Report on the preliminary investigation of

the collision involving

Stolt Perseverance

Mississippi River

26 June 2006

Cayman Islands Shipping Registry
Maritime Authority of the Cayman Islands
3rd Floor, Kirk House
22 Albert Panton Street
George Town
PO Box 2256 GT
Cayman Islands

Casualty 2006 / 09

The fundamental purpose of investigating an accident under the Cayman Islands Merchant Shipping Law, as amended, is to determine its circumstances and the cause with the aim of improving the safety of life at sea and the avoidance of accidents in the future. It is not the purpose to apportion liability, nor, except so far as is necessary to achieve the fundamental purpose, to apportion blame.

NOTE

This report is not written with liability in mind and is not intended to be used in court for the purpose of litigation. It endeavours to identify and analyse the relevant safety issues pertaining to the specific accident, and to make recommendations aimed at preventing similar accidents in future.

Synopsis

On 26 June 2006 Stolt Perseverance was under outbound pilotage in the Mississippi river. At approximately 04:00 hrs the pilot requested a course change from 155 degrees to 160 degrees. The ship continued to turn to starboard despite increasing amounts of port rudder being applied.

The ship made contact with a barge and tug moored at a grain wharf. The tug subsequently sank and the barge broke free from its moorings.

No personal injuries or pollution to the marine environment were reported.

The cause of the loss of steerage has been determined to be due to “rudder stall” caused by the rudder / speed limits recommended by the manufacturer being exceeded.

Glossary of Acronyms and Abbreviations

CISR	Cayman Islands Shipping Registry
COTP	Captain of the Port
ECDIS	Electronic Chart Display and Information System
ISM	International Management Code for the Safe Operation of Ships and for Pollution Prevention.
ISPS	International Ship and Port Facility Security Code
MACI	Maritime Authority of the Cayman Islands
NOAA	National Oceanic and Atmospheric Administration
OOW	Officer of the Watch
rev/min	Revolutions per minute
SOG	Speed over the ground
STW	Speed through the water
USCG	United States Coast Guard
VDR	Voyage Data Recorder

Factual Information

Particulars of STOLT PERSEVERANCE

Vessel details

Registered owner:	Stolt Perseverance BV
Manager:	Stolt Nielsen Transportation Group
Type:	Oil Tanker / Chemical Tanker
Gross Tonnage:	25,196
Deadweight:	37,059
Flag:	Cayman Islands
Port of Registry:	George Town
IMO Number:	9124471
Built:	2001, France / Croatia
Length (overall):	176.7m
Breadth:	31.227m
Depth:	15.6m
Draught:	12m
Construction:	Type I, double hull
Engine Type / Power:	Diesel Electric
Estimated Speed:	16 knots
Voyage Data Recorder:	Provided
Rudder arrangement:	Single Becker Flap Type Rudder
Steering Gear:	Rotary Vane

Incident details

Date and time:	26 June 2006 at 04:00 (L)
Location of accident:	Harvest States Grain Warf Mississippi River
Persons onboard:	29 Crew and 1 pilot
Condition of the ship:	Fully laden at 12m draught.
Injuries:	None

Damage:

The vessel sustained contact damage in way of her anchor shell appendage, starboard side just above and below the forepeak tank top, approx 3m, in way of the collision bulkhead (frames 211 to 207, collision bulkhead at frame 209).
Anchor appendage shell plating was found set in/buckled and torn approx. 300mm in way of frame 209 just above the forepeak tank top. The forepeak tank top was found locally buckled at the shell side and torn in two places, frames 209 and 208, at its connection to the shell side. The collision bulkhead, frame 209, was found locally buckled with a small tear at its connection to the shell side to the tank top Internals in way of the contact were found buckled/distorted variously.

Weather Conditions:

The weather at the time of the incident was reported as fine and dry with good night visibility.

Sequence of events

25 June 2006

23:03	Mississippi River Pilot boards the ship for the first leg of the outbound pilotage.
23:35	The last line is brought back onboard and the ship commences down river.

26 June 2006

02:04	Change of pilot at “Algiers” on the Mississippi River. River pilot departs.
03:50	The VDR shows the ship responding to rudder orders and keeping to desired course. Minimal rudder orders are required to maintain and alter course in accordance with the pilot’s instructions.
03:55 (approx)	Captain leaves the bridge to go to the bathroom in his cabin. On the bridge are: 3/O Geraldoy (OOW), Helmsman Slalzar, incoming OOW 2/O Paragas, incoming Helmsman Ramos and Mississippi Pilot Bach. Although present on the bridge, it is reported that the incoming watchmen were taking no active part in the pilotage. On watch in the engine room were C/E Skjelbred, 3/E Haro and Elect Magnusson The VDR recording shows the ship making 15.2kn SOG and 14.33kn STW. Engine revolutions are constant at the requested 82 rev/min.
03:57	Pilot orders a change of course from 155 to 160 degrees. The ship’s heading is 148.8 degrees and the helmsman applies 10 degrees of starboard rudder to achieve the desired course change. When the heading is 152.6 degrees the helmsman reduces the applied starboard rudder to 3 degrees. However, due to the proximity of the river bank on the ships Port side the rate of turn to Starboard continues to increase.

The helmsman then applies Port rudder to “meet” the ship and the rate of turn to Starboard starts to decrease. (The ship is still turning to starboard, but appears to be coming back under control of the helm orders).

03:58 The turn to starboard continues and the helmsman applies increasing amounts of port rudder until the rudder is put to the maximum of 70 degrees to port. With this type of rudder, rather than increasing the effectiveness of the rudder, large rudder movements at this speed rapidly reduce rudder performance and the rudder effectively “stalls”. The rate of turn to starboard again starts to increase. Due to the increased load on the engine propeller revolutions start to decrease thereby reducing the flow of water over the rudder, further reducing rudder efficiency.

Not realising that the rudder is already at 70 degrees to Port the pilot orders “Hard to Port”. The rudder position is confirmed by the helmsman.

The pilot and the helmsman confirm that the ship has effectively lost steering.

Neither the pilot or the OOW are aware that the loss of steerage is due to rudder stall.

03:59 The captain is called. The pilot orders that both anchors are made ready. The captain returns to the bridge, but has little time to evaluate the situation and regain control. The pilot order the engines stopped and then put full astern.

At this time, the rudder angle has reduced to 53 degrees to Port and the rate of turn to Starboard is seen to decrease. Around the time that “full astern” is ordered the rudder is again put back to “full Port” (70 degrees) and the rate of turn again starts to increase. At this point the propeller is still making about 70 rev/min ahead.

The bowthruster is engaged but has little effect as the ship is still making 10.5kn (STW).

04:00	The pilot orders the anchors to be let go. This order is acknowledged by the officer of the watch. The order to let go the anchors is countermanded by the pilot. Collision is now inevitable and occurs at 04:00:18. Ship collides with a small pusher tug "Jeck" and a barge moored at the Harvest States Grain Wharf. The tug sinks and three crewmen from the tug swim to safety.
04:07	Ship backs away from barge. Tanks sounded for water ingress and cargo/oil out flow. Operation of Steering Gear confirmed.
04:58	Ship commences anchoring in river about 2 miles upstream of collision site.

(Appendix 3 contains the raw VDR Data from 03:50 to 04:03, local time. Appendix 4 shows the ARPA Radar display for the same period.)

27 June 2006

Angus L McLean and Capt Peter Domladis of the Cayman Islands Shipping Registry (MACI) attend onboard and make the following observations:

The ship was effectively detained[1] under USCG COTP Order until cause of incident is determined and operation of steering gear confirmed.

Internal and external damage in the area of the collision was noted as shown in Appendix 1 and reported by class in Appendix 2. Temporary repairs were being effected to return the ship to a seaworthy condition.

Accounts from all onboard involved at the time of the incident are in agreement with that contained in the Lloyd's Register report included as Appendix 2. Officer of the Watch and Captain were of the opinion that the actions of the pilot before and during the incident were appropriate to the circumstances.

The paper charts in use were examined and found to concur with the ECDIS recordings, with manual position fixing every 5 – 10 minutes. Passage plans were shown to have been complied with.

At the time of the incident all of the ship's statutory certificates were valid with annual/intermediate surveys completed as required. This ship is entered into the Alternative Compliance scheme and all surveys (except ISM and ISPS) are fully delegated to the ship's classification society (Lloyd's Register).

[1] Deficiencies coded as "60a" ("Rectify deficiencies prior to movement to the satisfaction of Class/RO/RSO")

All onboard were found to be qualified, certificated and medically fit in accordance with Cayman Islands requirements.

Records of “hours of work and rest” were examined and found to comply with the applicable requirements.

The operation of the steering gear from the bridge and steering compartment was confirmed in both the normal and emergency modes of operation. Steering gear alarms were tested and found to be functioning correctly.

The engine room alarm log shows no steering gear alarms prior to or during the incident. The alarm log correctly recorded the steering gear alarms generated during the post incident testing. Engine room control data regarding helm orders and engine manoeuvres is in agreement with the account of the incident given by the master.

Despite providing a copy to the VDR data relating to the incident (and events immediately preceding) to the USCG, the Captain felt unable to release a copy to CISR. This information was later made available through the company’s office in Rotterdam. The copy of the VDR data supplied had been annotated by the company to give the findings of their own investigation into the incident. These annotations did not appear to disturb the data recorded.

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CISR Surveyors hold informal meeting with USCG Boarding officer (Lt Ron Fogin). Lt Fogin confirms the following:

> The pilot has stated that he has no criticism of the actions of the bridge team prior to and during the incident.
>
> The river in the area of the incident has been surveyed twice in the last year. Once by NOAA and again by the US Army Corps of Engineers. The surveys were required to reopen the river to navigation following the passage of hurricanes. No riverbed anomalies were noted during these surveys.

Temporary repairs completed to the satisfaction of the attending LR surveyor.

Diver undertakes video survey of underwater sections of the steering gear and reports all in order as far as can be seen.

Open water trials of ship confirm that the ship responds to helm commands satisfactorily.

Ship “released” from USCG control actions.

Findings and Conclusions

The direct cause of the loss of steering can be attributed to the reduced efficiency of this type of rudder when large rudder angles are applied at above manoeuvring speeds. These characteristics have been confirmed by the manufacturer of the active rudder system in use and were well known by the company.

Human error was a contributing factor in the following areas:

> A limit switch designed to restrict rudder movement at above manoeuvring speeds had not been engaged for this pilotage in contravention of the company's operating procedures.
>
> Despite evidence of an appropriate "pilot briefing" being carried out, the pilot appears to have been unaware of the rudder characteristics of this ship.
>
> The officer of the watch also appears to have been unfamiliar with the rudder characteristics of the ship on which he was sailing. At no time did he countermand the orders of the pilot or offer advice when the ship had effectively lost steerage and it was apparent that the rudder had stalled.
>
> It is unfortunate that the captain was not on the bridge at the time leading up to the incident. Even so, although the master had undertaken a ship handling course for the rudder system in use, he appeared to be totally unaware of the systems limitations. Had he been so aware it is reasonable to expect that at some stage, after he arrived on the bridge, he would have countermanded the pilot's orders for increasing amounts of port helm when the vessel was turning uncontrollable to starboard. It is however possible that there was insufficient time for the master to properly evaluate the situation fully prior to the actual collision, though this does not detract from the fact that there was a serious lack of appreciation on his part regarding the steering system's limitations.

The dropping of anchors when the pilot first ordered the anchors made ready may have helped prevent the collision. However the pilot's action in countermanding his own order to drop the anchors seems perfectly reasonable, given the time frame involved. At that time it was unlikely that dropping anchors would have prevented the collision and may have caused additional damage to the ship by "running over and impaling the ship" on the anchors.

There is no evidence of a permanent (or reproducible) failure in either the mechanical or control systems relating to the steering of the ship.

Recommendations:

1 The Maritime Authority of the Cayman Islands should issue an appropriate Shipping Notice stressing the importance of operating active type rudder systems within their operating limitations and the need for appropriate controls to be put in place to prevent inadvertent operation outside of these limitations.

2 The company (Stolt Nielsen Transportation Group) should:

(a) Ensure the masters and officers of all their ships fitted with similar rudder systems are aware of the potential consequences of operating outside of their design parameters.

(b) Review internal training and familiarisation procedures for bridge officers to ensure that all are fully aware of:

(i) the handling characteristics and limitations of the ships upon which they are serving;

(ii) the circumstances affecting the conning, piloting and safety of the ship when acting as the OOW in pilotage waters, including the need to question an order given by the pilot where the OOW does not fully understand the need for the order or believes the order to be ill advised or wrong; and

(iii) where the master is absent from the bridge for any reason, the need to immediately call the master to the bridge when the OOW believes there is any untoward danger to the vessel or where the OOW is not in agreement with an order given by the pilot.

(c) Review policies regarding the master's presence on the bridge during pilotages to include the appropriate controls to be put in place when the absence of the master is unavoidable.

(d) Review policies regarding the release of VDR data to the Flag State surveyor or inspector, particularly during the conduct of a casualty investigation, and otherwise as may be required, and ensure that masters and officers are fully aware of the provisions of Cayman Islands shipping law in this regard.

Appendix 1

Damage to Stolt Perseverance and illustrative diagram of the type of rudder system fitted to the ship.

Fig 1: Area of contact in way of starboard anchor pocket.

Fig 2: Detail of hole into fore peak

Fig 3: Internal damage in fwd store

Fig 4: Damage in forepeak tank

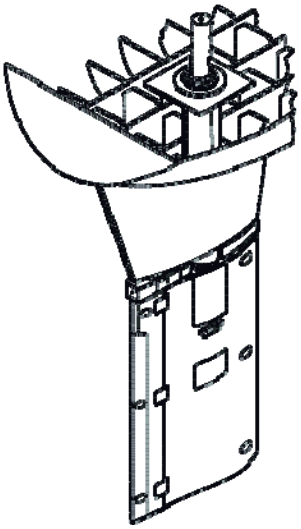


Fig 5: Becker “Flap Type” High Performance Rudder

Appendix 2

Narrative of attending LR Surveyor's report:

Stated cause: HULL-CONTACT: COLLISION
Date occurred: 26/06/06
Related reason: Stated collision whilst transiting outbound, Mississippi River, with small barge pusher, "Jeck", and a barge (ID unknown). "Jeck" sunk, barge stated to have been damaged.
Location of incident: Harvest States Grain Wharf
No injuries/casualties reported
See PSCM also.

Loading condition: LOADED
Ship activity: UNDERWAY
Ship location: RESTRICTED WATERS
Envrnmt pollution: NONE

MLIs affected: 5379 SHELL PLATING
5474 FORECASTLE TWEEN DECK SPACE/S
6365 NO.1 FORWARD F.W. CLEANING TANK
6422 NO.1 FOREPEAK W.B. TANK
7263 NO.13 STARBOARD SIDE W.B. TANK
SDN Defect/Damage 1.1
Defective MLIs: 5379 SHELL PLATING
5474 FORECASTLE TWEEN DECK SPACE/S
6365 NO.1 FORWARD F.W. CLEANING TANK
6422 NO.1 FOREPEAK W.B. TANK
7263 NO.13 STARBOARD SIDE W.B. TANK

Description: The vessel sustained contact damage in way of her anchor shell appendage, starboard side just above and below the forpeak tank top, approx 3m, iwo the collision bulkhead(frames 211 to 207, collision BHD frm 209).

Anchor appendage shell plating was found set in/buckled and torn approx. 300mm iwo frm 209 just above the forepeak tank top. The forepeak tank top was found locally buckled at the shell side and torn in two

places, frms 209 and 208, at its connection to the shell side.

The collision bulkhead, frm 209, was found locally buckled with a small tear at its connection to the shell side to the tank top
Internals in way of the contact were found buckled/distorted variously.
Plating tears have now been stop drilled.
A substantial cement box now fitted and plated in between frms 209-207 above the Forepeak tank top, and iwo the collision bulkhead between tank top brackets either side.

The temporary repairs were examined and are considered satisfactory, substantial but temporary. Bilge alarms forward were tested and forepeak tank level alarms adjusted and found satisfactory.
Shell side contact damage was also Found in the forward section of the starboard side water ballast no.13 at the shear strake, between frms 198-194 and the 1st and 2nd ssl's from deck head.
Internals in way were found variously distorted/locally buckled.

Web frames 196, 195 and 194 were found with small tears at their cut outs to ssl's 1 and 2 from deck head (5 in total, all at inboard side of fillet).
Tears now stopped drilled as a temporary measure.

COCH 01 now recommended, conditions are considered satisfactory in the interim.
Action taken: TEMPORARY REPAIR
CoC imposed: H01

Attended whilst the vessel was at anchorage, La Grange, Mississippi River, following a stated loss of steering and collision with a small barge pusher, ID "Jeck", and barge (ID unknown) stationed alongside Harvest States Grain Wharf whilst the vessel was proceeding outbound, loaded condition, 26 June 206, at approximately 0400 hrs.
The vessel was subsequently restricted to port by the USCG.

The vessel was not formally detained.
See Also HDAM.

