



**The Bahamas
Maritime Authority**

THE COMMONWEALTH OF THE BAHAMAS

M.v CALEDONIAN SKY

IMO NUMBER: 8802870

OFFICIAL NUMBER: 8001960



**Report of the marine safety investigation into a grounding
within Raja Ampat Marine Conservation Area to the
south of Pulau Gam, Indonesia on 04 March 2017**

The Bahamas conducts marine safety or other investigations on ships flying the flag of the Commonwealth of the Bahamas in accordance with the obligations set forth in International Conventions to which The Bahamas is a Party. In accordance with the IMO Casualty Investigation Code, mandated by the International Convention for the Safety of Life at Sea (SOLAS) Regulation XI-1/6, investigations have the objective of preventing marine casualties and marine incidents in the future and do not seek to apportion blame or determine liability.

It should be noted that the Bahamas Merchant Shipping Act, Para 170 (2) requires officers of a ship involved in an accident to answer an Inspector's questions fully and truly. If the contents of a report were subsequently submitted as evidence in court proceedings relating to an accident this could offend the principle that a person cannot be required to give evidence against themselves. The Bahamas Maritime Authority makes this report available to any interested individuals, organizations, agencies or States on the strict understanding that it will not be used as evidence in any legal proceedings anywhere in the world. You must re-use it accurately and not in a misleading context. Any material used must contain the title of the source publication and where we have identified any third-party copyright material you will need to obtain permission from the copyright holders concerned.

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1 GLOSSARY OF ABBREVIATIONS AND ACRONYMS

ANI	-	Approved Nautical Inspector
ARCS	-	Admiralty Raster Chart Service
ASI	-	Annual Safety Inspection
BMA	-	Bahamas Maritime Authority
BV	-	Bureau Veritas
°	-	Degree
CATZOC	-	Category of Zone of Confidence
C/O	-	Chief Officer
Conn	-	The act of giving wheel, hydroplane or engine orders
DPA	-	Designated Person Ashore
ECDIS	-	Electronic Chart Display Information System
ECR	-	Engine Control Room
ENC	-	Electronic Navigational Chart
GPS	-	Global Positioning System
GMT	-	Greenwich Mean Time
IHO	-	International Hydrographic Organization
IMO	-	International Maritime Organization
Knots (kts)	-	Nautical miles per hour
LT	-	Local time
m	-	Metre
mm	-	Millimetre

M.v Caledonian Sky – Marine Safety Investigation Report

MLC	-	Maritime Labour Convention 2006, as amended
NM	-	Nautical mile
OOW	-	Officer of the Watch
PA	-	Public address system
PSSC	-	Passenger Ship Safety Certificate
SITREP	-	Situation Report
SOLAS	-	International Convention for the Safety of Life at Sea 1974, as amended
STCW	-	International Convention on Standards of Training, Certification and Watchkeeping 1978, as amended
UKHO	-	United Kingdom Hydrographic Office
UTC	-	Universal Time Co-ordinated
VDR	-	Voyage Data Recorder
WP	-	Waypoint
WGS84	-	World Geodetic System, 1984 datum
Yds	-	Yards

All times noted in this report are given in the style of the standard 24-hour clock without additional annotations. The vessel time used on board at the time of the incident was Universal Co-ordinated Time (UTC) + 9.

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SUMMARY

- 2.1 Caledonian Sky is a small cruise ship specialising in expedition cruising around the globe. This particular 18-day cruise started on 25 February 2017 in Rabaul, Papua New Guinea and ended on the 13th March 2017 in Manila, Philippines.
- 2.2 On the eighth day of the cruise, the vessel was at anchor overnight off the southern coast of Gam Island, Indonesia and intended to make the short passage south to Kri Island where the passengers would have had the opportunity to disembark for a snorkelling excursion for the remainder of the day.
- 2.3 On completion of a scheduled routine man overboard (MoB) drill and while proceeding to the north of a predetermined navigation plan, the vessel went aground shortly after midday on an uncharted reef to the north of Kri Island, Indonesia.
- 2.4 Once the Master had identified that the vessel was aground, and after unsuccessfully attempting to re-float the vessel, he initiated grounding procedures and informed the necessary authorities. It was determined that the vessel was unable to free itself from the reef on a falling tide and therefore the decision to delay until sufficient water existed was taken. The Master requested assistance from the local agent and put a plan in place to attempt to re-float the vessel at the next high tide.
- 2.5 It was confirmed via internal inspection that the watertight integrity of the hull had not been breached. The expedition team on board were utilised to conduct a survey of the hull, conduct soundings in the immediate vicinity of the vessel and to confirm that no pollution had been caused as a result of the grounding.
- 2.6 The vessel was re-floated approximately 10 hours later with the assistance of a local tug.
- 2.7 It was confirmed that no injuries were sustained by passengers or crew as a result of the grounding.

3 DETAILS OF INVOLVED VESSEL(s) AND OTHER MATTERS

3.1 Vessel Details

- 3.1.1 Caledonian Sky is a purpose-built passenger vessel owned by Caledonian Sky Inc. and managed by Salen Ship Management of Gothenburg, Sweden and registered in the port of Nassau, Bahamas. The principle details as at 04 March 2017 are as follows:

Owner	Caledonian Sky Inc.
Manager	Salen Ship Management AB
Operator	Noble Caledonia
Shipbuilder	Nuovi Cantieri Apuania S.P.A
Year of build	30 November 1991
Registry	Nassau, Bahamas
Official Number	8001960
Type	Passenger vessel, single hull (steel)
IMO	8802870
Class	Bureau Veritas (BV)
Class notations	I+Hull +Mach
Gross Tonnage	4,200 tonnes
Net Tonnage	1,286 tonnes
Overall length	90.6 metres
Breadth	15.3 metres
Operating draft	4.25 metres
Machinery	2 MAN B&W L28/32A 750 rpm
Power	3520kW (4782 HP)
Propulsion	2 Controllable Pitch Propellers (CPP)
Thruster	Single forward thruster 447kW

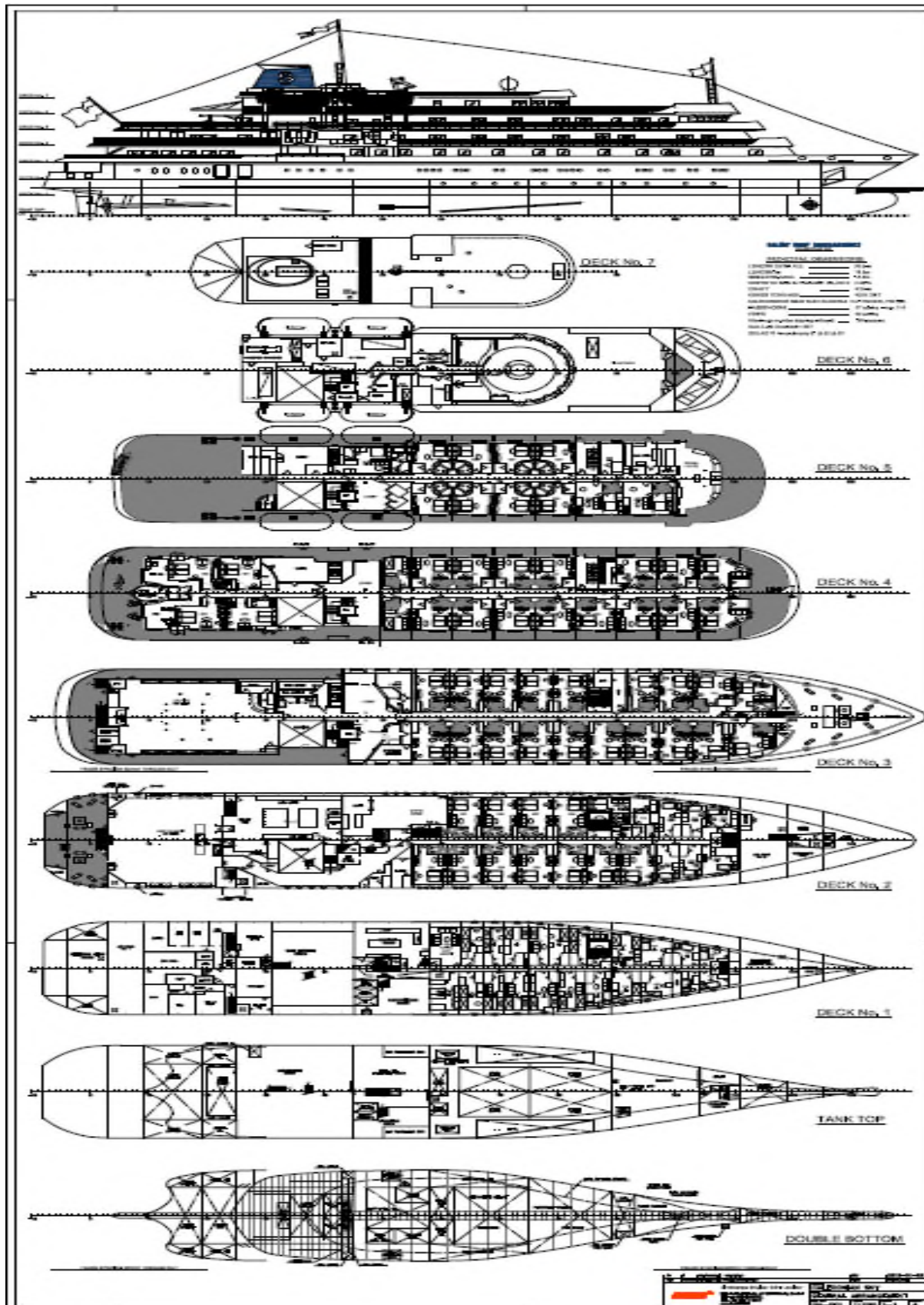


Figure 1: General arrangement plan of Caledonian Sky

3.2 Class and Statutory status

- 3.2.1 At the time of the grounding, the vessel was classed with Bureau Veritas and all statutory certificates remained valid.

