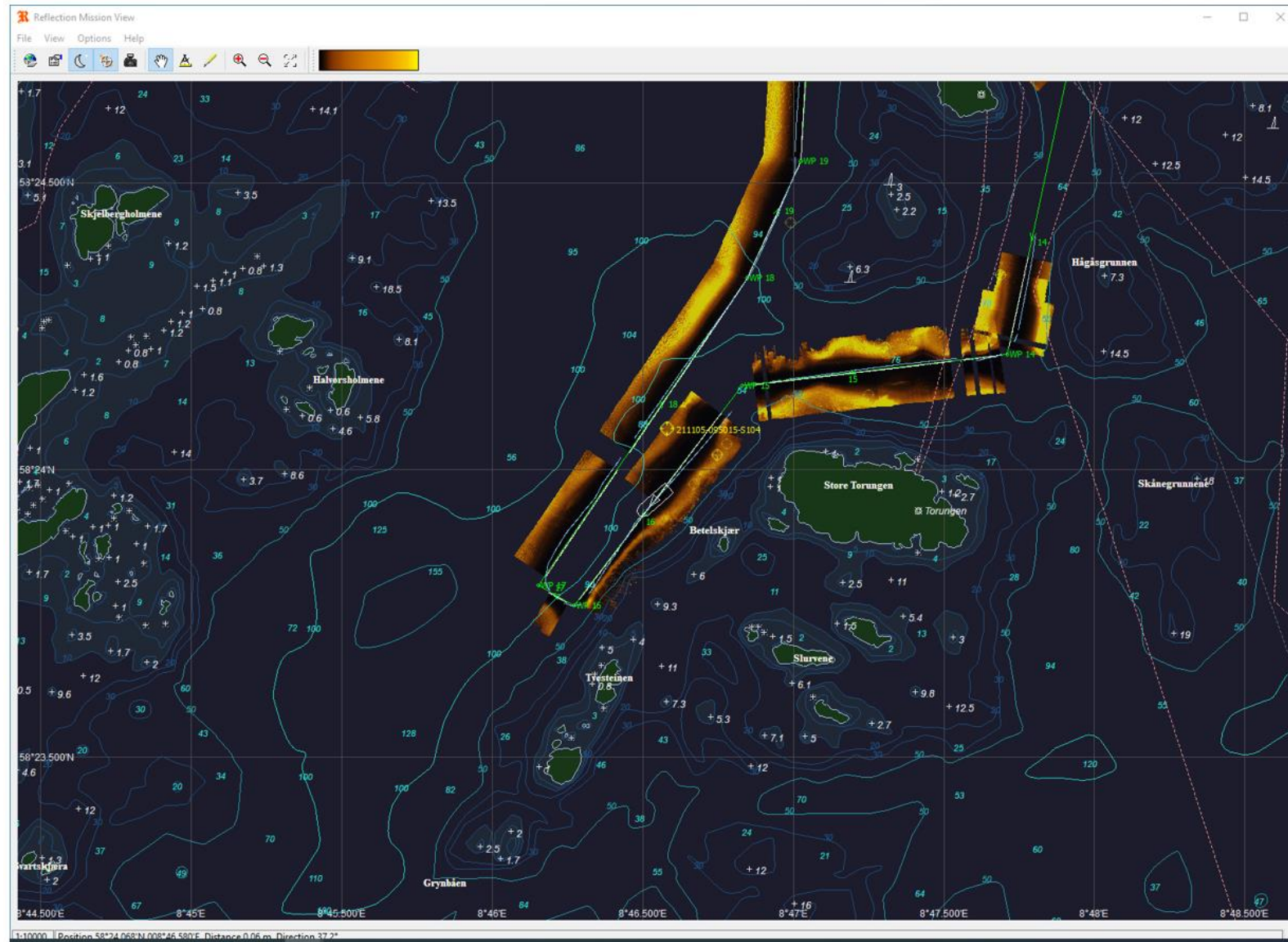


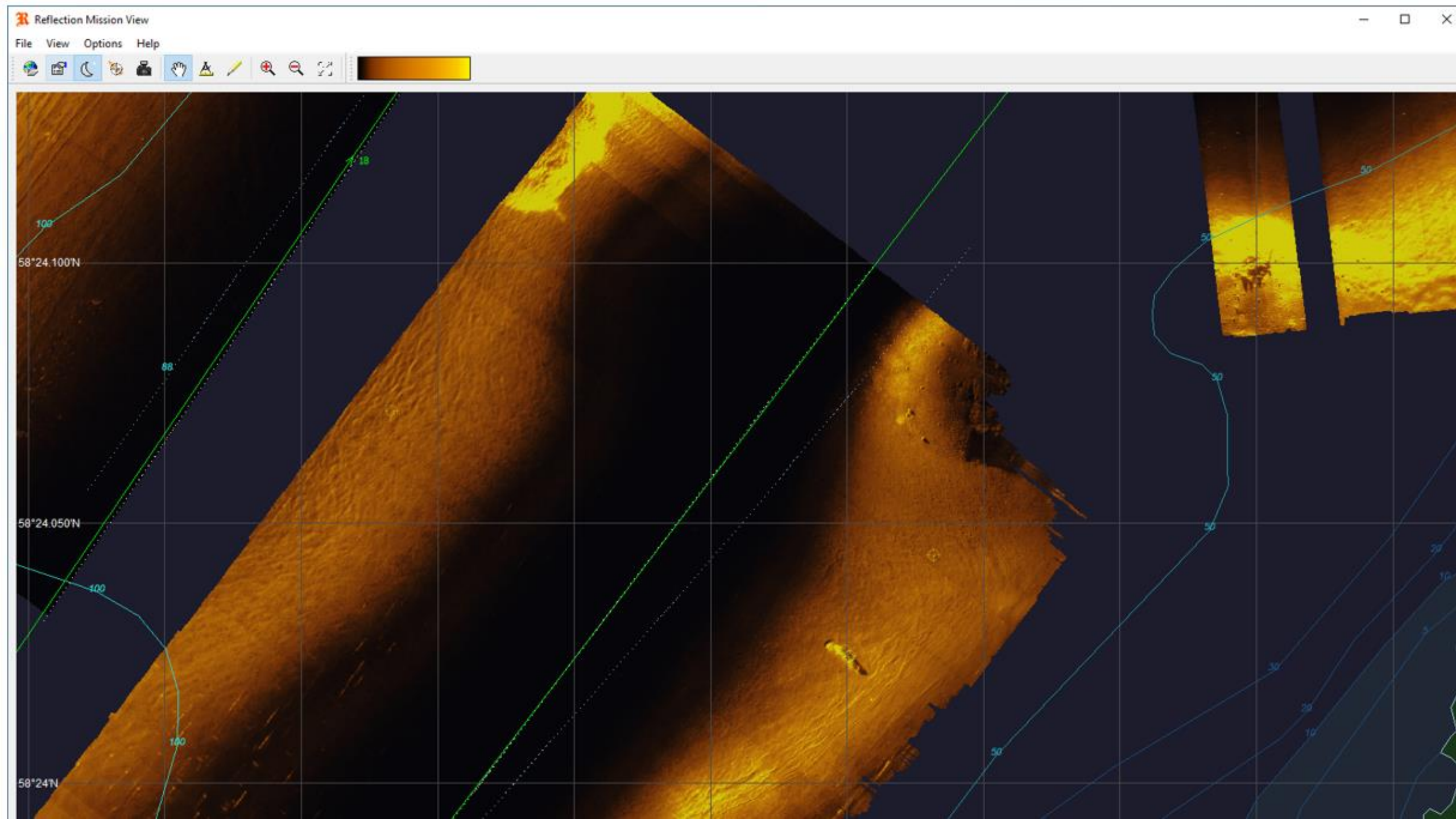
No:Tag	Depth	Alt	DMO	Latitude	Longitude	Course	GMO	RPM	Speed	SMo	Dur	Dist	Flags
# AUV i vannet, skip ut av farkostens planlegde kurs													
1:start	0.0	20.0	D			050	C	0	=	R	1:30	-	
# MUNIN akselererer med kurs 180 grader. Bro med. Verifiser at EM er standby													
2:akse1r	=	=	=	=	=	=	=	250	=	=	1:00	-	
# dykk til mellomdybde, verifiser hipap og ellers ingen feilmeldinger													
3:dive	20.0	=	=	=	=	=	=	=	=	2.00	S	1:00	- EMOn
# MUNIN mot havbunnen og følger denne.													
4:dive2	20.0	=	T	=	=	=	=	=	=	=	1:00	-	
5:	=	=	=	=	=	=	=	=	=	=	0:01	-	EM400Int
6:	=	=	=	=	=	=	=	=	=	=	0:01	-	DistTrigger