Found/Now Done:
Just prior to the stated loss of steering the Master stated that the pilot ordered steady-up course on heading 160 degrees from 155 degrees whilst negotiating a starboard bend in the river (screen print of ECDIS plot being forwarded).

He further stated that the vessel continued turning to starboard despite applying port rudder to check starboard turning.

The master also stated that an evasive manoeuvre of hard over to port was ordered by the pilot to avoid a possible collision with the tug/wharf. The VDR onboard indicated that the rudder responded to the helm order, approx 70 degrees port. This was also confirmed by the C/Eng who stated he had made his way to the steering flat and noted the rudder position. A second recorded data source from the engine room monitoring system appears to indicate the rudder responded to the orders also. However, the Master stated that the vessel continued to starboard making contact with the tug/wharf.

The Master stated the vessel then manoeuvred clear and proceeded up river to La Grange anchorage where she anchored without further incident.
The steering gear comprises rotary vane with a high lift rudder (Becker-High-Performance Rudder), designed to operate up to a maximum rudder angle of the order of 65 degrees. A copy of the Pilot Card Suppliment for steering gear operation, displayed on the bridge, and manufacturers general overview is being forwarded.

The steering gear, controls and alarms were examined and tested and found satisfactory. A CCTV diver examination has confirmed the rudder arrangements were in order as far as can be seen, and also confirmed expected rudder operation.

The vessel was released by the USCG to transit the river outbound, with tug boat attendance, in order to observe/trial steering gear operation. The results were found satisfactory.

Upon completion of the transit a form 1124 was issued to the vessel for possible presentation to the USCG and the vessel was subsequently released.

Appendix 3: Data from Stolt Perseverance Voyage Data Recorder (All time UTC)

Time	Heading	Rate of Turn	Rudder Order	Rudder Response	RPM Order	RPM Response	Bowthruster Order	Bowthruster Responce	STW Longt	SOG Longt
8:50:00	153.5	-4.2		2	82	82	0	0	14.4	15.32
8:50:01	153.4	-4.8	3	2	82	82	0	0	14.41	15.32
8:50:02	153.3	-5.4	3	2	82	82	0	0	14.4	15.31
8:50:03	153.2	-6	3	2	82	82	0	0	14.41	15.31
8:50:04	153.1	-6	7	2	82	82	0	0	14.43	15.32
8:50:05	153	-6	7	7	82	82	0	0	14.44	15.34
8:50:06	152.9	-6	9	7	82	82	0	0	14.44	15.34
8:50:07	152.8	-5.4	9	9	82	82	0	0	14.46	15.33
8:50:08	152.7	-5.4	9	9	82	82	0	0	14.47	15.35
8:50:09	152.6	-4.2	9	9	82	82	0	0	14.45	15.35
8:50:10	152.6	-4.2	11	9	82	82	0	0	14.46	15.35
8:50:11	152.6	-2.4	14	12	82	82	0	0	14.46	15.34
8:50:12	152.5	-0.6	14	14	82	82	0	0	14.45	15.33
8:50:13	152.5	1.2	14	14	82	82	0	0	14.43	15.34
8:50:14	152.6	1.8	3	14	82	82	0	0	14.43	15.33
8:50:15	152.6	1.8	3	10	82	82	0	0	14.41	15.32
8:50:16	152.6	1.2	9	4	82	82	0	0	14.43	15.33
8:50:17	152.6	1.2	11	4	82	82	0	0	14.43	15.32
8:50:18	152.7	1.2	11	7	82	82	0	0	14.43	15.31
8:50:19	152.7	2.4	3	10	82	82	0	0	14.44	15.32
8:50:20	152.8	3.6	3	10	82	82	0	0	14.41	15.31
8:50:21	152.8	3.6	3	6	82	82	0	0	14.42	15.3
8:50:22	152.9	3	3	2	82	82	0	0	14.41	15.31
8:50:23	152.9	3	3	2	82	82	0	0	14.4	15.3
8:50:24	153	2.4	3	2	82	82	0	0	14.39	15.32

Appendix 3: Data from Stolt Perseverance Voyage Data Recorder (All time UTC)

Time	Heading	Rate of Turn	Rudder Order	Rudder Response	RPM Order	RPM Response	Bowthruster Order	Bowthruster Responce	STW Longt	SOG Longt
8:50:25	153	2.4	3	2	82	82	0	0	14.4	15.32
8:50:26	153.1	1.8	-2	2	82	82	0	0	14.4	15.31
8:50:27	153.1	0.6	-2	-2	82	82	0	0	14.41	15.3
8:50:28	153.1	-0.6	-1	-2	82	82	0	0	14.4	15.31
8:50:29	153.1	-1.8	-2	-2	82	82	0	0	14.4	15.31
8:50:30	153	-2.4	-2	-2	82	82	0	0	14.4	15.31
8:50:31	153	-3.6	-2	-2	82	82	0	0	14.38	15.32
8:50:32	152.9	-4.2	-1	-2	82	82	0	0	14.37	15.33
8:50:33	152.8	-4.8	3	0	82	82	0	0	14.38	15.32
8:50:34	152.8	-4.2	3	2	82	82	0	0	14.39	15.32
8:50:35	152.7	-5.4	6	2	82	82	0	0	14.37	15.32
8:50:36	152.6	-5.4	6	5	82	82	0	0	14.35	15.31
8:50:37	152.5	-4.8	6	6	82	82	0	0	14.37	15.31
8:50:38	152.4	-5.4	8	6	82	82	0	0	14.39	15.3
8:50:39	152.3	-4.2	9	8	82	82	0	0	14.37	15.31
8:50:40	152.3	-4.2	10	10	82	82	0	0	14.39	15.32
8:50:41	152.2	-3	10	10	82	82	0	0	14.4	15.31
8:50:42	152.2	-3	10	10	82	82	0	0	14.41	15.31
8:50:43	152.1	-2.4	10	10	82	82	0	0	14.42	15.32
8:50:44	152.1	-1.8	10	10	82	82	0	0	14.43	15.33
8:50:45	152.1	0	11	10	82	82	0	0	14.43	15.33
8:50:46	152.1	0	11	11	82	82	0	0	14.45	15.33
8:50:47	152.1	1.2	11	11	82	82	0	0	14.43	15.34
8:50:48	152.1	1.8	3	11	82	82	0	0	14.44	15.35
8:50:49	152.2	1.8	5	8	82	82	0	0	14.43	15.35

Appendix 3: Data from Stolt Perseverance Voyage Data Recorder (All time UTC)

Time	Heading	Rate of Turn	Rudder Order	Rudder Response	RPM Order	RPM Response	Bowthruster Order	Bowthruster Responce	STW Longt	SOG Longt
8:50:50	152.2	1.8	3	4	82	82	0	0	14.44	15.34
8:50:51	152.2	1.2	6	2	82	82	0	0	14.46	15.34
8:50:52	152.2	0.6	7	3	82	82	0	0	14.46	15.34
8:50:53	152.3	1.8	7	6	82	82	0	0	14.44	15.34
8:50:54	152.3	1.8	7	6	82	82	0	0	14.43	15.37
8:50:55	152.3	2.4	7	6	82	82	0	0	14.43	15.38
8:50:56	152.4	2.4	3	6	82	82	0	0	14.44	15.38
8:50:57	152.4	2.4	3	2	82	82	0	0	14.43	15.37
8:50:58	152.5	2.4	3	2	82	82	0	0	14.43	15.37
8:50:59	152.5	2.4	5	2	82	82	0	0	14.44	15.37
8:51:00	152.5	1.8	5	5	82	82	0	0	14.47	15.35
8:51:01	152.6	1.2	3	5	82	82	0	0	14.49	15.34
8:51:02	152.6	1.8	3	2	82	82	0	0	14.48	15.34
8:51:03	152.6	1.2	3	2	82	82	0	0	14.47	15.33
8:51:04	152.6	0.6	3	2	82	82	0	0	14.47	15.34
8:51:05	152.7	0.6	3	2	82	82	0	0	14.47	15.34
8:51:06	152.7	0	3	2	82	82	0	0	14.49	15.35
8:51:07	152.7	0	6	2	82	82	0	0	14.47	15.35
8:51:08	152.7	1.2	6	5	82	82	0	0	14.45	15.36
8:51:09	152.7	0.6	3	5	82	82	0	0	14.47	15.35
8:51:10	152.7	0.6	3	2	82	82	0	0	14.47	15.35
8:51:11	152.7	0.6	5	2	82	82	0	0	14.47	15.36
8:51:12	152.7	0	5	4	82	82	0	0	14.47	15.37
8:51:13	152.7	0	5	4	82	82	0	0	14.47	15.36
8:51:14	152.8	0	6	5	82	82	0	0	14.51	15.35

Appendix 3: Data from Stolt Perseverance Voyage Data Recorder (All time UTC)

Time	Heading	Rate of Turn	Rudder Order	Rudder Response	RPM Order	RPM Response	Bowthruster Order	Bowthruster Responce	STW Longt	SOG Longt
8:51:15	152.8	0.6	6	6	82	82	0	0	14.49	15.36
8:51:16	152.8	0.6	8	7	82	82	0	0	14.5	15.36
8:51:17	152.8	1.2	8	8	82	82	0	0	14.51	15.37
8:51:18	152.8	1.8	3	8	82	82	0	0	14.48	15.39
8:51:19	152.9	1.8	7	6	82	82	0	0	14.46	15.41
8:51:20	152.9	2.4	7	6	82	82	0	0	14.47	15.4
8:51:21	153	3	7	6	82	82	0	0	14.44	15.4
8:51:22	153	3	8	6	82	82	0	0	14.44	15.42
8:51:23	153.1	4.2	3	8	82	82	0	0	14.46	15.42
8:51:24	153.2	4.2	3	8	82	82	0	0	14.46	15.43
8:51:25	153.3	4.8	3	4	82	82	0	0	14.44	15.44
8:51:26	153.3	4.8	3	2	82	82	0	0	14.44	15.44
8:51:27	153.4	4.2	1	2	82	82	0	0	14.43	15.44
8:51:28	153.5	3.6	3	1	82	82	0	0	14.4	15.45
8:51:29	153.6	3.6	3	1	82	82	0	0	14.4	15.46
8:51:30	153.6	3.6	1	1	82	82	0	0	14.4	15.46
8:51:31	153.7	3.6	1	1	82	82	0	0	14.4	15.46
8:51:32	153.7	3	-1	1	82	82	0	0	14.42	15.46
8:51:33	153.8	1.8	-1	-1	82	82	0	0	14.41	15.46
8:51:34	153.8	1.2	-1	-1	82	82	0	0	14.43	15.46
8:51:35	153.8	0.6	-1	-1	82	82	0	0	14.43	15.46
8:51:36	153.8	0	-1	-1	82	82	0	0	14.43	15.48
8:51:37	153.8	-0.6	3	-1	82	82	0	0	14.44	15.48
8:51:38	153.8	-0.6	3	2	82	82	0	0	14.46	15.48
8:51:39	153.8	-1.2	2	2	82	82	0	0	14.44	15.48

Appendix 3: Data from Stolt Perseverance Voyage Data Recorder (All time UTC)

Time	Heading	Rate of Turn	Rudder Order	Rudder Response	RPM Order	RPM Response	Bowthruster Order	Bowthruster Responce	STW Longt	SOG Longt
8:51:40	153.8	-1.2	3	2	82	82	0	0	14.43	15.49
8:51:41	153.7	-1.2	3	2	82	82	0	0	14.43	15.48
8:51:42	153.7	-1.8	3	2	82	82	0	0	14.44	15.47
8:51:43	153.7	-2.4	3	2	82	82	0	0	14.43	15.47
8:51:44	153.6	-2.4	3	2	82	82	0	0	14.43	15.48
8:51:45	153.6	-2.4	3	2	82	82	0	0	14.4	15.47
8:51:46	153.6	-2.4	1	2	82	82	0	0	14.42	15.48
8:51:47	153.5	-3	2	1	82	82	0	0	14.4	15.48
8:51:48	153.5	-3.6	3	2	82	82	0	0	14.43	15.49
8:51:49	153.4	-3.6	9	2	82	82	0	0	14.45	15.5
8:51:50	153.3	-3	9	9	82	82	0	0	14.45	15.51
8:51:51	153.3	-1.8	9	9	82	82	0	0	14.46	15.52
8:51:52	153.3	-1.2	9	9	82	82	0	0	14.45	15.52
8:51:53	153.3	-0.6	3	9	82	82	0	0	14.43	15.51
8:51:54	153.3	-0.6	8	4	82	82	0	0	14.47	15.52
8:51:55	153.2	-0.6	8	4	82	82	0	0	14.46	15.53
8:51:56	153.2	-0.6	8	8	82	82	0	0	14.45	15.51
8:51:57	153.2	0	8	8	82	82	0	0	14.47	15.51
8:51:58	153.3	1.2	6	8	82	82	0	0	14.46	15.53
8:51:59	153.3	1.2	3	6	82	82	0	0	14.47	15.52
8:52:00	153.3	1.2	3	3	82	82	0	0	14.47	15.52
8:52:01	153.3	1.2	6	2	82	82	0	0	14.48	15.51
8:52:02	153.4	1.2	8	6	82	82	0	0	14.48	15.52
8:52:03	153.4	2.4	3	7	82	82	0	0	14.47	15.53
8:52:04	153.5	3	7	7	82	82	0	0	14.45	15.52

Appendix 3: Data from Stolt Perseverance Voyage Data Recorder (All time UTC)

Time	Heading	Rate of Turn	Rudder Order	Rudder Response	RPM Order	RPM Response	Bowthruster Order	Bowthruster Responce	STW Longt	SOG Longt
8:52:05	153.5	4.2	3	7	82	82	0	0	14.47	15.51
8:52:06	153.6	4.2	3	4	82	82	0	0	14.47	15.51
8:52:07	153.6	3	-1	1	82	82	0	0	14.47	15.51
8:52:08	153.7	2.4	3	-1	82	82	0	0	14.48	15.5
8:52:09	153.7	1.2	3	-1	82	82	0	0	14.5	15.5
8:52:10	153.8	1.8	3	2	82	82	0	0	14.49	15.52
8:52:11	153.8	1.8	6	2	82	82	0	0	14.53	15.51
8:52:12	153.8	1.8	10	5	82	82	0	0	14.53	15.51
8:52:13	153.9	3	3	7	82	82	0	0	14.53	15.52
8:52:14	153.9	3.6	15	8	82	82	0	0	14.53	15.52
8:52:15	154	5.4	16	11	82	82	0	0	14.53	15.52
8:52:16	154.1	7.2	16	15	82	82	0	0	14.53	15.52
8:52:17	154.3	10.2	3	16	82	82	0	0	14.54	15.52
8:52:18	154.5	12	3	15	82	82	0	0	14.51	15.51
8:52:19	154.8	13.8	3	14	82	82	0	0	14.48	15.51
8:52:20	154.9	14.4	3	11	82	82	0	0	14.5	15.52
8:52:21	155.2	13.8	3	3	82	82	0	0	14.51	15.52
8:52:22	155.4	13.2	1	1	82	82	0	0	14.53	15.52
8:52:23	155.6	12.6	-6	1	82	82	0	0	14.58	15.52
8:52:24	155.8	12.6	-7	-3	82	82	0	0	14.59	15.52
8:52:25	156.1	9.6	-8	-6	82	82	0	0	14.58	15.53
8:52:26	156.2	7.8	-8	-8	82	82	0	0	14.57	15.52
8:52:27	156.3	4.2	-8	-9	82	82	0	0	14.56	15.51
8:52:28	156.3	2.4	-8	-9	82	82	0	0	14.53	15.51
8:52:29	156.3	-0.6	-8	-9	82	82	0	0	14.55	15.52

Appendix 3: Data from Stolt Perseverance Voyage Data Recorder (All time UTC)

Time	Heading	Rate of Turn	Rudder Order	Rudder Response	RPM Order	RPM Response	Bowthruster Order	Bowthruster Responce	STW Longt	SOG Longt
8:52:30	156.3	-3	-8	-9	82	82	0	0	14.53	15.52
8:52:31	156.2	-6	3	-9	82	82	0	0	14.52	15.52
8:52:32	156.1	-8.4	-3	-7	82	82	0	0	14.52	15.53
8:52:33	155.9	-9.6	3	-4	82	82	0	0	14.53	15.51
8:52:34	155.8	-9.6	3	1	82	82	0	0	14.56	15.51
8:52:35	155.6	-9.6	3	3	82	82	0	0	14.53	15.51
8:52:36	155.4	-10.2	2	3	82	82	0	0	14.53	15.51
8:52:37	155.2	-10.8	-5	1	82	82	0	0	14.52	15.5
8:52:38	155.1	-12	1	-3	82	82	0	0	14.53	15.49
8:52:39	154.8	-13.2	3	-3	82	83	0	0	14.51	15.48
8:52:40	154.7	-13.8	3	0	82	83	0	0	14.53	15.48
8:52:41	154.4	-13.8	-6	3	82	83	0	0	14.53	15.48
8:52:42	154.2	-13.8	-6	3	82	83	0	0	14.51	15.47
8:52:43	153.9	-15	-3	-2	82	83	0	0	14.52	15.48
8:52:44	153.7	-15.6	3	-2	82	83	0	0	14.51	15.48
8:52:45	153.4	-16.8	2	-2	82	83	0	0	14.52	15.49
8:52:46	153.2	-16.8	-1	3	82	83	0	0	14.51	15.5
8:52:47	152.9	-16.8	-5	3	82	82	0	0	14.53	15.49
8:52:48	152.6	-16.8	-4	1	82	82	0	0	14.55	15.48
8:52:49	152.3	-17.4	3	0	82	82	0	0	14.53	15.49
8:52:50	152	-18.6	3	0	82	82	0	0	14.5	15.51
8:52:51	151.7	-17.4	7	5	82	82	0	0	14.48	15.49
8:52:52	151.5	-16.2	10	7	82	82	0	0	14.47	15.5
8:52:53	151.2	-14.4	14	11	82	82	0	0	14.47	15.48
8:52:54	151	-12.6	14	14	82	82	0	0	14.47	15.45