Primary Certification:

Certificate of Class	issued	13 Mar 2015	expiry	06 Mar 2020
International Tonnage Certificate	issued	20 Feb 2017	expiry	-
International Load Line Certificate	issued	21 Dec 2014	expiry	06 Mar 2020
Passenger Ship Safety Certificate	issued	26 Dec 2016	expiry	23 Apr 2017
Safety Management Certificate	issued	15 Mar 2015	expiry	15 Mar 2020
Document of Compliance	issued	25 May 2015	expiry	13 Jul 2020
Maritime Labour Certificate	issued	15 Mar 2015	expiry	15 Mar 2020
Safe Manning Document	issued	25 Mar 2015	expiry	13 Jul 2020

3.3 Port State and Flag State Inspections

- 3.3.1 The vessel was inspected by Australian Maritime Safety Authority Port State Control (Tokyo-MoU) on 09 August 2016 in Darwin, Australia with no reported deficiencies recorded.
- 3.3.2 The Bahamas Annual Safety Inspection (ASI) was conducted on 08 February 2017 in Wellington, New Zealand. Two deficiencies were identified at the time, neither related to the safe navigation of the vessel or pertained specifically to bridge resources.

3.4 Details of Watchstanders

- 3.4.1 The Master (59 years of age) of the vessel held an unlimited Master Mariner Certificate at the management level (II/2)¹ required by the Standards of Training, Certification and Watchkeeping (STCW) issued by the United Kingdom of Great Britain and Northern Ireland on 26 September 2001 and endorsed by the Commonwealth of the Bahamas on the 05 August 2016 and was duly recognized in accordance with the provisions of Regulation I/10 of the STCW 1978 convention. Although only one Master serves on board at any one time, there are two Masters assigned to the vessel who alternate approximately every 10-weeks. At the time of the grounding, the Master had been onboard nearly 3 months and was scheduled to disembark in Manila. The Master had successfully completed an Electronic Chart Display Information System (ECDIS) Course on 09 October 2015 at the Maritime Professional Training provider in the United States of America. The training course was approved by the United States Coast Guard and recognized by the Maritime and Coastguard Agency to comply with the IMO model course 1.27, for ECDIS training

¹ Specification of minimum standard of competence for Masters and Chief Mates on ships of 500 gross tonnage or more.

at the Management Level as outlined in section A-II/2, and the operational level requirements as outlined on A-II/1 of the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers 1978, as amended.

- 3.4.2 The Chief Officer (41 years of age) held an unlimited Master Mariner Certificate at the management level (II/2) required by the Standards of Training, Certification and Watchkeeping (STCW) issued by the Republic of the Philippines on 25 May 2016 and endorsed by the Commonwealth of the Bahamas on the 04 July 2016 and was duly recognized in accordance with the provisions of Regulation I/10 of the STCW 1978 convention. At the time of the incident he had been on board for 3 months.
- 3.4.3 The 2nd Officer Navigation (41 years of age) held a Chief Mates Certificate at the management level (II/2) required by the Standards of Training, Certification and Watchkeeping (STCW) issued by the Republic of the Philippines on 12 May 2016 and endorsed by the Commonwealth of the Bahamas on the 12 August 2016 and was duly recognized in accordance with the provisions of Regulation I/10 of the STCW 1978 convention. At the time of the incident, he had been on board for 3 weeks. He had previously undertaken an ECDIS training course with a previous employer before 2011. The most recent Bridge Resource Management (BRM) course was undertaken between 2001 and 2004, no certificates could be provided verifying this fact.
- 3.4.4 The 2nd Officer Safety (42 years of age) held a Chief Mates Certificate at the management level (II/2) required by the Standards of Training, Certification and Watchkeeping (STCW) issued by the Republic of the Philippines on 08 November 2016 and endorsed by the Commonwealth of the Bahamas on the 25 November 2016 and was duly recognized in accordance with the provisions of Regulation I/10 of the STCW 1978 convention. At the time of the incident, he had been on board for 4 months.
- 3.4.5 All crew carried the appropriate documentation as required by the International Standards of Training, Certification and Watchkeeping. All document holders had the necessary endorsements provided by the Commonwealth of the Bahamas and complied with the vessel's safe manning document.
- 3.4.6 It was verified by the BMA that all the crew were in compliance with the statutory hours of rest requirements² at the time of the occurrence of the incident. The Master waived MLC compliance temporarily in order to deal with the incident.
- 3.4.7 Within three (3) hours of the vessel grounding, breathalyser testing was ordered by the Master in accordance with the Company Safety Management System on all bridge watchkeepers with negative results.

² Required by the International Convention of Standards of Training, Certification and Watchkeeping for Seafarers 1978 as amended (STCW) and the Maritime Labour Convention, 2006 (MLC 2006)

4

NARRATIVE OF EVENTS

- 4.1 The following narrative was taken from analysis of the voyage data recording and supplemented by witness testimony.
- 4.2 Caledonian Sky was engaged on an 18-day cruise from Rabaul, Papua New Guinea to Manila, Philippines covering a distance of 3229nm at an average speed of 10kts. The vessel was 8 days into the cruise with 102 passengers and 79 crew when the vessel went aground at 1241 on 04 March 2017.
- 4.3 The vessel's itinerary included three countries as part of this cruise, as can be seen below within figure 2, the route proceeded to the north of Papua New Guinea and Indonesia before transiting between many of the islands of the Philippines towards Manila.

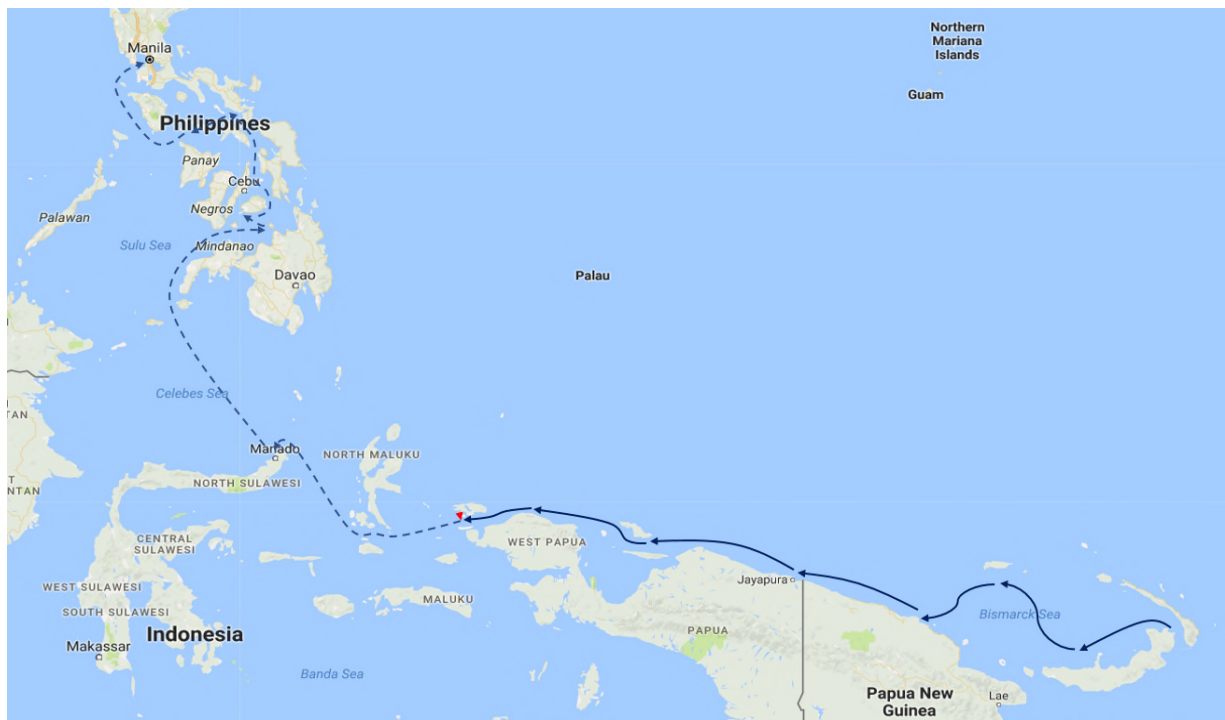


Figure 2: Voyage Schedule No. 022517 Rabaul – Manila (red arrow indicating the location of grounding)

- 4.4 The vessel was anchored south of Pulau Gam Island in approximately 20m of water in position 00° 32.10S 130° 36.29E. Prior to getting underway, the vessel's route was loaded onto Electronic Chart Display Information System (ECDIS) for a short passage of approximately 6nm south of the anchorage to another anchorage located to the south of Pulau Kri, passing to the east of Pulau Kri.