7:	=	=	=	=	=	=	=	=	=	=	0:01	-	SASPowerOn
8:	=	=	=	=	=	=	=	=	=	=	0:01	-	ETPowerOn
9:	=	=	=	=	=	=	=	=	=	=	0:01	-	SASOn
10:	=	=	=	=	=	=	=	=	=	=	0:01	-	SASHighPower
11:	=	=	=	=	=	=	=	=	=	=	0:01	-	ETOn
12:	=	=	=	58°30.705'N	008°55.629'E	=	=	=	=	=	=	=	
13:	=	=	=	58°30.801'N	008°55.857'E	(051)	=	=	=	=	(2:21)	(283)	
14:	=	=	=	58°30.969'N	008°55.843'E	(358)	=	=	=	=	(2:36)	(313)	
15:	=	=	=	58°31.109'N	008°56.213'E	(054)	=	=	=	=	(3:41)	(443)	
16:	150.0	=	=	58°30.973'N	008°56.554'E	(127)	=	=	=	=	(3:28)	(416)	
17:	=	=	=	58°31.043'N	008°57.273'E	(079)	=	=	=	=	(5:55)	(711)	
18:	20.0	=	=	58°31.220'N	008°57.660'E	(049)	=	=	=	=	(4:09)	(499)	
19:	=	=	=	58°31.214'N	008°58.179'E	(091)	=	=	=	=	(4:12)	(505)	