Appendix 3: Data from Stolt Perseverance Voyage Data Recorder (All time UTC)

Time	Heading	Rate of Turn	Rudder Order	Rudder Response	RPM Order	RPM Response	Bowthruster Order	Bowthruster Responce	STW Longt	SOG Longt
8:52:55	150.8	-10.8	14	14	82	82	0	0	14.47	15.44
8:52:56	150.6	-9.6	14	14	82	82	0	0	14.45	15.44
8:52:57	150.5	-7.2	14	14	82	82	0	0	14.43	15.45
8:52:58	150.4	-6	14	14	82	82	0	0	14.41	15.46
8:52:59	150.3	-4.2	14	14	82	82	0	0	14.4	15.45
8:53:00	150.3	-3	3	14	82	82	0	0	14.4	15.44
8:53:01	150.2	-2.4	0	11	82	82	0	0	14.4	15.41
8:53:02	150.2	-2.4	-2	4	82	82	0	0	14.38	15.42
8:53:03	150.1	-4.2	-2	-2	82	82	0	0	14.37	15.4
8:53:04	150.1	-4.2	-5	-4	82	82	0	0	14.37	15.39
8:53:05	149.9	-6.6	-6	-4	82	82	0	0	14.38	15.38
8:53:06	149.8	-7.2	1	-4	82	82	0	0	14.38	15.38
8:53:07	149.7	-8.4	3	-3	82	82	0	0	14.4	15.37
8:53:08	149.6	-7.8	3	2	82	82	0	0	14.39	15.35
8:53:09	149.4	-7.8	3	3	82	82	0	0	14.41	15.34
8:53:10	149.3	-8.4	3	2	82	82	0	0	14.37	15.33
8:53:11	149.2	-9.6	0	2	82	82	0	0	14.33	15.33
8:53:12	149	-9	3	2	82	82	0	0	14.33	15.32
8:53:13	148.8	-10.8	3	2	82	82	0	0	14.32	15.32
8:53:14	148.7	-10.8	3	2	82	82	0	0	14.34	15.31
8:53:15	148.5	-11.4	-1	2	82	82	0	0	14.34	15.32
8:53:16	148.3	-12	3	0	82	82	0	0	14.32	15.3
8:53:17	148	-12.6	10	0	82	82	0	0	14.31	15.32
8:53:18	147.9	-12.6	10	2	82	82	0	0	14.34	15.31
8:53:19	147.6	-11.4	10	8	82	82	0	0	14.35	15.31

Appendix 3: Data from Stolt Perseverance Voyage Data Recorder (All time UTC)

Time	Heading	Rate of Turn	Rudder Order	Rudder Response	RPM Order	RPM Response	Bowthruster Order	Bowthruster Responce	STW Longt	SOG Longt
8:53:20	147.5	-10.8	10	10	82	82	0	0	14.34	15.29
8:53:21	147.3	-9.6	10	10	82	82	0	0	14.34	15.3
8:53:22	147.2	-9.6	10	10	82	82	0	0	14.32	15.3
8:53:23	147	-8.4	13	11	82	82	0	0	14.34	15.29
8:53:24	146.9	-7.2	13	13	82	82	0	0	14.34	15.3
8:53:25	146.8	-6	15	13	82	82	0	0	14.31	15.3
8:53:26	146.7	-4.2	15	15	82	82	0	0	14.31	15.29
8:53:27	146.6	-2.4	15	15	82	82	0	0	14.3	15.3
8:53:28	146.6	-0.6	15	15	82	82	0	0	14.31	15.3
8:53:29	146.7	1.8	15	15	82	82	0	0	14.29	15.28
8:53:30	146.7	3.6	3	15	82	82	0	0	14.28	15.26
8:53:31	146.8	4.8	3	12	82	82	0	0	14.27	15.23
8:53:32	146.9	5.4	3	6	82	82	0	0	14.26	15.21
8:53:33	147	5.4	3	2	82	82	0	0	14.25	15.2
8:53:34	147	5.4	3	2	82	82	0	0	14.25	15.2
8:53:35	147.1	4.8	-5	2	82	82	0	0	14.23	15.2
8:53:36	147.2	4.2	-4	-3	82	82	0	0	14.22	15.2
8:53:37	147.3	3	-3	-3	82	82	0	0	14.2	15.19
8:53:38	147.3	1.8	-2	-3	82	82	0	0	14.2	15.2
8:53:39	147.3	1.2	-2	-2	82	82	0	0	14.23	15.21
8:53:40	147.4	0.6	3	-2	82	82	0	0	14.22	15.19
8:53:41	147.4	0	3	0	82	82	0	0	14.26	15.19
8:53:42	147.4	0	2	2	82	82	0	0	14.28	15.19
8:53:43	147.4	0.6	0	2	82	82	0	0	14.3	15.19
8:53:44	147.4	0	3	0	82	82	0	0	14.31	15.19

Appendix 3: Data from Stolt Perseverance Voyage Data Recorder (All time UTC)

Time	Heading	Rate of Turn	Rudder Order	Rudder Response	RPM Order	RPM Response	Bowthruster Order	Bowthruster Responce	STW Longt	SOG Longt
8:53:45	147.4	-1.2	3	0	82	82	0	0	14.31	15.2
8:53:46	147.3	-0.6	1	2	82	82	0	0	14.3	15.2
8:53:47	147.3	-1.2	3	2	82	82	0	0	14.3	15.22
8:53:48	147.3	-1.8	3	2	82	82	0	0	14.29	15.22
8:53:49	147.3	-1.2	2	2	82	82	0	0	14.3	15.22
8:53:50	147.3	-1.8	3	1	82	82	0	0	14.3	15.22
8:53:51	147.2	-1.8	3	1	82	82	0	0	14.28	15.22
8:53:52	147.2	-2.4	3	1	82	82	0	0	14.24	15.22
8:53:53	147.2	-2.4	3	2	82	82	0	0	14.24	15.22
8:53:54	147.1	-1.8	3	2	82	82	0	0	14.22	15.23
8:53:55	147.1	-2.4	3	1	82	82	0	0	14.21	15.23
8:53:56	147	-2.4	3	1	82	82	0	0	14.21	15.23
8:53:57	147	-2.4	3	1	82	82	0	0	14.23	15.24
8:53:58	147	-2.4	3	1	82	82	0	0	14.21	15.24
8:53:59	146.9	-3	7	2	82	82	0	0	14.19	15.25
8:54:00	146.9	-2.4	9	7	82	82	0	0	14.21	15.27
8:54:01	146.8	-1.2	10	9	82	82	0	0	14.21	15.26
8:54:02	146.8	0	10	10	82	82	0	0	14.23	15.26
8:54:03	146.9	1.2	10	10	82	82	0	0	14.22	15.26
8:54:04	146.9	1.8	3	10	82	82	0	0	14.25	15.25
8:54:05	146.9	2.4	3	4	82	82	0	0	14.26	15.23
8:54:06	147	2.4	3	3	82	82	0	0	14.25	15.22
8:54:07	147	3	3	3	82	82	0	0	14.27	15.22
8:54:08	147.1	3	3	3	82	82	0	0	14.28	15.22
8:54:09	147.1	3	-1	2	82	82	0	0	14.3	15.22

Appendix 3: Data from Stolt Perseverance Voyage Data Recorder (All time UTC)

Time	Heading	Rate of Turn	Rudder Order	Rudder Response	RPM Order	RPM Response	Bowthruster Order	Bowthruster Responce	STW Longt	SOG Longt
8:54:10	147.2	3	-1	-1	82	82	0	0	14.28	15.21
8:54:11	147.2	2.4	-2	-1	82	82	0	0	14.28	15.22
8:54:12	147.3	3	-2	-1	82	82	0	0	14.3	15.22
8:54:13	147.3	2.4	-2	-1	82	82	0	0	14.31	15.23
8:54:14	147.4	2.4	-2	-2	82	82	0	0	14.3	15.25
8:54:15	147.4	1.8	3	-2	82	82	0	0	14.31	15.26
8:54:16	147.4	1.8	3	0	82	82	0	0	14.3	15.26
8:54:17	147.5	3	0	2	82	82	0	0	14.29	15.25
8:54:18	147.5	2.4	3	2	82	82	0	0	14.31	15.25
8:54:19	147.6	2.4	-2	2	82	82	0	0	14.32	15.25
8:54:20	147.6	2.4	-2	-2	82	82	0	0	14.32	15.25
8:54:21	147.6	1.2	-2	-2	82	82	0	0	14.33	15.24
8:54:22	147.7	0.6	-2	-2	82	82	0	0	14.35	15.23
8:54:23	147.7	0.6	-2	-2	82	82	0	0	14.34	15.22
8:54:24	147.7	0	3	-1	82	82	0	0	14.32	15.23
8:54:25	147.7	0	2	2	82	82	0	0	14.34	15.22
8:54:26	147.7	1.2	2	2	82	82	0	0	14.31	15.25
8:54:27	147.7	1.2	3	2	82	82	0	0	14.3	15.26
8:54:28	147.8	1.2	3	2	82	82	0	0	14.31	15.27
8:54:29	147.8	1.2	3	2	82	82	0	0	14.31	15.27
8:54:30	147.8	1.8	-1	2	82	82	0	0	14.34	15.27
8:54:31	147.8	1.2	-1	-1	82	82	0	0	14.33	15.26
8:54:32	147.9	1.2	-2	-1	82	82	0	0	14.34	14.75
8:54:33	147.9	1.2	-1	-1	82	82	0	0	14.35	14.79
8:54:34	147.9	0.6	3	-1	82	82	0	0	14.34	14.83

Appendix 3: Data from Stolt Perseverance Voyage Data Recorder (All time UTC)

Time	Heading	Rate of Turn	Rudder Order	Rudder Response	RPM Order	RPM Response	Bowthruster Order	Bowthruster Responce	STW Longt	SOG Longt
8:54:35	147.9	1.2	-1	2	82	82	0	0	14.36	14.88
8:54:36	148	1.8	0	2	82	82	0	0	14.36	14.88
8:54:37	148	2.4	-1	2	82	82	0	0	14.37	14.9
8:54:38	148	1.8	-1	-1	82	82	0	0	14.36	14.93
8:54:39	148.1	1.2	-3	-3	82	82	0	0	14.36	14.95
8:54:40	148.1	1.2	-3	-3	82	82	0	0	14.34	14.97
8:54:41	148.1	0.6	-1	-3	82	82	0	0	14.34	15
8:54:42	148.1	0.6	-4	-3	82	82	0	0	14.34	15
8:54:43	148.1	-0.6	-4	-2	82	82	0	0	14.34	15.03
8:54:44	148.1	-0.6	-4	-3	82	82	0	0	14.34	15.03
8:54:45	148.1	-1.2	-4	-3	82	82	0	0	14.34	15.05
8:54:46	148	-1.8	-4	-3	82	82	0	0	14.32	15.05
8:54:47	148	-2.4	-4	-3	82	82	0	0	14.33	15.07
8:54:48	148	-3	-4	-3	82	82	0	0	14.34	15.1
8:54:49	147.9	-3.6	-3	-3	82	82	0	0	14.32	15.1
8:54:50	147.9	-3.6	3	-2	82	82	0	0	14.33	15.12
8:54:51	147.8	-3	3	3	82	82	0	0	14.36	15.11
8:54:52	147.8	-3	3	3	82	82	0	0	14.35	15.13
8:54:53	147.7	-2.4	3	3	82	82	0	0	14.37	15.16
8:54:54	147.7	-2.4	7	3	82	82	0	0	14.37	15.17
8:54:55	147.7	-1.2	3	7	82	82	0	0	14.37	15.18
8:54:56	147.7	0	3	7	82	82	0	0	14.36	15.17
8:54:57	147.7	1.2	0	5	82	82	0	0	14.36	15.15
8:54:58	147.7	0	-1	-1	82	82	0	0	14.34	15.17
8:54:59	147.7	0	-1	-1	82	82	0	0	14.34	15.18

Appendix 3: Data from Stolt Perseverance Voyage Data Recorder (All time UTC)

Time	Heading	Rate of Turn	Rudder Order	Rudder Response	RPM Order	RPM Response	Bowthruster Order	Bowthruster Responce	STW Longt	SOG Longt
8:55:00	147.7	0.6	-1	-1	82	82	0	0	14.35	15.18
8:55:01	147.7	0.6	-1	-1	82	82	0	0	14.34	15.18
8:55:02	147.7	0.6	-1	-1	82	82	0	0	14.33	15.18
8:55:03	147.7	0.6	-1	-1	82	82	0	0	14.33	15.19
8:55:04	147.7	0	-2	-1	82	82	0	0	14.33	15.21
8:55:05	147.7	0.6	-2	-1	82	82	0	0	14.34	15.22
8:55:06	147.7	0	-2	-1	82	82	0	0	14.32	15.21
8:55:07	147.7	0	3	-1	82	82	0	0	14.3	15.22
8:55:08	147.7	-0.6	0	-1	82	82	0	0	14.3	15.22
8:55:09	147.7	-0.6	0	-1	82	82	0	0	14.31	15.23
8:55:10	147.7	-0.6	3	1	82	82	0	0	14.34	15.22
8:55:11	147.7	0.6	-1	2	82	82	0	0	14.34	15.24
8:55:12	147.7	0.6	3	2	82	82	0	0	14.34	15.24
8:55:13	147.8	1.2	3	2	82	82	0	0	14.31	15.26
8:55:14	147.8	1.2	-1	2	82	82	0	0	14.32	15.24
8:55:15	147.8	1.2	-1	0	82	82	0	0	14.35	15.22
8:55:16	147.8	0.6	-2	-2	82	82	0	0	14.37	15.22
8:55:17	147.8	0.6	-2	-1	82	82	0	0	14.38	15.24
8:55:18	147.8	1.2	-2	-2	82	82	0	0	14.37	15.24
8:55:19	147.9	0.6	-2	-2	82	82	0	0	14.37	15.23
8:55:20	147.9	0.6	-2	-2	82	82	0	0	14.38	15.25
8:55:21	147.9	0	-2	-2	82	82	0	0	14.36	15.24
8:55:22	147.9	0.6	3	-1	82	82	0	0	14.37	15.26
8:55:23	147.9	0.6	-1	-1	82	82	0	0	14.37	15.24
8:55:24	147.9	0.6	3	1	82	82	0	0	14.37	15.23

Appendix 3: Data from Stolt Perseverance Voyage Data Recorder (All time UTC)

Time	Heading	Rate of Turn	Rudder Order	Rudder Response	RPM Order	RPM Response	Bowthruster Order	Bowthruster Responce	STW Longt	SOG Longt
8:55:25	147.9	1.2	3	2	82	82	0	0	14.36	15.25
8:55:26	148	2.4	3	2	82	82	0	0	14.37	15.26
8:55:27	148	2.4	3	2	82	82	0	0	14.37	15.26
8:55:28	148	2.4	-4	2	82	82	0	0	14.4	15.25
8:55:29	148.1	2.4	-4	-3	82	82	0	0	14.41	15.26
8:55:30	148.1	1.8	-4	-3	82	82	0	0	14.41	15.26
8:55:31	148.1	0.6	-4	-3	82	82	0	0	14.41	15.26
8:55:32	148.2	0	3	-3	82	82	0	0	14.44	15.26
8:55:33	148.2	0	3	-1	82	82	0	0	14.45	15.26
8:55:34	148.2	1.2	3	2	82	82	0	0	14.45	15.26
8:55:35	148.2	1.8	3	2	82	82	0	0	14.46	15.26
8:55:36	148.2	1.8	3	2	82	82	0	0	14.44	15.27
8:55:37	148.3	2.4	3	2	82	82	0	0	14.44	15.28
8:55:38	148.3	3	-3	2	82	82	0	0	14.43	15.29
8:55:39	148.4	3	-2	-1	82	82	0	0	14.43	15.29
8:55:40	148.4	2.4	3	-2	82	82	0	0	14.47	15.29
8:55:41	148.5	2.4	3	0	82	82	0	0	14.47	15.29
8:55:42	148.5	3	3	2	82	82	0	0	14.45	15.29
8:55:43	148.6	4.2	3	2	82	82	0	0	14.43	15.28
8:55:44	148.6	4.2	-1	2	82	82	0	0	14.41	15.27
8:55:45	148.8	5.4	-2	-1	82	82	0	0	14.4	15.26
8:55:46	148.8	4.8	-2	-2	82	82	0	0	14.38	15.27
8:55:47	148.9	4.8	-4	-2	82	82	0	0	14.4	15.26
8:55:48	149	4.2	-4	-3	82	82	0	0	14.42	15.27
8:55:49	149.1	4.2	-4	-3	82	82	0	0	14.39	15.29