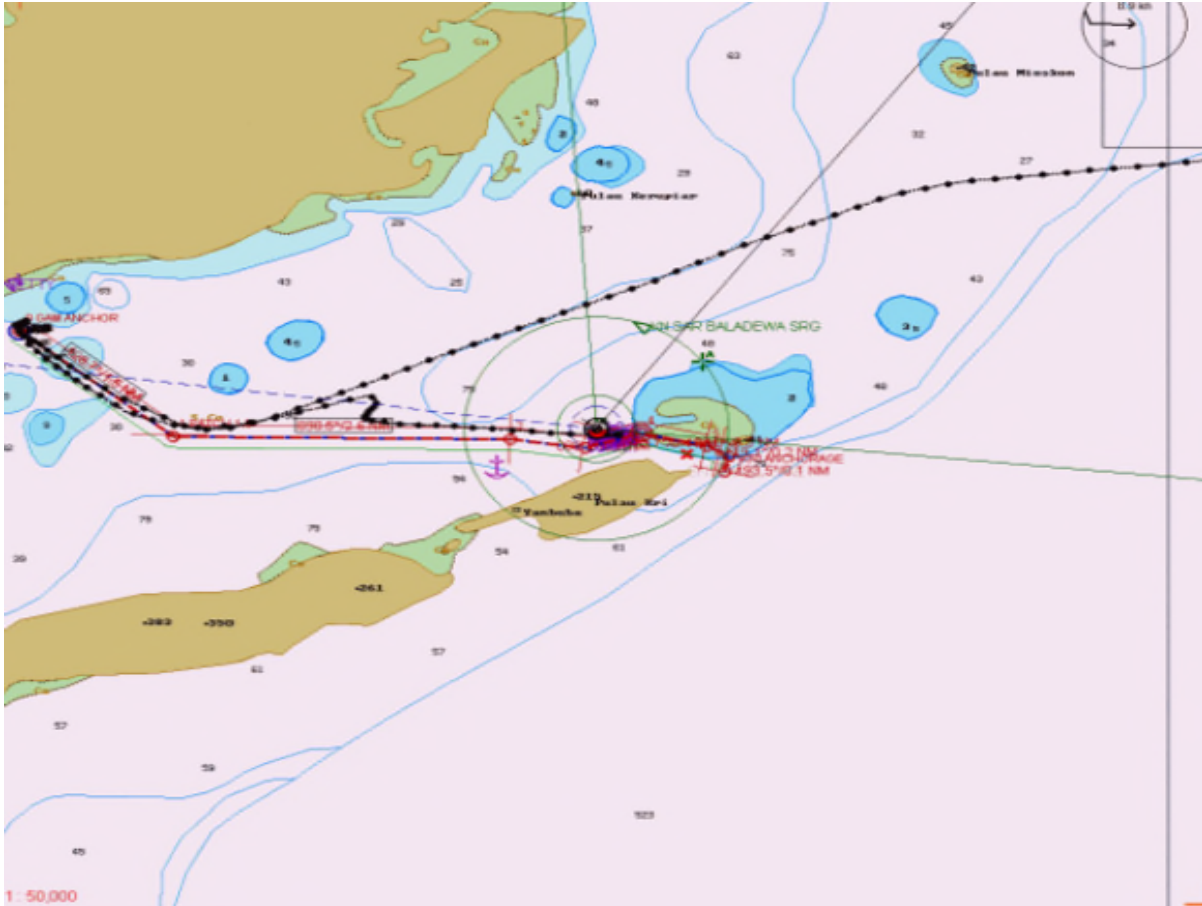


Figure 3: ECDIS screenshot displaying route (red line) from departure anchorage to proposed anchorage south of Pulau Kri

- 4.5 At 1156 the anchor was clear and the vessel commenced the route south with the Master, Navigator and Helmsmen on the bridge. The Master had the Conn³ for departure increasing speed to 9kts.
- 4.6 The Master conned the vessel onto the first leg of the route on a course of 127° remaining within the cross-track corridor. At 1201 the Master handed over the Conn to the 2nd Officer Safety in preparation for a man overboard (MoB) drill.
- 4.7 At 1206 the Master gave a conning order to the helm to steer to port altering the course to 110°. The 2nd Officer Safety still had the Conn but the Master continued to provide course and speed orders.
- 4.8 At 1213 the vessel was 3.5nm from the intended anchorage position in 32 meters (m) of water.

³ As per the Salen Ship Management Bridge Resource Management Manual, to have the navigational control of the vessel, i.e. the actual control of the ship's speed and direction, including giving helm and engine orders. The Conn must be formally taken/handed over to accept this responsibility. The Conn can only be held by the Navigator or the Pilot. The person assuming the Conn must clearly announce "I have the Conn".

- 4.9 At 1217 a MoB drill was conducted and the vessel made speed and course alterations to facilitate recovery using the rescue boat. Safe recovery of the boat with the simulated man was complete and at 1226, the vessel manoeuvred to re-join the intended navigational track.
- 4.10 A short time after and whilst steering to regain the track, the Master discussed with the Navigator the reason behind the “zig zag” in the route between waypoints 2, 3 and 4. The Navigator briefed the Master that this was the route taken on a previous cruise. Subsequently, the Master informed the Navigator that he intends to join the intended track at waypoint 4 (see figure 4).
- 4.11 Remaining outside the cross-track corridor by approximately 50 yards (yds), at 1232 the vessel proceeded at 8.3kts in 67m of water on a course of 093°. At 1234, the vessel entered the northern extremity of the cross-track corridor on a course intended to dissect leg 4 shortly before waypoint 4.
- 4.12 As the vessel proceeded towards waypoint 4, the depth continued to shoal⁴. At 1231 the depth recorded and displayed on the echo sounder and on ECDIS read 67.8m. By 1237 the depth recorded and displayed was 44.1m, a reduction of 23.7m in 6 minutes over a distance of 900 yds.
- 4.13 At 1237 the Master asked the Navigator why he decided not to anchor the vessel north of Pulau Kri in vicinity of waypoint 3. The Navigator stated that he was following the route taken previously.
- 4.14 At 1239 the ECDIS display was zoomed out to display the entire route from waypoint 1 to waypoint 8 (see figure 4).



Figure 4: ECDIS screenshot taken moments prior to the grounding at 1239

⁴ Charted depth of water reduces.

- 4.15 At 1239:53 the Master was asked by the expedition leader “*do you want to come and have a look at this*”, referring to shallow water observed visually from the bridge ahead and either side of the vessel. The depth was acknowledged by the Master as 16.1m while the vessel’s speed was steady at 8.8kts on a course of 091°. At this point, the Master ordered port 20°, followed by an acknowledgement that the depth had reduced further to 10m.
- 4.16 At 1240:23 the Master reported seeing shallow water. The speed reduced to 3.7kts and the echo sounder read 71m, at which point the Master stated: “*we don’t have soundings*”.
- 4.17 Some 23 seconds later, while the vessel’s speed log read 1.4kts, the Master requested ‘*all stop*’ on the engine control levers. At 1241:08 the Master acknowledges the fact that the vessel was aground in position 00° 33.02S 130° 40.67E, 280yds port of the planned navigation track and approximately 80yds outside the northern most cross-track corridor.

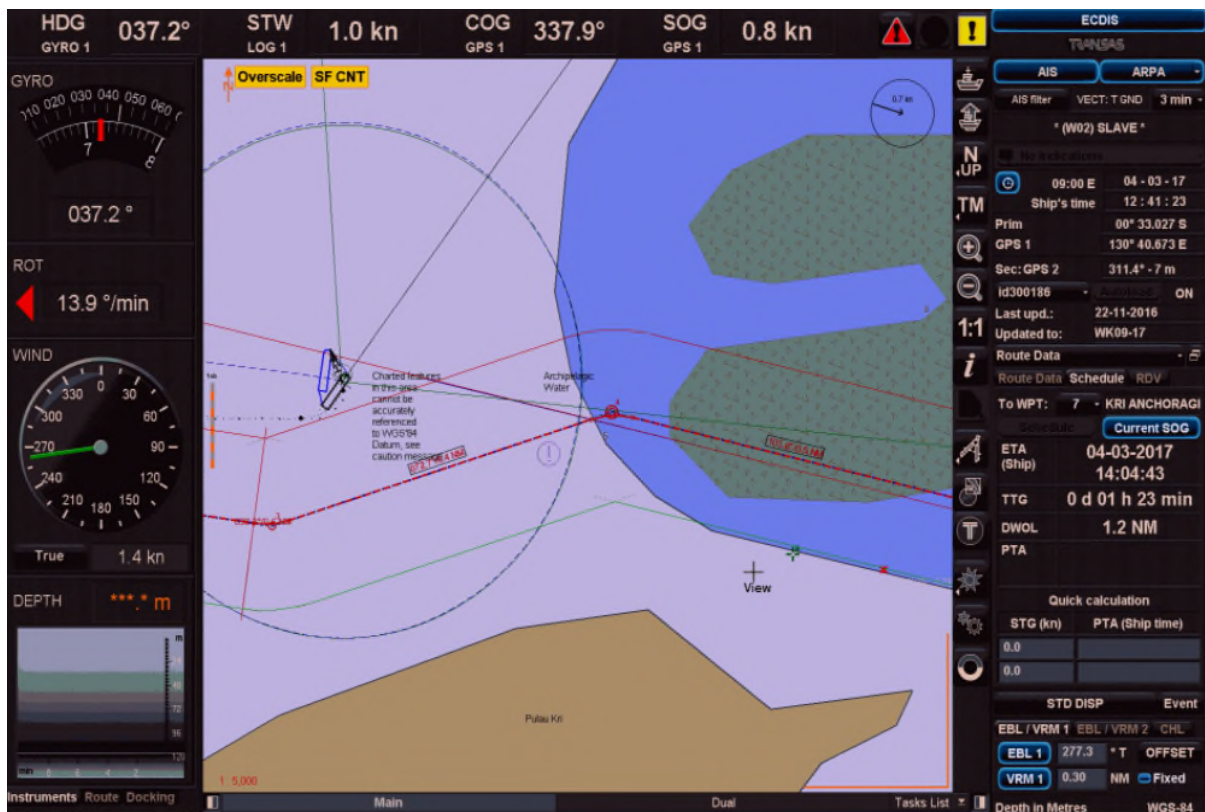


Figure 5: ECDIS screenshot of vessel aground, taken at 1241

- 4.18 Immediately after the grounding, the Master de-clutched the engines from the shaft and requested the expedition team to commence conducting soundings to determine where the deep water is located.
- 4.19 At 1243 the Master called the Engine Control Room (ECR) to speak to the Chief Engineer (C/E). He informed the C/E that the vessel is aground and that he intended to send the boats out with the expedition team on board to find deeper water in any direction.

