ACCIDENT REPORT

Report on the investigation into

the loss of propulsion in heavy weather experienced by

the passenger vessel

Spirit of Discovery

while crossing the Bay of Biscay, leading to over

100 injuries and one fatality

on 4 November 2023

VERY SERIOUS MARINE CASUALTY REPORT NO 6/2026 MARCH 2026

MAIB

MARINE ACCIDENT INVESTIGATION BRANCH

The United Kingdom Merchant Shipping

(Accident Reporting and Investigation)

Regulations 2012 – Regulation 5:

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NOTE

This report is not written with litigation in mind and, pursuant to Regulation 14(14) of the Merchant Shipping (Accident Reporting and Investigation) Regulations 2012, shall be inadmissible in any judicial proceedings whose purpose, or one of whose purposes is to attribute or apportion liability or blame.

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GLOSSARY OF ABBREVIATIONS AND ACRONYMS

°	-	degrees
ACEP	-	American College of Emergency Physicians
AIS	-	automatic identification system
ATLS	-	Advanced Trauma Life Support
BPG	-	Bridge Procedures Guide
BVS	-	Bon Voyage System
C/E	-	chief engineer
CCR	-	Canadian C-spine Rule
CCTV	-	closed-circuit television
CETO	-	chief electro-technical officer
CLIA	-	Cruise Lines International Association
CoC	-	Certificate of Competency
DE	-	drive end
DNV	-	Det Norske Veritas
DPA	-	Designated Person Ashore
DSP	-	decision support poster
EOOW	-	engineering officer of the watch
FMECA	-	Failure Mode, Effects and Criticality Analysis
gt	-	gross tonnage
IACS	-	International Association of Classification Societies
IMO	-	International Maritime Organization
IP	-	injured person
kts	-	knots
kW	-	kilowatt
LR	-	Lloyd’s Register
MCA	-	Maritime and Coastguard Agency
MCIP	-	mass casualty incident plan
MGN	-	Marine Guidance Note
MSC	-	Maritime Safety Committee
MSN	-	Merchant Shipping Notice
NCR	-	non-conformance report
NDE	-	non-drive end
NEXUS	-	National Emergency X-Radiography Utilization Study

NHS	-	National Health Service
NICE	-	National Institute for Health and Care Excellence
NSIA	-	Norwegian Safety Investigation Authority
NTSB	-	National Transportation Safety Board
NUC	-	not under command
OOW	-	officer of the watch
PAR	-	passenger accident report
PCS	-	propulsion control system
pods	-	Siemens SISHIp eSiPODs
rpm	-	revolutions per minute
Saga	-	Saga Cruises V Limited
Siemens Energy	-	Siemens Energy Global GmbH & Co. KG
SMS	-	safety management system
SOG	-	speed over the ground
SOLAS	-	The International Convention for the Safety of Life at Sea, 1974, as amended
START	-	Simple Triage and Rapid Treatment
STCW	-	International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978, as amended (STCW Convention)
TMAS	-	Telemedical Maritime Assistance Service
UK	-	United Kingdom
UK Met Office	-	The UK national weather service
UR	-	unified requirement
USA	-	United States of America
UTC	-	universal time coordinated
Vikand	-	Vikand Medical Solutions LLC
VDR	-	voyage data recorder
VMS	-	vessel management system
V.Ships	-	V.Ships Leisure SAM
VTS	-	vessel traffic services
WLS	-	water leakage stop
WMO	-	World Meteorological Organization
WRI	-	Weather Routing Incorporated

TIMES: all times used in this report are UTC +1 unless otherwise stated.

SYNOPSIS

Shortly after 1230 on 4 November 2023, the passenger vessel *Spirit of Discovery* lost propulsion in heavy weather while crossing the Bay of Biscay. This led to the vessel moving violently while the crew restarted the vessel's propulsion. The propulsion issues, storm force conditions and vessel motion continued until the vessel was able to resume its passage the following morning. Over 100 passengers were injured during this period. Eight of the seriously injured passengers were taken directly to hospital on arrival at Portsmouth, England. One of these passengers, Trevor Gilks, later died from his injuries.

The investigation found that *Spirit of Discovery* lost propulsion because the vessel's violent motion in heavy weather caused its propellers to over speed and its propulsion pods to automatically shut down. This loss of control was initially exacerbated by the propulsion control system automatically and unexpectedly parking both pods at 90° to the vessel's heading. During the 18 hours that the vessel was hove to, at slow speed, the port and starboard pods intermittently oversped and shut down a further eight times.

The investigation also found that *Spirit of Discovery*'s captain had amended the vessel's programme in anticipation of heavy weather during the return voyage. However, when a scheduled visit to A Coruña was cancelled the decision was made to cross the Bay of Biscay in very high waves. This decision was not effectively challenged by the crew and operational teams ashore despite weather guidance advising against the crossing. Once *Spirit of Discovery* was hove to, the crew's emergency response was hampered because the mass casualty incident plan was not implemented, which contributed to the vessel's medical team becoming over stretched. Later, delay in identifying that a passenger had suffered a severe spinal injury led to him receiving suboptimal treatment that may have affected the severity of his injury. Four days after the accident, he died in hospital from his spinal injury.

Spirit of Discovery's owner, manager, medical services provider, propulsion manufacturer and shipyard have taken significant action to address the safety issues identified by this investigation. These actions have included improved vessel itinerary and passage planning risk assessments, better tracking of technical issues, implementation of the mass casualty incident plan, enhanced specialist medical support, improved machinery failure checklists and securing of objects for heavy weather.

Recommendations have been made to the Maritime and Coastguard Agency to propose that international carriage requirements include electronic inclinometers, and to the vessel's classification societies to improve the assessment of vessel motion on equipment performance and the quality of instruction manuals. The propulsion manufacturer has been recommended to issue a customer advice note to owners of vessels fitted with similar pods. The Cruise Lines International Association has been recommended to increase the number of trauma trained medical personnel carried by passenger vessels and to update its policies on the risk assessment and securing of vessel furniture in heavy weather.

SECTION 1 – FACTUAL INFORMATION

1.1 PARTICULARS OF *SPIRIT OF DISCOVERY* AND ACCIDENT

SHIP PARTICULARS	
Vessel's name	*Spirit of Discovery*
Flag	UK
Classification society	Lloyd's Register
IMO number	9802683
Type	Passenger ship
Registered owner	Saga Cruises V Limited
Manager(s)	V.Ships Leisure SAM
Construction	Steel
Year of build	2019
Length overall	236.71m
Registered length	211.91m
Gross tonnage	58,119
Minimum safe manning	23
Authorised cargo	999 passengers

VOYAGE PARTICULARS	
Port of departure	Puerto del Rosario, Fuerteventura, Canary Islands, Spain
Port of arrival	Portsmouth, England
Type of voyage	International
Cargo information	943 passengers
Manning	503 crew

MARINE CASUALTY INFORMATION	
Date and time	4 November 2023 at about 1230
Type of marine casualty or incident	Very Serious Marine Casualty
Location of incident	Bay of Biscay
Place on board	Engine pod/passenger spaces
Injuries/fatalities	Over 115 passenger injuries and 1 fatality
Damage/environmental impact	Internal and external damage to the vessel, no environmental impact
Ship operation	Passenger/cruise
Voyage segment	Mid-water
External & internal environment	Force 11 winds, significant wave height, high to very high (8m to 11m); daylight; overcast; moderate visibility
Persons on board	1,446

1.2 BACKGROUND

The UK registered passenger vessel *Spirit of Discovery* departed Portsmouth, England on 24 October 2023 for a two-week 'Canary Island Quintet' cruise to Madeira, Portugal, the Canary Islands and A Coruña, Spain. The vessel was scheduled to return to Portsmouth on 7 November 2023.

Spirit of Discovery **(Figure 1)** was propelled by two podded azimuth drives positioned at its stern and fitted with two bow thrusters to assist with manoeuvring at slow speed. The pods were also used to steer the vessel in lieu of a rudder.

Spirit of Discovery was fitted with port and starboard retractable stabiliser fins that countered vessel rolling. The fins automatically retracted when the vessel's speed dropped to below 5 knots (kts) or when the bow thrusters were operational. The automatic retraction function could be overridden from the bridge.

V.Ships Leisure SAM (V.Ships) was *Spirit of Discovery*'s technical ship management company and was responsible for assuring the vessel's compliance with maritime regulations and standards and the day-to-day technical operation of the vessel. Saga Cruises V Limited (Saga) was responsible for delivering hotel operations and decisions about the vessel's itinerary.

There were 943 passengers on board *Spirit of Discovery* at the time of the accident. The youngest passenger was 50 years old and the oldest passenger was 96 years old; the average passenger age was 78.8 years old.

1.3 NARRATIVE

1.3.1 Heavy weather preparations

On 29 October 2023, *Spirit of Discovery*'s captain discussed their concerns about the heavy weather forecast for the vessel's return voyage to the UK from the Canary Islands with the Saga team ashore. These discussions continued until 1 November, when it was agreed with Saga that *Spirit of Discovery*'s final Canary Island port visit, to Las Palmas de Gran Canaria, would be cancelled. This change to the cruise itinerary meant that the vessel would arrive in A Coruña on the morning of 4 November and depart for Portsmouth on 5 November, once the storm had passed.

Later that day, the captain informed the passengers of the change in programme. That evening, *Spirit of Discovery* sailed from Puerto del Rosario, Fuerteventura, Canary Islands and started its passage to A Coruña.

During the morning of 2 November, *Spirit of Discovery*'s staff captain shared a risk assessment with key members of the deck and engine department on the precautions to be taken when the ship entered heavy weather. The risk assessment covered weather routing information; port closures; the need to secure the vessel's equipment for heavy weather; the potential for crew and passenger injuries; and the need to preserve the vessel's propulsion.

On how best to guard against the loss of *Spirit of Discovery*'s propulsion in heavy weather, the staff captain briefed the officers of the watch (OOW) on the importance of seeking approval from the engineering officer of the watch (EOOW) before

acknowledging any propulsion alarms. On completion of the briefing, the staff captain directed all departments to complete their heavy weather checklists by 1800 that evening. The staff captain also reviewed the vessel's stability condition.

At 1736, *Spirit of Discovery*'s captain made a passenger announcement that the vessel would encounter heavy weather during its passage back to the UK. The captain also mentioned that a plan was being considered for the ship to seek shelter near the Portuguese coast.

By 1800, the completed heavy weather checklists had been returned to the staff captain. That evening, the captain and the Saga team discussed potential visits to the Spanish ports of Vigo and El Ferrol as alternatives to A Coruña; both were discounted due to the direction of the forecasted swell. Later, as a precaution, all facilities on *Spirit of Discovery*'s upper decks were closed, including the Britannia Lounge, Grill and Lido restaurants on the Lido Deck – Deck 12. Passenger catering was moved to The Grand Dining Room, on the Main Deck – Deck 5 **(Figure 1** and **Figure 2)**.

At about 1000 on 3 November, as *Spirit of Discovery* was passing the southern tip of Portugal **(Figure 3)**, the vessel's port agent informed the captain by email that the port of A Coruña would be closed on 4 November as the forecast 6m to 9m wave height exceeded the pilot transfer limit. The captain discussed this information with the Saga team and agreed that a direct passage back to Portsmouth was the best option. The captain was later called by the vessel's Designated Person Ashore (DPA) to discuss and agree the revised passage plan. At midday, *Spirit of Discovery*'s captain made a passenger announcement explaining the programme change. At about 1400, the chief officer implemented the revised voyage plan.

At 1400, a 'Meet the Captain' session was held in the ship's theatre and transmitted on the internal television system. The captain explained the plan for the ship's return to Portsmouth and provided an overview of the weather conditions and progress of a forecast storm. The captain then explained that the plan was to put the wind and sea on *Spirit of Discovery*'s port quarter as the ship crossed the Bay of Biscay. The vessel would then pass ahead of the storm before completing its passage back to Portsmouth. The captain also explained why the forecast weather conditions made potential visits to the ports of A Coruña, Vigo, and Porto unsafe.

At the end of the captain's presentation, one of the passengers expressed concern[1] that the extreme weather would place older passengers in danger and suggested that the ship seek shelter in Lisbon. The captain responded that this would not be possible because they believed from discussions with Saga that there was intended strike action by Lisbon's port workers.

