REPUBLIC OF THE MARSHALL ISLANDS

Maritime Administrator

STELLAR BANNER CASUALTY INVESTIGATION REPORT

Grounding and Constructive Total Loss

Offshore Ponta da Madeira, Brazil | 24 February 2020

Official Number: 6941

IMO Number: 9726803

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AUTHORITY

An investigation, under the authority of the Republic of the Marshall Islands laws and regulations, including all international instruments to which the Republic of the Marshall Islands is a Party, was conducted to determine the cause of the casualty.

Maritime Administrator

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LIST OF ABBREVIATIONS

1 A/E	First Assistant Engineer
2 A/E	Second Assistant Engineer
2/O	Second Officer
3 A/E	Third Assistant Engineer
3/O	Third Officer
AIS	Automatic Identification System
APV	Aft Peak Void
ASD	Able Seafarer Deck
BA	British Admiralty
BRM	Bridge Resource Management
C/E	Chief Engineer
C/O	Chief Officer
CATZOC	Category Zone of Confidence
DBV	Double Bottom Centerline Void
DHN	Diretoria de Hidrografia e Navegação
DWT	Deadweight Tonnage
EBL	Electronic Bearing Line
ECDIS	Electronic Chart Display and Information System
ENC	Electronic Navigational Chart
ERM	Engine Room Management
FPV	Fore Peak Void
IHO	International Hydrographic Organization
IMO	International Maritime Organization
ISM Code	International Management Code for the Safe Operation of Ships and for Pollution Prevention (International Safety Management) Code
KR	Korean Register of Shipping

LT . . . . . Local Time

m . . . . . Meters

m^3/hr . . . . . Cubic Meters Per Hour

MLC, 2006 . . . . . Maritime Labour Convention, 2006

mm . . . . . Millimeters

MT. . . . . Metric Tons

mTH . . . . . Meters Total Head

NM . . . . . Nautical Miles

OOW . . . . . Officer on Watch

PIANC. . . . . World Association for Waterborne Transport Infrastructure

RPM . . . . . Revolutions Per Minute

SMS. . . . . Safety Management System

SOLAS . . . . . International Convention for the Safety of Life at Sea

T . . . . . True

STCW Code . . . . . Seafarers Training, Certification and Watchkeeping Code

UKC . . . . . Under Keel Clearance

UKHO . . . . . United Kingdom Hydrographic Office

VDR . . . . . Voyage Data Recorder

VLOC . . . . . Very Large Ore Carrier

WBT . . . . . Water Ballast Tank

PART 1: EXECUTIVE SUMMARY

On 24 February 2020, the Republic of the Marshall Islands-registered VLOC STELLAR BANNER, managed by Polaris Shipping Co. Ltd. (the "Company"), contacted the bottom after departing from Ponta da Madeira, Federative Republic of Brazil ("Brazil"), while laden with 294,871 MT of iron ore. The ship's hull was damaged, resulting in flooding of multiple voids and WBTs.

The ship anchored while the crewmembers assessed the damage and attempted to control the flooding using fixed and portable pumps. After several hours, it was determined that sea water was flooding the damaged voids and tanks faster than the fixed and portable pumps could pump it out. Based on this assessment, the Master moved STELLAR BANNER to shallower water and intentionally grounded the ship on the morning of 25 February 2020.

Between 12–26 March 2020, the salvors removed 3,500 MT of fuel oil and 140 MT of diesel fuel that had been on board the ship. The salvors then began lightering the ship's cargo. By 27 May 2020, about 145,000 MT of cargo had been lightered and the ship was refloated. The ship was immediately towed and re-anchored in deeper water, where a damage survey was conducted. Based on the findings of this survey, it was determined that STELLAR BANNER was a constructive total loss.

On 12 June 2020, STELLAR BANNER was scuttled with the remaining cargo on board approximately 55-60 NM northeast of the entrance to the Baía de São Marcos approach channel in more than 2,700 m of water. All hazardous materials had previously been removed from the ship before it was scuttled.

The marine safety investigation conducted by the Republic of the Marshall Islands Maritime Administrator (the "Administrator") identified the following:

1. Causal factors that contributed to this very serious marine casualty include:
   (a) the Master's decisions to:
      (i) deviate from the planned route during the outbound transit of Baía de São Marcos; and
      (ii) pass within 1 NM of a 20 m shoal based on limited hydrographic information provided on ENC BR321600;
   (b) that STELLAR BANNER contacted the bottom after deviating from the planned route, resulting in damage to the hull and flooding of multiple voids and WBTs;
   (c) the charted depths depicted on ENC BR321600 and BA Chart 543 in the immediate vicinity of the ship's position where it contacted the bottom did not provide a clear indication of the full range of depths within the 20-30 m contour or the size of the 20 m shoal that STELLAR BANNER passed over;
   (d) ineffective BRM during STELLAR BANNER's outbound transit of Baía de São Marcos; and
   (e) the Company's navigation watchstanding procedures did not provide clear expectations and guidance regarding the use of BRM by members of the ship's bridge team when the Master has the conn.
2. Causal factors that may have contributed to this very serious marine casualty include:
   (a) the time and the height of the tide used to calculate the ship's UKC for the leg that crossed the sandbar between buoys Nos. 1-4 did not take the correction factors included in the sailing directions issued by DHN or the terminal operator's regulations into account;
   (b) the calculated UKC for the leg that crossed the sandbar between buoys Nos. 1-4 was not updated when the ship's departure from the terminal was delayed due to the late arrival of the pilots;
   (c) the difference between how the 20 m contour near the ship's position at 2130[1] was depicted on ENC BR321600 and BA Chart 543;
   (d) the dredged channel that is between buoys Nos. 1-4 and the details of its minimum depth and maintenance are not indicated on either the ENC or the paper charts; and
   (e) the Master's decision to not anchor and wait for high tide to cross the sand bar between buoys Nos. 1-4.
3. Additional issues that were identified but that did not contribute to this very serious marine casualty include:
   (a) the more than 5 m difference in the water depth the 2/O used to calculate the ship's UKC and the depth he entered on the spreadsheet that included details for each leg of the ship's planned voyage; and
   (b) the setting of the echo sounder was changed from the 50 m to the 100 m scale while the ship was inshore of the 50 m contour.

1 Unless otherwise stated, all times are ship's local time (UTC -3).

PART 2: FINDINGS OF FACT

The following Findings of Fact are based on the information obtained during the Administrator's marine safety investigation.

1. Ship particulars: *see* chart to right.

2. STELLAR BANNER was a purpose-built, seven-hold, VLOC built in 2016 at the Hyundai Heavy Industries Co., Ltd. shipyard at Gunsan, Republic of Korea. It was designed, built, and classed in accordance with the applicable KR rules.

3. There were WBTs to port and starboard of the Cargo Holds Nos. 1, 3, 5, and 7 *(see Figure 1)*. Each of these tanks was the same length as the adjacent cargo hold.

4. There was also a WBT and a void space to port and starboard of Cargo Holds Nos. 2, 4, and 6. Each of these WBTs and voids were half the length of the adjacent cargo hold.

5. A single continuous DBV located under the cargo holds extended from frame No. 48 forward to frame No. 94.[2] In addition, there was an FPV and an APV.

Bilge System

6. The ship's bilge piping system included[3] a main line that extended from the engine room, forward through the DBV. There were branch lines from the main line leading to the port and starboard bilge wells in each cargo hold and the bilge suctions in the FPV, each wing void, and at the forward and aft ends of the DBV.

7. Each of the cargo hold bilge lines had a hydraulically activated valve controlled from the Deck Office. The valve for the FPV suction line was also hydraulically activated and could be operated remotely from the Deck Office or by using a hand pump located in the Bosun Stores.

8. The valves for the wing void bilge lines were manually operated.

9. Connected to the main bilge line were two self-priming, centrifugal general service pumps with a rated output of 530 m^3/hr at 30 mTH. The bilge system also included a 150 m^3/hr eductor for stripping the bilges.

2 The cargo length was located between frames Nos. 52-94.

3 The bilge piping for other spaces, including the APV, Engine Room, Bosun Stores, and chain lockers is not described.

SHIP PARTICULARS

Ship Name
STELLAR BANNER

Registered Owner
VP-12 Shipping Inc.

ISM Ship Management
Polaris Shipping Co. Ltd.

Flag State
Republic of the Marshall Islands

IMO No.	Official No.	Call Sign
9726803	6941	V7TC5

Year of Build	Gross Tonnage
2016	151,596

Net Tonnage	Deadweight Tonnage
50,544	300,660

Length x Breadth x Depth
328.5 x 55 x 29 m

Ship Type
VLOC

Document of Compliance Recognized Organization
KR

Safety Management Certificate Recognized Organization
KR

Classification Society
KR

Persons on Board
20

Ballast Water System

10. The ship's ballast water system had two main lines extending from the Engine Room forward through the port and starboard sides of the DBV. The line on the port side had branch lines extending to each of the port WBTs and the line on the starboard side had branch lines extending to the starboard WBTs.

11. There was also a single stripping line extending from the Engine Room forward through the DBV, with branch lines for each wing WBT. Each of the branch lines (primary and stripping) included a hydraulically activated butterfly isolation valve that was controlled from the Deck Office.

12. The ship had two 4,000 m^3/hr at 35 mTH centrifugal water ballast pumps. There was also a 350 m^3/hr eductor for stripping the WBTs.

13. The quantity of water in each WBT could be monitored in the Deck Office.

Water Ingress and Bilge High Level Alarms

14. As required by SOLAS, chapter XII, regulation 12, water ingress detectors were installed and located on or near the ship's centerline that provided both an audible and visual alarm when activated on the Bridge as follows:

    (a) 0.1 m above the deck in the Bosun Stores;

    (b) 0.1 m above the bottom shell in the FPV; and

    (c) 0.5 and 2 m above the hold bottom in each of the cargo holds.

15. Bilge high level alarm switches were installed at the forward and aft ends of the DBV, the Bosun Stores, Engine Room, and emergency fire pump space.