- 4.20 At 1247 the Master asked the Officer of the Watch (OOW) if there is a grounding checklist. Meanwhile, the expedition leader reported that the propellers are not obstructed. At 1249 the Master ordered the engines to be clutched-in and commences trying to shift the vessel off the obstruction by coming ahead on the port shaft and astern on the starboard in order to swing the bow to starboard.
- 4.21 At 1254, having been unable to move the vessel, the Master left the bridge. One minute later the Master returned to the bridge and received updates from the various outstations on the amount of water available either side of the vessel.
- 4.22 In an effort to reduce the vessel's draft, the Master ordered the lifeboats to be lowered into the water but remain connected, and to let go the starboard anchor.
- 4.23 At 1258 another attempt was made to free the vessel off the obstruction. At this point soundings from multiple outstations were reported to the bridge. Some of which were acknowledged and the majority not.
- 4.24 At 1305, approximately 25 minutes after the grounding, the Master made a public address announcement informing the passengers that the vessel is aground.
- 4.25 At 1306 the expedition leader offered to take a closer look under the vessel using a snorkel which was initially agreed to by the Master. The Master then denied the request due to lifeboats being lowered and engine clutched-in. At 1307, the Master attempted to manoeuvre the vessel again but to no avail.

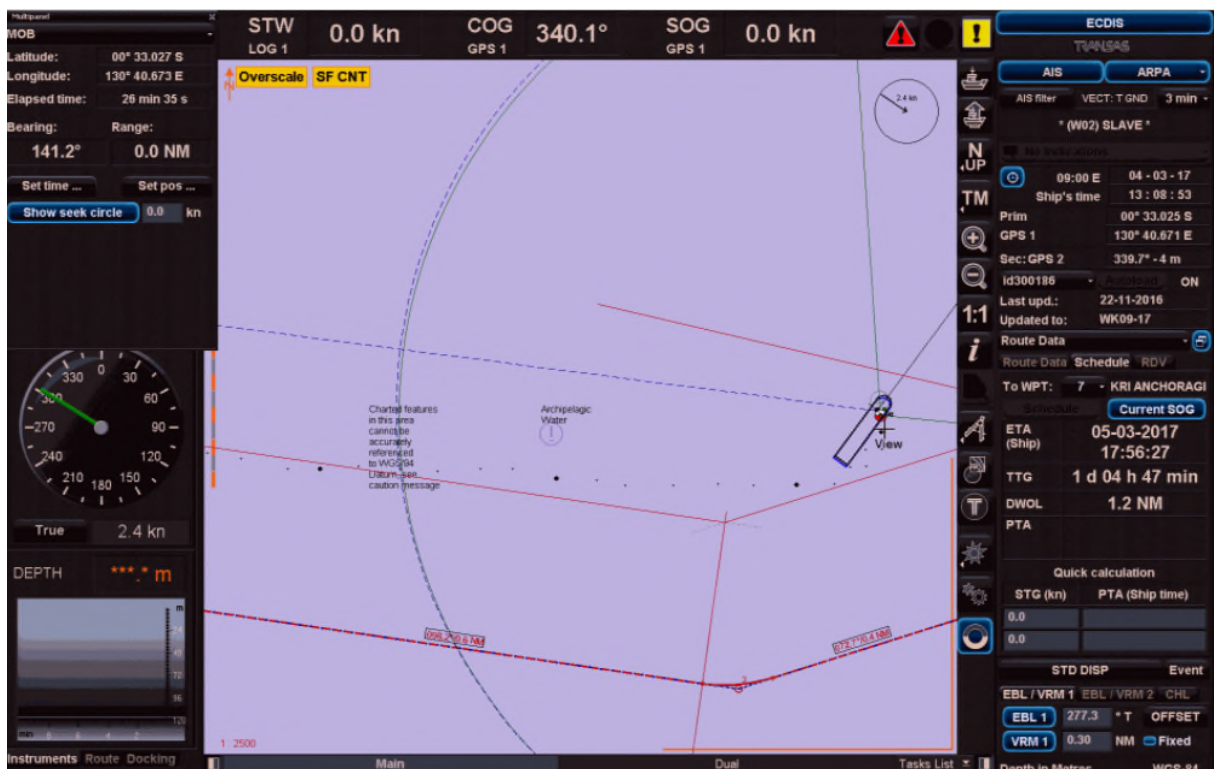


Figure 6: ECDIS screenshot at 1308, at the point where the vessel is hard aground. Note the route taken by the vessel marked by small black dots astern of the vessel

- 4.26 At 1322 another public announcement was made informing the passengers that the vessel remained aground. Shortly thereafter the Master left the bridge in order to inform the Designated Person Ashore (DPA) from Salem Ship Management that Caledonian Sky was aground on an uncharted reef on a falling tide. The agent was also advised at this point and a tug boat was requested to assist the vessel in manoeuvring off the reef.
- 4.27 The divers reported that the vessel was aground on a reef, with intermittent contact between the hull and the reef from approximately half the ship's length.
- 4.28 By 1345, the Master decided not to attempt using the engines to free the vessel again until the next high tide and requested the lifeboats be lifted out of the water and stowed in order to make the vessel "*heavy*" and avoid going further aground, by the action of the current against the vessel.
- 4.29 The agent confirmed that the nearest tug boat was approximately 5 hours away and was enroute to the vessel.
- 4.30 At 1425 the Master discussed with the Navigator how the Voyage Data Recorder (VDR) worked, specifically how to record and preserve data.
- 4.31 At 1430, the Master made another public-address announcement to the passengers informing them that "*he had exhausted all efforts to refloat the vessel and that they are conducting an external inspection to establish where the vessel has made contact*". Additionally, he informed the passengers that a tug boat was enroute and that he hopes to refloat at the next high tide.
- 4.32 At 1528 the vessel's Doctor was requested by the Master to come to the bridge to conduct a breathalyser test for alcohol of the bridge team. By 1552 the analysis was concluded with no alcohol content present on any bridge team member.
- 4.33 At 1559 the Master provided another SITREP⁵ to the shoreside management team. The management team requested the Master to initiate the required BMA reporting procedures by calling the Emergency Response Officer of the Bahamas Maritime Authority.
- 4.34 Approximately 1 hour later, as the flood tide continued to increase the amount of available water surrounding the vessel, the Master discussed with the bridge Officers regarding the preferred method for getting off the reef. Based on the information provided by the divers, deep water exists in every direction except ahead of the vessel and the point where the vessel is aground on the port side.
- 4.35 At 1705 all ship's boats were stowed back on the ship.
- 4.36 At 1750, the soundings taken surrounding the vessel were transposed onto the ECDIS as seen below within figure 7.

⁵ Situation Report



Figure 7: ECDIS screenshot displaying results of soundings taken in proximity to the vessel

- 4.37 By 1800 the Indonesian Police arrived on board to discuss the details behind the grounding, review available charts and intentions for getting off the reef. Additionally, local representatives from the Indonesian Coastguard attended on board to check the vessel's documentation.
- 4.38 Sunset occurred at 1830.
- 4.39 At 1910, a public-address update to the passengers was made by the Master. Further, at 1915 the Master proceeded to the communal lounge to meet with passengers to answer any questions they may have in person.
- 4.40 At 2041, the Chief Engineer confirmed no water ingress and therefore the integrity of the hull was not compromised.
- 4.41 By 2115, the vessel's bow started to move unaided. At this point, the Master requested the tug boat to be secured on the port shoulder. Three minutes later the engines and thrusters were requested for immediate use. The Master received advice from a local person, who advised the Master to proceed ahead and not astern, thereby changing the Master's original intentions to come astern off the reef.
- 4.42 At 2144 the vessel started coming ahead off the reef by use of the single tug forward. Shortly thereafter, the Master received confirmation that the propellers appear clear and in deep water with no obstruction. At that point, the Master decided to use the engines intermittently to assist the tug in coming ahead. The tug at this point reported that it was having engine trouble on one of its two engines and therefore was operating at reduced power.

- 4.43 By 2234, it was confirmed that the vessel was afloat and free from any underwater obstruction. Shortly thereafter the Master made a public-address announcement informing the passengers that the vessel was afloat and reassured them that there was no water ingress. The intention was to proceed to the location of the anchorage position in which the vessel departed that morning following the reciprocal route taken earlier in the day.
- 4.44 On 04 March 2017 at 2310 the VDR recording was preserved, providing the investigators with audio recording on the bridge and video recording of the Electronic Chart Display Information System (ECDIS), both radars, engine log, steering log and watertight door (WTD) status log.
- 4.45 Some 19 hours after the vessel sailed, the vessel arrived at the anchorage at 2349 with 5 shackles⁶ on deck in 21m of water.
- 4.46 The following day, the expedition team entered the water to dive on the hull to conduct a visual inspection. It was confirmed by the dive team that minimal damage had been sustained on the hull and confirmed that the watertight integrity of the hull had not been breached. It was also confirmed that the rudders, stabilisers and both propellers visually appeared in good condition with no evidence of damage.
- 4.47 Having assured themselves that the hull appeared to be in sound condition, the Master, with approval from the Indonesian Authorities sailed from Pulau Gam continuing the cruise to the next port of Bunaken, Indonesia. Arrangements were made for Class attendance and a further survey of the hull by an independent dive company once the vessel reached Kobe, Japan on the 27 March 2017. This was the first available port for Class attendance with adequate visibility for a hull inspection by divers.