Appendix 3: Data from Stolt Perseverance Voyage Data Recorder (All time UTC)

Time	Heading	Rate of Turn	Rudder Order	Rudder Response	RPM Order	RPM Response	Bowthruster Order	Bowthruster Responce	STW Longt	SOG Longt
8:55:50	149.1	4.2	-4	-3	82	82	0	0	14.39	15.29
8:55:51	149.2	3.6	-4	-3	82	82	0	0	14.4	15.29
8:55:52	149.3	3	-5	-3	82	82	0	0	14.38	15.3
8:55:53	149.3	2.4	-6	-4	82	82	0	0	14.38	15.3
8:55:54	149.3	2.4	-6	-4	82	82	0	0	14.38	15.3
8:55:54	149.3	1.8	-6	-5	82	82	0	0	14.38	15.3
8:55:55	149.4	0.6	-3	-5	82	82	0	0	14.38	15.3
8:55:56	149.4	0.6	-3	-3	82	82	0	0	14.4	15.32
8:55:57	149.4	0.6	-3	-3	82	82	0	0	14.39	15.32
8:55:58	149.4	0.6	3	-3	82	82	0	0	14.41	15.32
8:55:59	149.4	1.2	-3	1	82	82	0	0	14.4	15.32
8:56:00	149.4	1.2	-3	1	82	82	0	0	14.42	15.31
8:56:01	149.5	1.8	-3	-2	82	82	0	0	14.37	15.31
8:56:02	149.5	1.2	-5	-3	82	82	0	0	14.34	15.31
8:56:03	149.5	0	-6	-4	82	82	0	0	14.36	15.3
8:56:04	149.5	-1.2	-6	-5	82	82	0	0	14.36	15.3
8:56:05	149.5	-1.8	-6	-5	82	82	0	0	14.34	15.29
8:56:06	149.4	-1.8	-6	-5	82	82	0	0	14.33	15.3
8:56:08	149.4	-3.6	-2	-5	82	82	0	0	14.37	15.31
8:56:09	149.3	-3.6	-2	-2	82	82	0	0	14.37	15.3
8:56:10	149.2	-3	3	0	82	82	0	0	14.4	15.3
8:56:11	149.2	-1.8	3	2	82	82	0	0	14.41	15.31
8:56:12	149.2	-1.2	-3	2	82	82	0	0	14.43	15.3
8:56:13	149.1	-1.8	-4	-2	82	82	0	0	14.43	15.29
8:56:14	149.1	-1.8	-4	-3	82	82	0	0	14.45	15.29

Appendix 3: Data from Stolt Perseverance Voyage Data Recorder (All time UTC)

Time	Heading	Rate of Turn	Rudder Order	Rudder Response	RPM Order	RPM Response	Bowthruster Order	Bowthruster Responce	STW Longt	SOG Longt
8:56:15	149.1	-2.4	-4	-3	82	82	0	0	14.47	15.28
8:56:16	149	-2.4	-3	1	82	82	0	0	14.5	15.27
8:56:17	149	-1.8	-3	1	82	82	0	0	14.48	15.27
8:56:18	149	-0.6	3	1	82	82	0	0	14.5	15.26
8:56:19	149	0	3	2	82	82	0	0	14.51	15.26
8:56:20	149	0.6	3	1	82	82	0	0	14.47	15.26
8:56:21	149	1.2	3	1	82	82	0	0	14.47	15.26
8:56:22	149	2.4	-5	1	82	82	0	0	14.47	15.26
8:56:23	149.1	3	-5	-2	82	82	0	0	14.44	15.26
8:56:24	149.1	1.8	-6	-5	82	82	0	0	14.46	15.26
8:56:25	149.2	0.6	-6	-5	82	82	0	0	14.43	15.26
8:56:26	149.2	0	-6	-6	82	82	0	0	14.46	15.27
8:56:27	149.1	-1.2	-6	-6	82	82	0	0	14.48	15.27
8:56:28	149.1	-2.4	-7	-6	82	82	0	0	14.48	15.28
8:56:29	149	-4.2	-6	-7	82	82	0	0	14.47	15.27
8:56:30	149	-4.8	-6	-7	82	82	0	0	14.46	15.28
8:56:31	148.9	-5.4	-2	-5	82	82	0	0	14.47	15.28
8:56:32	148.8	-5.4	-2	-2	82	82	0	0	14.49	15.28
8:56:33	148.7	-4.2	3	-2	82	82	0	0	14.5	15.29
8:56:34	148.7	-3.6	3	3	82	82	0	0	14.51	15.28
8:56:35	148.6	-3	3	2	82	82	0	0	14.49	15.27
8:56:36	148.6	-2.4	3	2	82	82	0	0	14.47	15.27
8:56:37	148.5	-1.8	3	2	82	82	0	0	14.49	15.27
8:56:38	148.5	-1.2	3	2	82	82	0	0	14.5	15.27
8:56:39	148.5	-1.2	3	2	82	82	0	0	14.5	15.27

Appendix 3: Data from Stolt Perseverance Voyage Data Recorder (All time UTC)

Time	Heading	Rate of Turn	Rudder Order	Rudder Response	RPM Order	RPM Response	Bowthruster Order	Bowthruster Responce	STW Longt	SOG Longt
8:56:39	148.5	-0.6	-4	2	82	82	0	0	14.53	15.26
8:56:40	148.5	-1.2	-4	-3	82	82	0	0	14.53	15.26
8:56:41	148.5	-2.4	-4	-4	82	82	0	0	14.54	15.26
8:56:42	148.4	-1.8	-5	-3	82	82	0	0	14.53	15.26
8:56:43	148.4	-2.4	-5	-4	82	82	0	0	14.5	15.26
8:56:44	148.4	-2.4	2	-3	82	82	0	0	14.53	15.26
8:56:45	148.3	-2.4	3	1	82	82	0	0	14.53	15.26
8:56:46	148.3	-1.2	3	2	82	82	0	0	14.47	15.26
8:56:47	148.3	0	-2	2	82	82	0	0	14.5	15.26
8:56:48	148.3	0	-3	-2	82	82	0	0	14.49	15.25
8:56:49	148.3	-0.6	-4	-3	82	82	0	0	14.45	15.26
8:56:50	148.3	-0.6	-4	-3	82	82	0	0	14.45	15.26
8:56:51	148.3	-1.2	-2	-4	82	82	0	0	14.46	15.25
8:56:52	148.2	-1.2	2	-3	82	82	0	0	14.47	15.25
8:56:54	148.2	-0.6	-4	-1	82	82	0	0	14.49	15.23
8:56:55	148.2	-0.6	-5	-3	82	82	0	0	14.49	15.23
8:56:56	148.2	-0.6	-5	-4	82	82	0	0	14.5	15.23
8:56:57	148.2	0	-5	-4	82	82	0	0	14.48	15.23
8:56:58	148.2	-0.6	-5	-4	82	82	0	0	14.47	15.23
8:56:59	148.2	-0.6	-5	-4	82	82	0	0	14.43	15.24
8:57:00	148.2	-1.2	-5	-4	82	82	0	0	14.46	15.25
8:57:01	148.1	-1.2	1	-3	82	82	0	0	14.44	15.25
8:57:02	148.1	-1.2	-4	-1	82	82	0	0	14.44	15.25
8:57:03	148.1	-0.6	-5	-1	82	82	0	0	14.47	15.26
8:57:04	148.1	-1.2	-6	-5	82	82	0	0	14.46	15.25

Appendix 3: Data from Stolt Perseverance Voyage Data Recorder (All time UTC)

Time	Heading	Rate of Turn	Rudder Order	Rudder Response	RPM Order	RPM Response	Bowthruster Order	Bowthruster Responce	STW Longt	SOG Longt
8:57:05	148	-3	-6	-5	82	82	0	0	14.44	15.24
8:57:06	148	-3.6	3	-5	82	82	0	0	14.46	15.23
8:57:07	147.9	-3.6	3	-1	82	82	0	0	14.45	15.23
8:57:08	147.9	-2.4	3	2	82	82	0	0	14.43	15.25
8:57:09	147.8	-1.2	6	2	82	82	0	0	14.45	15.25
8:57:10	147.8	0	3	3	82	82	0	0	14.46	15.25
8:57:11	147.9	1.2	4	3	82	82	0	0	14.47	15.25
8:57:12	147.9	1.2	7	3	82	82	0	0	14.5	15.26
8:57:13	147.9	1.8	3	6	82	82	0	0	14.5	15.25
8:57:14	148	3	3	6	82	82	0	0	14.47	15.25
8:57:15	148	4.2	3	6	82	82	0	0	14.5	15.26
8:57:16	148.1	4.2	0	-1	82	82	0	0	14.5	15.26
8:57:17	148.2	4.2	-5	-2	82	82	0	0	14.52	15.27
8:57:18	148.2	4.2	-5	-4	82	82	0	0	14.5	15.27
8:57:19	148.3	3.6	-5	-4	82	82	0	0	14.5	15.27
8:57:20	148.4	4.2	-5	-4	82	82	0	0	14.51	15.28
8:57:21	148.5	3.6	-5	-4	82	82	0	0	14.49	15.28
8:57:22	148.5	3.6	-5	-4	82	82	0	0	14.51	15.28
8:57:23	148.6	3.6	3	-3	82	82	0	0	14.47	15.27
8:57:24	148.6	4.2	10	2	82	82	0	0	14.46	15.28
8:57:25	148.8	6.6	12	8	82	82	0	0	14.47	15.28
8:57:26	148.9	7.8	13	12	82	82	0	0	14.5	15.29
8:57:27	149.1	11.4	13	13	82	82	0	0	14.5	15.29
8:57:28	149.2	12.6	13	13	82	82	0	0	14.5	15.29
8:57:29	149.5	15	10	13	82	82	0	0	14.5	15.29

Appendix 3: Data from Stolt Perseverance Voyage Data Recorder (All time UTC)

Time	Heading	Rate of Turn	Rudder Order	Rudder Response	RPM Order	RPM Response	Bowthruster Order	Bowthruster Responce	STW Longt	SOG Longt
8:57:30	149.8	16.2	10	13	82	82	0	0	14.52	15.28
8:57:31	150.1	18	10	8	82	82	0	0	14.5	15.29
8:57:32	150.4	19.8	10	9	82	82	0	0	14.5	15.29
8:57:33	150.8	22.2	10	10	82	82	0	0	14.52	15.28
8:57:34	151.1	23.4	10	10	82	82	0	0	14.51	15.28
8:57:35	151.6	26.4	10	10	82	82	0	0	14.5	15.28
8:57:36	152	28.2	10	10	82	82	0	0	14.45	15.27
8:57:37	152.6	30.6	3	9	82	82	0	0	14.46	15.26
8:57:38	153	32.4	3	3	82	82	0	0	14.43	15.26
8:57:39	153.7	33	3	2	82	82	0	0	14.46	15.27
8:57:40	154.1	33	3	2	82	82	0	0	14.44	15.27
8:57:41	154.8	34.2	3	2	82	82	0	0	14.43	15.26
8:57:42	155.3	35.4	3	1	82	82	0	0	14.42	15.26
8:57:43	156	36.6	-6	0	82	82	0	0	14.4	15.25
8:57:44	156.5	37.2	-7	-4	82	82	0	0	14.4	15.24
8:57:45	157.2	35.4	-11	-7	82	81	0	0	14.41	15.23
8:57:46	157.7	34.2	-11	-9	82	81	0	0	14.37	15.22
8:57:47	158.2	31.8	-31	-10	82	81	0	0	14.37	15.22
8:57:48	158.8	29.4	-46	-13	82	81	0	0	14.36	15.22
8:57:49	159.3	27	-46	-18	82	81	0	0	14.36	15.21
8:57:50	159.7	25.2	-58	-24	82	81	0	0	14.37	15.19
8:57:51	160.2	22.8	-70	-29	82	81	0	0	14.34	15.19
8:57:52	160.4	22.2	-66	-36	82	81	0	0	14.34	15.18
8:57:53	160.9	21	-65	-41	82	80	0	0	14.34	15.15
8:57:54	161.2	20.4	-48	-23	82	80	0	0	14.29	15.13

Appendix 3: Data from Stolt Perseverance Voyage Data Recorder (All time UTC)

Time	Heading	Rate of Turn	Rudder Order	Rudder Response	RPM Order	RPM Response	Bowthruster Order	Bowthruster Responce	STW Longt	SOG Longt
8:57:55	161.6	19.8	-43	-48	82	79	0	0	14.28	15.1
8:57:56	161.8	19.2	-70	-48	82	79	0	0	14.27	15.07
8:57:57	162.2	18.6	-70	-50	82	78	0	0	14.25	15.06
8:57:58	162.4	18.6	-70	-59	82	77	0	0	14.21	15.03
8:57:59	162.8	18.6	-70	-65	82	77	0	0	14.18	14.99
8:58:00	163.1	18.6	-70	-65	82	77	0	0	14.16	14.95
8:58:01	163.5	19.2	-70	-65	82	76	0	0	14.14	14.94
8:58:02	163.7	19.2	-70	-65	82	75	0	0	14.09	14.9
8:58:03	164.1	20.4	-50	-65	82	75	0	0	14.07	14.89
8:58:04	164.4	20.4	-61	-57	82	75	0	0	14.02	14.86
8:58:05	164.8	20.4	-68	-57	82	75	0	0	13.96	14.83
8:58:06	165.1	20.4	-60	-58	82	75	0	0	13.95	14.8
8:58:07	165.5	21	-70	-65	82	75	0	0	13.9	14.77
8:58:08	165.8	21	-70	-65	82	75	0	0	13.85	14.73
8:58:09	166.2	21	-70	-65	82	75	0	0	13.84	14.69
8:58:10	166.5	21.6	-70	-65	82	75	0	0	13.84	14.67
8:58:11	166.9	21.6	-70	-65	82	75	0	0	13.79	14.65
8:58:12	167.2	21.6	-70	-65	82	75	0	0	13.75	14.62
8:58:13	167.7	22.2	-70	-65	82	74	0	0	13.7	14.58
8:58:14	168	22.8	-70	-30	82	74	0	0	13.66	14.54
8:58:15	168.4	24	-70	-30	82	74	0	0	13.63	14.5
8:58:16	168.8	24	-70	-65	82	74	0	0	13.63	14.46
8:58:17	169.3	24	-70	-65	82	74	0	0	13.62	14.41
8:58:18	169.6	24.6	-70	-65	82	74	0	0	13.58	14.4
8:58:19	170.1	25.2	-70	-65	82	74	0	0	13.54	14.36

Appendix 3: Data from Stolt Perseverance Voyage Data Recorder (All time UTC)

Time	Heading	Rate of Turn	Rudder Order	Rudder Response	RPM Order	RPM Response	Bowthruster Order	Bowthruster Responce	STW Longt	SOG Longt
8:58:20	170.4	24.6	-70	-65	82	74	0	0	13.5	14.34
8:58:21	170.9	25.8	-70	-65	82	74	0	0	13.48	14.29
8:58:22	171.3	25.2	-70	-65	82	74	0	0	13.42	14.25
8:58:23	171.7	25.2	-70	-65	82	74	0	0	13.39	14.22
8:58:24	172.1	25.8	-70	-65	82	73	0	0	13.34	14.18
8:58:25	172.7	26.4	-70	-65	82	73	0	0	13.27	14.15
8:58:26	173	26.4	-70	-65	82	73	0	0	13.22	14.11
8:58:27	173.6	27	-70	-65	82	73	0	0	13.19	14.06
8:58:28	173.9	27.6	-70	-65	82	73	0	0	13.17	14.04
8:58:29	174.5	28.2	-70	-65	82	73	0	0	13.1	13.99
8:58:30	174.9	28.2	-70	-65	82	73	0	0	13.06	13.95
8:58:31	175.4	28.8	-70	-65	82	73	0	0	13.02	13.93
8:58:32	175.8	29.4	-70	-65	82	73	0	0	12.99	13.9
8:58:33	176.4	28.8	-70	-65	82	73	0	0	12.98	13.87
8:58:34	176.8	29.4	-70	-65	82	73	0	0	12.93	13.84
8:58:35	177.3	29.4	-69	-30	82	73	0	0	12.89	13.8
8:58:36	177.8	30	-70	-65	82	73	0	0	12.83	13.75
8:58:37	178.4	30.6	-70	-65	82	73	0	0	12.76	13.71
8:58:38	178.8	30.6	-70	-65	82	73	0	0	12.71	13.67
8:58:39	179.4	30.6	-58	-65	82	73	0	0	12.69	13.64
8:58:40	179.9	31.2	-58	-65	82	73	0	0	12.68	13.62
8:58:41	180.5	31.8	-70	-64	82	73	0	0	12.62	13.58
8:58:42	180.9	31.8	-70	-64	82	73	0	0	12.57	13.54
8:58:43	181.6	31.8	-59	-65	82	73	0	0	12.55	13.49
8:58:44	182	32.4	-70	-65	82	72	0	0	12.54	13.46