At about 1800, in anticipation of the heavy weather forecast for the next day, Saga's head of safety and policy assurance emailed *Spirit of Discovery*'s captain and senior leadership team, including the doctor and senior nurse. The email advised the doctor to be prepared for passenger injuries and suggested they reviewed the mass casualty incident plan (MCIP) with the senior leadership team so that it was *fresh in everyone's mind*. The email also proposed that the doctor review the medical team's duty rota to ensure there was out of hours support.

[1] The same passenger had spoken to the captain on 2 November 2023, expressing similar concerns about the forecast weather. On 3 November 2023, the passenger emailed the guest services manager to express their concern.

Images courtesy of Meyer Werft shipyard

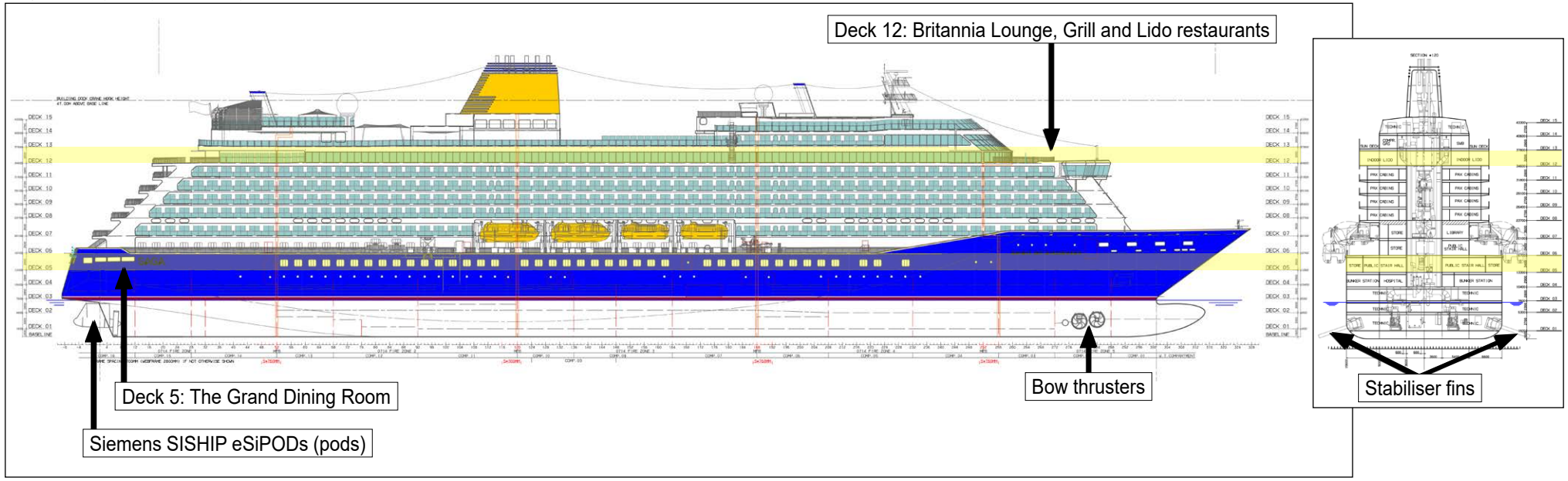

Figure 1: *Spirit of Discovery* profile and transverse arrangement

Images courtesy of Saga Cruises Limited

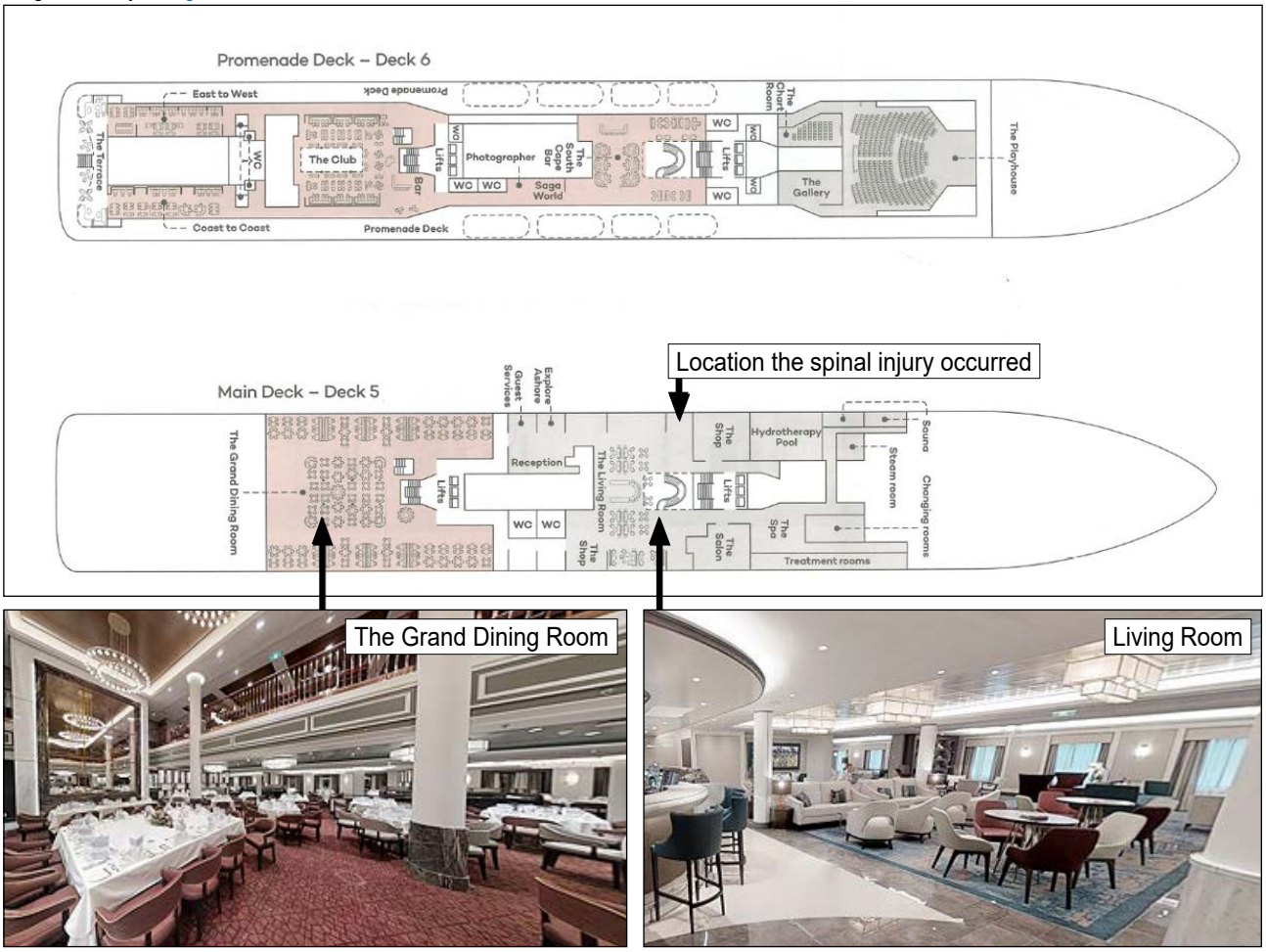

Figure 2: Promenade Deck and Main Deck general arrangements

The head of safety and policy assurance's email further advised the hotel general manager to plan to serve food and beverages to the passengers in their cabins and make sure that everything in hotel services was secured. In response, the doctor and senior leadership team independently discussed heavy weather preparations with their departmental teams.

1.3.2 The accident

At about 0800 on 4 November, *Spirit of Discovery* rounded Cape Finisterre and entered the Bay of Biscay **(Figure 3)**. The vessel's speed over the ground (SOG) was 14.4kts; the wind was south-westerly, storm force 10; the sea state was very rough[2], accompanied by a heavy swell[3]; and the ship was pitching and rolling heavily[4]. The vessel's stabiliser fins were deployed and in use.

By midday, the wind was westerly force 8 to 9 accompanied by a very rough sea and long heavy swell. *Spirit of Discovery* was pitching heavily and rolling violently and the vessel's SOG was approximately 16kts.

[2] Defined in the UK Met Office marine forecasts glossary as a *Wave height of 4m to 6m.*

[3] Defined by the World Meteorological Organization as a height over 4m.

[4] The deck log pitching and rolling options were steady; slightly; easily; moderately; heavily; and violently.

Image courtesy of Esri (Airbus, USGS, NGA, NASA, NOAA, CGIAR, GEBCO, NLS, OS, NMA, Geodatastyrelsen, GSA, GSI and the GIS User Community)

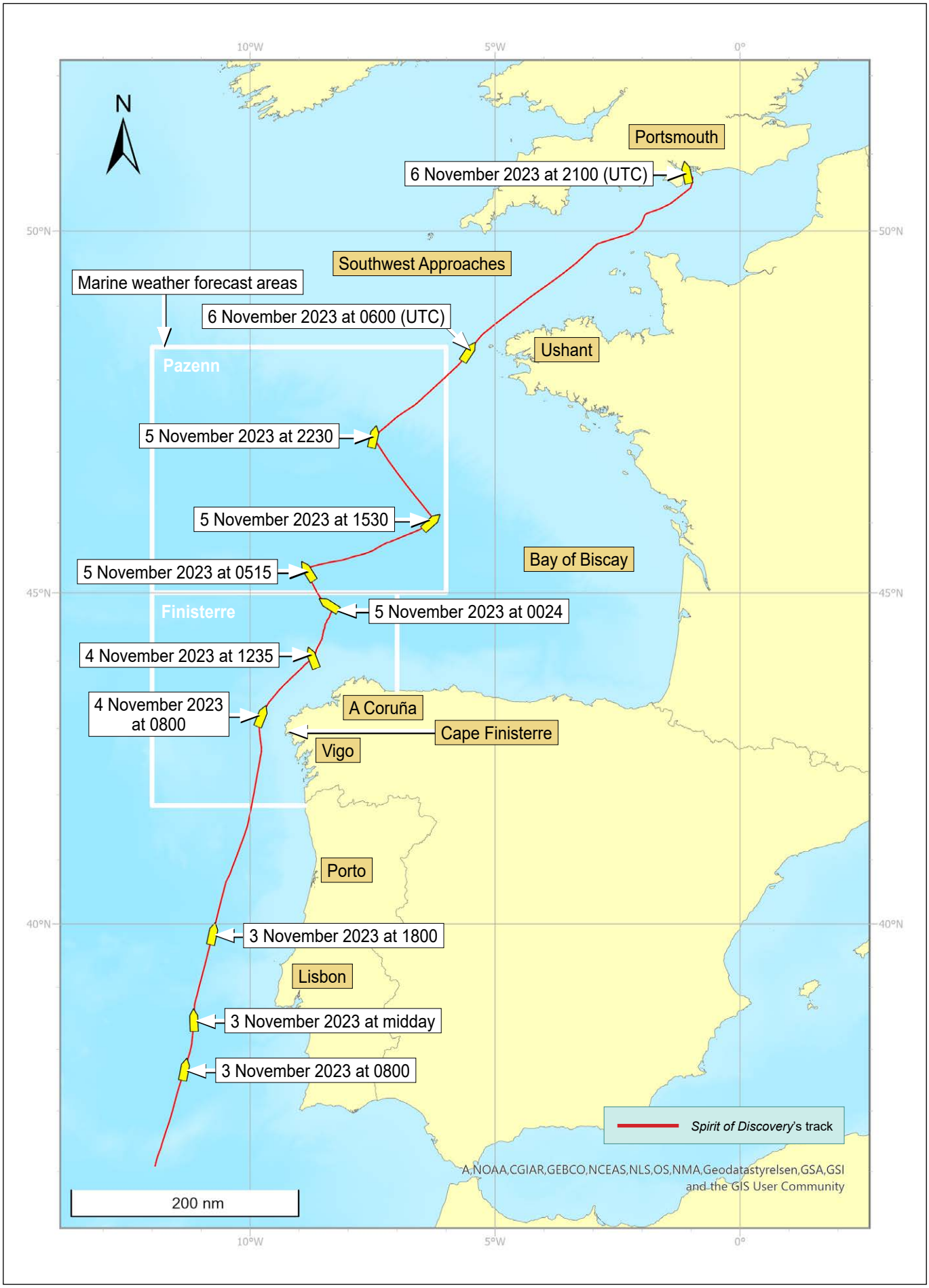

Figure 3: *Spirit of Discovery*'s navigational track overlaid with marine forecast areas

At 1230, the port pod water leakage stop (WLS) sequence alarm activated. One of the two OOWs on the bridge discussed this alarm with the EOOW in the control room. The EOOW advised the OOW that the WLS sequence alarm was not a concern and could be acknowledged.