20:	=	=	=	58°31.175'N	008°58.178'E	(181)	=	=	=	=	(0:35)	(71)	
21:	=	=	=	58°31.004'N	008°57.697'E	(236)	=	=	=	=	(4:42)	(565)	
22:	=	=	=	58°30.789'N	008°57.543'E	(200)	=	=	=	=	(3:33)	(427)	
23:	=	=	=	58°30.796'N	008°57.401'E	(275)	=	=	=	=	(1:09)	(139)	
24:	=	=	=	58°31.012'N	008°57.290'E	(345)	=	=	=	=	(3:27)	(415)	
25:	=	=	=	58°30.978'N	008°56.892'E	(261)	=	=	=	=	(3:15)	(392)	
26:	=	=	=	58°30.864'N	008°56.607'E	(233)	=	=	=	=	(2:53)	(348)	
27:	=	=	=	58°30.809'N	008°56.221'E	(255)	=	=	=	=	(3:14)	(389)	
28:	=	=	=	58°30.699'N	008°55.928'E	(234)	=	=	=	=	(2:55)	(351)	
29:	=	=	=	58°30.737'N	008°55.853'E	(314)	=	=	=	=	(0:50)	(101)	
30:	=	=	=	58°30.933'N	008°56.143'E	(038)	=	=	=	=	(3:49)	(460)	