Baía de São Marcos

16. The Ponta da Madeira Terminal is located to the north of the Porto de Itaqui, Brazil near where the Mearim River enters the Baía de São Marcos

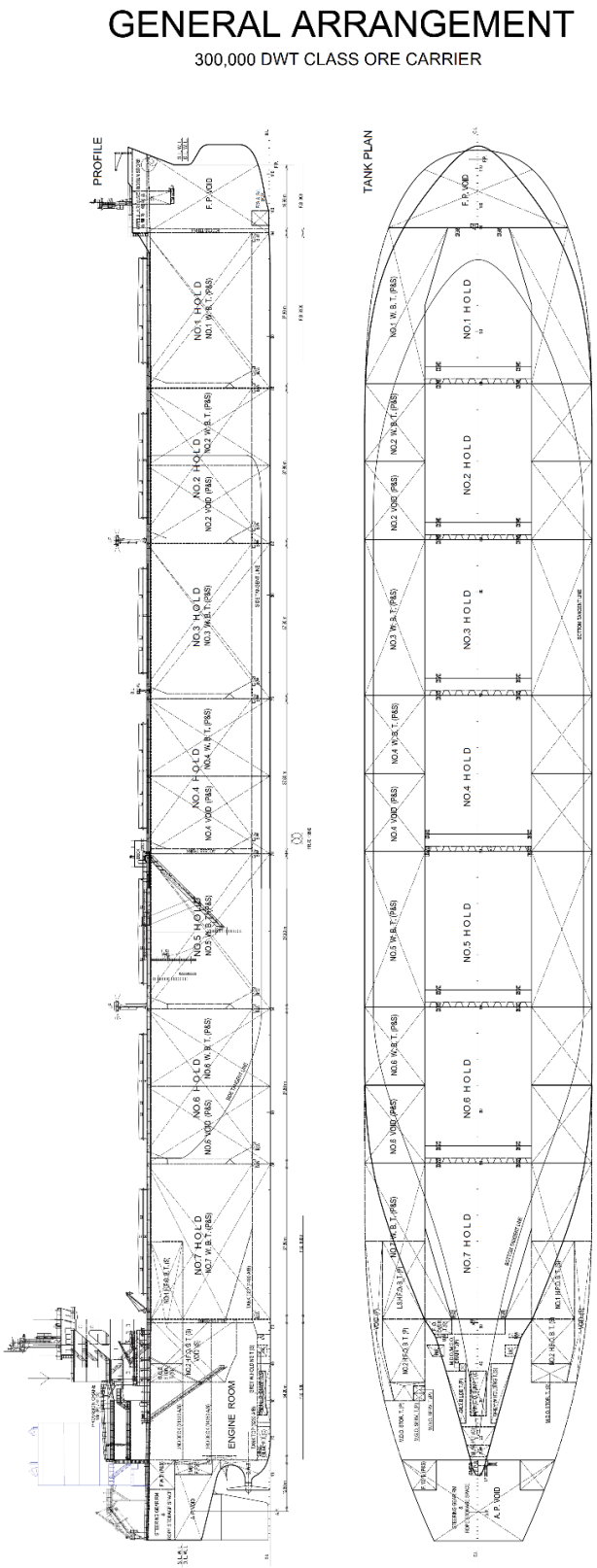

Figure 1: STELLAR BANNER General Arrangement Drawing.

on Brazil's northeast coast. A 55 NM long, buoyed approach channel marks safe passage through the many sandbanks found throughout the bay *(see Figure 2)*.

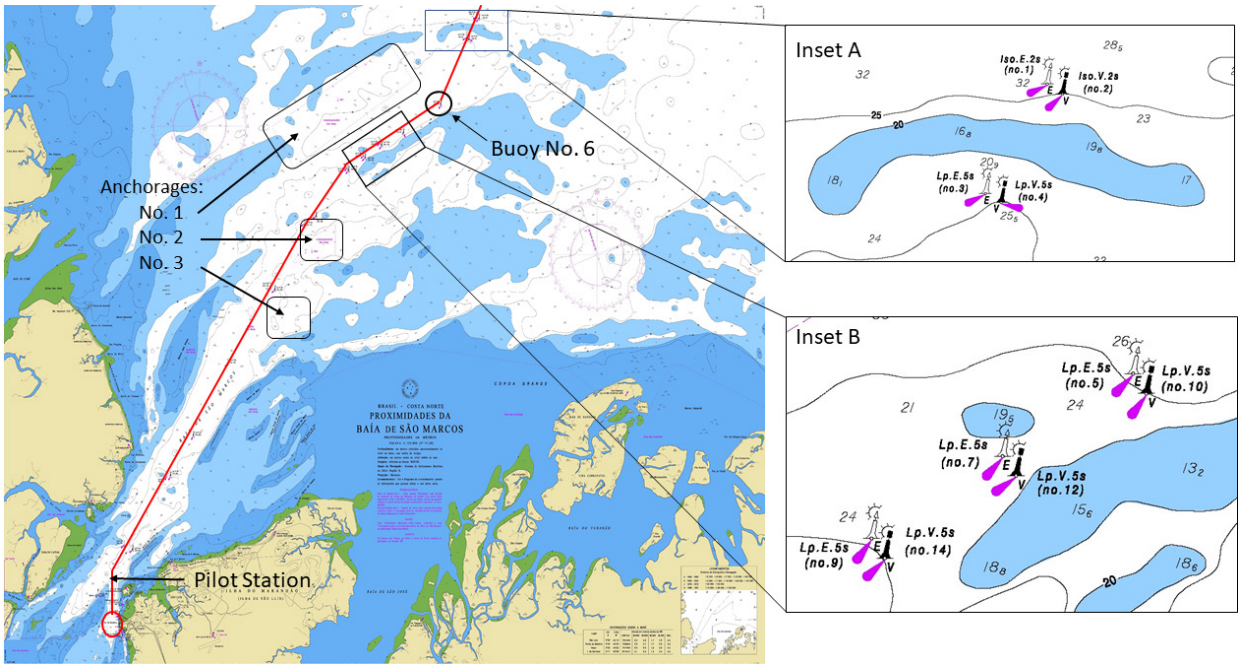

Figure 2: Baía de São Marcos. The location of the Ponta da Madeira Terminal is shown by the red circle and the approach channel is indicated by the red line. Also shown is the sandbar at the channel entrance (Inset A), the narrowest portion of the channel (Inset B), the locations of the Pilot Station, and the three designated anchorages are also shown. (Source: Chart No. 410 issued by DHN.)

17. The channel's outer approaches cross over a sandbar and are marked by two pairs of buoys, Nos. 1 and 2 and Nos. 3 and 4 *(see Figure 2, Inset A)*.[4] The charted depths of water over the sandbar are 16.8-19.8 m. The charted depths for the rest of the channel are greater than 20 m.

18. The Admiralty Sailing Directions covering South America state that the channel in the vicinity of the sandbar is dredged to a depth of 23 m.[5] It was reported that the channel had last been dredged to this depth in May 2019.

19. Bathymetric surveys of the channel between buoys Nos. 1-4 are conducted annually on behalf of the terminal operator. Based on a survey conducted on 16 February 2020, the depths in the channel between these buoys were 23 m or more.[6]

20. The sailing directions issued by DHN for the north coast of Brazil state that Baía de São Marcos is subject to major changes in depth due to siltation and that navigation outside of the marked channels should only be attempted with local knowledge.[7]

4 There is an outer fairway buoy located approximately 17 NM to the north of buoys Nos. 1 and 2.

5 UKHO, Admiralty Sailing Directions NP5 South America Pilot, Vol. 1. (Sailing Directions NP5), paragraphs 4.54 and 4.63.

6 A hydrographic survey conducted in April 2020 using multibeam sonar determined the depth of the channel between buoys Nos. 1-4 was between 22-32 m. This survey was conducted by a commercial firm under a contract from Shipping Protection Ship Services of São Luís (https://www.shipping-protection.com) under the authority of a permit issued by DHN. Based on the project description that was submitted to DHN, the purpose of the survey was specific to the grounding of STELLAR BANNER. The survey was not intended to be used for updating navigational documents.

7 DHN, *See* DHN, DH1-I-11: Roteiro Costa Norte (11ª edição, 1993, 4ª reimpressão, 2013), p. 150. This document is in Portuguese.

21. The narrowest portion of the channel (about 500 m wide) is between buoys Nos. 10-14 *(see Figure 2, Inset B)*. The charted depths of the shoal to the south of this area are between 13-16 m. The shoal to the north has a charted depth of 19 m.

22. There are two anchorages (Nos. 2 and 3) to the south of the channel *(see Figure 2)*. These are designated for use by outbound ships with a draft greater than 20 m waiting for the tide to transit the channel between buoys Nos. 10-14 and to cross the sandbank at the channel's seaward entrance. Anchorage No. 2 is near buoys Nos. 16 and 18. Anchorage No. 3 is near buoys Nos. 15 and 18.[8]

Nautical Charts and Hydrographic Information

23. The largest scale paper charts for Baía de São Marcos and the adjacent offshore coastal area are Charts Nos. 410 and 21600 issued by the DHN, and BA Charts 543 and 3958 issued by the UKHO in accordance with a bilateral agreement with DHN.[9] The best scale ENC for this area is BR321600 issued by DHN.[10]

24. The charted depths for the approach channel are based on surveys conducted by DHN between 1990–1999. The charted depths for the adjacent offshore coastal waters north of 01° 46' S are based on surveys conducted by DHN between 1970–1976.[11] DHN reported that hydrographic surveys of the area are included on its Hydrographic Work Plan for 2020–2023.

25. Datum for the charted depths on the charts issued by DHN and the UKHO is mean low water springs.

26. Some of the 20 m depth contours in the coastal waters seaward of the approach channel are shown on BA Chart 543 as approximate. The depths shown on this chart are the same as those shown on Chart No. 410.

27. The accuracy of the charted depths shown on ENC BR321600 along the length of the approach channel and the adjacent offshore coastal waters are assigned a CATZOC of B.[12]

28. Neither the paper charts nor the ENC indicate that a portion of the channel between buoys Nos. 1-4 is dredged.[13]

Tidal Information

29. The tides in the Baía de São Marcos are semidiurnal. DHN publishes official tidal information for the Ponta da Madeira Terminal and the nearby Port of Itaqui, which is south of the terminal.[14] The terminal operator also published tidal information for the terminal that is based on tide gauges located at Piers Nos. 1 and 4.

30. The sailing directions for the north coast of Brazil issued by DHN include guidance for determining the height of the tide for the of portion of Baía de São Marcos and adjacent coastal waters that are between the northern edge

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8 There is also a third anchorage (No. 1) located to the north of the channel between buoys Nos. 6 and 10 that is designated for use by inbound ships with a draft greater than 11 m. This anchorage is also for use by ships undergoing repairs. *See* UKHO, Sailing Directions NP5, and Vale S.A.'s (the "terminal operator" or "Vale") regulation of the Terminal of Ponta da Madeira ("Ponta da Madeira Terminal regulations" or "terminal operator's regulations"), Chapter II, Sub section 9.3, Art. 16.

9 Chart No. 410 has a scale of 1:135,000, BA Chart 535 has a scale of 1:150,000, ENC BR321600 has a scale of 1:180,000, Chart No. 21600 has a scale of 1:300,000, and BA Chart 3958 has a scale of 1:500,000. DHN and the BA also issue larger scale charts for the inshore portion of Baía de São Marcos and the Pointa da Madeira Terminal. These are Chart No. 411 and BA Chart 565. Both charts have a scale of 1:50,000.