Very shortly after this discussion, the port pod propeller overspeed alarm activated. The port pod then automatically shut down; applied its shaft brake; rotated so that the propeller was orientated 90° inboard to the vessel's heading; and, once the propeller had stopped, inflated its shaft seal. On the bridge, one OOW engaged hand steering using the starboard pod to control the vessel's heading, while the other OOW called the captain, informing them of the propulsion failure. The other OOW then requested an update from the EOOW.

The captain quickly arrived on the bridge and took control of the vessel from the OOW who was steering, operating the starboard pod and using the bow thruster to control the vessel's heading and put the wind and sea on the port bow. The vessel's stabiliser fins automatically housed themselves when the bow thrusters were operated. An announcement was made advising passengers and crew to keep calm and hold on.

At 1236, *Spirit of Discovery*'s starboard pod's WLS sequence alarm activated. This was followed by the overspeed alarm, and the starboard pod automatically shut down and parked just as the port pod had done. The vessel's bow swung to port, placing the wind on the port bow, sea and swell just abaft[5] the vessel's port beam. The vessel was now pitching heavily and rolling more violently. The captain made an announcement to the crew and passengers advising them to sit down and minimise movement within the vessel. *Spirit of Discovery*'s SOG was approximately 4kts.

Shortly afterwards, at about 1240, multiple passenger injuries were reported in The Grand Dining Room and the OOW made a "*Code Alpha"* medical emergency announcement. The staff captain, who was also now on the bridge, informed Saga's operations director and the vessel's DPA of the vessel's condition.

At about 1245, *Spirit of Discovery*'s engineers activated the propulsion control system (PCS) warning override, restarted the starboard pod and returned the propulsion system to bridge control. Concurrently, the vessel's engineering crew started to pump out the motor unit bilges in both pods. The OOW changed the vessel's status on its automatic identification system (AIS) to not under command (NUC)[6].

At about 1300, Finisterre vessel traffic services (VTS) saw that *Spirit of Discovery*'s AIS status had changed to NUC. The VTS operator called the vessel on very high frequency radio and asked why it had stopped and changed its heading. The staff captain responded that the vessel had lost propulsion, and that work was ongoing to recover it.

At 1308, *Spirit of Discovery*'s port pod was restored at reduced speed. In The Grand Dining Room, the safety officer, who was coordinating the vessel's emergency response, advised guests to lie on the deck and minimise movement while the crew assessed the situation.

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[5] Behind or aft of.

[6] A vessel that is unable through some exceptional circumstance to manoeuvre, and therefore unable to keep out of the way of another vessel.

Between 1300 on 4 November and 0420 on 5 November, *Spirit of Discovery*'s port and starboard pods intermittently oversped and shut down a further eight times. Except for the period between 1718 and 1727, when both the port and starboard pods were out of action, the captain and OOWs were able to control the vessel's heading using a combination of the vessel's bow thruster and available pods. Generally, the engineering crew were able to reset and restart the pods within about 10 to 15 minutes of their automatic shutdown.

From about 1535 on 4 November, *Spirit of Discovery*'s stabilisers were deployed with the override on. The stabiliser fins were then periodically rehoused to allow the hydraulic system to cool down.

Between 1445 and about 2100, several announcements were made to update the ship's passengers and crew; these stated that the captain was on the bridge manoeuvring the vessel and emphasised that the safety of all on board was a priority. The announcements also advised passengers to stay in their cabins and minimise their movement within the vessel.

The weather deteriorated during the afternoon and evening of 4 November. Initially, the south-westerly wind increased from storm force 10 to hurricane force 12 before moderating to gale force 8 in the early hours of 5 November. *Spirit of Discovery*'s motion remained significant throughout, with the vessel often pitching and rolling violently. The staff captain routinely assessed the vessel's stability and ensured that it remained within acceptable limits.

"*Code Alpha*" medical emergency announcements continued throughout the afternoon of 4 November and into the evening. Several reports of damage to the vessel and its fixtures and fittings were also received by the bridge and responded to by the crew.

The captain remained on the bridge until about 0530 on 5 November, overseeing the manoeuvring of the vessel.

1.3.3 Resuming the passage to Portsmouth

During the early hours of 5 November the weather gradually improved, and *Spirit of Discovery* began to make headway to the north-west. By 0515, the captain judged that the sea and swell had reduced sufficiently to allow the vessel to continue its passage towards Ushant, France. To minimise vessel motion, *Spirit of Discovery'*s passage plan was adjusted to tack across the Bay of Biscay **(Figure 3)** at a SOG of between 11.5kts and 14.5kts.

At 0200 on 6 November, the clocks on board *Spirit of Discovery* were put back one hour to universal time coordinated (UTC) to synchronise the ship's time with the local time at its arrival port. The vessel rounded Ushant at approximately 0500 UTC and entered the South West Approaches.

At about 2100 that evening, *Spirit of Discovery* berthed at Portsmouth International Port and at 2119 UTC the gangway was connected. The vessel was met by several paramedics, who tended the seriously injured passengers and transferred some of those who needed further treatment to hospital by ambulance.

1.4 FATAL PASSENGER INJURY

Shortly after 1330 on 4 November, 85-year-old Trevor Gilks (passenger 1) had arrived on the port side of *Spirit of Discovery*'s Living Room on the Main Deck (Deck 5). He was walking and pushing his wife in her wheelchair without apparent difficulty. On arrival, passenger 1 sat in a red, high-backed chair **(Figure 4)** with his wife nearby.

At about 1710, *Spirit of Discovery* rolled violently to approximately 10° to 13°. Passenger 1's chair toppled backwards, and he rolled backwards onto the deck. The main impact of the fall and subsequent roll was to his neck. Nearby crew saw passenger 1's fall from the chair and raised the alarm.

Figure 4: Example of the high-backed chair used by passenger 1

Three minutes later, a nurse from the vessel's medical team arrived and attended passenger 1. Once the nurse's examination was complete, the crew helped passenger 1 to stand up; he appeared unsteady on his feet and was assisted back into the chair from which he had fallen. The nurses' contemporaneous medical notes stated that passenger 1 reported *severe pain in his upper back, radiating to his shoulders and back of his neck*.

At about 1930, passenger 1, who now had limited mobility, was assisted into a wheelchair and taken to his cabin by the crew. At about 2119, having been unable to move unassisted to the bathroom in his cabin, passenger 1 was taken to the medical centre in a wheelchair by a nurse. His head was noticeably forward, with his chin almost on his chest. While passenger 1 was waiting to be seen by the doctor in the medical centre, one of the crew in the area noticed that his head had slumped forward, and that he was having difficulty breathing. The doctor straightened passenger 1's neck and fitted a neck collar and his breathing improved.

At about 2230, an X-ray was taken of passenger 1's neck and he was admitted to the medical centre's 2-bed ward. The X-rays were emailed for review by a shore-based radiologist.

At about 1400 on 5 November, the shore-based radiologist emailed *Spirit of Discovery*'s doctor advising that they were unable to determine from the X-rays whether passenger 1's cervical spine was damaged as no lateral views had been provided. No further X-rays of passenger 1's neck were taken.

Throughout 5 November, passenger 1 remained in bed in the medical centre with the neck collar in place; he was not on a spinal board. Later that evening, passenger 1 reported a tingling sensation in his upper limbs. The medical staff also noted that his breathing was laboured, and he was given oxygen.

On the morning of 6 November, passenger 1 reported that he had lost feeling in his legs; the doctor examined him and diagnosed quadriplegia[7]. Later, the doctor raised a concern with the captain that passenger 1 would be paralysed by his injury and needed to be medically evacuated from the ship. Given the weather conditions, and having discussed with the doctor the risks of helicopter transfer in high seas, the captain decided that it would be better for passenger 1 to remain on board *Spirit of Discovery* until the vessel berthed in Portsmouth that evening, when he could be safely disembarked to hospital.

The doctor communicated their concern about passenger 1's condition with their employer ashore (see section 1.11.1). The doctor did not seek and was not advised to seek specialist medical advice from a spinal surgeon.

On the evening of 6 November, paramedics attended passenger 1 when *Spirit of Discovery* berthed in Portsmouth and he was transferred by ambulance to hospital. Passenger 1 was diagnosed with a severe cervical spinal injury and he and his family were advised that he would be permanently quadriplegic.

Passenger 1 died on 8 November 2023. His interim death certificate[8] recorded the cause of death as complete cervical spine injury.

1.5 PASSENGER INJURIES AND VESSEL DAMAGE

1.5.1 Passenger injuries

On 4 November, *Spirit of Discovery*'s medical team treated 115 passengers. While most suffered minor injuries, eight passengers were severely injured and were transferred by ambulance to hospital when the vessel berthed in Portsmouth. The severe passenger injuries had been caused by falls and included fractured hips and ribs, a shoulder injury, head trauma and spinal injury.

Following the accident the investigation sent a questionnaire to *Spirit of Discovery*'s injured passengers that included questions about where on board and when they were injured. The results **(Figure 5)** showed that most of the respondents were in either The Grand Dining Room or their cabin and that around 67% of these injuries occurred when propulsion was initially lost at about 1236 on 4 November. The casualty rate thereafter was approximately two injuries per hour.

The investigation's survey of injured passengers also found that:

- 82% recalled being warned about the heavy weather;
- 77% considered that the medical treatment they received was adequate. The remaining 23% attributed any shortfall to the ship's medical staff being overwhelmed;

[7] Paralysis of all four limbs.

[8] Coroner's certificate of the fact of death, dated 14 November 2023.

- 49% required further medical treatment after they disembarked; and,
- 87% took 4 days or more to fully recover from their injuries.

Almost all the respondents highly praised the crew's response to the accident.

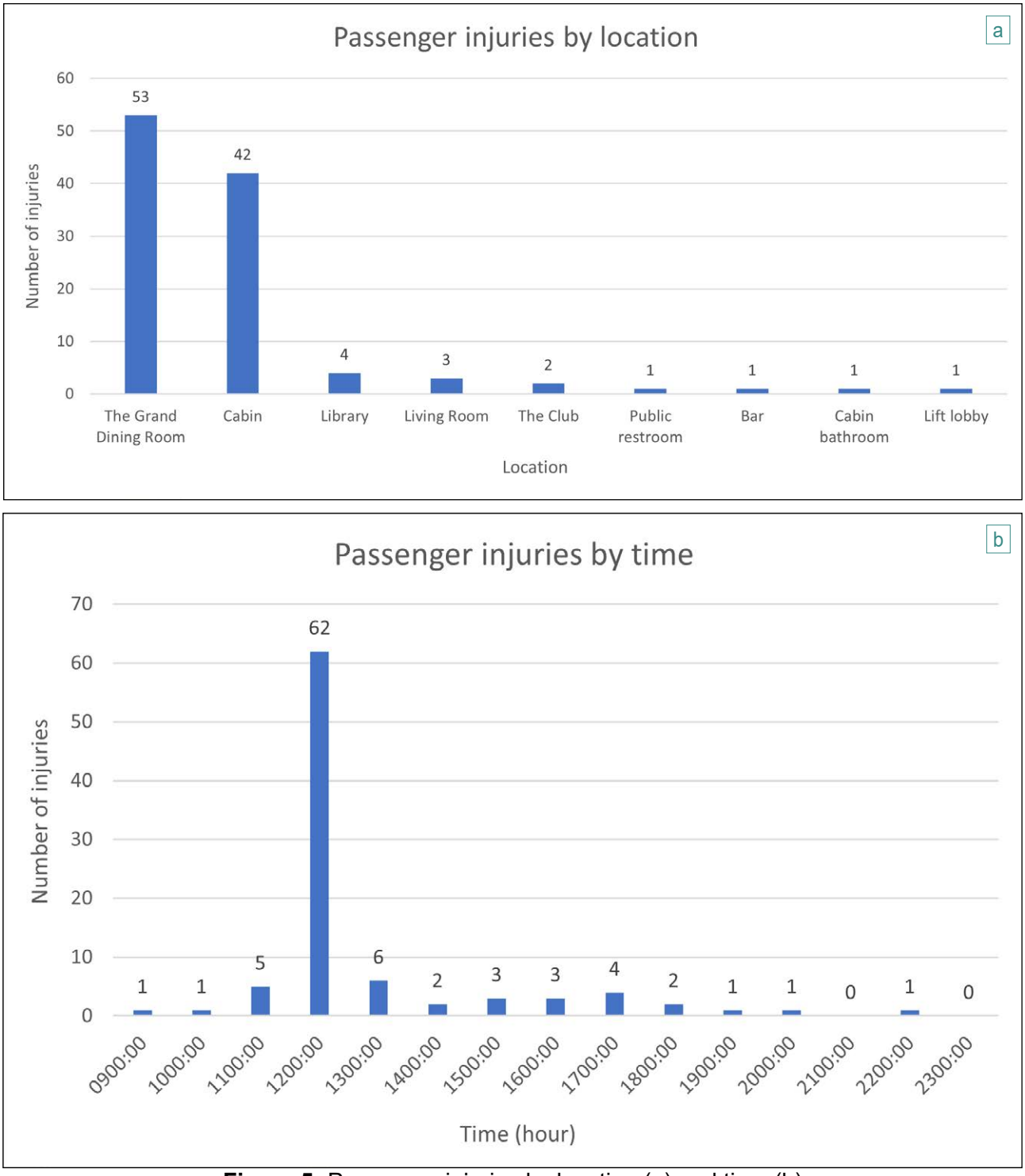

Figure 5: Passenger injuries by location (a) and time (b)