⁶ A shackle is a nautical unit used for measuring the length of an anchor cable (chain) equal to 15 fathoms, 90 feet or 27.432 meters. Therefore 5 shackles is equal to 137.16 meters of anchor chain.

5

ANALYSIS AND DISCUSSION

5.1 Aim

- 5.1.1 The purpose of the analysis is to determine where possible the contributory causes and circumstances of the accident as a basis for making recommendations to prevent recurrence in the future.

5.2 Fatigue

- 5.2.1 The Master was awake from 0300 and retired to his cabin at 0001 on the 05 March, a period of 21 hours. At the point where the vessel ran aground, the Master had been awake for 9.5 hours of which 6.5 hours was recorded as working hours. Between 0430 and 0800 the Master was participating in a walking expedition ashore whilst the vessel was at anchor off Pulau Gam.
- 5.2.2 The vessel was considered afloat at 2234 at which point the Master had been on duty for 16 hours, exceeding the daily allowance by 2 hours.
- 5.2.3 The Master had recorded 17.5 hours of work on 04 March, exceeding the maximum hours of work requirement⁷ by 3.5 hours in any 24-hour period.
- 5.2.4 The Master can deem it necessary to suspend the scheduled hours of rest requirement for a seafarer, including himself, if he deems it necessary to perform the work for the immediate safety of the ship⁸. Compensatory rest must be afforded once the normal situation on board has been restored. When such an occurrence is required, the details of the affected seafarer should be recorded in the Official Log Book. The Caledonian Sky Official Log Book had no such recording.
- 5.2.5 It cannot be known the degree of fatigue affecting the Master and his decision-making ability once his daily hours of rest had been exceeded. There was however, no provision documented in consideration of the danger posed by the potential fatigue affecting the Master and the conduct of his duties. Further, there was insufficient supervision by the Managers ashore, particularly when those duties involve navigational safety, to ensure the Master was adequately directed to rest during periods where the immediate safety of the vessel was not in jeopardy.
- 5.2.6 The managers ashore nor the Master considered the impact affecting his mental capacity, having been awake for 19 hours at the point of floating off and manoeuvring away from the reef, may have had on the safety of the vessel and those on board, particularly if the situation had deteriorated.

⁷ The International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978 as amended (STCW) and the Maritime Labour Convention, 2006 (MLC 2006) require that all seafarers are provided with minimum periods of rest or maximum hours of work.

⁸ In accordance with the Bahamas Maritime Authority Information Bulletin No. 144, Guidance and Instructions for Hours of Rest.

- 5.2.7 All watchkeepers with the exception of the Master remained within their allowance⁹ and did not exceed their maximum daily hours of work.

5.3 Charted Data

- 5.3.1 It was determined through the course of multiple witness interviews and VDR playback analysis, whilst taking into consideration the extensive experience of the Master, it can be concluded that the Master had no intention of deliberately standing the vessel into danger.
- 5.3.2 The Master was aware of the shoal water and therefore inherent danger to navigation this posed ahead of the vessel between waypoints (WP) 4 and 6, as indicated on the Indonesian chart 186 which was on display on ECDIS as an updated¹⁰ electronic navigational chart (ENC) (chart ref. number 300186) as seen within figure 8 below.
- 5.3.3 Chart 300186 is produced to the IHO Standard S-57¹¹ at a scale of 1:200,000 and was the only chart covering this particular area held on board within the ECDIS portfolio and in use at the time of the grounding. The paper equivalent of this chart (No.186) is derived from hydrographic data obtained from Indonesian Government charts of 2007 to 2015 and was compiled based mainly on surveys from 1911 to 1926 by the Netherlands, and miscellaneous lines of passage soundings. Satellite imagery was also used for the coastline and delineation of visible shoal areas. A screenshot of the ENC 300186 is shown below within figure 8.

⁹ Maximum hours of work shall not exceed 14 hours in any 24-hour period; and 72 hours in any seven-day period.

¹⁰ Notice to Mariner updated through week 09/17. The last software update was conducted on 22 November 2016.

¹¹ Transfer standard for digital hydrographic data (including the product specification for Electronic Navigational Chart (ENC)).

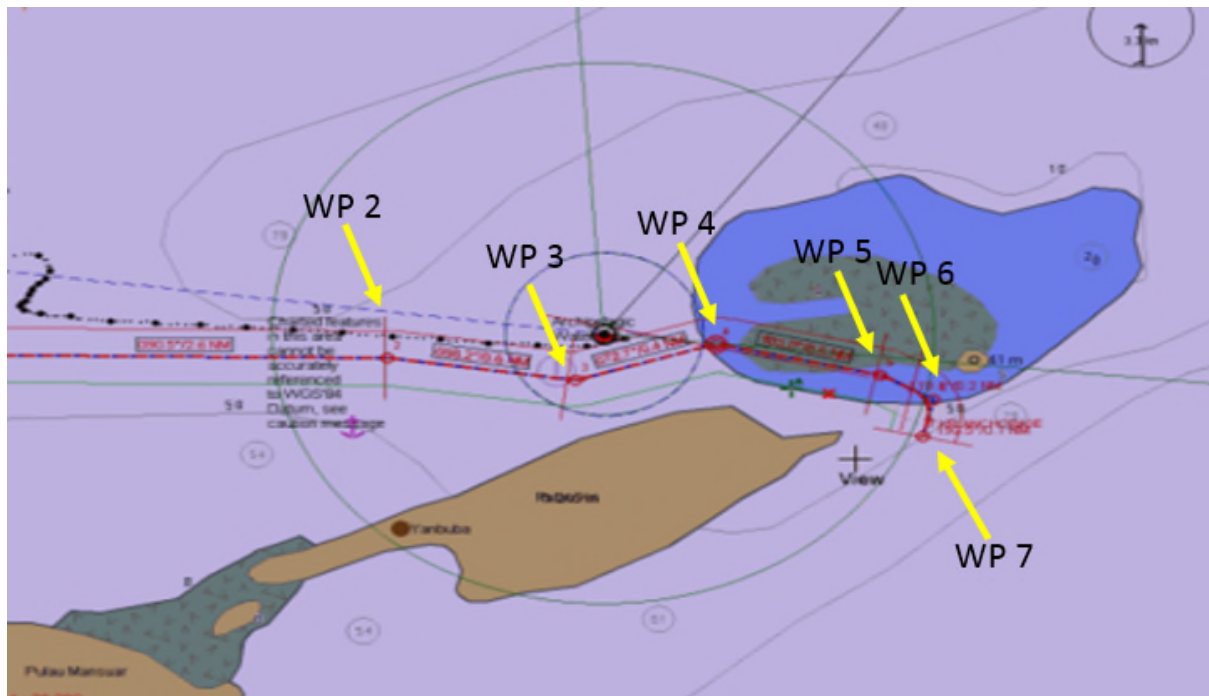


Figure 8: ENC 300186 as displayed on the ECDIS

5.3.4 The paper version of chart 300186 is shown below and although the chart was not present on board, a copy of the area is shown below within figure 9 demonstrating the equivalence of the same chart in a different format.

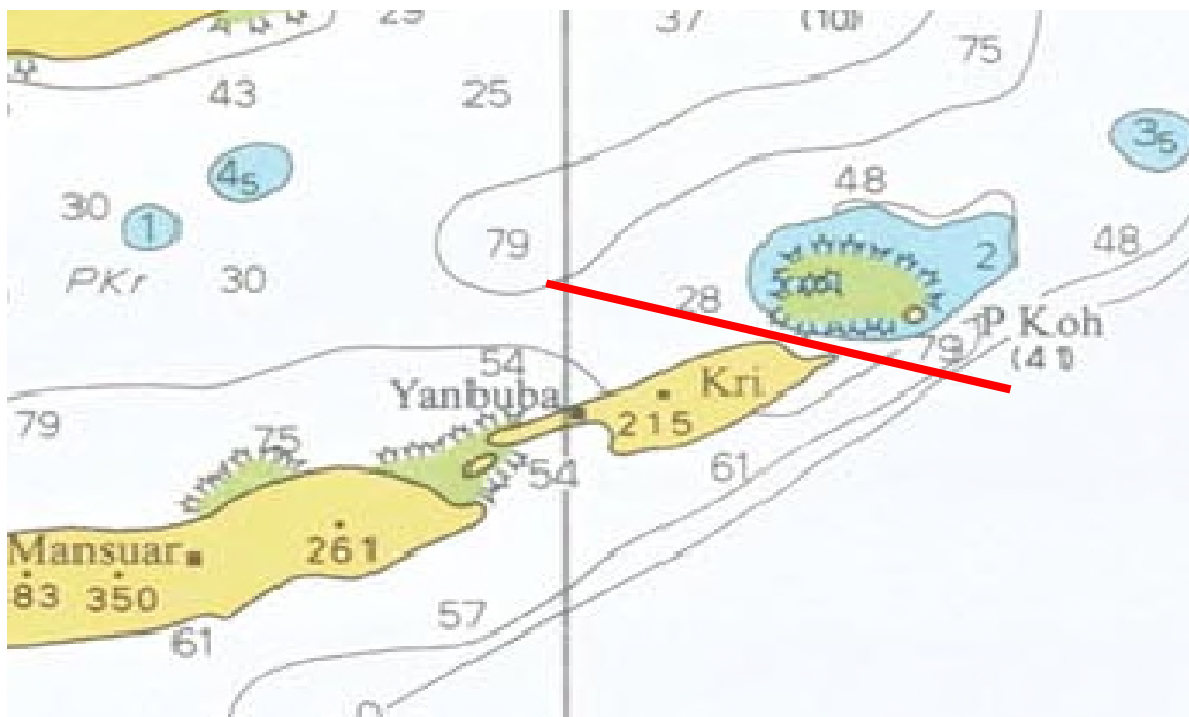


Figure 9: Local Indonesian paper chart 186 and for illustration purposes, the safe water between the eastern most reef and Pulau Kri