10 ENC BR321600 has a scale of 1:180,000.

11 The northern limit of Chart No. 410 is 01° 46' S.

12 The IHO has defined seven CATZOCs. These are intended to provide mariners a means of assessing the quality of the hydrographic data from which the chart is compiled. Details regarding CATZOC B are provided later in this report.

13 DHN reported that the project information for the dredged channel has not been submitted to that agency.

14 The UKHO also publishes tidal information for the terminal. *See* UKHO, Admiralty Tide Tables, Vol. 7 (NP207), South West Atlantic Ocean and South America.

of Chart No. 410 and latitude 01° 56' S. This area includes the portion of the approach channel between the entrance at buoys Nos. 1 and 2 to just past buoy No. 6 *(see Figure 2)*.[15]

31. The sailing directions issued by DHN indicate that high and low tide for the portion of the approach channel from buoys Nos. 1 and 2 to about buoy No. 6 occur one hour and 15 minutes before the time of the high and low tide at the Port of Itaqui. The height of the tide is determined by multiplying half the difference between tides[16] by a factor of 0.4. The result is then either subtracted from or added to the height of the corresponding high or low tide.

32. The terminal operator's Ponta da Madeira Terminal regulations state that high and low tides at buoys Nos. 1 and 2 occur 75 minutes before the time of high and low tide at the terminal and have an amplitude of 60% of the predicted height at the terminal.

33. The times and heights of the high and low tides at buoys Nos. 1 and 2 are based on correction factors provided in DHN's Roteiro Costa Norte and the terminal operator's regulations and the corresponding reference stations for 24–25 February 2020 were:

SOURCE	DATE	REFERENCE STATION		BUOYS NOS. 1 AND 2	
		TIME (LT)	HEIGHT (M)	TIME (LT)	HEIGHT (M)
DHN	24 February 2020	1353	0.80	1238	1.86
		1958	6.10	1848	5.00
	25 February 2020	0206	0.60	0051	1.66
		0815	5.90	0700	4.88
Vale	24 February 2020	1353	0.76	1238	1.77
		2001	5.81	1846	4.77
	25 February 2020	0208	0.63	0053	1.63
		0817	5.63	0702	4.66

Note: The reference station for tides based on DHN's guidance is the Port of Itaqui and for tides based on the terminal operator's regulations is the Ponta da Madeira Terminal.

Passage Plan

34. The ship's 2/O prepared the passage plan for the voyage from Ponta da Madeira Terminal to Qingdao, People's Republic of China. The Master verified the passage plan and the C/O and 3/O reviewed it as required by the Company's SMS.

35. The planned route for the outbound transit of Baía de São Marcos was through the buoyed approach channel.

36. The charts identified in the passage plan for navigation included ENC BR321600 and BA Charts 543 and 3958.

37. The passage plan identified the portion of the channel between buoys Nos. 1-4 *(see Figure 2, Insert A)* as an area of concern due to shallow waters and that the Navigation Officer, who was the 2/O, was required to pay particular attention.

15 *See* DHN, DH1-I-11, pp, 152-153.

16 In the guidance issued by DHN, "amplitude" refers to the difference between the height of two successive tides and "semi-amplitude" is used to refer to half of this difference.

38. The Master did not include any additional observations regarding potential hazards or areas where additional care was required when he reviewed the passage plan. When interviewed, the Master stated that the portion of the channel between buoys Nos. 7-12 and Nos. 9-14 *(see Figure 2, Insert B)* was also of concern due to the surrounding shoals in this area.

39. As required by the Company's passage planning procedures, the 2/O calculated the ship's UKC for the portions of the outbound transit that had the smallest charted depths using the Company's worksheet for shallow water. These legs were the transit from the berth to the pilot station and where the approach channel crossed the sandbank at the outer entrance of the channel between buoys Nos. 1-4.

40. The calculated UKC for crossing the sandbank between buoys Nos. 1-4 at about 2000 on 24 February 2020 was 1.61 m, or 7.3% of the ship's dynamic draft.[17] When a CATZOC correction was applied to the water depth, the calculated UKC was reduced to 0.24 m, or 1% of the ship's dynamic draft.

41. The calculated UKC was determined using a calculated maximum dynamic draft of 22.17 m and a calculated controlling (anticipated) water depth of 23.78 m. The basis for the dynamic draft and calculated controlling water depth is shown in the following table:

DYNAMIC DRAFT	
Maximum static draft	21.50 m
Squat at 5 knots	0.42 m
Heeling effect based on 0.5° roll	0.25 m
Calculated maximum dynamic draft	22.17 m
CONTROLLING DEPTH	
Least depth found on chart (based on average of two closest charted depths)	18.30 m
Height of tide	5.81 m
Sea state correction based on maximum swell of 0.5 m	-0.33 m
Calculated controlling depth	23.78 m
Calculated controlling depth with a CATZOC correction of -1.37 m applied	22.41 m

Note: The magnitude of the CATZOC correction was determined by applying the expected depth accuracy of a sounding with an assigned CATZOC B. Details are provided later in the report.

42. The passage plan did not include any comments addressing the statement in Admiralty Sailing Directions NP5 that the channel between buoys Nos. 1-4 is dredged.

43. A note included on the form used by the 2/O to calculate the UKC stated: "This area UKC was confirmed over 5 m of UKC instead of charted information (4 times a year)." The Company reported that depths of 23 m had been observed when ships in the Company's managed fleet had crossed the sandbank at the entrance to Baía de São Marcos in 2019. The Company also pointed out that the Admiralty Sailing Directions NP5 state that the channel is dredged to this depth but that the depth of 23 m is not shown on the chart.

17 Dynamic draft is the equal to the sum of the ship's maximum draft, squat, density change, and heeling effect. Squat is a function of a ship's displacement, length between perpendiculars, beam, draft, and speed through the water. Heeling effect accounts for the expected increase in the ship's draft when rolling.

44. The form used by the 2/O to calculate the ship's UKC indicated that the UKC required by port regulations was 2.456 m. The Company reported this figure was entered in error and that the space where it was recorded should have been left blank or replaced with a figure that was the minimum required by the Company's UKC policy.

45. The form indicated the calculated UKC complied with Company policy[18] and that it was not necessary to report the calculated UKC to the Company's Marine Division. The Master and 2/O made this determination based on UKCs over 5 m having been observed during prior port calls at the Ponta da Madeira Terminal.

46. The port authorities have not established minimum UKC requirements for ships using the Baía de São Marcos approach channel. The terminal operator informed the Administrator that Masters should use guidance issued by the PIANC, which recommends a minimum UKC of 0.5 m.[19]

47. In addition to the passage plan, a spreadsheet of pertinent data for the voyage was prepared. This spreadsheet is used onboard all ships in the Company's managed fleet and included waypoints along with the planned course and speed for each leg of the planned route. It also had the minimum charted depth of water, squat, the expected height of the tide, estimated roll, and the UKC for each leg of the planned route. This spreadsheet is used onboard all ships in the Company's managed fleet.

48. The spreadsheet with the waypoints indicated that the UKC for the leg that included crossing the sandbank at the entrance to Baía de São Marcos was 3.4 m. This was based on a speed of 6 knots, a charted depth of 24 m, and the height of the tide being 5.6 m. The Company reported that the 2/O adjusted the predicted high tide (5.81 m) using the UKHO's simplified harmonic method[20] to accommodate passage an hour before or after the time of high tide. It was not reported how he determined the minimum water depth that was entered for this leg.

49. The 2/O used the tidal predictions for the terminal that were published by the terminal operator when calculating the UKC calculations at buoys Nos. 1 and 2 and for the height of the tide entered in the spreadsheet that had the details for each leg without applying the correction factors contained in either the sailing directions issued by DHN or the terminal operator's regulations. It was not reported why these corrections were not applied.

50. The passage plan did not include any indication whether it was planned to anchor at either anchorage No. 2 or No. 3 during the outbound transit of Baía de São Marcos to wait for the tide to transit the narrow portion of the channel located between buoys Nos. 10-14 and the sandbank at the outer entrance of the marked channel between buoys Nos. 1-4.

Departure

51. At 1411 on 24 February 2020, two pilots from the Ponta da Madeira Terminal embarked STELLAR BANNER for the outbound transit of Baía de São Marcos. It was reported that the pilots had been scheduled to board the ship at 1330.

18 Details of the Company's UKC policy are provided later in this report.

19 The minimum UKC of 0.5 m recommended by PIANC is based solely on ship related factors and does not include corrections based on the CATZOC of the soundings. *See* PIANC, Report No. 121, Harbour Approach Channels Design Guidelines, Report of the Maritime Navigation Commission (2014), pp. 23 and 33 (PIANC Report No. 121). Applying a CATZOC correction is a Company requirement.

20 *See* UKHO, NP207, pp. xy-xxi.

52. At 1442, STELLAR BANNER got underway laden with 294,871 MT of Iron Ore. This was approximately 40 minutes after the ship's planned departure time and about 50 minutes after low tide. The ship's drafts on departure were 21.33 m forward, 21.5 m midships, and 21.43 m aft. The estimated date of arrival at the planned discharge port was 4 April 2020.

53. It was reported that the ship's navigation equipment, main engine, auxiliary engines, and steering gear were fully operational on departure.

54. The passage plan, which included the ship's calculated UKC, was not updated when the departure was delayed.

Outbound Transit

55. At 1524, the pilots disembarked after the ship had passed Isla de Medo to starboard and entered the approach channel marking safe passage through Baía de São Marcos *(see Figure 2)*. The bridge team consisted of the Master, the C/O, who was the OOW, and an ASD, who was the Helmsman. Steering was by hand.

56. The ECDIS was used for navigation. The ENC used was BR321600. The ship's positions were also plotted on BA Chart 543 every 15 minutes.

57. The reported weather conditions were clear skies with visibility more than 5 NM, winds of Beaufort Force 4 from the northeast, and seas of 1-2 m, also from the northeast.

58. STELLAR BANNER had reached anchorage No. 3 by 1800 and anchorage No. 2 by 1845. The ship's speed was about 11 knots. The distance to the sandbank at the outer entrance to the marked channel was approximately 20 NM. The Master stated that he decided to not anchor since the ship would be crossing the sandbank at or close to the time of hightide.

59. Based on the tidal information issued by the terminal operator and the correction factors in the Ponta da Madeira Terminal regulations for buoys Nos. 1 and 2, high tide at these buoys was at 1846 with a height of 4.77 m.