Appendix 3: Data from Stolt Perseverance Voyage Data Recorder (All time UTC)

Time	Heading	Rate of Turn	Rudder Order	Rudder Response	RPM Order	RPM Response	Bowthruster Order	Bowthruster Responce	STW Longt	SOG Longt
8:58:45	182.7	32.4	-51	-65	82	72	0	0	12.53	13.43
8:58:46	183.1	32.4	-66	-57	82	72	0	0	12.48	13.37
8:58:47	183.6	32.4	-70	-57	82	72	0	0	12.42	13.33
8:58:48	184.2	32.4	-49	-57	82	72	0	0	12.39	13.27
8:58:49	184.8	33	-66	-57	82	72	0	0	12.36	13.26
8:58:50	185.3	32.4	-66	-57	82	72	0	0	12.35	13.2
8:58:51	185.9	32.4	-50	-51	82	72	0	0	12.3	13.16
8:58:52	186.4	33	-50	-51	82	72	0	0	12.26	13.11
8:58:53	187	32.4	-50	-51	82	72	0	0	12.22	13.07
8:58:54	187.5	32.4	-50	-51	82	72	0	0	12.21	13.04
8:58:55	188.1	32.4	-51	-26	82	72	0	0	12.15	12.99
8:58:56	188.6	32.4	-59	-51	82	72	0	0	12.1	12.95
8:58:57	189.2	31.8	-70	-65	82	72	0	0	12.11	12.91
8:58:58	189.6	32.4	-70	-65	82	72	0	0	12.07	12.86
8:58:59	190.2	33	-70	-65	82	72	0	0	12.04	12.86
8:59:00	190.7	32.4	-70	-65	82	72	0	0	12.01	12.84
8:59:01	191.4	32.4	-70	-65	82	71	0	0	11.95	12.78
8:59:02	191.8	32.4	-70	-65	82	71	0	0	11.88	12.73
8:59:03	192.5	32.4	-70	-65	82	71	0	0	11.84	12.68
8:59:04	192.9	32.4	-70	-65	82	71	0	0	11.82	12.66
8:59:05	193.6	32.4	-43	-53	82	71	0	0	11.78	12.6
8:59:06	194	32.4	-43	-53	82	71	0	0	11.74	12.56
8:59:07	194.6	31.8	-44	-47	82	71	0	0	11.69	12.51
8:59:08	195.1	31.8	-48	-46	82	71	0	0	11.66	12.45
8:59:09	195.7	31.2	-70	-51	82	71	0	0	11.63	12.43

Appendix 3: Data from Stolt Perseverance Voyage Data Recorder (All time UTC)

Time	Heading	Rate of Turn	Rudder Order	Rudder Response	RPM Order	RPM Response	Bowthruster Order	Bowthruster Responce	STW Longt	SOG Longt
8:59:10	196.1	31.2	-70	-51	82	71	0	0	11.54	12.41
8:59:11	196.6	31.2	-61	-61	82	71	0	0	11.51	12.35
8:59:12	197.2	30.6	-54	-65	82	71	0	0	11.46	12.3
8:59:13	197.8	30.6	-52	-56	82	71	0	0	11.44	12.29
8:59:14	198.2	30.6	-52	-56	82	71	0	0	11.41	12.26
8:59:15	198.8	30.6	-52	-27	82	71	0	0	11.37	12.2
8:59:16	199.2	30	-52	-53	82	71	0	0	11.34	12.15
8:59:17	199.8	30	-53	-53	82	70	0	0	11.3	12.11
8:59:18	200.2	29.4	-53	-53	82	70	0	0	11.28	12.07
8:59:19	200.8	29.4	-53	-53	82	70	0	0	11.22	12.01
8:59:20	201.2	29.4	-53	-53	82	70	0	0	11.19	11.95
8:59:21	201.8	29.4	-53	-53	79	70	0	0	11.15	11.9
8:59:22	202.2	29.4	-53	-53	79	70	0	0	11.09	11.9
8:59:23	202.6	28.8	-53	-53	78	70	0	0	11.06	11.85
8:59:24	203.1	28.8	-53	-53	74	70	0	0	11.03	11.83
8:59:25	203.7	28.8	-53	-53	73	70	0	0	11	11.78
8:59:26	204.1	28.8	-53	-53	73	70	0	0	10.96	11.72
8:59:27	204.7	28.2	-53	-53	73	70	0	0	10.96	11.68
8:59:28	205	28.2	-53	-53	73	70	0	0	10.95	11.65
8:59:29	205.6	27.6	-55	-59	-38	70	0	0	10.93	11.6
8:59:30	206	27.6	-55	-59	-38	70	0	0	10.87	11.54
8:59:31	206.5	27.6	-58	-60	-72	70	0	0	10.83	11.5
8:59:32	206.9	27.6	-66	-65	-86	70	0	0	10.8	11.46
8:59:33	207.5	27.6	-70	-65	-91	69	0	0	10.78	11.44
8:59:34	207.8	28.2	-70	-65	-91	69	0	0	10.73	11.4

Appendix 3: Data from Stolt Perseverance Voyage Data Recorder (All time UTC)

Time	Heading	Rate of Turn	Rudder Order	Rudder Response	RPM Order	RPM Response	Bowthruster Order	Bowthruster Responce	STW Longt	SOG Longt
8:59:35	208.3	28.2	-69	-30	-93	69	0	0	10.67	11.37
8:59:36	208.8	28.2	-70	-65	-94	68	0	0	10.65	11.33
8:59:37	209.4	28.2	-70	-65	-94	67	0	0	10.59	11.28
8:59:38	209.7	28.8	-70	-65	-94	65	0	0	10.55	11.25
8:59:39	210.3	28.8	-70	-65	-94	64	-73	-54	10.51	11.21
8:59:40	210.7	29.4	-70	-65	-94	62	-44	-19	10.49	11.16
8:59:41	211.3	29.4	-70	-65	-94	61	-29	-20	10.45	11.12
8:59:42	211.7	30	-70	-65	-94	59	-7	-13	10.4	11.06
8:59:43	212.3	30	-70	-65	-94	58	0	-5	10.39	11.03
8:59:44	212.7	30	-70	-65	-94	56	1	-2	10.34	10.99
8:59:45	213.3	30.6	-65	-65	-94	56	2	-2	10.31	10.96
8:59:46	213.7	30.6	-65	-65	-94	54	2	0	10.24	10.93
8:59:47	214.3	31.2	-65	-65	-94	53	2	0	10.19	10.88
8:59:48	214.8	31.2	-65	-65	-94	52	2	0	10.16	10.85
8:59:49	215.4	32.4	-65	-65	-94	50	2	0	10.11	10.81
8:59:50	215.9	32.4	-69	-65	-94	48	2	0	10.06	10.74
8:59:51	216.5	33	-70	-65	-94	46	2	0	9.96	10.7
8:59:52	217	33	-70	-65	-94	45	2	0	9.97	10.67
8:59:53	217.6	33.6	-70	-65	-94	43	3	0	9.95	10.62
8:59:54	218.1	33.6	-70	-65	-94	42	2	0	9.89	10.57
8:59:55	218.8	34.8	-69	-30	-94	40	3	1	9.86	10.53
8:59:56	219.2	34.8	-70	-65	-94	40	3	1	9.82	10.51
8:59:57	220	35.4	-70	-65	-94	38	3	1	9.77	10.45
8:59:58	220.4	35.4	-70	-65	-94	37	3	3	9.73	10.4
8:59:59	221	36	-70	-65	-94	35	6	5	9.72	10.34

Appendix 3: Data from Stolt Perseverance Voyage Data Recorder (All time UTC)

Time	Heading	Rate of Turn	Rudder Order	Rudder Response	RPM Order	RPM Response	Bowthruster Order	Bowthruster Responce	STW Longt	SOG Longt
9:00:00	221.6	36.6	-70	-65	-94	34	5	5	9.67	10.31
9:00:01	222.4	37.8	-70	-65	-94	32	5	4	9.61	10.26
9:00:02	222.9	37.8	-70	-65	-94	31	5	4	9.55	10.24
9:00:03	223.6	38.4	-70	-65	-94	29	6	5	9.51	10.15
9:00:04	224.2	39	-70	-65	-94	27	7	9	9.44	10.09
9:00:05	225	39	-70	-65	-94	26	5	6	9.41	10.07
9:00:06	225.5	39.6	-70	-65	-94	24	4	4	9.28	10.01
9:00:07	226.3	40.2	-70	-65	-94	22	4	3	9.26	9.95
9:00:08	226.8	40.8	-70	-65	-94	22	4	2	9.23	9.89
9:00:09	227.7	41.4	-70	-65	-94	20	3	2	9.29	9.83
9:00:10	228.2	42	-70	-65	-94	19	3	3	9.2	9.77
9:00:11	228.9	42.6	-70	-65	-94	17	4	2	9.1	9.73
9:00:12	229.7	43.2	-70	-65	-94	16	4	2	9.1	9.67
9:00:13	230.5	43.8	-70	-65	-94	15	3	2	9.08	9.61
9:00:14	231.1	43.8	-69	-31	-94	13	4	2	9.06	9.54
9:00:15	231.9	34.2	-69	-30	-94	12	4	2	9.02	9.43
9:00:16	232.3	33.6	-70	-65	-94	10	4	3	9.03	9.29
9:00:17	233	25.8	-70	-65	-94	8	4	3	9.01	9.2
9:00:18	233.2	19.2	-70	-65	-94	7	4	4	9.01	9.14
9:00:19	233.5	13.8	-70	-65	-94	6	5	4		9.15
9:00:20	233.7	12	-70	-65	-94	4	5	4		9.15
9:00:21	234	15.6	-70	-65	-94	3	7	7		9.15
9:00:22	234.3	21	-70	-65	-94	1	6	7		9.15
9:00:23	234.6	24	-70	-65	-94	0	5	4		9.15
9:00:24	235.1	27.6	-70	-65	-94	0	4	2		9.15

Appendix 3: Data from Stolt Perseverance Voyage Data Recorder (All time UTC)

Time	Heading	Rate of Turn	Rudder Order	Rudder Response	RPM Order	RPM Response	Bowthruster Order	Bowthruster Responce	STW Longt	SOG Longt
9:00:25	235.7	33	-70	-65	-94	-4	3	2		9.15
9:00:26	236.2	36	-70	-65	-94	-6	3	1		9.15
9:00:27	237	37.8	-62	-65	-94	-8	3	1		9.15
9:00:28	237.5	39.6	-70	-65	-94	-10	2	1		9.15
9:00:29	238.3	41.4	-70	-65	-94	-10	3	0		9.15
9:00:30	238.8	41.4	-70	-65	-94	-12	3	1		9.15
9:00:31	239.7	40.8	-70	-65	-94	-14	3	0		9.15
9:00:32	240.2	40.2	-70	-65	-94	-17	2	-1		9.15
9:00:33	241	38.4	-65	-65	-94	-18	1	-3		9.15
9:00:34	241.5	38.4	-69	-65	-94	-21	0	-4		9.15
9:00:35	242.1	37.8	-70	-65	-94	-23	-1	-4		9.15
9:00:36	242.8	37.8	-70	-65	-94	-25	0	-4		9.15
9:00:37	243.6	36.6	-67	-65	-93	-27	-1	-4		9.15
9:00:38	244	36	-43	-63	-74	-30	0	-5		9.15
9:00:39	244.7	34.8	-43	-50	-86	-32	0	-5		9.15
9:00:40	245.2	34.2	-43	-45	-90	-33	-1	-4		9.15
9:00:41	245.9	33.6	-43	-43	-92	-36	-1	-4		9.15
9:00:42	246.3	33	-43	-43	-93	-37	-1	-4		9.15
9:00:43	247	33.6	-43	-43	-94	-39	-1	-4		9.15
9:00:44	247.4	33.6	-35	-43	-94	-41	-1	-4		9.15
9:00:45	248.1	34.8	-35	-40	-94	-44	-1	-4		9.15
9:00:46	248.6	36.6	-35	-35	-94	-46	-1	-4		9.15
9:00:47	249.2	37.8	-35	-35	-94	-48	-1	-4		9.15
9:00:48	249.9	37.8	-35	-35	-94	-50	-1	-4		9.15
9:00:49	250.6	38.4	-35	-35	-94	-51	0	-4		9.15

Appendix 3: Data from Stolt Perseverance Voyage Data Recorder (All time UTC)

Time	Heading	Rate of Turn	Rudder Order	Rudder Response	RPM Order	RPM Response	Bowthruster Order	Bowthruster Responce	STW Longt	SOG Longt
9:00:50	251.2	39	-35	-35	-94	-52	-1	-4		9.15
9:00:51	252	39.6	-35	-35	-94	-52	-1	-4		9.15
9:00:52	252.5	39	3	-33	-94	-52	0	-4		9.15
9:00:53	253.3	39	3	-25	-94	-52	0	-4		9.15
9:00:54	253.8	39	3	-11	-94	-52	-1	-3		9.15
9:00:55	254.5	37.8	3	-10	-94	-52	0	-4		9.15
9:00:56	255	37.8	3	-10	-94	-52	0	-4		9.15
9:00:57	255.8	36.6	3	-8	-94	-52	0	-3		9.15
9:00:58	256.3	36	3	-6	-94	-52	0	-3		9.15
9:00:59	256.9	34.8	3	-3	-94	-52	0	-3		9.15
9:01:00	257.5	34.2	3	2	-94	-52	0	-3		9.15
9:01:01	258.1	34.2	3	2	-94	-53	0	-3		9.15
9:01:02	258.6	33	3	2	-94	-53	0	-3		9.15
9:01:03	259.2	32.4	3	2	-94	-53	0	-3		9.15
9:01:04	259.7	32.4	3	2	-94	-53	1	-3		9.15
9:01:05	260.3	31.8	3	2	-94	-54	0	-3		9.15
9:01:06	260.7	30.6	3	2	-94	-54	2	0		9.15
9:01:07	261.3	30	3	2	-94	-54	4	2		9.15
9:01:08	261.7	29.4	3	2	-94	-54	5	4		9.15
9:01:09	262.3	28.2	3	3	-94	-54	5	4		9.15
9:01:10	262.7	28.2	3	3	-94	-55	6	4		9.15
9:01:11	263.1	27	3	3	-94	-55	5	5		9.15
9:01:12	263.6	26.4	3	2	-94	-55	5	5		9.15
9:01:13	264.1	25.8	3	3	-94	-56	7	6		9.15
9:01:14	264.4	25.2	3	2	-94	-56	6	6		9.15

Appendix 3: Data from Stolt Perseverance Voyage Data Recorder (All time UTC)

Time	Heading	Rate of Turn	Rudder Order	Rudder Response	RPM Order	RPM Response	Bowthruster Order	Bowthruster Responce	STW Longt	SOG Longt
9:01:15	264.9	25.2	3	2	-94	-56	8	9		9.15
9:01:16	265.3	24.6	3	2	-94	-56	8	8		9.15
9:01:17	265.8	24	3	3	-94	-56	7	7		9.15
9:01:18	266.1	22.8	3	3	-94	-56	7	8		9.15
9:01:19	266.6	22.2	3	3	-94	-56	9	12		9.15
9:01:20	266.8	22.2	3	2	-94	-56	10	12		9.15
9:01:21	267.3	21	3	2	-94	-56	9	11		9.15
9:01:22	267.5	21	3	2	-94	-56	7	7		9.15
9:01:23	267.9	20.4	3	3	-94	-56	7	6		9.15
9:01:24	268.2	20.4	3	2	-94	-56	6	7		9.15
9:01:25	268.6	19.8	3	2	-94	-56	7	8		9.15
9:01:26	268.9	19.2	3	3	-94	-56	11	14		9.15
9:01:27	269.3	19.2	3	2	-94	-56	11	14		9.15
9:01:28	269.5	18.6	3	2	-94	-56	13	16		9.15
9:01:29	269.9	18.6	3	2	-94	-56	12	14		9.15
9:01:30	270.2	18	3	2	-94	-56	12	14		9.15
9:01:31	270.5	17.4	3	3	-94	-56	11	13		9.15
9:01:32	270.8	17.4	3	3	-94	-56	9	11		9.15
9:01:33	271.1	16.8	3	3	-94	-56	8	10		9.15
9:01:34	271.3	16.8	3	3	-94	-56	10	10		9.15
9:01:35	271.6	16.2	3	3	-94	-56	8	10		9.15
9:01:36	271.9	15.6	3	2	-94	-56	9	11		9.15
9:01:37	272.2	15	3	2	-94	-56	8	9		9.15
9:01:38	272.4	15	3	3	-94	-56	9	8		9.15
9:01:39	272.7	15.6	3	2	-94	-56	1	-1		9.15

Appendix 3: Data from Stolt Perseverance Voyage Data Recorder (All time UTC)