A review of the vessel's closed-circuit television (CCTV) images showed that many passengers fell and were injured by unsecured tables, chairs and crockery in the public spaces. Not all the furniture was observed to be equally affected by the vessel's violent motion. Lighter café style tables and chairs appeared the most vulnerable and were observed to cause some chair occupants to fall to the deck or, having toppled over, slide across the deck, occasionally striking passengers. Heavier, more stable tables and chairs with a broad base and low centre of gravity appeared less affected. One passenger was injured in a lift lobby when they were unable to hold onto anything to prevent themselves falling **(Figure 6)**. Of those who were injured in their cabins, 52% fell while standing; 36% fell while sitting; 10% were struck by furniture or other items; and 2% fell from their mobility aids.

Many of the injured passengers reported that they found the events of 4 November very traumatic.

Images courtesy of Saga Cruises Limited

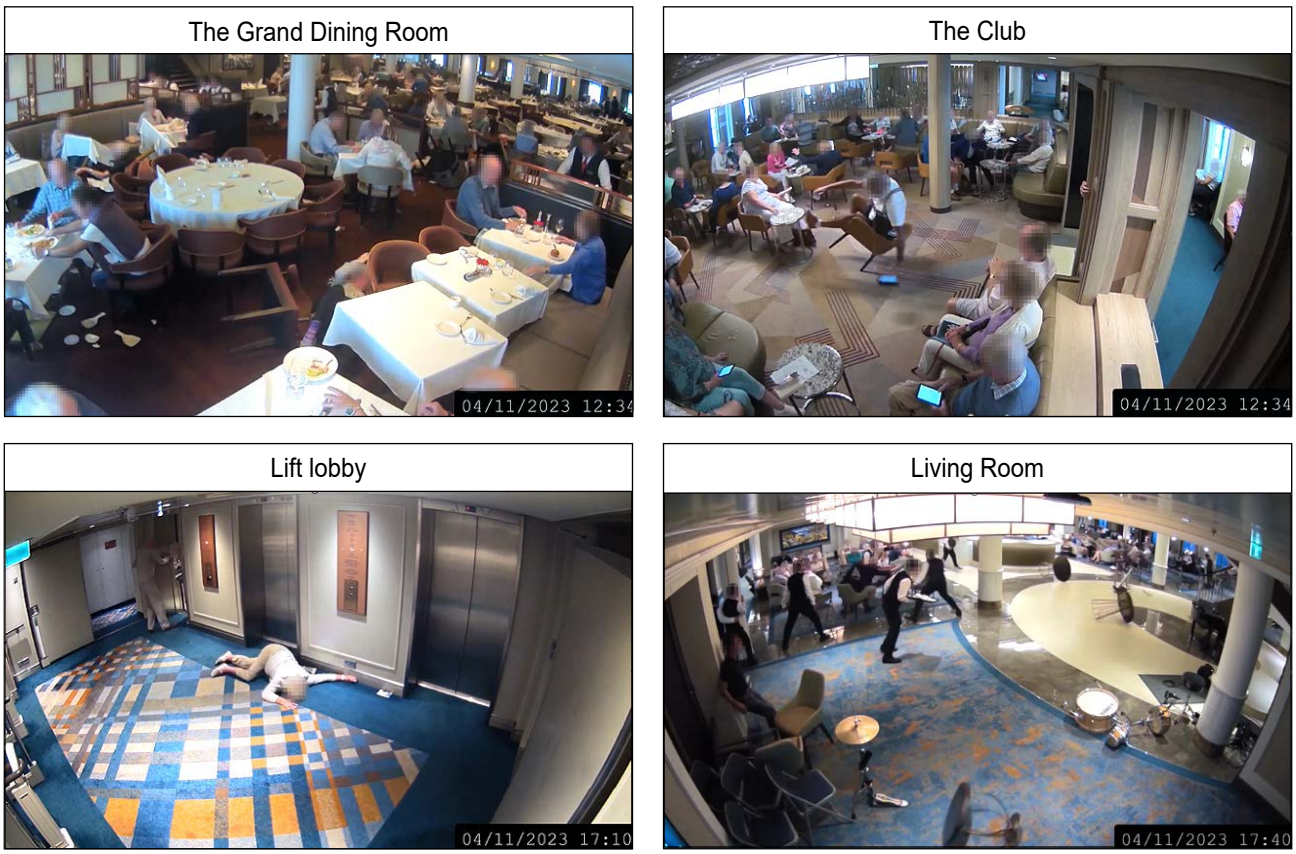

Figure 6: CCTV images of public spaces after propulsion was lost

1.5.2 Vessel damage

Spirit of Discovery sustained damage to some of its balcony glass panels, gym equipment, and furniture as well as crockery and glassware. The vessel's watertight integrity remained intact and there was no structural damage **(Figure 7)**.

Images courtesy of Saga Cruises Limited

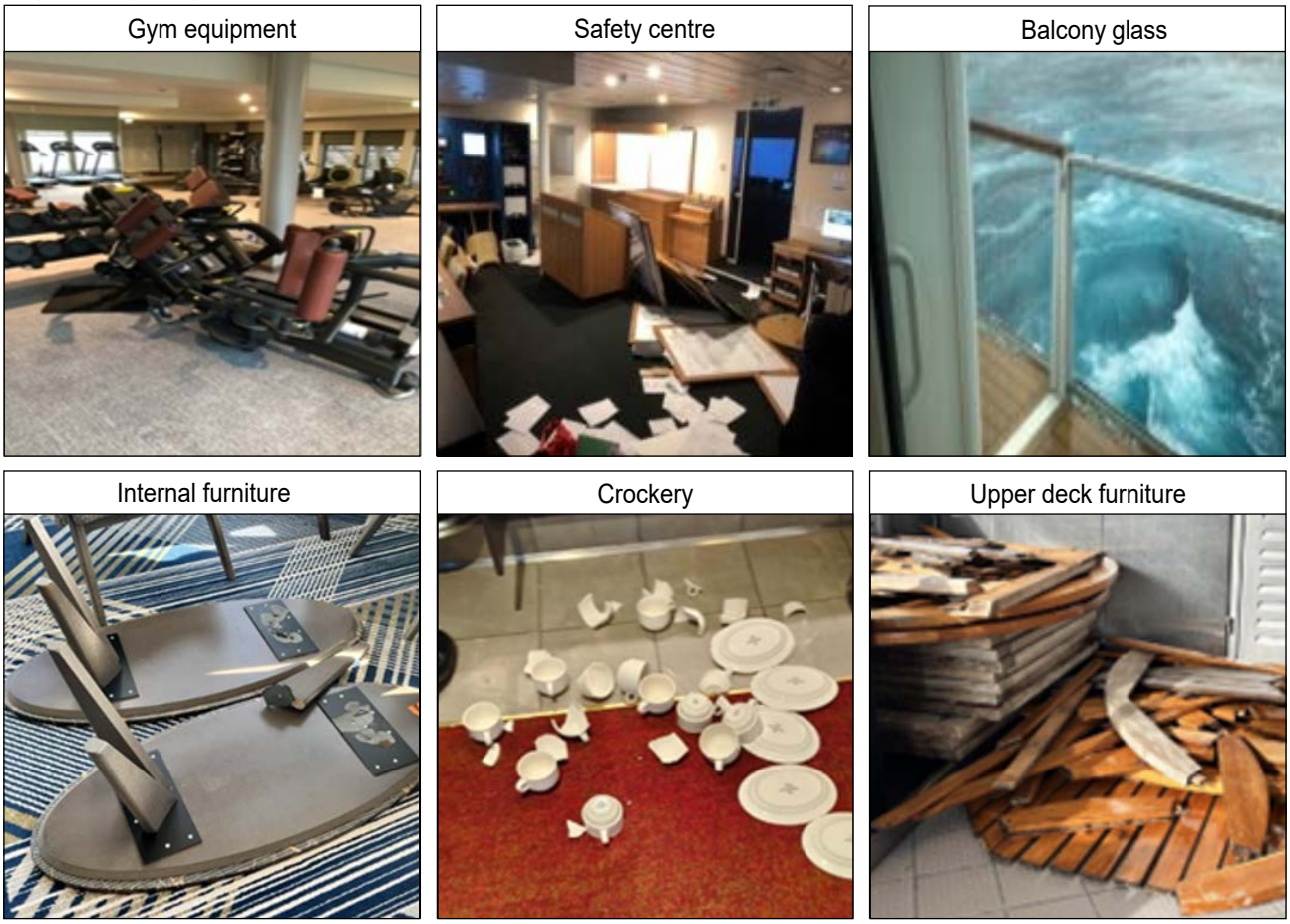

Figure 7: Examples of the damage

1.6 *SPIRIT OF DISCOVERY*

1.6.1 Vessel

Spirit of Discovery was a Saga Spirit Class passenger vessel built by Meyer Werft[9]. The vessel entered service in 2019 and was taken out of service between 15 March 2020 and 27 June 2021 due to the COVID-19 pandemic. Cruises on *Spirit of Discovery* and its sister vessel *Spirit of Adventure* were marketed to passengers over 50 years old.

Spirit of Discovery was built to conform with the technical standards of the Det Norske Veritas (DNV) classification society. The vessel changed classification society to Lloyd's Register (LR) on 24 September 2020.

[9] Meyer Werft GmbH, Papenburg, Germany.

The SOLAS[10] Part 1, Chapter II-2 regulations[11] required passenger vessels to be designed to be able to safely return to port under their own propulsion after sustaining damage from fire or flood. As it was difficult to safely trial every aspect of the vessel's operations at sea, the shipyard had created a 200-page Failure Mode, Effects and Criticality Analysis (FMECA) document to demonstrate that the vessel's design complied with this regulation. There was no similar documentary evidence to prove that the vessel's propulsion would reliably operate at the extremities of the SOLAS motion limits (see section 1.13.1).

1.6.2 Crew

Spirit of Discovery had 503 crew[12], led by the captain. The organisational structure comprised a deck department of 49 crew that included the medical team and was led by the staff captain; an engineering department of 49 crew, led by the chief engineer (C/E); and a hotel and passenger services department of 404 crew, led by the hotel general manager.

The captain joined Saga in 2017 as the staff captain on board *Saga Sapphire*. Since May 2020, they had stepped up to the role of relief captain on eight occasions[13]. The captain joined *Spirit of Discovery* as staff captain on 4 September 2023 and was promoted to captain on 24 October 2023. The captain held an STCW[14] II/2 Master Unlimited Certificate of Competency (CoC).

The staff captain joined Saga in June 2022 as a safety officer. They had completed two 3-month contracts as staff captain before joining *Spirit of Discovery* on 24 October 2023. The staff captain held an STCW II/2 Master Unlimited CoC. The staff captain was the line manager for the vessel's deck department and the ship's doctor and medical team.