60. STELLAR BANNER continued to transit the approach channel without incident.

61. Just before 2000, the 3/O relieved the C/O as OOW. Based on the audio recording from the ship's VDR, the Master told the C/O to take a rest but that the C/O could return if he was curious about the progress of the outbound transit.[21]

62. Based on the VDR audio recording, the Master called the 2/O at 2002 and told him that he should come to the Bridge at 2100. He also told the 2/O that he expected that they would keep going.[22]

63. At 2007, the Master directed the 3/O to change the scale on the echo sounder from 50 m to 100 m. The ship was inshore of the 50 m contour.

64. At about 2030, the ship passed buoy No. 6 to starboard. This was where the passage plan indicated that the ship's course should be changed from a base course of 057° T to 029° T. The planned speed was 10 knots. Rather than changing course as planned, STELLAR BANNER remained steady on a course of 057° T at a speed of 11 knots.

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21 The Master made this statement to the C/O in Korean.

22 No explanation was provided regarding what the Master meant by the statement that he expected to keep going.

65. Based on the Master's statement, he had decided to leave the marked channel since it was after high tide and there was deeper water outside the channel. The charted depths outside the channel were all greater than 20 m *(see Figure 3)*. Based on the VDR audio recording, the Master did not tell the 3/O why he decided to leave the marked channel, nor did the 3/O ask the Master why he had decided to not follow the planned route.

Figure 3: Position of STELLAR BANNER at 2030 when passing buoy No. 6 as shown on ENC BR321600. The charted depths in the gap between the two sandbanks are 21-23.5 m. The lighter colored areas are where the charted depths are 20 m or less. (Source: STELLAR BANNER VDR information.)

66. At 2030, the height of the tide at buoys Nos. 1 and 2 was approximately 4.1 m.[23]

67. The Master stated he used the EBL on the ECDIS to determine the ship's course after leaving the approach channel. He also stated that he intended to pass about 1 NM to the west of the 20 m shoal that was seaward of the sandbars. The route he intended to take after leaving the marked channel was not plotted on either the ECDIS or the paper chart.

68. The 2/O arrived on the Bridge at about 2115 to complete the departure report.

69. At 2118, the main engine operating condition was set for sea navigation.

70. Between 2128–2129, the ship's speed over ground suddenly slowed from between 11-12 knots to 9 knots for less than a minute. At the same time, the speed through the water suddenly slowed from about 10 knots to 7 knots, also for less than a minute.

71. At a speed through the water of 10 knots, calculated squat would have been about 1.7 m.[24]

72. At 2130, multiple bilge and tank alarms activated. These included the forward and aft DBV bilge alarms, the port and starboard forward and the aft Engine Room bilge well alarms, the main engine recess bilge alarm, and multiple alarms for the double bottom tanks in way of the Engine Room.

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23 This was determined using the tidal predictions and the corrections for the time and height of the tide published by the terminal operator and the UKHO's simplified harmonic method for determining the height of the tide at any time.

24 This was determined using the equation for squat in confined waters that is included on the Company's worksheet for calculating UKC: Squat = $\frac{2C_b v2}{100}$, where C_b is the ship's block coefficient and v is its speed through the water. Based on STELLAR BANNER's Trim and Stability Booklet, its C_b was 0.8534.

73. At about this same time, the Master, the other members of the ship's bridge team, watchstanders in the Engine Room, and off-duty crewmembers throughout the Accommodation reported feeling a vibration. Some of the off-duty crewmembers stated that it woke them up.

74. The Master and OOW reported that when the vibration was felt the echo sounder showed the depth beneath the keel as "- - -" forward and 8 m aft. The "- - -" indicates a loss of signal or that the depth of water was less than could be measured.[25]

75. Based on the position plotted on BA Chart 543, STELLAR BANNER was inside the 20 m depth contour at 2132. Based on ENC BR321600, this shoal was about 1 NM off the ship's starboard side *(see Figure 4)*. The ship's position was 01° 44.45′ S, 043° 44.66′ W. The speed through the water was about 10 knots.

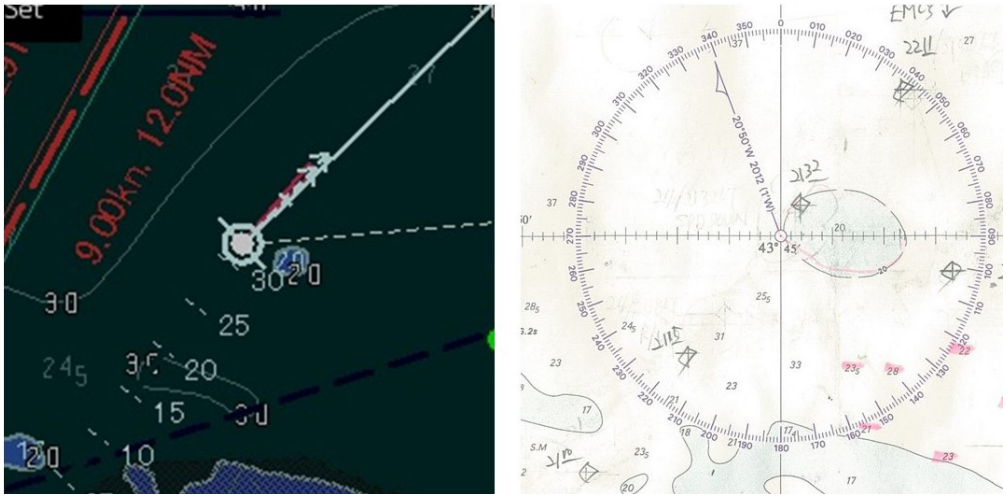

Figure 4: STELLAR BANNER's position at 2132 as displayed on ENC BR321600 (left) and BA Chart 543 (right). The two images are not to scale. Note the use of a dashed line to show the depth contour on BA Chart 543.

76. The dimensions of the 20 m shoal that was off STELLER BANNER's starboard side at 2132 is shown on ENC BR321600 and Chart No. 21600 as approximately 0.5 NM by 0.5 NM. This same shoal is shown on BA Charts 543 and 3958 as about 1.6 NM by 2.3 NM. The shoal is centered on the same position on all three paper charts and the ENC.

77. The contour for this shoal is shown with a solid line on charts issued by DHN. It is shown with a dashed line on charts issued by the BA.

78. The soundings in this area are widespread.

79. At 2133, the ship's main engine speed dropped from 57-58 RPM to 54 RPM for around 30 seconds. Within a minute the ship's speed over ground dropped from just over 12 knots to about 7 knots. Based on the audio recording from the VDR, the Master said "2.3 m" in the form of a question.

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25 The ship was equipped with a JRC model JFE-680 echo sounder. The unit could simultaneously display information from the forward and aft transducers and was able to measure water depths of 1 m or more. As required by the applicable IMO performance standards, its accuracy was ±2.5% of the indicated depth. *See* IMO Resolution MSC.74(69), Annex 4.

80. Based on information recorded by the VDR, the water depths began to increase to 8 m and more less than a minute after the Master noted the depth of 2.3 m.[26]

81. At 2134, the Master ordered port 10° rudder. At the same time, he directed the 3/O to call the Engine Room to have the main engine speed reduced to maneuvering.

82. At 2136, the Master directed the C/O and 2/O to go forward to check the FPV for flooding and prepare to anchor. The Bosun and off-duty deck ratings were all called forward to assist. Within a few minutes they were joined by the C/E and 2 A/E.

83. At 2140, the Master ordered hard starboard rudder. He then ordered the main engine speed slowed to Dead Slow ahead in preparation for anchoring.

84. At the same time, the C/O informed the Master that air was coming out of the FPV sounding pipe and that they were not able to sound it. A few minutes later, he told the Master that air was also coming from the manhole cover for the FPV. The Master then directed the C/O to prepare to anchor and for the 2/O to go to the Deck Office and start pumping out the FPV.

85. At 2211, STELLAR BANNER anchored in position 01° 42.26′ S, 043° 42.74′ W. The closest charted depth was 27 m *(see Figure 5)*. This position was approximately 3 NM to the northeast of where the crewmembers reported feeling a vibration.

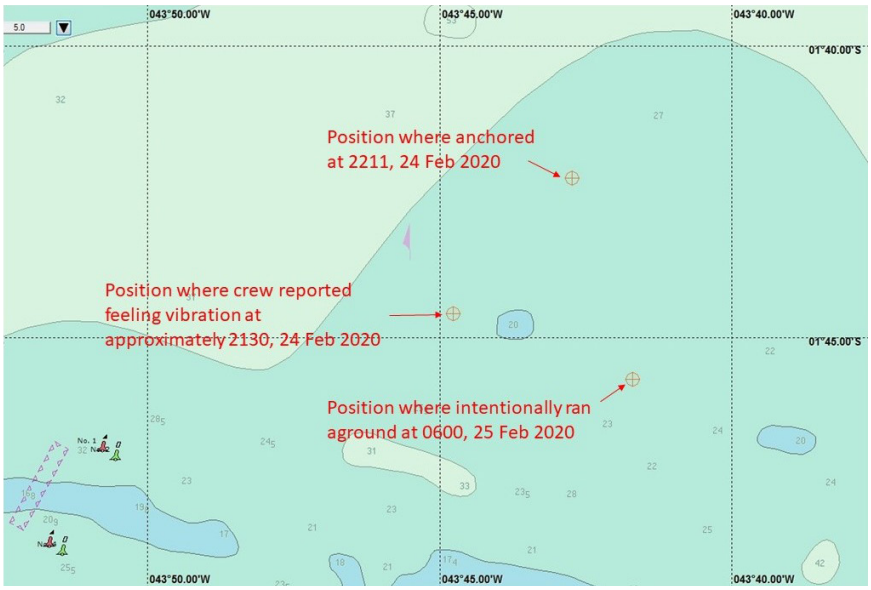

Figure 5: Positions where the crewmembers reported feeling vibration, where STELLAR BANNER was anchored, and where it was intentionally run aground. These positions are shown on ENC BR321600.

86. The Bosun and deck ratings began checking the voids and WBTs for flooding immediately after the ship anchored. They determined that in addition to the flooding of the FPV, there was also flooding in the DBV and Nos. 1 and 2 starboard WBTs. The most serious flooding was reported in the FPV and the DBV.

26 The aft transducer was the input source for the water depths recorded by the VDR.

87. The C/E directed the 1 A/E, who was in the Engine Room with the 3 A/E, to start the second General Service pump and the bilge eductor.

88. With assistance from the 2 A/E, the C/E began trying to remove the manhole cover for the FPV. They were initially unable to safely remove the cover due to the amount of air coming out of the tank.

89. By 2154, the 2/O had reached the Deck Office and informed the Master he was waiting for the valve for the FPV bilge suction to open. He also reported that the ship's drafts were 21.6 m forward and 22 m aft. The Master then directed the C/E to check the valve for the FPV.