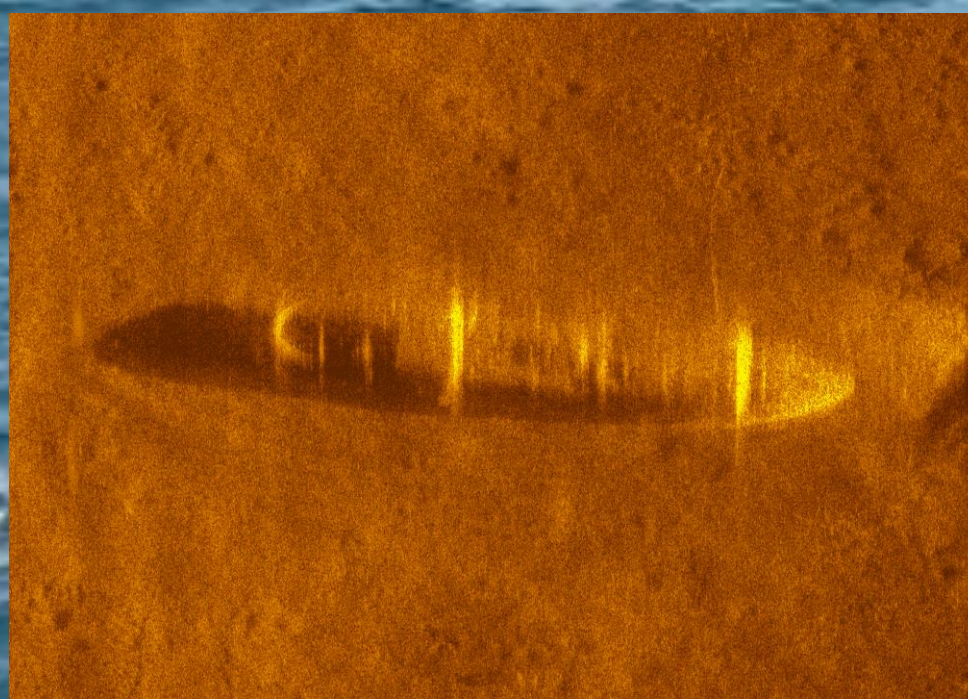
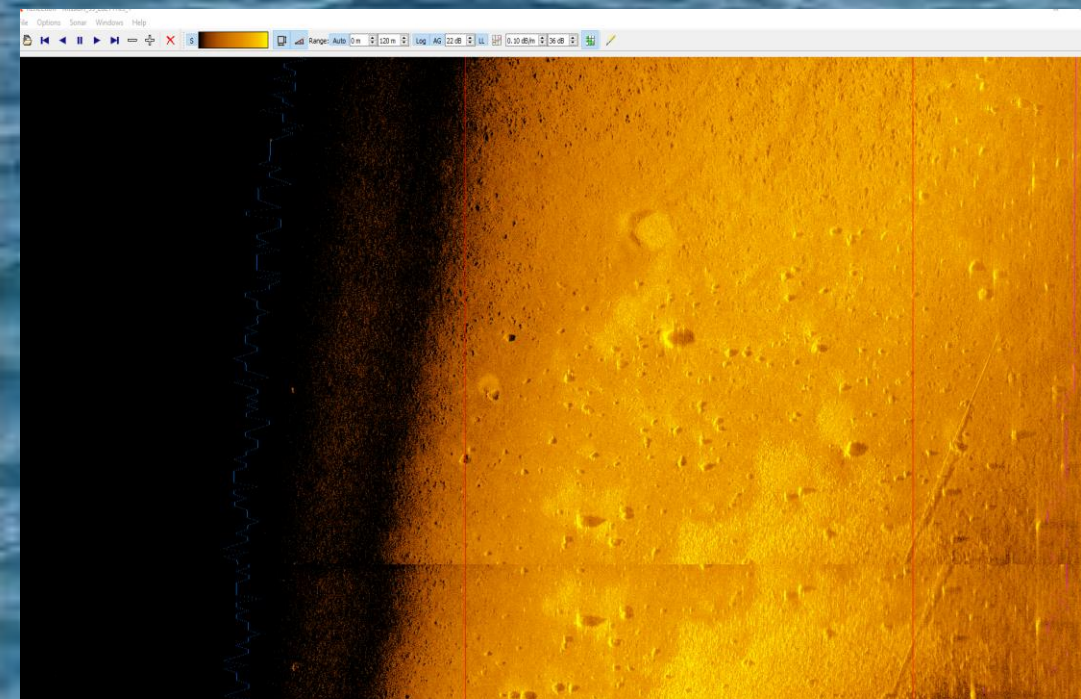
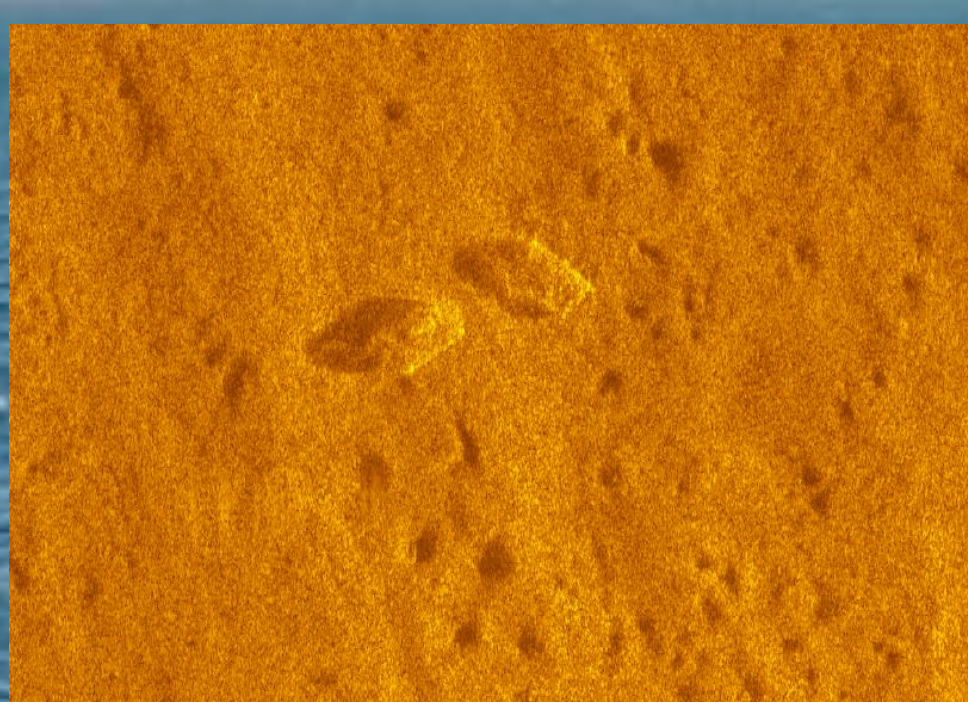


# Munin+ Reflection post processing SW











# Munin+ - Status



- 2 vehicle delivered
- Testing onboard IMR vessels is ongoing and will continue. It will be a long test period.
- Used during survey for 15 days in April onboard «Hydrograf»
  - Challenges with the removable HIPAP. Installed on a pipe welded to the shipside. The vessel could not transit with the HIPAP out and e.g. follow the AUV.
  - Limited weather window due to launching over the side. Need almost calm sea.
  - Challenges with diving in calm sea.
- Used during Mareano –15 days juni, «G.O. Sars»
  - Challenges with diving in calm sea.
  - AUV pick false bottom signal and the AUV dropped the lead weights and surfaced.
  - Kongsberg has solved the diving problem. Two ways to dive. Full forward, up and down, or astern until submerged and than forward. Testing ongoing. False bottom signal not solved yet.





# Sounder

USV - Unmanned Surface Vehicle

Planned delivery early 2023



- We will start testing and operation using one of our vessels as a mother vessel and operate within visual sight. It will be a long test period.
- Rules and regulations for operation of these vessels does not exist, but expected to come soon. Many autonomous ships planned for different operations in Norway (ferries and cargo vessel crossing fjords).
- IMR procedures and manning needed for operation and maintenance ongoing.