The C/E joined Saga for the delivery of *Spirit of Discovery* from the shipyard to its owners. They had since served as C/E on *Spirit of Adventure* until being transferred back to *Spirit of Discovery*. The C/E had joined *Spirit of Discovery* on 24 October 2023 and held an STCW III/2 Chief Engineer Unlimited CoC.

The doctor qualified as a medical doctor in 2012 in Venezuela and had since worked as a general practitioner, an emergency department doctor and an intensive care resident. The doctor had worked on a variety of passenger vessels since October 2021, and had joined Saga in January 2023.

1.6.3 Safety management

V.Ships was the document of compliance holder for *Spirit of Discovery* and was responsible for the vessel's compliance with the International Safety Management Code, a mandatory standard set by the International Maritime Organization (IMO). V.Ships was also the author of *Spirit of Discovery*'s safety management system (SMS), known as the vessel management system (VMS), which detailed the procedures to be followed by the crew.

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[10] The International Convention for the Safety of Life at Sea, 1974, as amended.

[11] Construction – Fire Protection, Fire Detection and Fire Extinction: Part G – Special Requirements.

[12] The crew's age ranged from 18 years old to 65 years old. The average age of the crew was 38 years old.

[13] Once on *Spirit of Discovery* and seven times on *Spirit of Adventure*.

[14] International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978, as amended (STCW Convention).

V.Ships provided Saga with technical management and a DPA for both of its vessels. The DPA acted as the link between ship and shore and was employed to evaluate the effectiveness of the VMS. The DPA visited the vessel periodically and audited its safe operation and environmental compliance.

1.6.4 Digital information recording devices

Spirit of Discovery was fitted with a voyage data recorder (VDR) that captured the vessel's bridge communications and navigational information. The vessel was also fitted with internal and external CCTV cameras covering the *Spirit of Discovery*'s public passenger areas.

Spirit of Discovery was fitted with a mechanical inclinometer at the rear of the bridge that gave an indication of the vessel's rolling motion. The vessel was not fitted with, nor required to be fitted with, an electronic inclinometer that met the IMO's Maritime Safety Committee (MSC) performance standard[15]. The investigation measured *Spirit of Discovery*'s pitch and roll using a combination of video evidence and data from engineering management systems that recorded the vessel angle of heel and trim. These measurements indicated that the vessel rolled up to 13° and pitched up to 4° between 1230 on 4 November and 0530 on 5 November.

1.6.5 Propulsion pods

Spirit of Discovery's propulsion pods **(Figure 8)** were Siemens SISHIp eSiPODs designed and built, along with their control system, by Siemens Energy Global GmbH & Co. KG (Siemens Energy). Each pod had a single fixed pitch propeller driven by a 6,500 kilowatt (kW) permanent magnet synchronous electric motor that was housed in a motor unit. The pods were capable of propelling the vessel up to a maximum speed of 20kts. Each pod could be steered through 360° at one revolution per minute, in either direction, by four electric azimuth steering motors.

Siemens Energy's System Description[16] document stated that the transient limits of propulsion operation were +/- 22.5° of roll and +/- 7.5° of pitch.

1.6.6 Pod motor units

Each pod had a sealed motor unit that could only be accessed when the vessel was in dry dock. Each motor unit comprised a motor room and drive end (DE) and non-drive end (NDE) casing area that contained:

- a 6,500kW synchronous electrical motor;
- shaft bearings at each end of the motor unit;
- a propeller shaft brake;
- an inflatable emergency propeller shaft seal;
- level sensors and bilge pumps at the forward and aft end of the motor room and in the DE and NDE casing.

[15] IMO Resolution MSC.363(92), Performance Standards for Electronic Inclinometers, adopted on 14 June 2013.

[16] System Description, SISHIp eSiPODs-M10.

Images courtesy of Siemens Energy Global GmbH & Co. KG

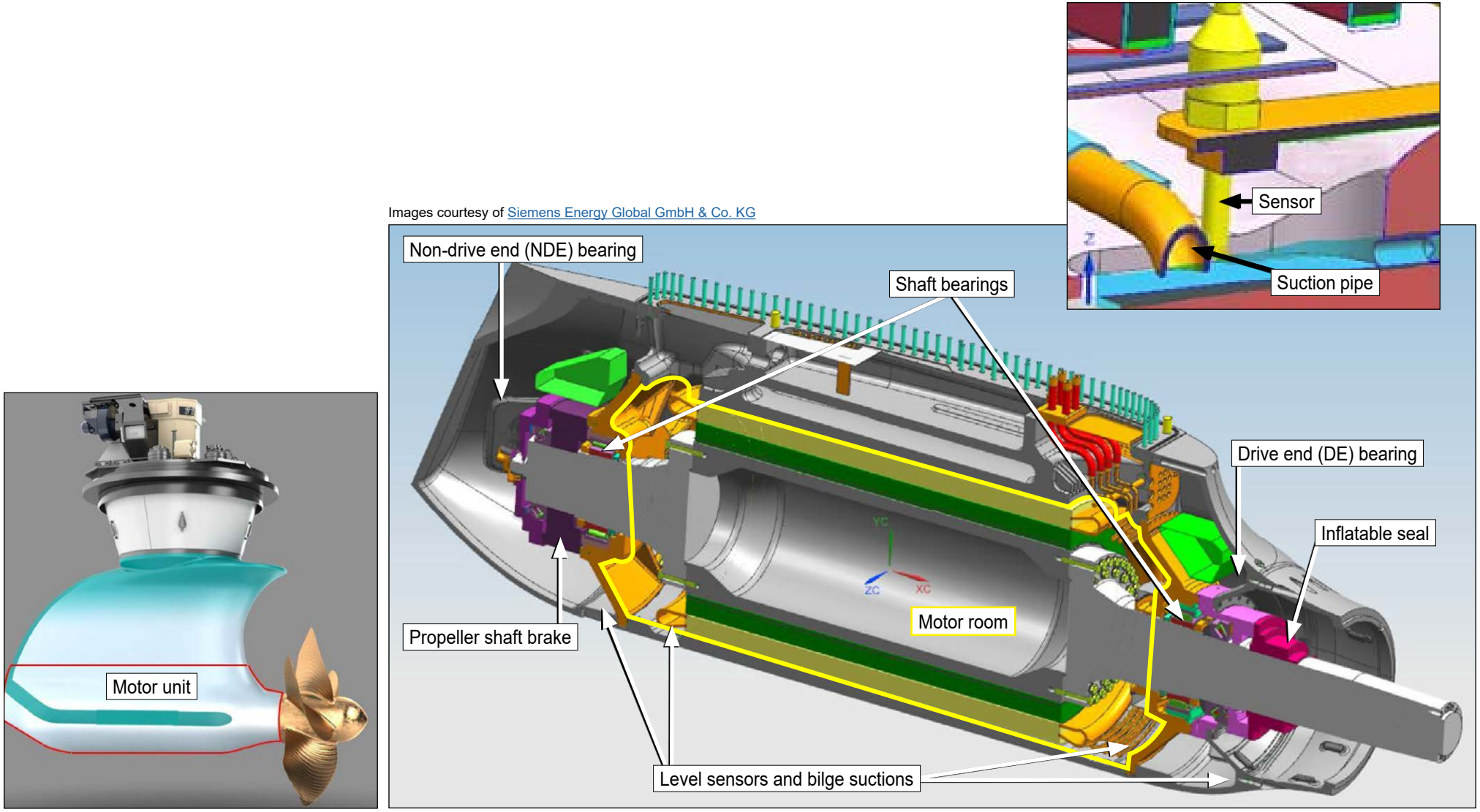


Figure 8: Cross-section of a Siemens SISHIp eSiPOD motor unit and bilge arrangements

1.6.7 Motor unit bilge system

The motor unit bilge system was designed to remove any oil or water that accumulated within the unit.

The motor unit bilge system was automatically initiated via level sensors that, when activated, removed any liquid via one of four separate suctions. If fluid activated the level sensor in any of the bilges, the WLS sequence alarm was initiated.

1.6.8 Water leakage stop sequence alarm

Activation of the WLS alarm created a sequence request, which was stored within the PCS. When the pod was next stopped, either manually by the operator or automatically by the PCS, the WLS shutdown sequence initiated. This:

- turned the pod 90° to the vessel's heading;
- applied the propeller shaft brake; and,
- once the shaft had stopped rotating, inflated the emergency shaft seal to prevent seawater ingress and protect the electric motor.

The crew could not override the WLS sequence once it had started The reason the pod rotated 90° to the vessel's heading was to prevent the pod's propeller rotating and its motor acting as an electrical generator, potentially damaging the vessel's propulsion system. Following a WLS shutdown the affected pod could not be restarted until the initiating liquid had been pumped out and the bilge sensors had been deactivated and reset. It was not possible to steer the affected pod until it had been restarted.

On the day of the accident the WLS sequence request activated on the port pod immediately before the port pod oversped, indicating that fluid had been detected in the motor unit bilges. Shortly afterwards, the WLS sequence request also activated on the starboard pod. After the initial loss of both pods, *Spirit of Discovery*'s engineers disconnected the bilge line and rigged portable pumps to remove liquid from the port and starboard motor units before the pods could be restarted. The liquid extracted from each motor unit appeared to be about 100 millilitres of oil and fresh water.

1.6.9 Propulsion modes of operation

The pod propulsion motors were controlled via a PCS that limited the motor speed. The PCS carried out several functional requirements, including a speed set point controller with specific speed ramping and limitation.

The speed ramping controlled the rate at which the motor speed increased or decreased when the speed set point was changed. The operator could change manually between two modes of pod operation. Meyer Werft's manoeuvring booklet detailed the manoeuvring characteristics of the vessel as required by the IMO[17]:

[17] IMO Resolution A.601(15), Provision and Display of Manoeuvring Information On Board Ships, adopted on 19 November 1987.

Manoeuvre mode provides faster speed set point run-up run-down time curves for the speed controller and faster diesel load curves, thus providing faster response times for the drive to the speed set point commands.

Sea mode activates the standard (slower) run-up and run-down time curves for the speed controller and the diesel load. This is the normal operating mode for the eSiPODs for open sea with slower ramp time settings for reaching the reference speed. The steering angle is limited to +/- 35° to provide safe operation at higher ship speeds. [sic]

On the day of the accident, *Spirit of Discovery* was in sea mode until propulsion was initially lost from the port pod. As the vessel's speed had reduced below 12kts the OOW then changed the system to manoeuvre mode, which allowed the crew to use the vessel's bow thrusters and the pods to be rotated beyond 35° to help maintain its heading.

1.6.10 Propulsion overspeed protection

Spirit of Discovery's propulsion motors' maximum rated speed was 120 revolutions per minute (rpm). To prevent mechanical damage due to motor overspeed, the PCS automatically shut the pod motor down if it reached 132 rpm, which was 110% of the maximum rated speed. The vessel's engine management records indicated that this pod overspeed protection led to each loss of propulsion.

1.6.11 Power limitation function

Immediately before the first loss of propulsion on the day of the accident the vessel's power limitation function was active. This indicated that the propulsion system was automatically reducing motor speed to shed load due to hull resistance caused by the high sea state.

1.6.12 Propulsion manuals

Siemens Energy had provided 20 manuals and associated technical drawings that described *Spirit of Discovery*'s propulsion system. This documentation included a 186-page set of operating instructions for the pods and a 243-page instructional manual.

Meyer Werft's manoeuvring booklet referred to the Siemens Energy instruction manual and also contained a brief overview of the system's three automatic protection sequences: WLS; motor short circuit; and the crash stop.

On the WLS sequence, the Siemens Energy instruction manual[18] stated:

*At this stage no automatic sequence WLS will be initiated by the event of water leakage! **Only** if the operator follows the WATER LEAK STOP REQUEST by using the STOP PROP pushbutton with pending WATER LEAKAGE STOP REQUEST, the following sequence will be initiated.* [sic]

Section 2.9.1 of the instruction manual further stated:

*If the water leakage sequence once is initiated, it cannot be interrupted. While the execution is active, **no steering** of the POD is possible.*

[18] SISHIp SiPOD-M10 Functional Description, Instruction Manual, 2021-06-22.