90. At 2157, the C/O informed the Master that there was 6 m of water in the FPV. The Master then directed him to try to open the valve for the bilge suction using the local control. Within a minute, the 2/O, who was in the Deck Office, reported that the valve appeared to be opening. This was followed by a report that the valve would only open halfway.

91. The Master informed the Company of the incident sometime after STELLAR BANNER was anchored and the initial damage assessment had been completed. The Company then informed KR that the ship may have contacted the bottom and provided the ship's current condition.

92. By 2300, the FPV manhole cover had been removed. It was reported that water appeared to be entering the void very fast. It was later estimated that the water level in the void was rising at a rate of about 2 m per hour.

93. At 2310, the C/E determined the bilge eductor was not removing water quickly enough from the FPV. He then directed the 3 A/E, who had remained in the Engine Room, to stop the eductor and start taking direct suction.

94. By about 0100 on 25 February 2020, the crewmembers had rigged portable pumps to pump sea water out of the flooding tanks and voids.

95. KR conducted a damage stability assessment after being informed by the Company that STELLAR BANNER may have contacted the bottom. This assessment assumed that the FPV, Nos. 1 and 2 starboard WBTs, and the DBV were fully flooded. It was determined that fully flooding these tanks would cause the ship to list between 6-7° to starboard. This list would submerge the starboard main deck aft to approximately frame No. 85 and partially submerge the starboard side outboard portion of the hatches for Cargo Holds Nos. 1 and 2. KR advised the Company that the ship should be moved immediately into shallow water. The time KR made this recommendation to the Company was not reported to the Administrator.

96. By 0400, the Master determined sea water was flooding the damaged tanks and voids faster than the ship's fixed and portable pumps could pump it out. In consultation with the Company the Master decided to intentionally ground STELLAR BANNER.

97. At 0500, after completing preparations for getting underway, the anchor was raised and the ship proceeded on a southerly heading toward shallower water.

98. At 0615, STELLAR BANNER was intentionally run aground in position 01° 45.7' S, 043° 41.7' W (*see Figure 5)*. This position is approximately 4 NM from where the ship had been anchored. The charted depths in the area were 23-24 m.

99. The crewmembers continued to check for flooding, running the fixed and portable pumps, and taking soundings around the ship. Flooding of No. 3 starboard WBT was also detected.

100. At approximately 2000, several members of the ship's crewmembers reported hearing a loud sound on the starboard side. They put on lifejackets, went to the port quarter and began preparing a liferaft and ladder.

101. At 2100, the Master called all crewmembers to the Bridge and explained the situation. He also explained that salvage vessels were en route and that it was necessary to disembark the ship.

102. At approximately 2300, a salvage vessel was alongside to port and the crewmembers began disembarking the ship. Within an hour, all members of the ship's crew had safely disembarked STELLAR BANNER. It was reported that the ship had a 20° list to starboard by this time.

103. By 27 February 2020, the starboard deck was awash with water reaching the cargo hold hatch coamings *(see Figure 6)*. Members of the salvage team began going aboard and started preparing to lighter the ship.

Figure 6: STELLAR BANNER aground with starboard deck awash on 27 February 2020. (Source: Brazilian Navy.)

104. On 12 March 2020, the salvors began removing fuel oil from STELLAR BANNER.

105. By 13 March 2020, the ship had developed a list of 25° to starboard. It was reported that the salvors' prior attempts to seal the hatch covers had not been successful and that water had entered Cargo Holds Nos. 1-5. Portable pumps were used to try to remove this water. Divers were unable to safely inspect the ship's bottom shell due to the local current and swell.

106. By 26 March 2020, most of the ship's 3,500 MT of fuel oil and 140 MT of diesel fuel had been lightered. It was also reported that there was water in all seven cargo holds and that the salvors initial attempt to lighter cargo had to be stopped when the crane that was being used malfunctioned.

107. Cargo lightering resumed in early April 2020 and continued through May 2020.

108. By 27 May 2020, approximately 145,000 MT of cargo had been lightered and preparations made to refloat the ship by pumping air into the starboard side voids and WBTs. The ship was successfully refloated with a 10-15° list to starboard and was then towed and re-anchored in deeper water.

109. On 4 June 2020, KR surveyors attended the ship to conduct a damage survey, which included an underwater hull inspection conducted by divers and a remotely operated underwater vehicle. The WBTs and voids were inaccessible and were not examined internally. Documented damage included:

    (a) Starboard side main deck plates along the entire cargo length were distorted. The average depth of the observed distortion was 500 mm with a maximum depth of 1,000 mm.

    (b) Starboard side shell plates between the base line and a draft of 12 m along the entire cargo length were distorted and fractured. The average depth of the distortion was 10,000 mm with a maximum depth of 12,000 mm.

    (c) Starboard side bottom shell plates along the entire cargo length between the starboard longitudinal bulkhead and the turn of the bilge were distorted and fractured. The average depth of the distortion was 10,000 mm and with a maximum depth of 12,000 mm.

    (d) The bottom shell plates along the entire cargo length between the No. 4 port bottom longitudinal and the starboard longitudinal bulkhead were distorted and fractured. The average depth of the distortion was 2,000 mm with a maximum depth of 4,000 mm.

110. That same day, VP-12 Shipping Inc., the ship's registered owner, issued a Notice of Abandonment to the hull underwriters in which they stated that STELLAR BANNER was considered a constructive total loss.

111. On 12 June 2020, STELLAR BANNER was towed about 45 NM farther offshore and scuttled in position 01° 16' S, 043° 02' W in 2,700 m of water after all hazardous materials had been removed from the ship.

Ship's Crew

112. STELLAR BANNER had a complement of 20 crewmembers, four more than required by the Minimum Safe Manning Certificate issued by the Administrator. Each crewmember held the appropriate Republic of the Marshall Islands-issued seafarer documentation for their position on board.

113. The experience of the crewmembers who were on the Bridge between 2000-2150 on 24 February 2020 is in the table below.

RANK	TIME ON BOARD STELLAR BANNER	TIME IN RANK	TIME WITH COMPANY	TOTAL TIME AT SEA
Master	9 months	7 years, 1 month	2 years, 9 months	17 years, 9 months
2/O	2 months	1 year, 7 months	3 years, 8 months	3 years, 11 months
3/O	2 months	2 months	2 months	1 year, 3 months
ASD	9 months	4 years, 3 months	9 months	8 years, 1 month

114. The Master and all officers in charge of a navigational watch had completed BRM courses as required by the Company's training policy and the STCW Code.

115. The Master stated he had been on board ships that loaded at the Ponta da Madeira Terminal more than ten times, including while on board the Company-managed, 278,258 DWT, VLOC STELLAR EAGLE (IMO No. 9044229)

from July 2018 to January 2019 and STELLAR BANNER since May 2019. He also stated that while outbound he had previously used either the approach channel, a passage to the north of the outer sandbar, or the route used by STELLAR BANNER on 24 February 2020. Further, he also indicated he had used the same route when he was on board STELLAR EAGLE. He did not state if this was during the inbound transit or the outbound transit.

116. The 2/O stated he had been on board ships that loaded at the Ponta da Madeira Terminal about ten times. His most recent experience at this terminal was on board STELLAR SAMBA in June 2019. He indicated that the passage plans he had previously prepared for outbound transits from Ponta da Madeira Terminal used the approach channel.

117. Neither the 3/O nor the ASD assigned to the 2000–2400 watch had previously been on board a ship that loaded at the Ponta da Madeira Terminal.

118. There is no indication that any crewmembers who were on the Bridge between 2000–2150 on 24 February 2020 had not received the rest mandated by the STCW Code, Section A-VIII/1, paragraphs 2 and 3 and the MLC, 2006, Regulation 2.3.

SMS

119. As required by the ISM Code, the Company's SMS provided procedures for shipboard tasks including passage planning and navigation watchstanding. The SMS also included UKC requirements.

120. In accordance with the Company's passage planning procedures, the passage plan is supposed to be prepared by the ship's 2/O and reviewed and approved by the Master. The ship's officers in charge of a navigational watch are responsible for its execution.

121. The Company's procedures require that when preparing a passage plan for navigation in coastal and pilotage waters that the following below factors are reviewed:

SOURCES OF INFORMATION	FACTORS TO CONSIDER	INFORMATION TO IDENTIFY
• Available navigational charts • Sailing directions • Tide tables • Port guides • Other relevant information	• Adequacy of available navigational charts • Advice provided in sailing directions • Reliability of hydrographic data • Tidal information • Draft restrictions • UKC requirements • Anchoring and contingency options	• The ship's planned route • Positions of waypoints • The course, planned safe speed, and length of each leg • Calculated squat and UKC • Safety depths and contours • No-go areas • Safe water depths based on the height of the tide • Decision points for critical maneuvers • Contingency plans, including anchorages

122. The passage plan is supposed to be revised to include any changes that might be made to the planned route while the ship is underway. Any changes that might be made are to be approved by the Master.

123. The Company's navigation watchstanding procedures include requirements for navigation in coastal waters, narrow channels, and shallow waters. These are characterized as periods of critical navigation, which is defined as situations where a minor mistake by the crewmembers could endanger the safety of the ship, crew, or the environment.[27]

124. The Company's procedures define channels that are less than 2 NM wide as a narrow channel.[28] Requirements for navigation in narrow channels include that the Master have the conn, ensuring the tide table for the area is available, compliance with the Company's UKC requirements, that the OOW determine the ship's position as often as possible, that the duty ASD be on the Bridge, and that the ship be steered using manual steering.

125. The Company's procedures define shallow waters as those where the ship's UKC is less than 50% of its deepest draft. Requirements for navigating in shallow waters follow those for narrow channels, and that the echo sounder be operating, continuously monitored, and compared to the soundings on the chart.

126. The Company's navigation watchstanding procedures do not include guidance or establish expectations regarding BRM when the Master has the conn.

127. Company-managed ships are required to have a minimum UKC that complies with any applicable port regulations. Their procedures require that ships calling at ports without UKC regulations have an UKC that is 10% or more of its dynamic draft when at a berth or navigating in a channel, and 15% or more of its dynamic draft when navigating in a narrow channel.

Master's Standing Orders

128. The Master's Standing Orders provided general guidance for OOWs, including a reminder about the danger of over reliance on ECDIS. They also included bridge watch level requirements for different navigational situations.

129. The required bridge watch for periods of critical navigation or when either entering or leaving port consisted of the Master, an OOW, and an ASD. The Master was responsible for conning and collision avoidance, the OOW was responsible for navigation and VHF communications, and the ASD was responsible for steering and maintaining a lookout.