- 5.3.5 An alternative chart, not held on board, of the same area is chart 3923. This chart is at a scale of 1:500,000 and available in paper and electronic vector form as an Admiralty Vector Chart Service (AVCS)¹² chart (ENC ID 203923). However, the scale of ENC 300186 is at a more favourable scale and therefore was the preferred chart in use at the time.
- 5.3.6 It is advisable and common practice to use all available means when planning a navigational passage. This is discussed within the International Chamber of Shipping Bridge Procedures Guide section 2.4 which states: *‘that during the planning stage of a passage, the appraisal of all charts, nautical publications and additional information should be used to prepare a passage plan’*. A cross-reference of the two charts would have identified a significant discrepancy. As seen within figure 10, the drying height surrounding Pulau Kri is significantly larger than that shown on chart no. 186. This drying height extends the length of the island and does not show the narrow channel between the eastern most shoal.



Figure 10: Chart 3923 illustrating drying height at the eastern end of Pulau Kri

- 5.3.7 A satellite image of Pulau Kri shows a number of reefs and the available water to the east in which the vessel intended to sail. An overlay of the vessel's intended track and cross-track corridor has been placed on top of the satellite image. As shown, the intended track, if followed would have resulted in the vessel's safe passage to the intended anchorage south of Pulau Kri.

¹² Admiralty Vector Chart Service (AVCS) brings together Electronic Navigational Charts (ENC) from Hydrographic Offices around the world with new ENCs produced by United Kingdom Hydrographic Office in co-operation with foreign governments to provide the most comprehensive, official, worldwide nautical chart coverage available.



Figure 11: Satellite imagery of Pulau Kri and adjacent drying heights and location of the grounding as indicated by the yellow circle (Source: Google Maps 2018)

- 5.3.8 To determine the reliability and quality of a chart the source data diagram should be reviewed. When operating on ENC's, the reliability and quality is determined by examining the Category of Zone of Confidence (CATZOC). CATZOC's provide the bridge team with the facility to examine the source data, giving an estimate of the reliability and quality of data for a given area. The Zone of Confidence in this particular geographic area is categorized as CATZOC D, which stipulates the following survey characteristics: *'that poor quality data or data that cannot be quality assessed due to lack of information, and depth accuracy in excess of 2m +5% and positional accuracy greater than 500m'*. Adequate precaution should always be exercised as required by the Convention on the International Regulations for Preventing Collisions at Sea, 1972, specifically Rule 2 (Responsibility) which states: *'Nothing in these rules shall exonerate any vessel, or the owner, master or crew thereof, from the consequences of any neglect to comply with these rules or of the neglect of any precaution which may be required by the ordinary practice of seamen, or by the special circumstances of the case.'* It is known that this route was only chosen based on the successful transit undertaken in November 2016. Taking into consideration the CATZOC features, it could be considered that undertaking this route demonstrates a lack of precaution required by the ordinary practice of seamen. The vessel may have been familiar with this route but for the Master, this was new and unfamiliar territory.

5.4 Navigational Procedures and Practices

- 5.4.1 According to the Master’s testimony, the Navigator briefed the Master on the passage plan and the 6nm navigational track from the anchorage south of Gam Island to the anchorage south of Kri Island. The track presented at the passage plan brief was the exact track used on the previous voyage in November 2016. The Master can be heard on the VDR recording, while the vessel was underway having commenced its passage, asking the Navigator why this particular route was chosen, why the anchorage is to the south of Kri Island and why the track is laid close to the shoal water. The Navigator replies with the following statement: “*this is what we did before*” to which the Master replies “*okay*”. The vessel ran aground to port of the intended track, outside the cross-track corridor and in between waypoint 3 and waypoint 4 shortly after this conversation.
- 5.4.2 The primary objective of the passage plan¹³ is to determine if the route is safe and achievable. If the passage is deemed unsafe the Master has ample time to adjust the passage to ensure the risk is as low as reasonably practicable. This particular route was chosen based on scanty information. The route was previously undertaken in November 2016 by a different Master but with the same Navigator. Aside from the track, no further details were provided from one Master to another. This was a significant contributory factor in the grounding of the vessel. The Master relied heavily on the Navigator for this passage as he had experience having completed this route some four months prior. The single danger was identified as passing between the eastern edge of Pulau Kri and the adjacent shoal patch. At no stage was it considered that the chart data in the region was poor and therefore this route should be avoided in its entirety or the previous track should be followed meticulously due to the lack of accurate chart data.

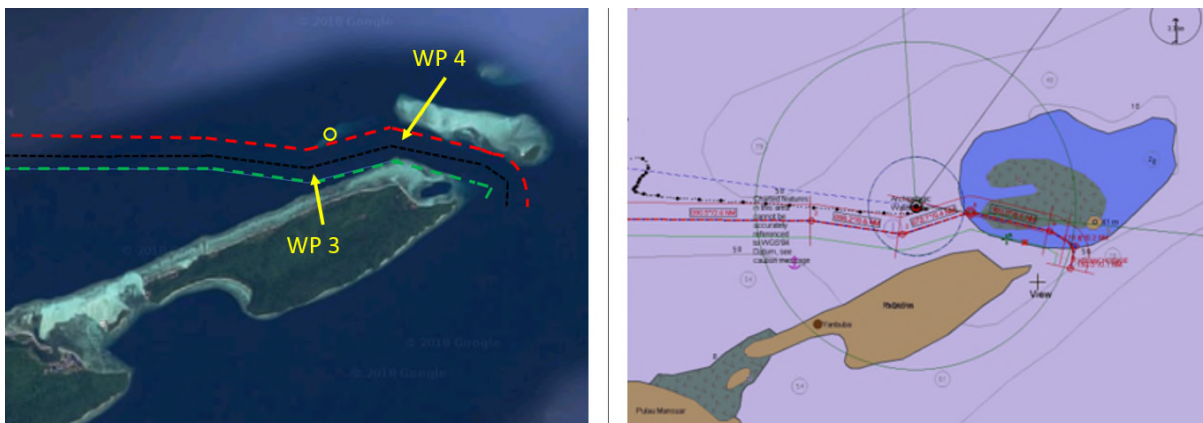


Figure 12: Comparison between satellite imagery and nautical chart 300186 used for navigation against the vessel's track

¹³ As defined within Annex 1 of the IMO Assembly Resolution A.893(21) Guideline for Voyage Planning. Paragraph 1.1: The development of a plan for voyage or passage, as well as the close and continuous monitoring of the vessel's progress and position during the execution of such a plan, are of essential importance for the safety of life at sea, safety and efficiency of navigation and protection of the marine environment.

- 5.4.3 The approved passage plan stipulated that the speed required was 6kts for the hour-long transit between the two anchorages. The passage plan makes no reference to a man overboard drill taking place on departure from the anchorage and subsequently does not take into account the time taken to execute the man overboard drill. On completion of the man overboard drill, the required speed to make good the anchorage by 1230 was 9.5kts. It was determined through the course of the investigation that the arrival time at the anchorage was approximate and the increase in speed was necessary to improve manoeuvrability and counteract the current. This increase in speed was not accounted for in the passage plan nor did the Master re-brief the bridge team that he intended to continue at 9.5kts instead of 6kts. The passage plan contains no detail on expected tide or current data and therefore there is no way of knowing if ephemeral data was taken into consideration by the bridge team.
- 5.4.4 At 6kts there is minimal squat¹⁴ experienced. However, at 9.5kts the vessel will on average squat in the region of 0.5m. When questioned, the Master confirmed that squat is not considered or calculated either during the passage plan or while underway. The consequence of squat increases the effective draught of the vessel from 4.25m to 4.75m.
- 5.4.5 The ECDIS safety contour was set to 5m. Therefore, any charted depth of 5m or less will be highlighted in dark blue on the ECDIS display. The safety contour should have been constructed using the following data: draught (4.25m) + squat (0.5m) + under keel clearance (UKC (0m)) – height of tide at 1230 (1.5m) = safety contour (3.25m). The Master confirmed that a safety depth (UKC)¹⁵ was not applied to the draught which would ordinarily take into account swell, tidal differences, charted anomalies and acceptable risk appetite of the Company in regard to depth beneath the keel.
- 5.4.6 As an example, if a 2m safety depth been applied, the effective draught of the vessel would be 5.25m at 9.5kts taking into account squat and the height of tide at 1230. The safety contour highlighted on ECDIS would then require the 10m contour to be highlighted, distinguishing the gradient of water adjacent to the contour below 10m as unsafe, thus providing a more realistic representation of safe water in which to navigate.
- 5.4.7 The Master's Standing Orders require the bridge team to continually monitor the location of the vessel and when in pilotage¹⁶ waters the vessel is to be fixed at suitable frequent intervals using visual cross bearings, radar bearings and ranges (distance) whenever possible. The vessel was in sight of land and therefore the most accurate and reliable method to determine the location of the vessel is by visual and radar lines of position, obtained from charted objects. On review of the ECDIS playback, not one fix or line of position was laid on the chart throughout the transit. The Master and all

¹⁴ The squat effect is the hydrodynamic phenomenon by which a vessel moving quickly through shallow water creates an area of lowered pressure that causes the ship to be closer to the seabed than would otherwise be expected.