To recover the POD propulsion system after the water leakage stop sequence, the HIGH/HIGH and WATERLEAKAGE ACTIVE alarms from the PAC[19] *must be reset at the PAC service panel…*

None of these manuals provided instruction on the use of *Spirit of Discovery*'s power limitation system or management of the vessel's propulsion when operating in heavy weather.

1.7 CRUISE AND VOYAGE PLANNING

1.7.1 Cruise planning

Spirit of Discovery's cruise programme was developed by Saga and its itineraries were published a year to 18 months in advance. All of the ship's cruises started and finished in the UK. The captain and crew delivered the cruise programme using the voyage planning procedure detailed in *Spirit of Discovery*'s VMS.

Any proposed changes to the vessel's cruise programme were discussed by the captain and the Saga team. The decision on whether to adopt these changes was made by the captain, who retained ultimate responsibility for the vessel's safe operation.

1.7.2 Voyage planning

Spirit of Discovery's voyage planning procedure was described in the VMS and comprised:

- The pre-cruise voyage overview brief. The brief for the 'Canary Island Quintet' itinerary focused on the port visits, specifically the likely weather conditions; tidal information; potential berths; mooring arrangements; gangway access; logistics; and tours. It also discussed the voyage and passage plan. The brief advised the master to make use of weather routing services for information on the forecast conditions during the voyage.

- A berth-to-berth passage plan. The voyage planning procedure required the navigating officer to produce a berth-to-berth passage plan for each leg of the cruise, making use of regularly updated weather forecasts provided by either NAVTEX[20] or the weather routing providers. The VMS also advised that:

  The Master and Officers must never remain committed to a pre-planned course of action, if the prevailing circumstances render a departure from the plan necessary for the safety of the ship. [sic]

- The voyage execution procedure. This required the master to execute the voyage plan in consideration of the forecast weather conditions. It emphasised the need to *Undertake prompt action, such as altering course or reducing speed, to avoid extreme weather conditions*.

- The voyage monitoring procedure. This detailed how the vessel's navigational safety was to be monitored during the voyage.

[19] Pod auxiliary control system.

[20] An international automated direct printing telex system fitted to the bridge of all merchant vessels. The NAVTEX broadcasts contained official Maritime Safety Information, including navigational warnings, weather warnings and weather forecasts for the area.

Spirit of Discovery's VMS defined adverse weather as: winds greater than Beaufort force 7; significant wave heights of more than 4m. It did not define vessel motion limits. There was no reporting threshold for heeling events; some passenger vessel operators required all instances of heel above 5° to be reported to their head offices.

1.8 THE WEATHER

1.8.1 The Bay of Biscay

Spirit of Discovery's voyage plan, approved by the captain, required the vessel to cross the Bay of Biscay from Cape Finisterre to Ushant. This leg of the voyage, about 390 nautical miles at a speed of 16kts, was predicted to take just over 24 hours to complete. The Admiralty Sailing Directions: NP22 Bay of Biscay Pilot, stated *The Bay of Biscay is well known for its extremely rough seas*…[21].

1.8.2 Weather

The UK Met Office weather analysis charts valid for 1200 UTC on 3 November and 1200 UTC on 4 November **(Figure 9)** showed a series of low-pressure systems crossing the North Atlantic Ocean. These low-pressure systems followed the named storm 'Ciarán'[22] that had already crossed the Bay of Biscay on 2 November. The UK Met Office reported that the 2023/24 storm season[23] saw 12 named storms, the highest number since the system was introduced in 2015.

The investigation commissioned the UK Met Office to retrospectively calculate the significant wave height and direction that *Spirit of Discovery* encountered during the afternoon of 4 November 2023. The data is summarised in **Table 1**.

The UK Met Office defined 'significant wave height' as the *average height of the highest third of the waves*, with the highest individual waves that could be encountered having a height *up to double that of the significant wave height*.

4 November 2023 local time (UTC +1)	Significant wave direction (°)	Average significant wave height (m)
1200	269	8.1
1300	267	8.5
1400	267	9.0
1500	267	9.6
1600	269	10.0
1700	271	10.4
1800	274	10.7

Table 1: UK Met Office hindcast data for wave direction and height

[21] Edition 14, Chapter 1: Sea Level and Tides, section 1.104

[22] Met Office UK case study November 2023: Storm Ciarán

[23] The storm season ran from 1 September 2023 to 31 August 2024.

Images courtesy of UK Met Office

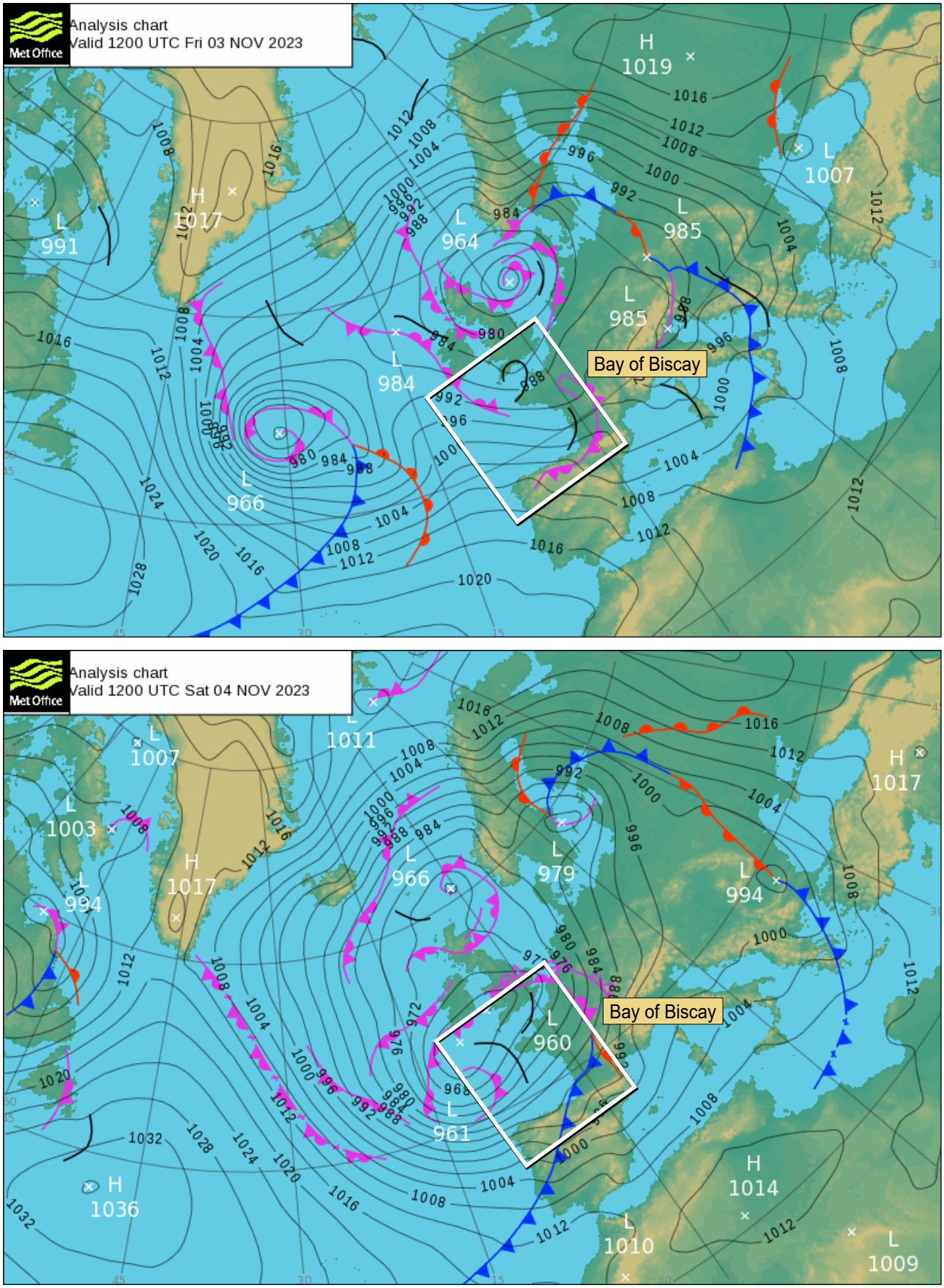


Figure 9: North Atlantic weather analysis charts for 3 November and 4 November 2023, highlighting the Bay of Biscay

1.8.3 Marine weather forecasting

The World Meteorological Organization (WMO) oversaw the Worldwide MetOcean Information and Warning Service, which provided mariners with marine weather forecasts, gale and storm force wind warnings. As defined under SOLAS and as part of GMDSS for compliant Maritime Safety Information receipt, the crew could access forecasts and warnings via the vessel's NAVTEX receiver for the METAREA 2 region, which included the Bay of Biscay and surrounding waters. At the time of the accident *Spirit of Discovery* was in NAVTEX area Finisterre and later Pazenn **(**see **Figure 3)**. The NAVTEX Weather Warning for Friday 3 November 2023 issued at 1030 was:

FINISTERRE.
FROM 03/15 UTC TO 04/12 UTC AT LEAST.
WEST OR SOUTHWEST 8 FROM WEST, AT TIMES 9 IN NORTH, INCREASING LOCALLY 9 OR 10 IN NORTH AT END, LOCALLY 8 OR 9 IN SOUTH. SEVERE GUSTS.
HIGH (4-9m)*, BECOMING HIGH* (4-9m) *OR VERY HIGH* (6-14m) *AT END.*

PAZENN.
FROM 03/15 UTC TO 04/12 UTC AT LEAST.
WEST OR SOUTHWEST 8, INCREASING 8 OR 9 AT END, LOCALLY 9 OR 10 IN SOUTH.
HIGH (4-9m)*, BECOMING HIGH* (4-9m) *OR VERY HIGH* (6-14m) *AT END.*

The NAVTEX forecast for these areas at 2150 UTC on 3 November was:

FINISTERRE.
CONTINUING TO 05/03 UTC.
WEST OR SOUTHWEST INCREASING RAPIDLY 8 FROM WEST, AT TIMES 9 IN NORTH, INCREASING LOCALLY 9 OR 10 IN NORTH IN DAYTIME AND 8 OR 9 IN SOUTH, THEN VEERING WEST 8 IN EVENING, LOCALLY 9 IN NORTH. SEVERE GUSTS.
HIGH (4-9m) *OR VERY HIGH* (6-14m)*.*

PAZENN.
CONTINUING TO 05/06 UTC.
WEST OR SOUTHWEST INCREASING 8 OR 9, LOCALLY 10 IN SOUTH IN DAYTIME, THEN VEERING WEST OR NORTHWEST 8 OR 9 ON SATURDAY EVENING. SEVERE TO VIOLENT GUSTS.
HIGH (4-9m) *OR VERY HIGH* (6-14m)*.*

Spirit of Discovery's captain also consulted online weather information websites such as Windy.com, Windfinder.com and YR.no.

1.8.4 Weather routing and information services

Saga had contracted the services of three weather routing and information providers to assist *Spirit of Discovery*'s crew with voyage planning and execution: BonVoyage System (BVS)[24]; Navimeteo; and Weather Routing Incorporated (WRI). The Navimeteo and WRI weather routing information emailed daily to *Spirit of Discovery* included route forecasts and 5-day summaries. The BVS software was updated

[24] BVS provided weather forecast data.

automatically, allowing the operator to view a dynamic forecast for the voyage. **Table 2** summarises the weather routing and information providers' forecast predictions for the afternoon of 4 November 2023. The WRI and Navimeteo weather predictions were based on a SOG of approximately 12kts. The BVI information was configured on board based on a planned SOG of approximately 16kts.

Date forecast received	**Weather service provider**	**Forecast conditions for 4 November (PM)**				**Remarks**
		Wind direction[25]	**Beaufort wind force**	**Swell direction**[26]	**Significant wave height (m)**	
3 November (AM)	Navimeteo	WSW	9	NW	6.5	Based on anticipated A Coruña port visit
	WRI	No message received[27]				
	BVS	NW	7	W	7	
3 November (PM)	Navimeteo	W	10 to 11	WNW	8 to 12	After cancellation of A Coruña port visit
	WRI	WSW to WNW	10	WSW to WNW	13	
	BVS	SW	8	W	7 to 8	

Table 2: Weather forecast summary for the afternoon of 4 November 2023

At about midday on 3 November, *Spirit of Discovery*'s crew informed the weather routing providers that the visit to A Coruña had been cancelled and the vessel would proceed directly to Portsmouth. The providers' updated forecasts collectively predicted that *Spirit of Discovery* would experience winds up to force 11 from the west-south-west accompanied by 7m to 13m waves.