Bulk Carrier Outbound Transits

130. Based on the Administrators' review of AIS information for the world fleet, there were 1,167 outbound bulk carrier transits from Baía de São Marcos in 2019.[29] Of these, 280 transits were by bulk carriers that left the approach channel in the vicinity of buoy No. 6 and proceeded along a route similar to that followed by STELLAR BANNER on 24 February 2020. AIS information for inbound transits was not reviewed.

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27 Other periods of critical navigation included in the Company's procedures are navigation in restricted visibility, in heavy weather, in cold areas, in war zones, and in pirate infested waters.

28 Traffic separation schemes that are more than 2 NM wide are also considered narrow channels.

29 The data may not reflect all outbound bulk carrier transits.

131. A summary of the outbound bulk carriers based on DWT[30] that left the approach channel in 2019 and passed through the sandbanks to the east of the buoyed channel is shown in the following table *(see Figure 7)*:

BULK CARRIER VESSEL SIZE	NUMBER OF SHIPS
Handysize (10,000-39,999 DWT)	57
Handymax/Supramax (40,000-64,999 DWT)	47
Panamax (65,000-84,999 DWT)	63
Post-Panamax (85,000-119,999 DWT)	34
Capesize (120,000-219,999 DWT)	67
VLOC (220,000 and greater DWT)	12

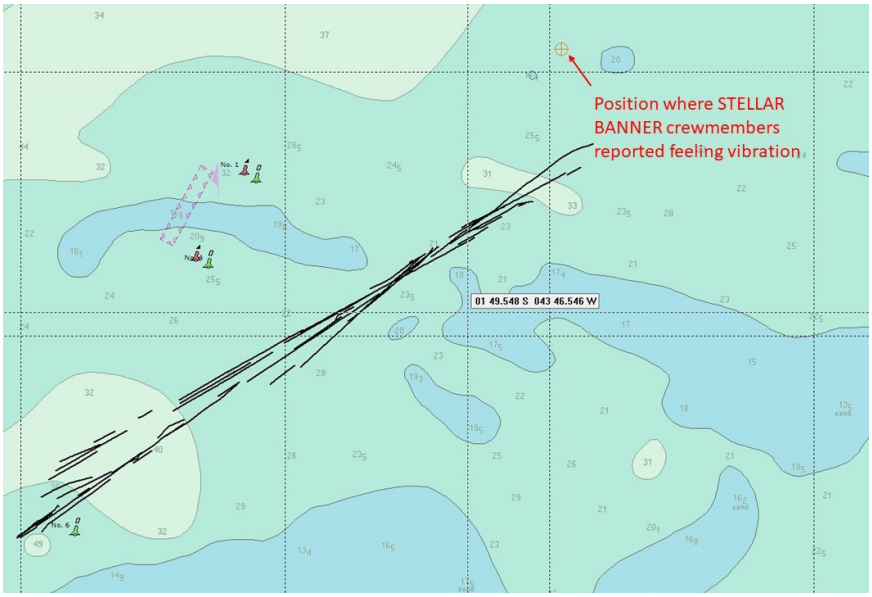

Figure 7: Plot of AIS information for outbound VLOCs that in 2019 used a route similar to the one followed by STELLAR BANNER on 24 February 2020.[31]

132. The AIS information indicates there were no outbound transits outside the channel by Company-managed bulk carriers in 2019 *(see Figure 8)*.[32]

30 DWT was used rather than draft since the draft included in a ship's AIS information is voyage related data and must be entered manually. In contrast, DWT is static information and does not need to be entered for each voyage.

31 Gaps in individual tracks are due to not all the data that was transmitted by a ship's AIS unit having been received or recorded. This commonly occurs when the AIS information is recorded by satellite.

32 Based on AIS information, STELLAR EAGLE did not make any outbound transits from Baía de São Marcos in January 2019. As previously stated, the Master of STELLAR BANNER had worked as Master of STELLAR EAGLE from July 2018 to January 2019.

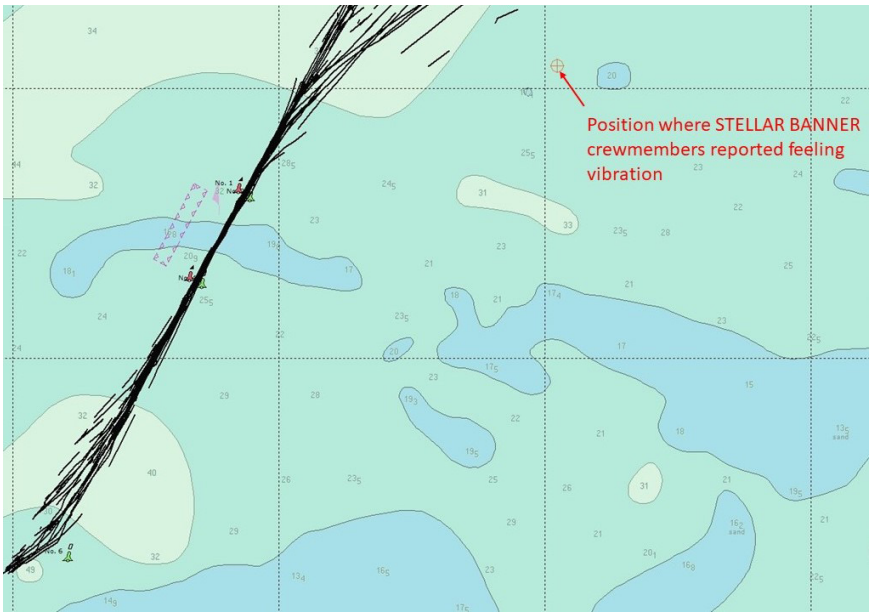

Figure 8: Plot of all outbound transits by Company-managed ships in 2019.

IHO Standards

133. The IHO has established regulations and specifications that are applicable to medium and large scale[33] national and international charts. These are found in IHO Publication S-4, Regulations of the IHO for International Charts and Chart Specifications of the IHO (Publication S-4).[34] This document is divided into three parts. Parts A and C contain regulations and specifications for international charts, which are charts issued by an IHO member State for areas outside their own national waters. Part B contains specifications for medium and large scale national and international charts.

134. Both Brazil and the United Kingdom of Great Britain and Northern Ireland are IHO member States.

135. The IHO's standards for encoding information for use as part of an ENC include requirements for hydrographic information.[35] Based on these requirements, charted depths designated as CATZOC B were obtained during hydrographic surveys for which the search area did not cover the full seafloor within the survey area. Further, although uncharted hazards to surface navigation are not expected, they may exist.

136. Charted depths designated as CATZOC B were obtained by surveys conducted using a modern survey echosounder without either sonar or a mechanical sweep system. These charted depths have a position accuracy of ±50 m and a depth accuracy equal to the sum of ± (1 m + 0.02d), where "d" is the charted depth.[36]

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33 These are charts with a scale of 1:2,000,000 and larger.

34 All references are to the edition 4.8.0, which was issued in October 2018.

35 These requirements are found in IHO Publication S-57, Transfer Standard for Digital Hydrographic Data, Supplementary Information for Encoding of S-57 Edition 3.1 ENC Data (Publication S-57, Supp. 3).

36 *See* IHO Publication S-57, Supp. 3, pp. 13-15.

137. The IHO's specifications for representing water depth state that the charted soundings and bottom contours provide a "reasonable representation of the seabed."[37] They also include a requirement that the density of charted depths "should have a minimum of soundings, fairly evenly spaced, but gradually becoming more widely spaced as the depth increases."[38]

138. The IHO's specifications for indicating bottom contours dictate the use of continuous black lines to indicate bottom contours and dashed lines to mark areas "where it is necessary to draw the navigator's attention to inadequacy in survey data."[39]

139. The IHO specifications for charting dredged channels include requirements for how the limits of a dredged area should be indicated, showing the minimum depth of the dredged area, and information regarding maintenance of the dredged area.[40]

140. The IHO specifications for the display of information on ENCs cross reference include the specifications in Publication S-4 for indicating approximate bottom contours and dredged areas.[41]

Chart Corrections

141. In February 2021, DHN issued a correction to Charts Nos. 21020 (INT 2003) and 21600 (INT 2109) to insert a sounding of 17.4 m in position 01° 45.1' S, 043° 45.3' W.[42] A similar correction was made to BR321600, which was the ENC being used onboard STELLAR BANNER when the grounding occurred *(see Figure 9)*. The date of the survey or source of the correction was not reported.

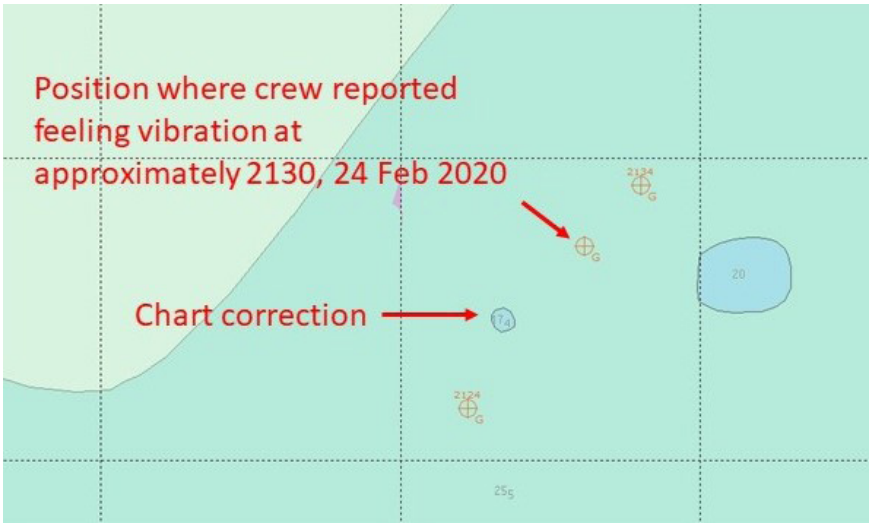

Figure 9: BR321600 showing the 17.4 m sounding and the positions of STELLAR BANNER at 2124, 2130, and 2134 on 24 February 2020.

37 *See* IHO Publication S-4, paragraph B-410 c.

38 *See* IHO Publication S-4, paragraph B-410 d.

39 *See* IHO Publication S-4, paragraphs B-411.1 and B-411.2.

40 *See* IHO Publication S-4, section B-414.

41 *See* IHO Publication S-57, Transfer Standard for Digital Hydrographic Data, Appendix A, edition 3.1.

42 *See* DHN, Brazilian Notice to Mariners No. 4/2021, p. 23. These are both smaller scale charts issued by DHN that include coastal and ocean waters seaward of Baía de São Marcos. The area where the correction was made is included in BA Chart 543. It was this chart that was being used onboard STELLAR BANNER.