Time	Heading	Rate of Turn	Rudder Order	Rudder Response	RPM Order	RPM Response	Bowthruster Order	Bowthruster Responce	STW Longt	SOG Longt
9:01:40	272.9	15	3	2	-94	-55	0	-3		9.15
9:01:41	273.2	13.8	3	3	-94	-55	0	-3		9.15
9:01:42	273.4	13.8	3	2	-94	-55	5	4		9.15
9:01:43	273.6	13.8	3	2	-92	-55	8	7		9.15
9:01:44	273.8	13.8	3	2	-80	-55	5	5		9.15
9:01:45	274.1	12.6	3	2	-74	-55	4	3		9.15
9:01:46	274.2	12	3	2	-86	-55	4	2		9.15
9:01:47	274.5	12.6	3	2	-91	-55	4	2		9.15
9:01:48	274.7	12	3	3	-91	-55	3	2		9.15
9:01:49	274.9	11.4	3	2	-93	-55	3	2		9.15
9:01:50	275.1	10.8	3	2	-94	-54	3	1	3.58	
9:01:51	275.3	11.4	3	2	-94	-54	3	1	3.31	
9:01:52	275.5	12	3	2	-94	-54	3	1	2.83	
9:01:53	275.7	11.4	3	2	-94	-54	3	1	2.46	
9:01:54	275.8	10.8	3	3	-94	-54	4	2	2	
9:01:55	276	10.8	3	2	-94	-54	4	3	1.59	
9:01:56	276.2	10.8	3	3	-94	-54	6	6	1.41	
9:01:57	276.4	10.2	3	3	-94	-54	9	10	1.21	
9:01:58	276.5	9.6	3	2	-94	-54	7	6	1.02	
9:01:59	276.7	9.6	3	2	-94	-54	7	6	0.87	
9:02:00	276.9	9.6	3	3	-94	-54	4	2	0.74	
9:02:01	277	9.6	3	2	-94	-54	4	3	0.64	
9:02:02	277.2	9.6	3	2	-94	-54	4	2	0.54	
9:02:03	277.4	9	3	2	-94	-54	4	2	0.43	
9:02:04	277.5	8.4	3	2	-94	-54	3	2	0.35	

Appendix 3: Data from Stolt Perseverance Voyage Data Recorder (All time UTC)

Time	Heading	Rate of Turn	Rudder Order	Rudder Response	RPM Order	RPM Response	Bowthruster Order	Bowthruster Responce	STW Longt	SOG Longt
9:02:05	277.7	9	3	2	-94	-54	3	2	0.29	
9:02:06	277.8	9	3	2	-94	-54	3	2	0.23	
9:02:07	278	8.4	3	2	-94	-54	3	2	0.11	
9:02:08	278.1	8.4	3	2	-94	-54	4	3	0.16	
9:02:09	278.2	7.8	3	2	-94	-54	4	2	0.14	
9:02:10	278.3	8.4	3	3	-94	-54	4	3	0.11	
9:02:11	278.5	9	3	3	-94	-54	4	3	0.1	
9:02:12	278.6	7.8	3	2	-94	-54	4	3	0.06	
9:02:13	278.8	7.2	3	2	-94	-54	7	6	0.08	
9:02:14	278.9	7.2	3	3	-94	-54	6	4	0.06	
9:02:15	279	7.8	3	3	-94	-54	4	3	0.03	
9:02:16	279.2	7.8	3	2	-94	-54	3	2	0.08	
9:02:17	279.3	6.6	3	2	-94	-54	4	2	0.08	
9:02:18	279.4	6.6	3	3	-94	-54	3	1	0.05	
9:02:19	279.5	6.6	3	3	-94	-54	3	2	0.04	
9:02:20	279.6	7.2	3	3	-88	-54	5	4	0.04	
9:02:21	279.8	6.6	3	2	-78	-54	6	7	-0.02	
9:02:22	279.8	6	3	2	-74	-54	6	6	-0.07	
9:02:23	279.9	6	3	2	-48	-54	6	5	-0.03	
9:02:24	280	6.6	3	2	-34	-54	6	6	-0.02	
9:02:25	280.2	6	3	2	-41	-54	8	9	0	
9:02:26	280.3	6	3	2	-44	-54	10	11	0.02	
9:02:27	280.4	6	3	2	-45	-53	12	14	0	
9:02:28	280.5	6.6	3	3	-45	-52	9	10	-0.03	
9:02:29	280.6	6.6	3	2	-34	-51	8	7	-0.05	

Appendix 3: Data from Stolt Perseverance Voyage Data Recorder (All time UTC)

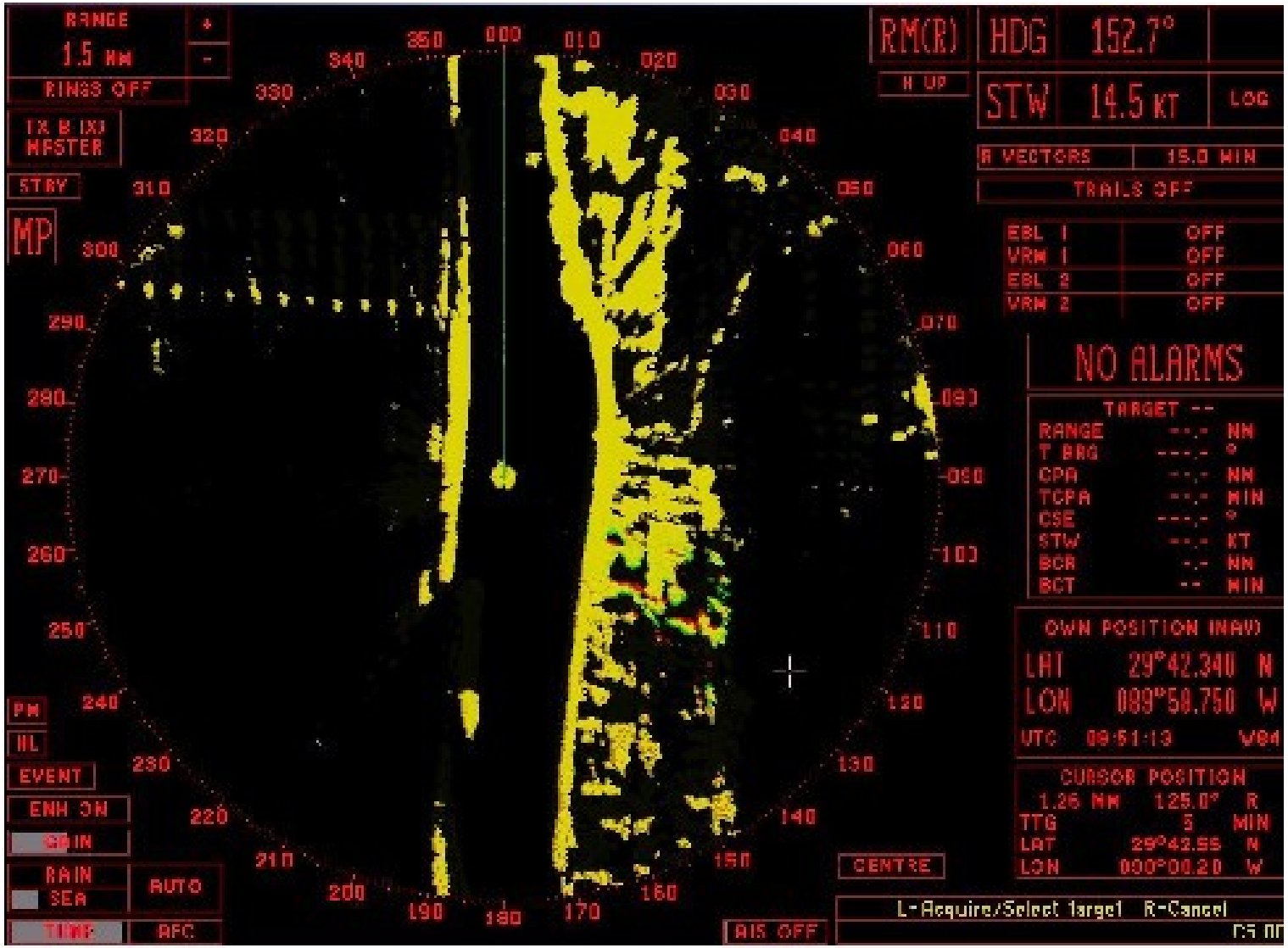
Time	Heading	Rate of Turn	Rudder Order	Rudder Response	RPM Order	RPM Response	Bowthruster Order	Bowthruster Responce	STW Longt	SOG Longt
9:02:30	280.7	6	3	3	-14	-50	7	7	-0.06	
9:02:31	280.8	5.4	3	2	-6	-48	7	7	0.02	
9:02:32	280.9	6	3	2	-4	-47	10	11	0.08	
9:02:33	281	6	3	2	-3	-47	9	11	0.1	
9:02:34	281.1	5.4	3	3	-1	-46	9	11	0.11	
9:02:35	281.2	5.4	3	2	-1	-44	10	12	0.03	
9:02:36	281.3	5.4	3	2	-1	-42	9	9	-0.02	
9:02:37	281.4	5.4	3	2	-1	-41	8	9	-0.02	
9:02:38	281.5	6	3	3	-1	-39	11	12	-0.08	
9:02:39	281.6	4.8	3	3	-1	-38	9	9	-0.08	
9:02:40	281.7	5.4	3	3	-1	-36	8	8	-0.12	
9:02:41	281.8	6	3	3	-1	-34	8	8	-0.05	
9:02:42	281.9	6	3	3	-1	-33	9	11	0.02	
9:02:43	282	4.8	3	3	-1	-32	10	16	0.01	
9:02:44	282.1	4.8	3	3	-1	-31	14	17	-0.02	
9:02:45	282.2	4.8	3	2	-1	-30	16	20	-0.04	
9:02:46	282.2	5.4	3	3	-1	-28	16	20	0	
9:02:47	282.3	4.2	3	3	-1	-26	15	19	0.03	
9:02:48	282.4	4.2	3	3	-1	-25	12	13	0.04	
9:02:49	282.5	4.2	3	3	-1	-23	10	11	-0.01	
9:02:50	282.5	4.2	3	3	0	-22	10	13	-0.05	
9:02:51	282.6	4.2	3	2	18	-20	14	17	-0.09	
9:02:52	282.7	4.2	3	2	28	-18	12	13	-0.08	
9:02:53	282.8	3.6	3	2	31	-17	14	18	-0.06	
9:02:54	282.8	3.6	3	3	33	-16	14	19	-0.03	

Appendix 3: Data from Stolt Perseverance Voyage Data Recorder (All time UTC)

Time	Heading	Rate of Turn	Rudder Order	Rudder Response	RPM Order	RPM Response	Bowthruster Order	Bowthruster Responce	STW Longt	SOG Longt
9:02:55	282.9	3.6	3	3	34	-15	18	25	0.02	
9:02:56	282.9	3.6	3	2	41	-14	19	25	0	
9:02:57	283	3	3	3	46	-12	16	20	-0.01	
9:02:58	283	3	3	2	47	-10	12	14	-0.03	
9:02:59	283.1	3.6	3	2	48	-9	10	12	-0.03	
9:03:00	283.2	3	3	2	48	-7	11	12	-0.05	

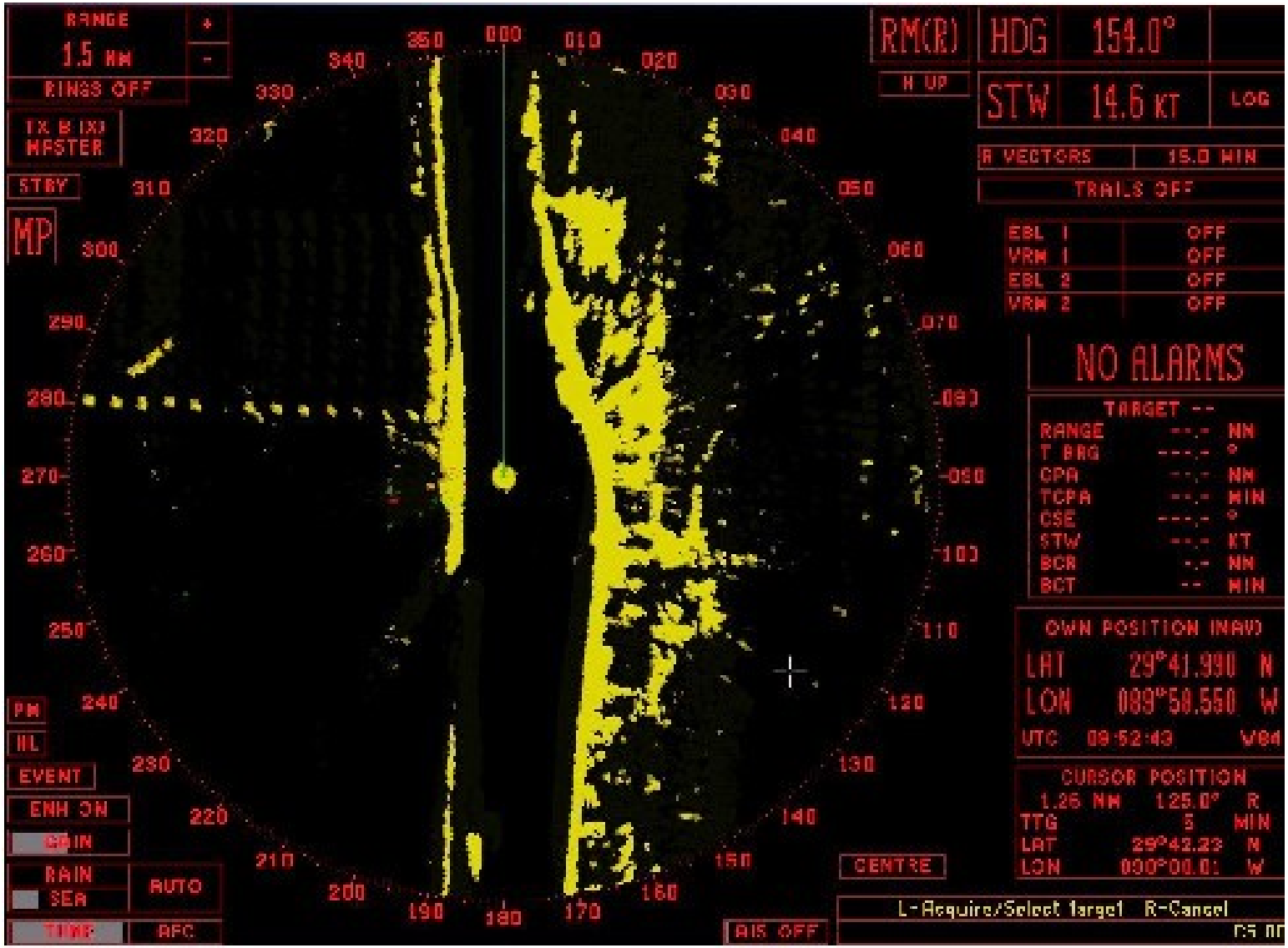
Appendix 4: ARPA Radar Display from Stolt Perseverance (UTC Time information contained in “OWN POSITION” section of the display.

Appendix 4: ARPA Radar Display from Stolt Perseverance (UTC Time information contained in “OWN POSITION” section of the display.