At 1408 on 3 November, Navimeteo emailed the Saga team advising that:

> *Heading towards Portsmouth is not a good idea.*
>
> *On Saturday, November 4th, a new deep depression between Finisterre and the entire Bay of Biscay will bring storm force W'ly winds and 12-meter-high waves from W. These prohibitive conditions will continue until Sunday, the 5th. Heading north is not a good option either.*
>
> *Our suggestion if possible, for you is to find shelter S of Portugal, heading North only from Monday 6th.* [sic]

[25] Key to abbreviations: north-westerly (NW); south-westerly (SW); westerly (W); west-north-westerly (WNW); west-south-westerly (WSW).

[26] See footnote 21.

[27] WRI sent a forecast at 1551 UTC on 2 November, stating: *expect heavy sea throughout the voyage. Swells expected to top out at 8 metres on the 3rd. Expect winds to pick up late on 3rd. Wind gusts up to 70 knots during this time.*

The Saga email accounts to which this email was sent were not being monitored on the afternoon of 3 November and this message was not forwarded to *Spirit of Discovery*'s crew. The WRI forecast sent to *Spirit of Discovery*'s crew and the Saga team at 1703 stated:

> *Updated forecast is on the basis Master's intentions to proceed direct to Portsmouth. Please note that the vessel will encounter unavoidable dangerous and very heavy conditions of 10-13m swells on the 04th and into the 05th/ AM. If able, we would recommend the vessel seek shelter along coastal Portugal no further north than 40N latitude until 05th/12z before continuing onto Portsmouth.* [sic]

1.9 SCOPE TO DELAY THE PASSAGE

The investigation modelled the potential effect of delaying *Spirit of Discovery*'s passage through the Bay of Biscay by 24, 36 and 48 hours. The model used weather data from similar databases[28] to those used by weather routing providers. The results are summarised in **Table 3**.

***Spirit of Discovery* track**	**Wind[29]**		**Significant wave height**		**Estimated arrival at Portsmouth**
	Direction	**Beaufort wind force**	**Direction**	**Height (m)**	
Original	WSW	9	W	9.2	6 November at 2130
+ 24 hours	WSW	6	W	7.1	6 November at 2300
+ 36 hours	WNW	6	W	5.5	7 November at 1100
+ 48 hours	WNW	6	W	3.8	7 November at 2300

Table 3: Delayed crossing effect on weather conditions and Portsmouth arrival

1.10 HEAVY WEATHER OPERATIONS

1.10.1 The securing of objects on board

A review of *Spirit of Discovery*'s VMS following a heavy weather incident on 20 February 2023 (see section 1.15.1) led to the creation of a register of *objects requiring securing* that listed approximately 200 items by deck, estimated weight and securing method. The register included items such as pallets of stores, balcony furniture, service trolleys, gym equipment, pianos and medical equipment.

This register did not include tables and chairs in *Spirit of Discovery*'s public spaces such as the Britannia Lounge, Living Room and The Grand Dining Room, nor did it include furniture in passenger cabins. These areas were instead subject to a dynamic risk assessment that included the direction from Saga for the crew to provide room service to passengers in their cabins if restaurant service was deemed unsafe.

[28] Historic weather and sea state data was obtained from Made Smart Group software.

[29] See footnote 21 for key to abbreviations.

1.10.2 Seakeeping and manoeuvring

To allow *Spirit of Discovery*'s crew to predict vessel movement in heavy weather Meyer Werft had provided a seakeeping and manoeuvring decision support poster (DSP). Based on the shipyard's scale model tests the DSP allowed the crew to use its polar diagrams for the appropriate wave type and height, the relative direction of the waves, and the vessel's speed to predict whether *Spirit of Discovery* would:

- be unable to sustain a planned speed;
- ship green seas over its bow;
- roll to more than 2°; and,
- make passengers and crew feel seasick.

The DSP provided predictions for significant wave heights that ranged from 2.5m to 7.5m, including breaking waves and swell, with and without operational stabilisers. A DSP extract for the highest significant wave height of 7.5m, with operational stabilisers, is shown in **Figure 10**. This predicted that when *Spirit of Discovery* was operating in a 7.5m following sea, the vessel would be unaffected by the weather if the vessel's speed remained above 9kts. The DSP's polar diagrams did not predict the likelihood of propeller emergence and overspeed.

1.11 MEDICAL SERVICES

1.11.1 Overview

Medical services on *Spirit of Discovery* were provided by Vikand Medical Solutions LLC (Vikand), based in the USA. Vikand recruited and employed the vessel's medical staff and oversaw the provision of the medical services on board.

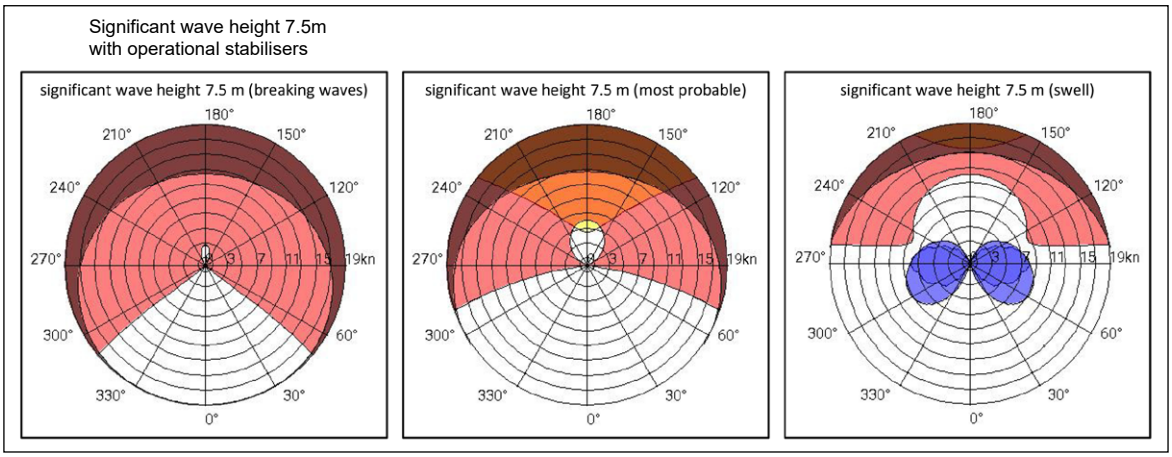
Spirit of Discovery's medical centre was located on Deck 4. It comprised a reception area, doctor's office, laboratory, surgery and two wards that were equipped with hospital beds and able to accommodate three patients in total. *Spirit of Discovery* carried a doctor and five nurses. The medical centre was equipped with defibrillators, cardiac monitors, an X-ray machine and pharmacological laboratory equipment.

The medical team's working hour report showed that the doctor and nurses had all worked from 0800 on 4 November until 0300 on 5 November, with a 30-minute break for meals.

1.11.2 Medical facilities audit

On 20 March 2023, Vikand had audited *Spirit of Discovery*'s medical facilities against the 2019 Cruise Lines International Association (CLIA) policy in force at the time that was based on member adherence to the 2019 American College of Emergency Physicians (ACEP) Cruise Ship Health Care Guidelines (ACEP guidelines). This audit identified several areas for improvement, all of which were rectified before the accident. The 2023 updated ACEP guidance was not in force at the time (see section 1.13.6) and the audit did not assess the vessel's contingency medical plans.

Images courtesy of Meyer Werft



Legend to Operability Diagrams

Diagrams on this poster are provided for housed stabilizers (left side) and active stabilizers (right side). The information presented is valid for significant wave heights of 2.5 m to 7.5 m (from top to bottom) as well as for short and breaking waves (left column), most probable conditions (middle column) and swell (right column).

The color scale legend provides information on the following operability criteria:

sustained speed: The attainable speed based on wave added resistance and 100% available propulsion power is given. Added resistance due to wind is not accounted for.

green sea shipping at bow: Events of green sea shipping at bow are considered within this criterion. The number of exceedance is set to one such event per hour in the prevailing conditions

roll motion: The general roll motion behavior is considered here. As the criterion an average roll motion of 2.0 deg (rms) is set.

motion sickness incidents: The number of people feeling sea-sick for an exposure time of 3 hrs is considered. The criterion considers 10% of the people feeling sea-sick as the limiting value. The criterion is evaluated at the location of the "Britannia Lounge".

losing balance: The criterion considers loss of balance due to ship motion. The number of exceedance is set to one such event per hour. The criterion is evaluated at the location of the "Britannia Lounge".

Instruction to read Operability Diagrams

Within the diagrams each node of the grid provides information for a certain combination of ship speed and wave encounter angle. On the radial axis the ship speed is plotted in a range of 0 to 19 knots. The circumferential axis provides the relative wave heading, while 180° is corresponding to head wave conditions. This means that the sailing direction of the ship is always upwards.

Figure 10: Extract from the Seakeeping and Manoeuvring – Decision Support poster

1.11.3 Mass casualty incident plan

Spirit of Discovery's Shipboard Emergency Organisation Part 1 incorporated the Master's Decision Support System and contained a Mass Casualty Incident Flow Chart, the final step of which directed the crew to *Follow Ships Mass Casualty Incident plan*.

Spirit of Discovery's MCIP was kept with the medical team on board and was not available to the crew through the VMS; there was no record that the plan had been drilled.

1.11.4 Advanced Trauma Life Support training

Spirit of Discovery's doctor held an Advanced Trauma Life Support (ATLS) qualification. The ATLS course provided doctors with the skills to provide emergency care for patients who had suffered traumatic injuries.

1.11.5 Medical triage

On the evening of 3 November, *Spirit of Discovery*'s doctor briefed the medical team to use the Simple Triage and Rapid Treatment system[30] in the event of a mass casualty event the following day. The doctor briefed the medical team to assess the ability of each injured person (IP) to walk and breathe, as well as their breathing rate, pulse and mental status. Assessment for potential spinal injury did not form part of this IP triage process.

1.12 SPECIALIST MEDICAL REVIEW

The investigation commissioned a practising orthopaedic and spinal injury consultant (the specialist) to undertake a medical review of passenger 1's treatment on board *Spirit of Discovery*. The specialist, who was a Fellow of the Royal College of Surgeons and a member of the British Association of Spine Surgeons, provided the following opinions:

- Passenger 1's age, mechanism of injury and symptoms should have raised the possibility of a spinal injury immediately post-fall. This should have led to him being immobilised with spinal protection in place before being transferred to the vessel's medical centre.

- The British Orthopaedic Association recommended that spinal protection should consist of keeping the injured person lying flat on their back, on a spinal board, without rotating or bending the spine and using a properly sized rigid cervical neck collar. Additional bolster or straps could then be used to restrict spinal movement. The Association also recommended that spinal protection should remain in place until the risk of a spinal injury had been excluded. This was important as inadequate restriction of spinal motion could cause additional neurological damage and worsen patient outcome.

- Once admitted to the medical centre, passenger 1 should have remained immobilised until the X-rays had determined whether he had suffered a spinal injury. It was unclear why further X-rays were not attempted on 5 November, on

[30] A widely used simple mass casualty triage system designed in the USA for first responders to prioritise patient treatment.

receipt of the radiologist's report stating that the X-rays were non-diagnostic as no lateral views had been provided.

- It would have been helpful if the vessel's doctor had sought specialist medical advice from a spinal surgeon ashore.

1.13 REGULATION AND GUIDANCE

1.13.1 Propulsion performance/motion limits

Regulation 26.6[31] of SOLAS required a vessel's main propulsion machinery to be designed to operate when rolling up to 22.5° either way and pitching up to 7.5° by bow or stern.

At the time of *Spirit of Discovery*'s build this requirement was reflected in the International Association of Classification Societies (IACS) unified requirement (UR) M46, Ambient Conditions – Inclinations and Ship Accelerations and Motions[32]. The UR required classification societies to ensure that a vessel's main and auxiliary machinery was able to operate within these dynamic limits.