142. In April 2021, the UKHO issued a correction to BA Chart 543 to insert a sounding of 17.4 m and extend the 20 m approximate contour to enclose position 01° 45' 06" S, 043° 45' 32" W *(see Figure 10)*.[43] The correction was based on the correction issued by DHN in February 2021.

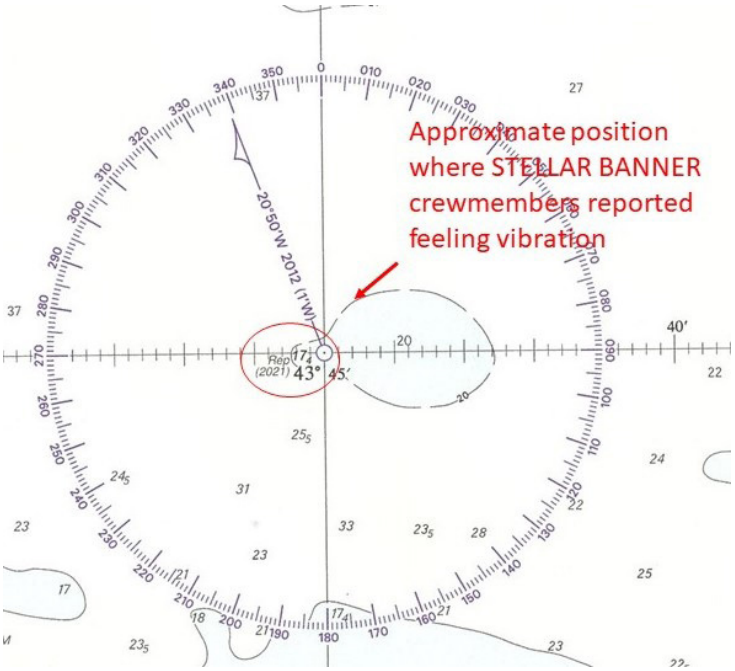

Figure 10: BA Chart 543 showing the addition of the 17.4 m sounding and the extension of the 20 m approximate contour.

PART 3: ANALYSIS

The following Analysis is based on the above Findings of Fact.

Grounding

On 24 February 2020, as STELLAR BANNER was proceeding outbound on a laden voyage from Ponta da Madeira Terminal with drafts of 21.3 m forward, 21.5 m midships, and 21.4 m aft. Between 2128–2129, the ship's speed over ground slowed from between 11-12 knots to 9 knots for less than a minute before increasing. At 2130, crewmembers throughout the ship reported feeling a vibration. When the vibration was felt, the echo sounder indicated that there was either a loss of signal or that the depth of water was less than could be measured. At the same time multiple bilge and tank alarms activated.

Within 3–4 minutes after the bilge and tank alarms activated, the echo sounder indicated a sudden change in the depth of water beneath the keel from between 8 m or more to 2.3 m. In less than a minute the depth beneath the keel increased to 8 m and more. There was also an unplanned slowdown of the main engine and second decrease of

43 *See* UKHO, Admiralty Notices to Mariners No. 16/2021.

the of speed over ground, which dropped from just over 12 knots to 7 knots. Within 10 minutes, air was detected coming from the FPV sounding pipe with sufficient force that the crewmembers could not sound the tank. Flooding was also detected in the DBV and Nos. 1 and 2 starboard WBTs.

The Master was using the ECDIS to navigate after leaving the approach channel. Based on the positions displayed on the ECDIS, ENC BR321600 indicated there was a 20 m shoal approximately 1 NM off the ship's starboard side between the time that the bilge and tank alarms activated and when the unplanned reduction of speed occurred. However, based on the position plotted on BA Chart 543 at 2132, the ship was inside the 20 m contour and was passing over the shoal during this time.

As previously stated, STELLAR BANNER's speed through the water before 2130 was about 10 knots. Based on this speed, the ship's sinkage due to squat could have been about 1.7 m, resulting in a dynamic forward draft of approximately 23 m.[44] The implication is that the ship would have contacted the bottom if the water depth was less than about 23 m.

Nautical Charts and Hydrographic Information

The charted depths around the ship's position at about 2130 that are shown on ENC BR321600 and BA Chart 543 are based on hydrographic surveys conducted by DHN between 1970–1976.

There is a difference in how some of the 20 m contours in the coastal waters outside the approach channel are indicated on these charts. Solid lines are used to depict all of these contours on ENC BR321600, but dashed lines are used to depict some of these contours on BA Chart 543, including the 20 m shoal located in the immediate area where STELLAR BANNER contacted the bottom. The IHO standards prescribe the use of dashed lines when necessary to draw the navigator's attention to inadequacies in survey data. This shoal is also depicted on BA Chart 543 as being larger than it is on ENC BR321600.

ENC BR321600 indicated that the charted depths along the approach channel and adjacent offshore coastal waters were designated as CATZOC B. As previously noted, depths with this designation have a position accuracy of ±50 m and a depth accuracy equal to ± (1 m +0.02d), where "d" is the charted depth. Based on this, the charted depths between 20-30 m could have been between 1.4-1.6 m shallower, although they could have been deeper by the same amount.

A hydrographic survey of the area in the vicinity of STELLAR BANNER's position at approximately 2130 was not conducted after this incident. However, based on the available information, it is considered likely that the depths near the ship's position at the time were less than 23 m. It is also possible that the actual size of the 20 m shoal was larger than depicted on ENC BR321600 *(see Figures 4 and 5)*. It is noted that DHN issued a correction to ENC BR321600 to include the addition of a 17.4 m sounding that was near STELLAR BANNER's positions between 2124–2130 on 24 February 2020 *(see Figure 9)*. In addition, the UKHO issued a correction for BA Chart 543 to include this 17.4 m sounding and to extend the 20 m approximate contour that the ship was inside when crewmembers reported feeling a vibration *(see Figure 10)*.

44 Bulk carriers generally squat more by the bow than the stern. *See* PIANC, Report No. 121, pp. 26-27.

Passage Plan

A passage plan for STELLAR BANNER's voyage from Ponta da Madeira Terminal to Qingdao had been prepared by the 2/O and approved by the Master, as required by the Company's SMS. The ship's planned route for the outbound transit of Baía de São Marcos was through the buoyed approach channel.

Based on the worksheet used to calculate the ship's UKC that was included as part of the passage plan, it was planned to cross the sandbar between buoys Nos. 1-4 at around 2000 on 24 February 2020. This was just over one hour after high tide at these buoys. Based on the correction factors included in the Ponta da Madeira Terminal regulations, high tide at this location occurred at 1846.[45]

The height of the tide used by the 2/O to calculate the UKC for crossing the sandbar between buoys Nos. 1-4 neither accounted for the height correction included in the terminal operator's regulations nor that the ship would be transiting this area just over an hour after high tide. Rather, he used the height of the high tide that was predicted to occur at the terminal at 2001. The calculated UKC (1.61 m and 0.24 m after applying a CATZOC correction) would have been less if he had corrected the height of the tide according to the terminal operator's regulations.

The calculated UKC for crossing the sandbar between buoys Nos. 1-4 was not updated to account for the ship's delayed departure from the terminal following the late arrival of the pilots.

When determining the height of the tide to enter in the spreadsheet that included the details of each leg, the 2/O applied the UKHO's simplified harmonic method to the predicted height at the terminal to account for crossing the sandbar about an hour after high tide.

Since the depth of water used for the UKC calculations was based on the charted depth (18.3 m) and not the dredged depth (23 m), the ship's actual UKC when crossing the sandbar would have been larger. This is consistent with the statement included on the UKC worksheet that UKCs over 5 m greater than what would be expected based the charted depths had been observed four times during the previous year. The Master reviewed and signed this worksheet. These reported larger UKCs are consistent with the buoyed channel being dredged to a depth of 23 m.

The UKC for the leg crossing the sandbar that was included on the spreadsheet that had detailed information for each leg of the planned voyage was based on a minimum charted depth of 24 m, which is 5.7 m deeper than the depth that the 2/O used when calculating the UKC for this leg. How the 2/O determined that the minimum charted depth for this leg was not reported.

Deviation from Planned Route

The Master stated he decided to not anchor and wait for the tide since he expected that the ship would be crossing the sandbank at or close to the time of high tide. The Master also stated he decided to deviate from the planned route when passing buoy No. 6 since it was after high water and there was deeper water to the east of the buoyed channel.

45 This is two minutes earlier than the time of high tide in this area based on the guidance in the sailing directions issued by DHN.

The charts of the area indicate there was deeper water to the east of the buoyed approach channel than there was within the channel where it crosses the sandbank between buoys Nos. 1-4.

The larger UKCs that had been observed previously suggests the water depths for the buoyed channel were possibly deeper than those to the east of the channel. Due to the proximity of this area to buoys Nos. 1 and 2, any effect of the height of the tide on the water depth would have been similar in both places.

As previously stated, based on the correction factors in the terminal operator's Ponta da Madeira Terminal regulations, on 24 February 2020 the time of the high tide at buoys Nos. 1 and 2 was 1846. The ship was passing buoy No. 6 at 2030, which was almost two hours after high tide at buoys Nos. 1-4. Even if STELLAR BANNER had departed at 1400 as planned rather than at 1440, the ship would possibly have been completing the outbound transit more than an hour after high tide.

The Master had been on ships that loaded at the Ponta da Madeira Terminal more than ten times before and should have been aware how much time was required to complete the outbound transit. Based on this, he should have been aware that the tide would be falling when STELLAR BANNER reached the seaward end of the buoyed approach channel.

The distance from buoy No. 6 to the portion of the sandbar located between buoys Nos. 1-4 is about 5 NM. Assuming that the ship's speed was slowed so that the speed through the water was 5 knots[46] while transiting this portion of the channel, STELLAR BANNER might have been crossing the sandbar sometime between approximately 2100–2115, or 30–45 minutes after passing buoy No. 6.

Based on the height of the tide at the buoys using the tidal predictions and the corrections for the time and height of the tide issued by the terminal operator and the UKHO's simplified harmonic method for determining the height of the tide at any time, the height of the tide at buoys Nos. 1 and 2 would have been about 3.9 m during this time.

Based on the height of the tide being about 3.9 m and the charted water depth of 18.3 m, the sea state correction of -0.33 m, and the CATZOC correction of -1.37 m that were used by the 2/O when calculating the ship's UKC at buoys Nos. 1 and 2, the calculated expected water depth in the channel where it crosses the sandbar would have been approximately 20.5 m, which was less than the ship's calculated dynamic draft of 22.17 m at 5 knots.