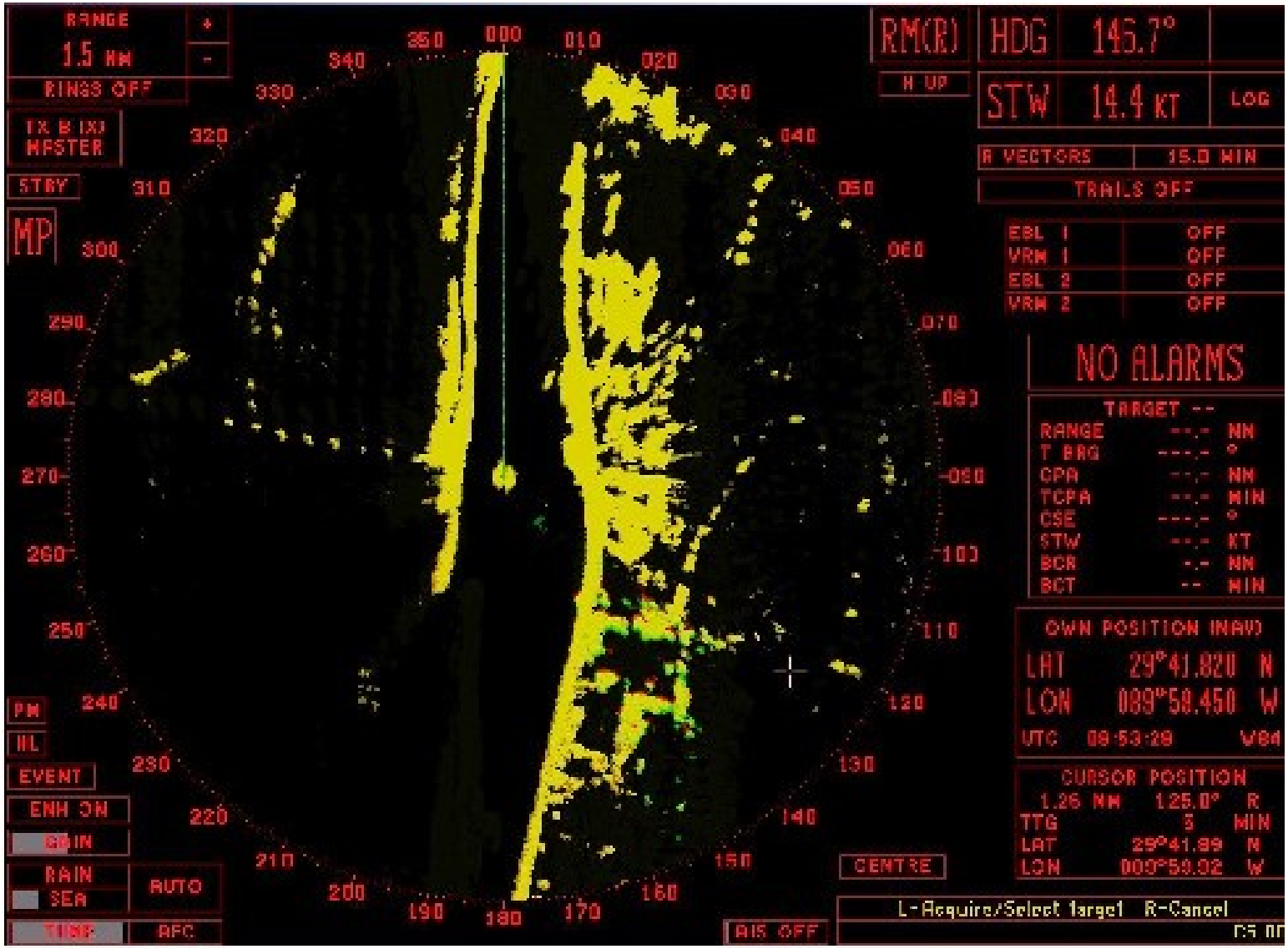


Appendix 4: ARPA Radar Display from Stolt Perseverance (UTC Time information contained in "OWN POSITION" section of the display.

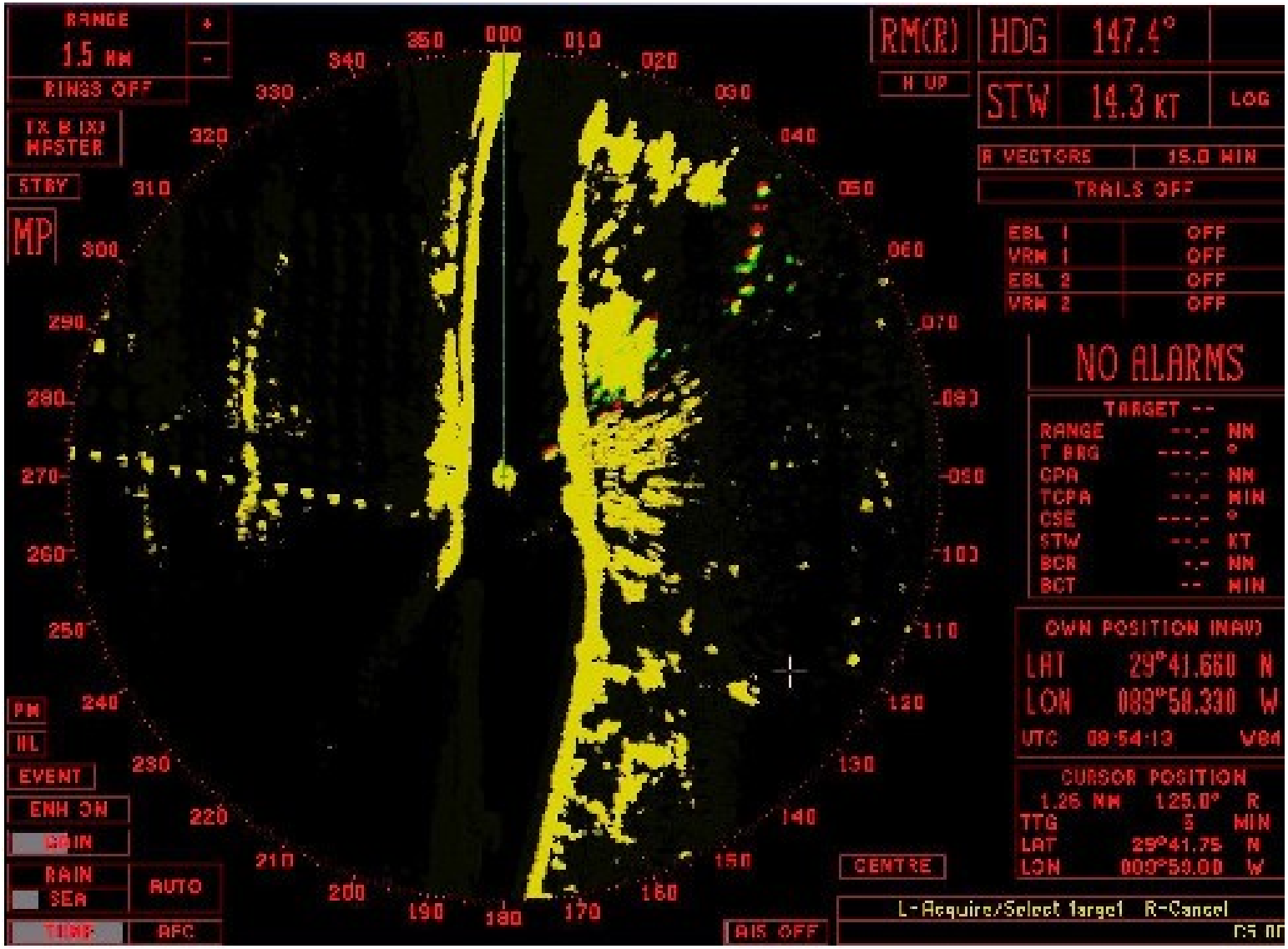
Appendix 4: ARPA Radar Display from Stolt Perseverance (UTC Time information contained in “OWN POSITION” section of the display.



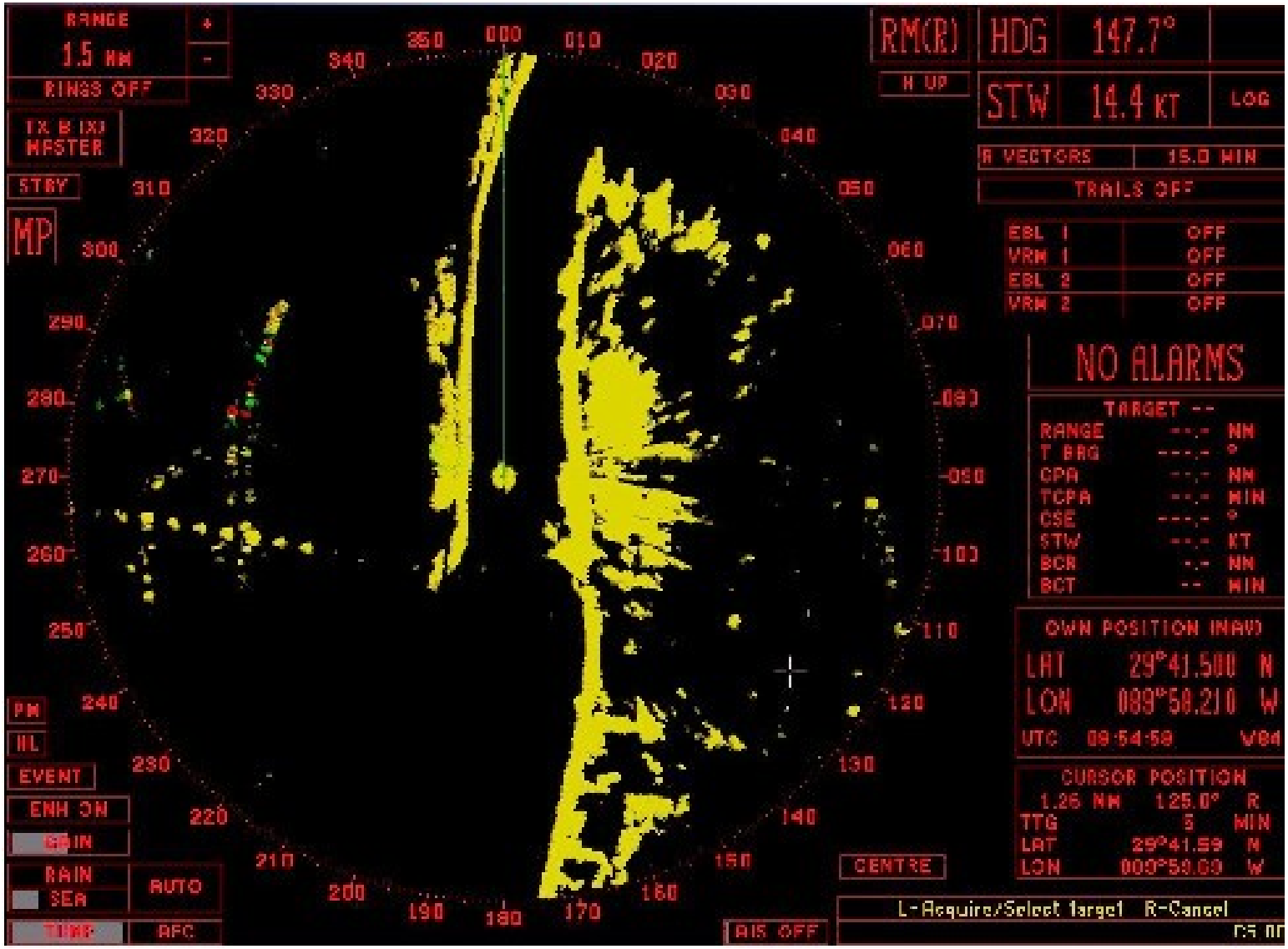
Appendix 4: ARPA Radar Display from Stolt Perseverance (UTC Time information contained in "OWN POSITION" section of the display.



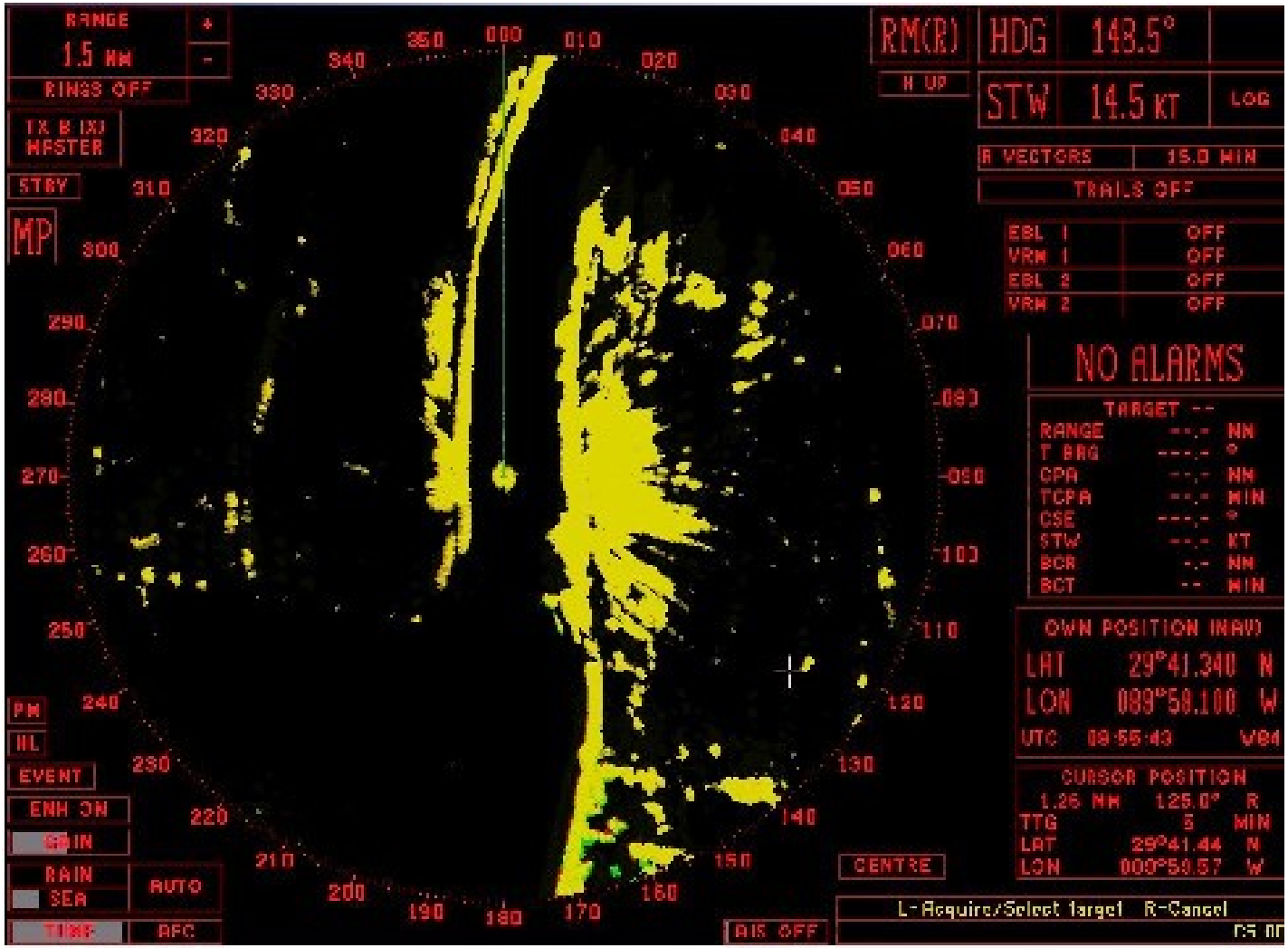
Appendix 4: ARPA Radar Display from Stolt Perseverance (UTC Time information contained in “OWN POSITION” section of the display.



Appendix 4: ARPA Radar Display from Stolt Perseverance (UTC Time information contained in “OWN POSITION” section of the display.

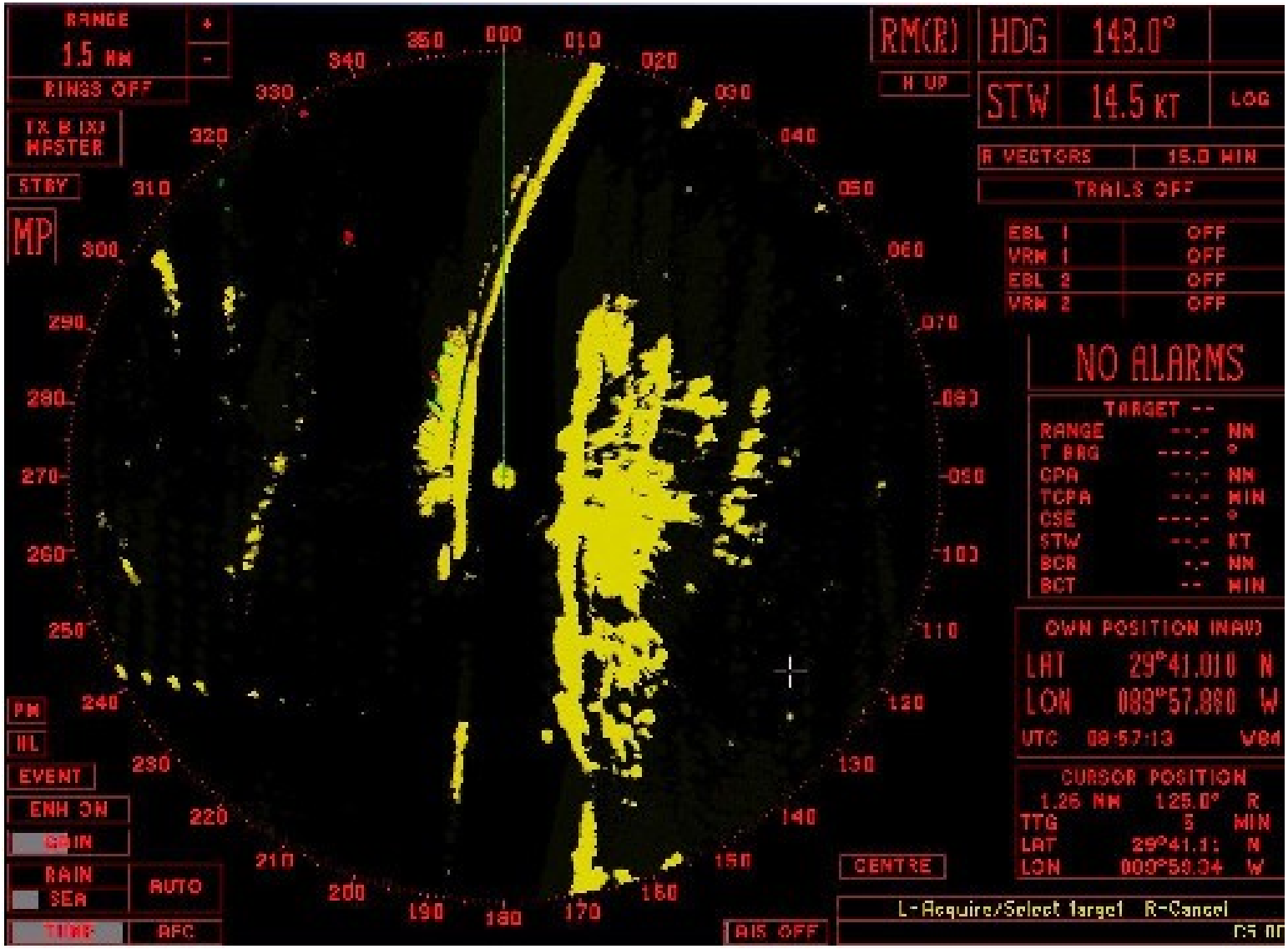


Appendix 4: ARPA Radar Display from Stolt Perseverance (UTC Time information contained in “OWN POSITION” section of the display.