¹⁵ ((Safety depth = Draught + Squat) + Company UKC adopted to increase safety beneath the keel = Effective Draught)

¹⁶ Confined waters in close proximity to land.

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members of the bridge team clearly relied heavily on GPS to determine the vessel's position which is in contravention and disregard of the Master's Standing Orders.

- 5.4.8 The Master's standing orders specifically refers to the use of parallel indexes in that they should be used at all times. This navigation technique is common practice on radar and ECDIS as it provides an immediate reference of the vessel's position in relation to the track. At no point during this passage was a parallel index used as a method of determining the vessel's position.
- 5.4.9 According to the passage plan, the vessel's draught was recorded as 4.2m, minimum depth expected was 20.2m and the minimum under keel clearance (UKC) was 20m. The voyage plan on the reverse of the passage plan lists the squat and UKC for each leg. The UKC for the first 3 legs is below the minimum UKC expected for the transit. In practical terms, the bridge team were prepared for the depth beneath the keel to always be in excess of 20m. However, in reality and according to the voyage plan, the depth beneath the keel was expected to range from 5.8m – 40m. This discrepancy undermines the voyage plan and the importance of monitoring the available depth of water.

Voyage No.: 142 Ship's Name: CALEDONIAN SKY FROM: GAM ANCHORAGE TO: KRI ANCHORAGE Master's Name: CAPT. MIKE TAYLOR
Route name: GAM ISLAND TO KRI 2017

WAYPOINTS									
WPT	Name	Position	Leg	Total Distance	X PORT X STBD	Turn Radius	Draught	Squat	UKC
0	GAM ANCHOR	00° 32.104 S 130° 36.303 E	XXX.X XXX.X	XXX.X	XXX.X XXX.X	XXX.X	XXX.X	XXX.X	XXX.X
1	PATCH 1.0	00° 33.120 S 130° 37.584 E	128.2° 1.60 NM	1.60 NM	0.10 NM 0.10 NM	0.10 NM	4.2 m	Undefined	5.8 m
2		00° 33.114 S 130° 40.018 E	089.9° 2.46 NM	4.06 NM	0.10 NM 0.10 NM	0.10 NM	4.2 m	Undefined	15.8 m
3		00° 33.196 S 130° 40.584 E	098.2° 0.56 NM	4.62 NM	0.10 NM 0.10 NM	0.10 NM	4.2 m	Undefined	15.8 m
4		00° 33.063 S 130° 41.009 E	072.7° 0.44 NM	5.06 NM	0.10 NM 0.10 NM	0.10 NM	4.2 m	Undefined	40.0 m manual
5		00° 33.178 S 130° 41.505 E	103.0° 0.52 NM	5.58 NM	0.10 NM 0.10 NM	0.10 NM	4.2 m	Undefined	40.0 m manual
6		00° 33.268 S 130° 41.665 E	119.1° 0.12 NM	5.70 NM	0.10 NM 0.10 NM	0.10 NM	4.2 m	Undefined	40.0 m manual
7	KRI ANCHORAGE	00° 33.405 S 130° 41.633 E	193.5° 0.19 NM	5.90 NM	0.10 NM 0.10 NM	0.30 NM	4.2 m	Undefined	40.0 m manual

Figure 13: Voyage plan from Gam anchorage to Kri anchorage

- 5.4.10 Admiralty sailing direction ASD35¹⁷ was consulted for advice on passages between Pulau Gam and the passage between Pulau Augusta, which states: passage in vicinity of Pulau Merpati are “*not recommended*”. The passage within this area, although not specifically referred to within ASD35, does recommend that the passages around these islands ‘*remain navigable in clear weather, but preferably only with the benefit of local knowledge, on account of a number of dangerous detached shoals and strong currents in the vicinity of the reefs and islets.*’ It is known that the Admiralty Sailing Directions were not consulted prior to or incorporated within the construction of the passage and therefore did not feature as part of the risk assessment process, known more formally as the voyage plan or passage plan brief.
- 5.4.11 The Bridge Resource Manual requires the bridge team to adopt a heightened operational stance on the bridge to reduce distraction and improve communication flow when operating within confined waters. This policy encompasses a closed bridge

¹⁷ Admiralty Sailing Directions NP35, Indonesia Pilot, Volume 3, 7th Edition 2017

condition referred to as Red Zone operation. When this condition is in force only essential, operational communication is to take place and all non-essential forms of communication to and from the bridge are to cease. The implementation of this condition during confined water transits reduces distraction and interference and helps to focus the attention of all bridge personnel with the primary matter in hand which is the safe conduct of navigation. This condition as stipulated within the SMS should have been adopted during this passage. However, this condition was not adopted, and the bridge remained in Green Zone condition allowing the free flow of personnel, communication and information to provide a ready distraction in contravention to Company procedures and to the detriment of safe navigation in confined waters.

- 5.4.12 The implementation of Red Zone condition prevents the undertaking of any drills, which includes the initiation of a MoB drill. Despite the Master's intention of achieving a realistic MoB drill, it was to the detriment of navigational safety and in contravention of safety procedures and navigational policy.

5.5 Bridge Resource Management (BRM)

- 5.5.1 Bridge Resource Management training was not required to be undertaken by all watchkeepers prior to assuming their role and responsibility. In house BRM training was provided at the end of each Master's contract, the results of which were sent ashore to the DPA for review and comment.
- 5.5.1 The method of communication used on the bridge could be described as informal and relaxed. The Bridge Resource Management manual stipulates that a technique known as closedloop communication is utilized which aims to avoid misunderstanding by ensuring any instruction passed is repeated back by the recipient to ensure complete understanding. This method, despite being required to be implemented on board was not exercised by the bridge team. Although not known at the time, a significant amount of information was lost between the bridge and the various out-stations transmitting vital information pertaining to the work of the expedition boats and the data that they were recovering on behalf of the Master. The result of this missing information meant the Master did not have full situational awareness and was not therefore, best placed to coordinate operational activities on board.
- 5.5.2 Section 5 of the Bridge Resource Management Manual identifies that the Master should set the tone on the bridge such that all members of the team are encouraged to actively contribute to effective bridge communications. The Master's leadership style did not encourage active participation by the bridge team to communicate information freely and without ridicule. On a number of occasions, the Master mocked and embarrassed members of the bridge team in a dictatorial manner. Insufficient evidence exists to determine if this was a systemic practice or simply one that came to light because of the stressors of the situation.

5.6 Damage sustained to environment and vessel

- 5.6.1 The reef had the following seabed characteristics which consisted of rock, sand and coral. As a consequence of the grounding, the vessel sustained damage to the hull in the form of intermittent compression, minor damage to bilge fin and removal of anti-foul paint between frames 10 to 100. At no point was the hull punctured or water tight integrity compromised.
- 5.6.2 The vessel was considered to be bodily aground in that the majority of the hull was in contact with seabed and the vessel was sat in an even keel condition. An occasional survey of the hull was conducted by the vessel's classification society to determine and obtain a damage assessment of the hull. The evidence provided by the Class approved independent dive company, Yusen Navtec, consisted of photographs and a written report describing the damage sustained. The Class report stated the following *"Not found any serious damage affected to Class Rule"*.
- 5.6.3 As depicted in figure 14, the vessel came to rest on the seabed between frames 10 and 100. The remainder of the hull appeared to have no signs of damage.



Figure 14: Caledonian Sky aground on the reef with lifeboats in the water

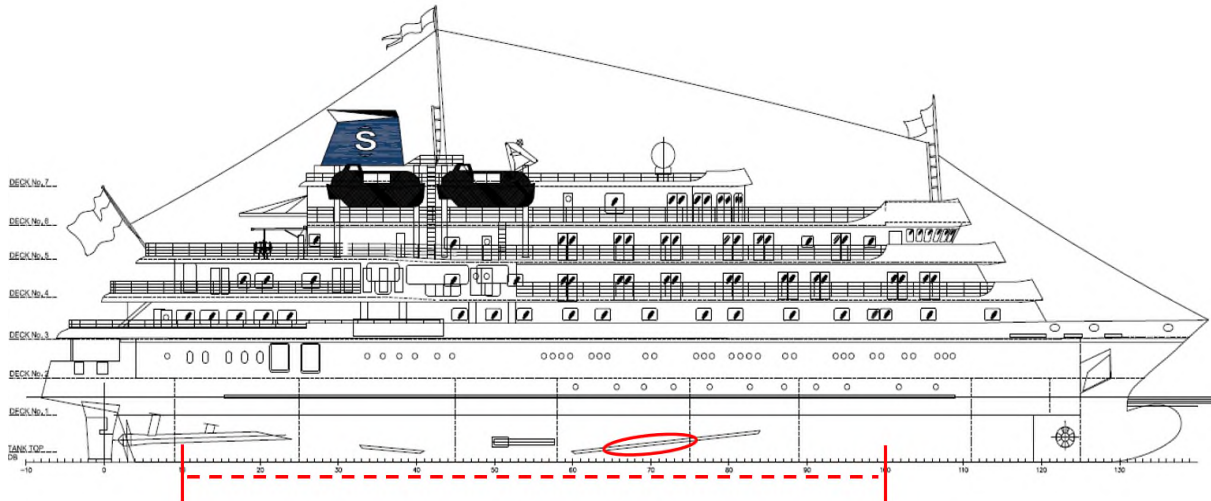


Figure 15: Damage sustained beneath the waterline

- 5.6.4 The pictures of the hull shown within figure 16 indicates the type of damage sustained to the hull and bilge fin. Scratches can be seen along the majority of the hull between frames 10 and 100 and intermittent compression against the aft longitudinal rib in vicinity of frame 70.