However, based on the reported dredged depth of 23 m and the sea state correction used by the 2/O, and a CATZOC correction of -0.73 m,[47] the expected water depth would have been about 25.8 m. Considering that the hydrographic survey conducted in April 2020 determined that the depths in the channel were between 22-32 m, the least expected water depth between buoys Nos. 1-4 may have been 24.8 m. This would have resulted in an UKC of about 2.63 m, or 12% of the ship's dynamic draft, at 5 knots.

Although it cannot be confirmed, based on the VDR audio recording and statements of the C/O, 2/O, and 3/O, it is possible that the Master may have decided to deviate from the planned route sometime before STELLAR BANNER reached

46 This is the speed the 2/O used for the UKC calculations.

47 The value of the CATZOC correction was determined using the depth accuracy of ± (0.5 + 0.01d) for soundings assigned a CATZOC of A1.

buoy No. 6 since none of these officers gave any indication that they were surprised by the Master's decision to deviate from the planned route.

Based on both the Master's acknowledged use of the alternate routes, including while as Master of another VLOC, and the AIS information for outbound transits completed in 2019, it appears that it was a relatively common practice for bulk carriers, including some VLOCs, to deviate from the buoyed approach channel after passing buoy No. 6.

Navigation Watchstanding

The Master had the conn throughout STELLAR BANNER's outbound transit, as required by the Company's procedures for navigation in narrow channels and shallow water. Further, the Master was continuously monitoring the ship's position using ECDIS, while the OOW plotted its position on a paper chart every 15 minutes. The Master was not sharing his assessment of the ship's position based on the positions shown on the ECDIS with the OOW. There is also not any indication that the OOW was assessing the ship's progress and proximity of hazards to navigation based on the positions plotted on the paper chart and then providing that information to the Master.

After deviating from the planned route, the course the Master intended to take was not plotted on the ECDIS as required by the Company's SMS procedures. The Master also did not inform the OOW of the intended course so that it could be plotted on the paper chart. This would have reduced the OOW's ability to effectively monitor and assess the ship's position to help ensure any potential hazards, such as the 20 m shoal depicted using a dashed line on BA Chart 543, to navigation were identified and avoided. There is also no indication that the OOW asked the Master why he had decided to divert from the planned route or his intentions for passing the 20 m shoal after passing through the sandbanks to the east of the marked channel.

Although the echo sounder was operating as required when navigating in shallow water, its usefulness would have been limited in the area where the vibration was felt at approximately 2130. As discussed above, this was due to the charted soundings being more widespread than they were further inshore *(see Figures 3, 4, and 5)*. The echo sounder's usefulness would have been further reduced since it was switched from the 50 m scale to the 100 m scale before the ship was in water that was greater than 50 m deep.

The Master's Standing Orders include a caution against overreliance on the ECDIS. The orders mentioned the importance of checking the ship's position using other means to verify the accuracy of the ECDIS. This is particularly important for inshore navigation.

Because the OOW was not assessing the ship's progress based on the positions plotted on the paper chart, it is possible that he may not have recognized that the ship might pass over the 20 m shoal. If information had been shared between the Master and OOW, particularly as the ship was passing through the sandbanks to the east of the marked channel, it might have drawn their attention to the fact that the 20 m shoal was depicted on BA Chart 543 with an approximate contour and as also being larger than shown on ENC BR321600.

BRM

BRM is a safety and management tool intended to improve safety. This is accomplished by making use of each member of a ship's bridge team during all phases of navigation, both when the Master is on and off the Bridge, to identify and break potential error chains to prevent dangerous situations. Some of BRM's core principles are effective communications, assertiveness and leadership, and obtaining and maintaining situational awareness.[48] Demonstrating knowledge and understanding of these principles is required by the STCW Code for certification as a navigation watch officer.

The Company's navigation watchstanding procedures did not include guidance regarding expectations for the use of BRM by members of the ship's bridge team when the Master has the conn. Such guidance is of particular importance for BRM to be effective. This is because an OOW or other navigation watch officer must be able to question a Master's decision without it being considered an attempt to undermine the Master's authority and ultimate responsibility for the safety of the ship and crew.

Some indicators of ineffective BRM during STELLAR BANNER's outbound transit from the Ponta da Madeira Terminal include:

1. the Master neither informed the OOW of his intention to deviate from the planned route and what the decision to deviate was based on, nor did he direct the OOW to plot the route he intended to take after leaving the buoyed channel on the ECDIS or paper chart;
2. neither the OOW nor the 2/O, who returned to the Bridge at 2115, asked the Master why he deviated from the planned route or how he planned to proceed after the ship left the buoyed channel so that the intended courses could be plotted on the chart;
3. the Master did not share his assessment of the ship's progress and proximity to hazards to navigation based on the positions displayed on the ECDIS;
4. there is no indication that the OOW was assessing the ship's progress and proximity of hazards to navigation based on the positions plotted on the paper chart and providing that information to the Master; and
5. there is no indication that the Master or OOW compared how the 20 m shoal was depicted on the ENC and the paper chart.

The apparent lack of information sharing between the Master and the OOW prevented them from having good overall situational awareness regarding where the ship was, where it was heading, and whether it was approaching any potential hazards to navigation.

48 The other core principles are allocation, assignment, and prioritization of resources and consideration of team experience. *See* STCW Code, Table A-II-1.

PART 4: CONCLUSIONS

The following Conclusions are based on the above Findings of Fact and Analysis and shall in no way create a presumption of blame or apportion liability.

1. Causal factors that contributed to this very serious marine casualty include:
   (a) the Master's decisions to:
      (i) deviate from the planned route during the outbound transit of Baía de São Marcos; and
      (ii) pass within 1 NM of a 20 m shoal based on limited hydrographic information provided on ENC BR321600;
   (b) that STELLAR BANNER contacted the bottom after deviating from the planned route, resulting in damage to the hull and flooding of multiple voids and WBTs;
   (c) the charted depths depicted on ENC BR621600 and BA Chart 543 in the immediate vicinity of the ship's position where it contacted the bottom did not provide a clear indication of either the full range of depths within the 20-30 m contour or the size of the 20 m shoal that STELLAR BANNER passed over;
   (d) ineffective BRM during STELLAR BANNER's outbound transit of Baía de São Marcos; and
   (e) the Company's navigation watchstanding procedures did not provide clear expectations and guidance regarding the use of BRM by members of the ship's bridge team when the Master has the conn.

2. Causal factors that may have contributed to this very serious marine casualty include:
   (a) the time and the height of the tide used to calculate the ship's UKC for the leg that crossed the sandbar between buoys Nos. 1-4 did not take the correction factors included in the sailing directions issued by DHN or the terminal operator's regulations into account;
   (b) the calculated UKC for the leg that crossed the sandbar between buoys Nos. 1-4 was not updated when the ship's departure from the terminal was delayed due to the late arrival of the pilots;
   (c) the difference between how the 20 m contour near the ship's position at 2130 was depicted on ENC BR321600 and BA Chart 543;
   (d) the dredged channel that is between buoys Nos. 1-4 and the details of its minimum depth and maintenance are not indicated on either the ENC or the paper charts; and
   (e) the Master' decision to not anchor and wait for high tide to cross the sand bar between buoys Nos. 1-4.

3. Additional issues that were identified but that did not contribute to this very serious marine casualty include:
   (a) there was more than a 5 m difference in the water depth the 2/O used to calculate the ship's UKC and the depth he entered on the spreadsheet that included details for each leg of the ship's planned voyage; and
   (b) the setting of the echo sounder was changed from the 50 m to the 100 m scale while the ship was inshore of the 50 m contour.

PART 5: PREVENTIVE ACTIONS

In response to this very serious marine casualty, the following Preventive Actions have been taken.

1. The Company revised the relevant SMS procedures to require that:
   (a) Masters conduct a navigation safety briefing with all navigation watch officers prior to each arrival and departure and to report the completion of these briefings to the Company;
   (b) passage plans be submitted to the Company for review by designated shore staff; and
   (c) each ship in the Company's managed fleet undergo a remote third-party navigation and Engine Room audit twice a year.
2. The Company is fitting 11 closed circuit television cameras that can be monitored daily by a third-party on the Bridge and in the Engine Room of each of the ships in the Company's managed fleet.
3. The Company issued operational guidance for ships arriving and departing from the Ponta da Madiera Terminal to:
   (a) require laden ships establish passage plans that provide for transiting the portion of the channel between buoys Nos. 1-4 at high tide, have a maximum speed of 6 knots;
   (b) wait at an anchorage when necessary to wait for the tide, and to use the buoyed channel; and
   (c) prohibit Engine Room operations such as running up the main engine, changing auxiliary engines, and completion of fuel oil change over until the ship is seaward of the 30 m contour.
4. The Company implemented a vessel monitoring system to verify that ships in the Company's managed fleet proceed according to the planned route.
5. The Company revised their training program to prevent accidents and to enhance the shipboard safety culture by using in-house and outside training centers to conduct:
   (a) pre-departure orientation seminars for all crewmembers before they sign-on a ship in the Company's managed fleet;
   (b) Safety Officer training every three years for all senior officers; and
   (c) BRM and ERM refresher training every three years for all officers. Senior and junior officers will attend together in order to promote a culture of open communications.

PART 6: RECOMMENDATIONS

The following Recommendations are based on the above Conclusions and in consideration of the Preventive Actions taken.

1. It is recommended that the Company:
   (a) amend its navigational watchstanding procedures for all bridge team members to more clearly recognize and implement the use of BRM during all phases of navigation, including when the Master has the conn;

(b) revise its passage planning procedures to include guidance regarding when deviating from planned routes might be warranted for reasons other than collision avoidance, weather routing, etc.;

(c) revise its UKC policy to:

(i) ensure that any relevant corrections for the time and height of tides that may be included in coast pilots, sailing directions, and port guides are considered during passage planning and when calculating UKC; and

(ii) minimize the potential for any differences between UKCs calculated using the Company's worksheet and those calculated using the spreadsheet; and

(d) review and revise its procedures for conducting navigational audits, including those conducted remotely, to:

(i) assess the appropriateness of any identified deviations from planned routes for reasons other than collision avoidance, weather routing, etc.; and

(ii) provide a meaningful evaluation of the bridge team's performance with respect to the principles of BRM.

2. It is recommended that DHN:

(a) Consider including the limits of the dredged channel between buoys Nos. 1-4 of the Baía de São Marcos approach channel along with the dredged depth and maintenance information on ENC BR321600 and Chart No. 410 per the relevant IHO standards.

3. It is recommended that the UKHO:

(a) Consider including the limits of the dredged channel between buoys Nos. 1-4 of the Baía de São Marcos approach channel along with the dredged depth and maintenance information on BA Chart 543 provided they are included on Chart No. 410.

The Administrator's marine safety investigation is closed. It will be reopened if additional information is received that would warrant further review.