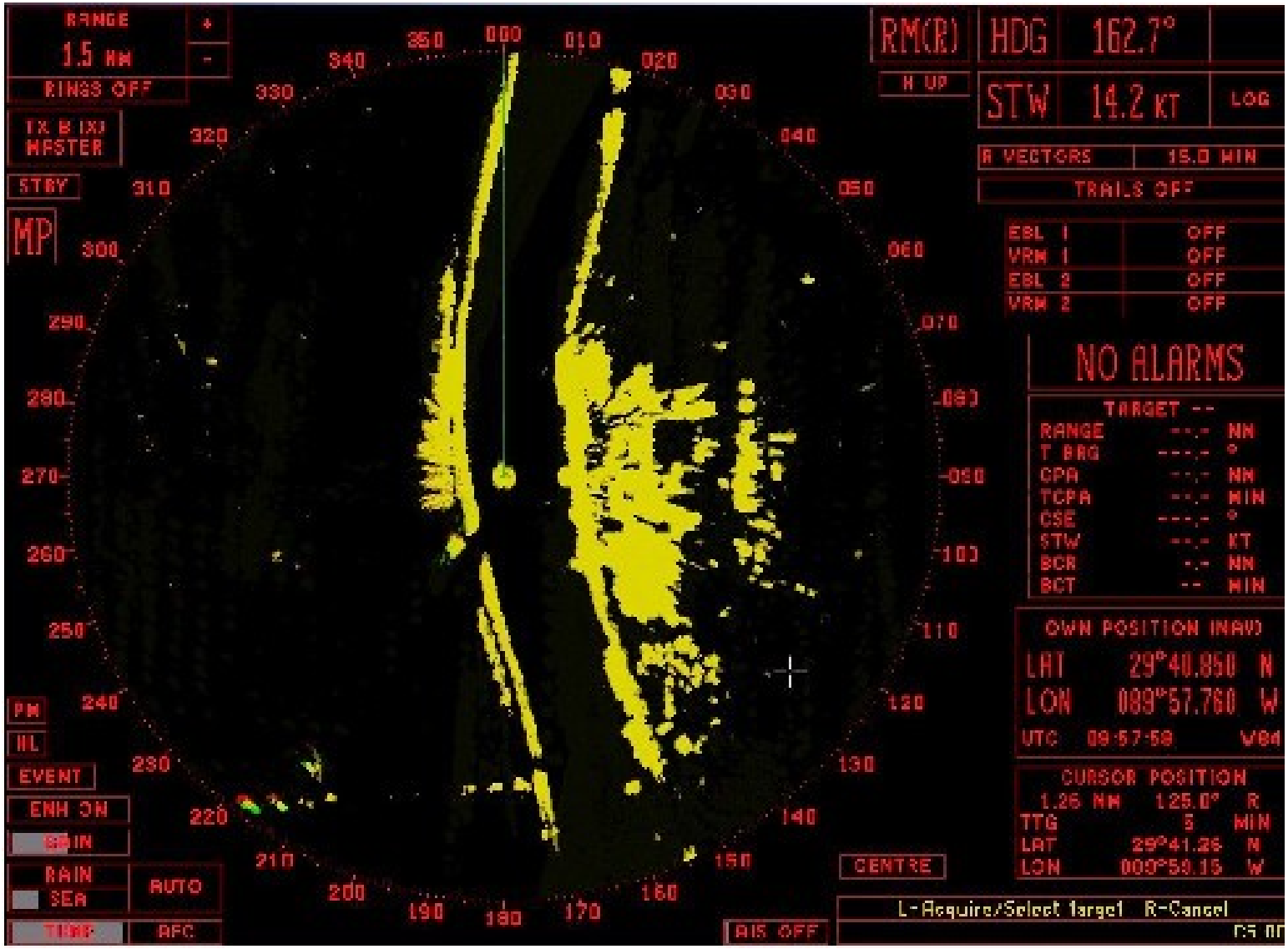


The above displays from 08:50 to 08:55 (UTC) show the ship easily maintaining the desired course.

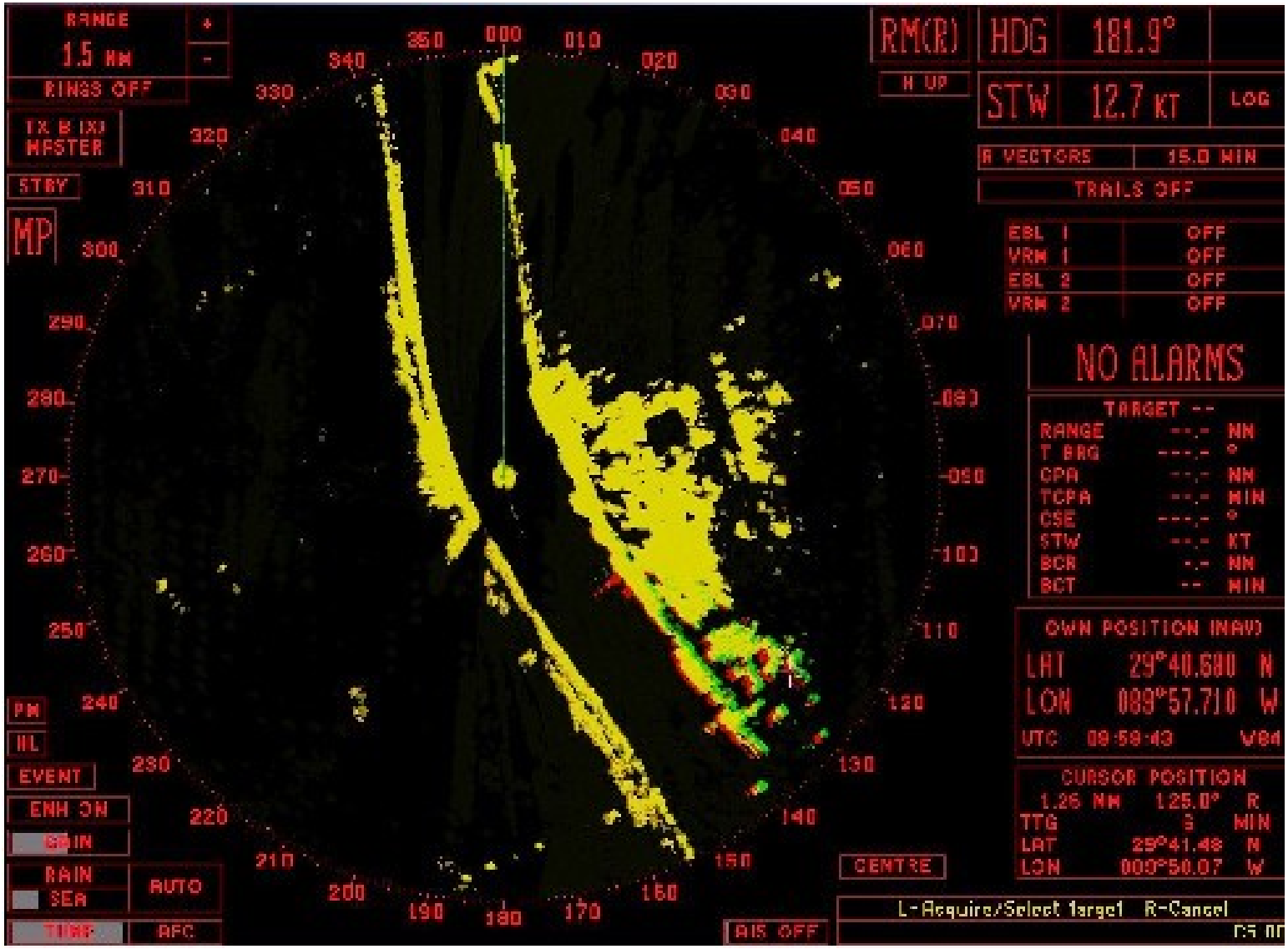
Appendix 4: ARPA Radar Display from Stolt Perseverance (UTC Time information contained in “OWN POSITION” section of the display.



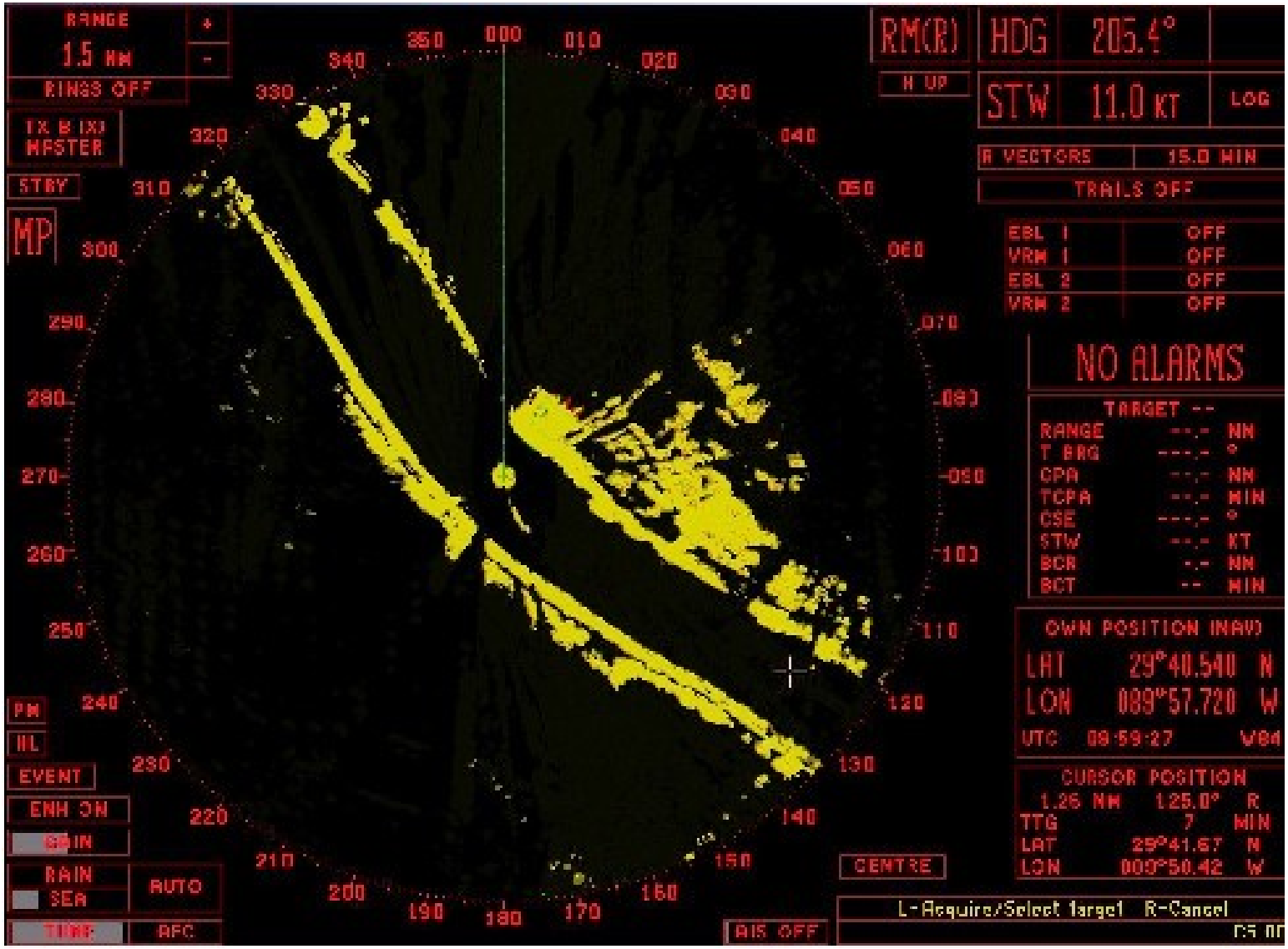
Appendix 4: ARPA Radar Display from Stolt Perseverance (UTC Time information contained in “OWN POSITION” section of the display.



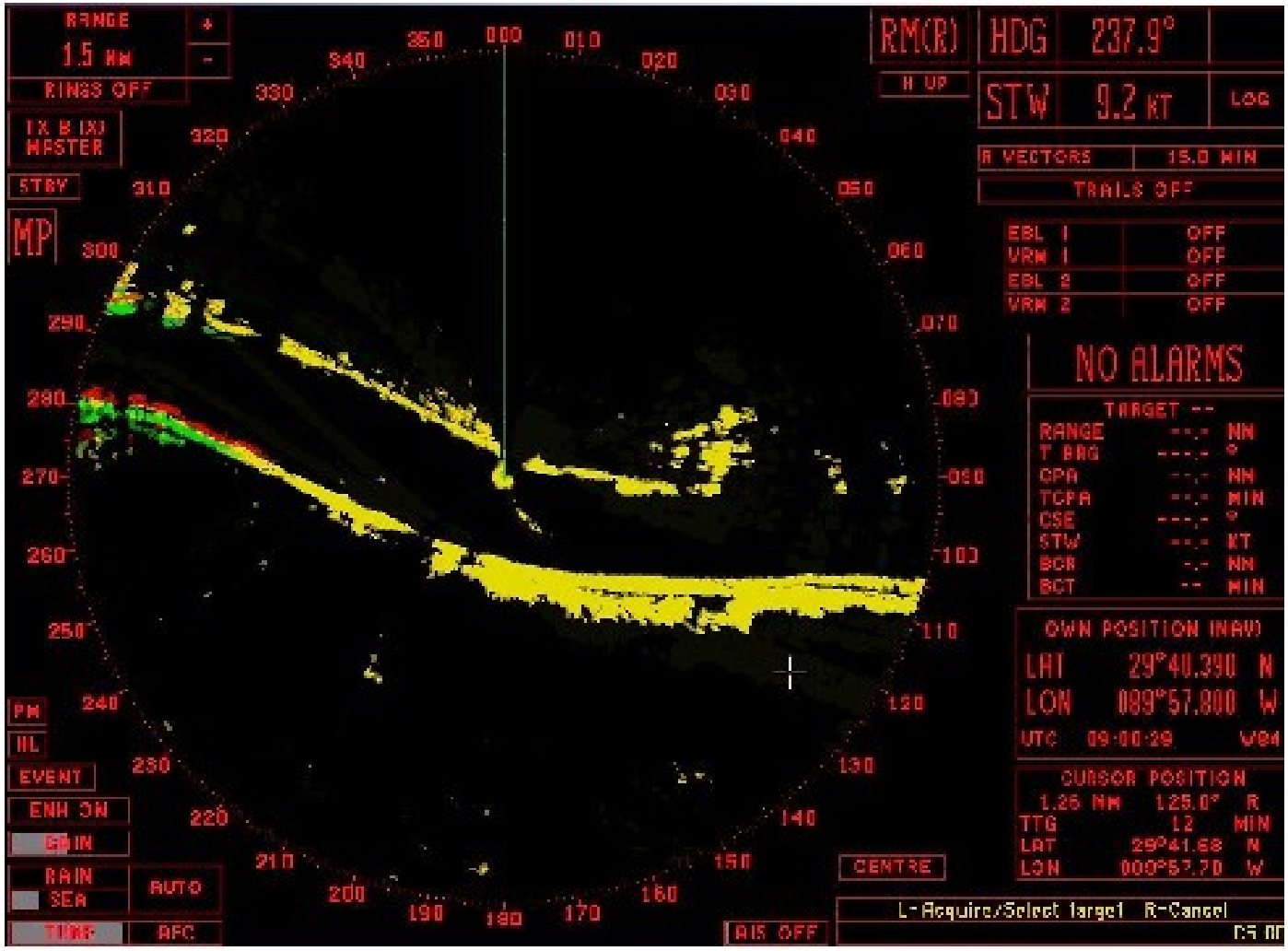
Appendix 4: ARPA Radar Display from Stolt Perseverance (UTC Time information contained in “OWN POSITION” section of the display.



Appendix 4: ARPA Radar Display from Stolt Perseverance (UTC Time information contained in “OWN POSITION” section of the display.



Appendix 4: ARPA Radar Display from Stolt Perseverance (UTC Time information contained in "OWN POSITION" section of the display.



The above displays show the loss of steerage and the collision with the tug/barge.