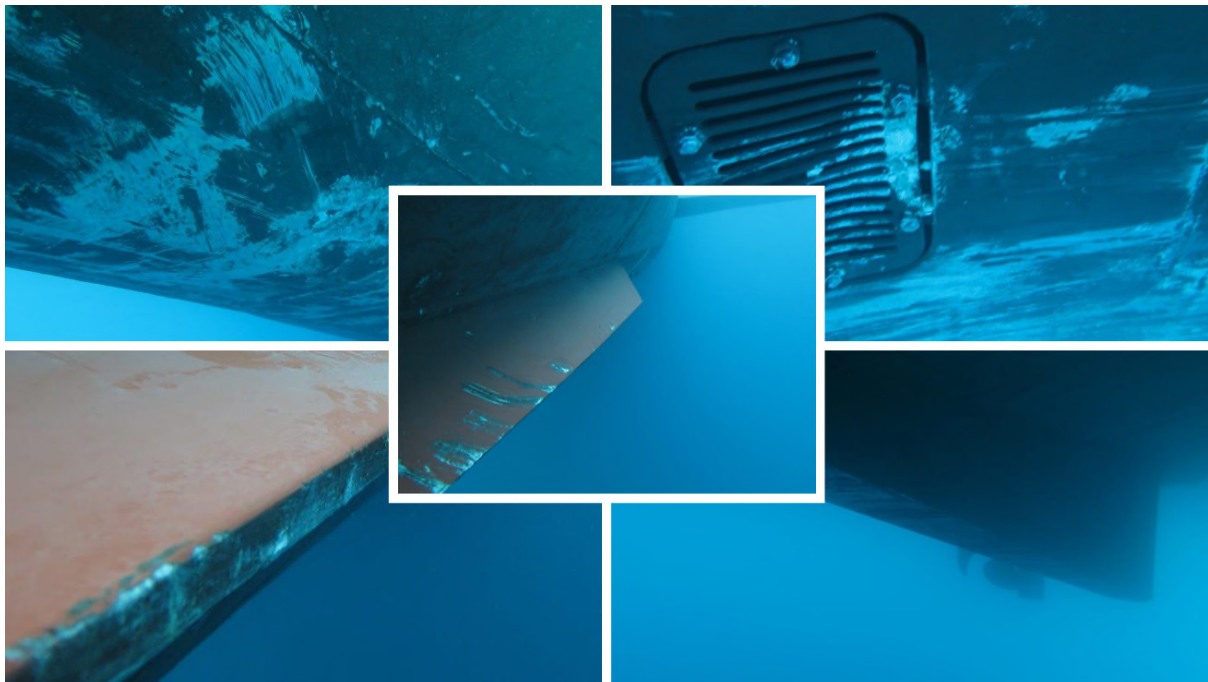


Figure 16: Hull damage

5.7 Actions to re-float

- 5.7.1 Multiple attempts were made to get the vessel off the reef immediately after the grounding. The decision to delay until the next high water was taken after every effort was exhausted. The intervening period afforded the Master the opportunity to assess the immediate danger surrounding the vessel and determine a course of action, with

the assistance of a tug and after an assessment of the depth of water surrounding the vessel.

- 5.7.2 The Master initially decided to stern board the vessel off the reef at high tide. This decision was based on the survey data provided by the expedition team which indicated that the deepest water was astern of the vessel and not ahead. Shortly before high water, the Master decided to come ahead once the vessel was known to be no longer aground. The Master requested the tug to pass a line forward and stand by to pull the vessel off the reef with intermittent use of the engines to minimise damage to the propellers and steering gear should either come into contact with the reef.
- 5.7.3 The Master based his decision to extricate the vessel from the reef based on local knowledge in spite of the survey data provided.
- 5.7.4 The tug connected forward was operated by a local company. A language barrier existed which meant information flow to and from the tug was unreliable. The tug at times was operating independently and not pulling in the direction requested by the Master. No risk assessment was conducted or considered prior to undertaking the evolution. Communication between both vessels could have been improved and misunderstanding mitigated had a qualified member of the bridge team been placed on board the tug to assist the tug Master.

6

CONCLUSIONS

- 6.1 The navigational procedures demonstrated by the bridge team fell short of the requirements outlined within the Master's Standing Orders and in contradiction with the policies outlined within the safety management system. A lack of prior planning and adequate preparation resulted in a poor common understanding of the specific navigational techniques required to undertake a passage from Gam Island to an anchorage south of Kri Island, an area generally not recommended for navigation.
- 6.2 The Master may have been required to make significant and potentially life-saving decisions during a time where his capacity to think clearly and quickly was potentially jeopardised, on account of the lack of rest. This may have been detrimental to the overall safety of the vessel and those on board despite his best intentions to ensure a safe conclusion.
- 6.3 The charted information contained on the charts held on board within the chart folio, and those charts produced but not held on board, fail to identify the reef in which the vessel grounded. Although the extended drying height and in general deficient charted detail on all charts for the precise region, demonstrates the overall lack of confidence of the charted area, there is no way of knowing the exact location of the reef which the vessel struck, based solely on charted data.
- 6.4 Insufficient navigation warnings exist either physically, charted or in writing warning seafarers of the dangers that exist.
- 6.5 An assumption was made by the Master that this route was safe because it had been undertaken previously. No further assessment was conducted to determine, for themselves, the dangers involved, particularly when deviating from the planned route.
- 6.6 It is imperative to the safety of navigation to know where the vessel is in relation to its surroundings. More importantly you need to know where the vessel is in order to accurately predict the estimated position in the future. GPS is deemed a reliable position source providing the latitude and longitude coordinates are verified by visual and radar means. At no point could the position of the vessel, or its intended future location be assured on the basis that the GPS position was not verified by any other position source.
- 6.7 The passage plan, which was based on scanty information, lacked sufficient detail to accurately mitigate against the risk of executing a passage in an area with poor and unreliable chart data.
- 6.8 The Bridge Resource Management technique used and endorsed by the Master was sporadic and counter-productive to safe operations. A large proportion of information and therefore knowledge was lost due to the relaxed atmosphere embedded on the bridge.
- 6.9 The seabed characteristics combined with the shallow angle of approach of the hull against the reef at the point of initial impact, resulted in only minor damage being sustained. This is evident by the fact that the hull was not penetrated and therefore no pollution was expelled from the vessel. Significant damage to the reef was reported

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by local authorities. A formal assessment of the damage sustained to the reef was requested from local authorities in Indonesia but to date this has not been forthcoming, without which it cannot be known the full extent of damage to this marine conservation area.

7

RECOMMENDATIONS

Recommendations for the operator:

- 7.1 The company should consider implementing a method of oversight of its vessels by implementing remote VDR-auditing to assess the effectiveness of its Safety Management System on board.
- 7.2 The company is recommended to develop a company fatigue management plan so that when hours of rest are exceeded, adequate procedures can be implemented to ensure appropriate rest is afforded to personnel in order to ensure the operational effectiveness of watch-keepers is maintained.
- 7.3 The company should consider conducting annual, independent navigational audits, at sea, to ensure a full assessment of the bridge team's capability and competency can be assured.
- 7.4 It is highly recommended that external Bridge Resource Management training is undertaken by every bridge watchkeeper in line with Standards of Training, Certification and Watchkeeping.

Recommendation for the Indonesian Navy Hydrography and Oceanography Center:

- 7.5 It is highly recommended that a hydrographic survey of the region is conducted in order to update the nautical charts in order to inform mariners of the precise location of underwater hazards so as to improve navigational safety and efficiency in the region.

8

ACTIONS TAKEN

By the Operator:

- 8.1 The Company conducted an internal investigation and provided their own report to the Bahamas Maritime Authority. In addition, the Company commissioned an independent internal investigation to review the incident and provide additional recommendations. The Company further stated: *“following both internal investigations, an action plan to implement the relevant recommendations was developed and has been fully implemented”*.
- 8.2 Passage planning is being reviewed as a separate item on the annual internal ISM audit for each vessel.
- 8.3 An under keel clearance (UKC) policy was implemented in the Safety Management System shortly after the grounding.
- 8.4 A Zone of Comfort (ZOC) policy and limitations will be implemented in the vessel Safety Management System within the passage planning section.
- 8.5 The internal Bridge Resource Management (BRM) document was implemented at the beginning of 2015. This is a living document and is constantly being reviewed, updated and improved. In addition to the internal BRM policy, all bridge Officers are required to attend an external BRM course every 5 years and renew their certification.
- 8.6 A provision for incorporating specific route notes within ECDIS has been implemented.
- 8.7 A procedure to formulise the delegation of conduct when hours of rest or during extensive work periods is exceeded will be implemented within the Safety Management System in accordance with MLC Regulation 2.3.
- 8.8 It is intended to implement navigational audits on an annual basis during the annual internal audit.
- 8.9 The capability to conduct an audit of the Voyage Data Recorder is available.