1.13.2 Propulsion manuals

The IACS Recommendation No.71 – Guide for the Development of Shipboard Technical Manuals, provided guidance on the development of *user-friendly technical manuals* for the operation and maintenance of the vessel and its equipment. Section 6.4.2 of the IACS recommendation detailed that the operating instructions should: *provide full details of the procedures to be followed in preparing, starting, running and shutting down a system under normal and emergency conditions*.

1.13.3 Voyage planning

The IMO Resolution A.893(21) – Guidelines for Voyage Planning detailed the four stages of voyage planning: appraisal, planning, execution, and monitoring. Section 3.4.7 of the International Chamber of Shipping's Bridge Procedures Guide (BPG) Sixth Edition described these stages in more detail, advising that:

> *Weather routing is an aid to navigation and the Master should always consider routeing information as well as applying good seamanship.*[33]

1.13.4 Weather routing

The IMO Resolution A.528(13) – Recommendation on Weather Routeing[34] recommended that governments advised their vessels of the availability of weather routing services. The IMO's MSC.1/Circ.1063 – Participation of Ships in Weather Routing Services[35] provided further guidance to ship operators and crews on the minimum standards for the provision of weather routing services provided to mariners. This guidance included the need for weather routing providers to supply advice at regular intervals and to include swell data and significant wave height.

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[31] Chapter II-1: Construction – Structure, subdivision and stability, machinery and electrical installations – Part C, Machinery Installations.

[32] IACS UR M46, Revision 1, June 2002.

[33] ICS BPG, 3.4.7

[34] Adopted on 17 November 1983.

[35] Issued on 19 December 2002.

1.13.5 Securing of objects during heavy weather

The CLIA issued industry level policies to its members to incorporate procedures into their SMSs to ensure the securing of heavy objects during heavy/severe weather[36]. This included:

> *a deck by deck inspection to identify unsecured and potentially hazardous heavy objects. Integral to the procedures is a list of identified objects which have a significant potential to cause injury.*

1.13.6 Medical provision on cruise ships

The Maritime and Coastguard Agency (MCA) issued Merchant Shipping Notice (MSN) 1841(M) Maritime Labour Convention, 2006: Medical Care Ship's Doctors. This MSN set out a requirement for UK vessels carrying more than 100 people on international voyages of 72 hours or more to carry a ship's doctor. The MSN required the ship's doctor to be qualified and registered to practice in the country where they were resident.

The CLIA policy required members to meet or exceed the ACEP guidelines to prioritise shipboard medical care. The 2019 ACEP guidelines comprised a one-page set of principles for cruise ship medical facilities. This was updated in October 2023, one month before the accident, to include an eight-page *Cruise Ship Health Care Guidelines* document. The 2023 ACEP guidelines provided detailed advice to vessel operators on the provision of cruise ship medical facilities, including staffing; clinical practice; documentation; equipment; pharmacy; infection control; imaging; medico-legal practice; patient feedback; and contingency medical plans. The guidance further advised that at least one doctor on board should be certified in ATLS or an equivalent qualification. The guidelines did not place any requirement on the ATLS training for nursing staff or set a threshold for the initiation of a mass casualty incident on board a cruise ship.

1.13.7 Mass casualty contingency plan

Guideline 11 of the 2023 ACEP guidelines recommended that passenger vessels should have a *Comprehensive written medical contingency plan which is subject to regular review, not to exceed three years*. The plan was to *incorporates mass casualty incidents* and mass casualty incident drills that were to be *conducted on a regular basis*.

1.13.8 Access to specialist medical advice

The MCA issued Marine Guidance Note (MGN) 623 (M+F) –Telemedical Advice Service for Ships at Sea in 2019. The MGN's purpose was to provide crew with access, via the coastguard, to specialist medical advice from either the Queen Alexandra Hospital, Portsmouth or Aberdeen Royal Infirmary. The Telemedical Maritime Assistance Service (TMAS) was free of charge and available 24-hours a day, 7-days a week.

[36] CLIA Oceangoing Cruise Line Policies: operational safety

1.13.9 Treatment of spinal injuries

Chapter 7 of the ATLS course manual provided guidance on the treatment of *Spine and Spinal Cord Trauma*. The manual recommended the use of the Canadian C-spine Rule (CCR) and National Emergency X-Radiography Utilization Study (NEXUS) to determine whether patients might have suffered a spinal injury and needed to undergo radiography.

The CCR guidance was that all patients over 65 years old who had suffered a dangerous mechanism of injury or tingling (paraesthesia) in their extremities should be spinally immobilised until the risk of spinal injury had been discounted by X-ray.

1.14 REFERENCE

1.14.1 National Institute for Health and Care Excellence clinical guideline

In April 2025, the UK's National Institute for Health and Care Excellence (NICE) published guideline NG249 – *Falls: assessment and prevention in older people and in people 50 and over at higher risk*. The context[37] noted that:

> *Although falls can occur at any age, they become increasingly common as people get older. Around a third of people aged 65 and over, and around a half of people aged 80 and over, fall at least once a year. The impact of falls, especially in people aged 65 and over, includes distress, pain, injury including fractures, loss of confidence, loss of independence, and mortality.*

The overview stated that guideline NG249 was for:

- health and social care practitioners
- local authorities
- care home providers, managers and staff
- commissioners and providers of health and social care services
- people aged 65 and over, their families and carers
- people aged 50 to 64 with a condition or conditions that might put them at risk of falls, their families and carers

1.14.2 Mass casualty definition

The National Health Service (NHS) England guidance *Concept of Operations for Managing Mass Casualties*, published in November 2017, defined a mass casualty incident as one *causing casualties on a scale that is beyond the normal resources of the emergency and healthcare services' ability to manage*.

[37] NICE guideline for falls: older people and people 50 and over at higher risk

1.15 PREVIOUS ACCIDENTS – *SPIRIT OF DISCOVERY*

1.15.1 February 2023 – overspeed event

During the evening of 20 February 2023, while on passage in heavy weather in the Norwegian Sea, *Spirit of Discovery*'s port and starboard pods overspeed trips activated after propeller emergence when pitching. The vessel was experiencing very heavy rolling and pitching in storm force 11 winds accompanied by 12m head seas, which led to injuries to multiple passengers, six of whom were treated in the ship's medical centre.

Spirit of Discovery's captain[38], raised a Passenger Accident Report (PAR) detailing the accident. The PAR concluded that the weather experienced was more severe than forecast, and that future February cruises off the Norwegian coast needed to be risk assessed. *Spirit of Discovery*'s PAR was accompanied by a non-conformance report (NCR) highlighting the vessel's lack of suitable securing arrangements for furniture and stores on board. This NCR led to Saga commissioning its Spirit Class – Storing and Securing Project.

The Storing and Securing Project led by *Spirit of Discovery*'s crew identified 30 potential improvement areas that were then reviewed by the Saga team, V.Ships and the DPA. The project resulted in additional securing arrangements being added to storerooms and lockers in many areas. In the restaurants, Saga decided that the securing of the tables and chairs was:

> *Not considered necessary. Loss of flexibility. Assessed at build and design. No accident is space etc. Dynamic risk assessment should be done for heavy weather and if conditions deem it unsafe for guests to be served in restaurants, it is closed and room service provided for guests. Heavy weather checklist. If tables needed to stow away any additional securing points needed?* [sic]

No additional securing points were added to these public spaces. The seating and furniture in the Living Room was not assessed.

In February 2023, *Spirit of Discovery*'s chief electro-technical officer (CETO) informed Siemens Energy of the propulsion motor overspeed event and asked the company to investigate. In May 2023, Siemens Energy responded that shutdowns had been valid to avoid damage to the vessel's propulsion and advised it could happen again in heavy weather.

1.15.2 February 2023 – water leakage stop sequence event

On 27 February 2023, the WLS sequence unexpectedly initiated when *Spirit of Discovery*'s propulsion was manually stopped following the vessel's arrival in harbour. The CETO requested Siemens Energy to investigate why the WLS sequence had been initiated.

After communications between *Spirit of Discovery*'s engineering team, V.Ships and Siemens Energy, revised WLS software was trialled on *Spirit of Adventure* in May 2023, but this proved unsuccessful. A WLS software update was not successfully implemented on *Spirit of Discovery* until after the November 2023 accident.

[38] A different captain to the one who was on board in November 2023.

1.16 SIMILAR ACCIDENTS

1.16.1 *Crown Princess* – severe heeling incident

On 18 July 2006, the passenger vessel *Crown Princess* heeled to about 24° while departing Port Canaveral, USA. The heeling event caused people to be thrown about and struck by unsecured objects, resulting in 14 serious and 284 minor injuries to passengers and crew. The vessel, which had been in service for about a month, also sustained considerable damage to its interior caused by unsecured items. The National Transportation Safety Board (NTSB) investigation report[39] found that this accident demonstrated the need for obtaining and archiving data on vessel angles of heel. The report also made recommendations to CLIA to urge its members to introduce appropriate ship handling training for the crew.

1.16.2 *Pacific Sun* – heavy weather damage

On the evening of 30 July 2008, the passenger vessel *Pacific Sun* rolled heavily in gale force winds and high seas while returning to Auckland, New Zealand on the final leg of an 8-day South Pacific cruise (MAIB report 14/2009[40]). Seventy-seven of the 1,730 passengers and 671 crew were injured, with seven sustaining major injuries. The investigation resulted in recommendations being made to improve the securing of items in public spaces.

1.16.3 *Viking Sky* – heavy weather damage

On 23 March 2019, the passenger vessel *Viking Sky* experienced a total loss of electrical power and propulsion in storm force winds off the Norwegian coast. The vessel came within a ship's length of grounding with more than 1,300 people on board. The Norwegian Safety Investigation Authority (NSIA) report[41] led to recommendations being made to the shipyard, operators and classification society to improve the design, operation and assurance of diesel generators in rough weather. This recommendation resulted in the revision of IACS UR M46 to require shipbuilders of SOLAS vessels to:

> *identify and document the ship accelerations and motions periods to which machinery and equipment might be subjected to. The expected accelerations and ship motions periods are to be within machinery and equipment manufacturers requirements. The estimations are to consider vessel type, machinery or equipment location and expected service conditions.*[42] [sic]

A further recommendation was made via the Norwegian authorities to the IMO that inclinometer information compliant with the technical requirement for inclinometers (IMO Resolution MSC.363(92)) be recorded on the VDRs of all SOLAS ships with a gross tonnage (gt) of 3,000 and above.

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[39] NTSB/MAR-08/01 PB2008-916401, notation 7963B, adopted January 30, 2008.

[40] MAIB report 14/2009: Pacific Sun

[41] Norwegian Safety Investigation Authority report 5/2024: Viking Sky

[42] IACS UR M46, Revision 3, August 2023.

1.16.4 Cruise ship passenger injuries

In the 12 months before *Spirit of Discovery*'s accident the MAIB received 133 reports of passenger injuries on cruise ships, of which the majority resulted from falls. The average age of the passengers involved in these incidents was 68 years old and the average significant wave height was 1.25m or less.

There have been several other investigations into marine accidents that have occurred on passenger vessels in heavy weather or that have been caused by extreme vessel motion that led to vessel damage or passenger injury. These accidents are summarised in **Table 4**.

Vessel	Year	Number of passengers		Angle of roll/heel	Wave height (m)	Beaufort wind force
		Total	Injured			
Crown Princess	2006	3,285	298 (9%)	24° heel	0.5 to 1	2 to 3
Pacific Star	2007	1,287	Unknown	Unknown	5	12
Pacific Sun	2008	1,730	77 (4%)	31° heel	10	8
Viking Sky	2019	954	19 (2%)	14° roll	4 to 6	11
Spirit of Discovery	2023	943	114 (12%)	Up to 13° roll	12	12

Table 4: Comparison of similar previous accidents

SECTION 2 – ANALYSIS

2.1 AIM

The purpose of the analysis is to determine the contributory causes and circumstances of the accident as a basis for making recommendations to prevent similar accidents occurring in the future.

2.2 OVERVIEW

Spirit of Discovery was pitching heavily and rolling violently in heavy weather when it lost propulsion while crossing the Bay of Biscay shortly after midday on 4 November. The vessel then repeatedly lost propulsion and remained hove to for almost 18 hours. The vessel continued its passage to Portsmouth the following morning, once the weather conditions had improved.

Spirit of Discovery's violent motion during the period of intermittent loss of propulsion led to over 100 passengers being injured, eight of whom were treated in hospital when the vessel arrived in Portsmouth. Trevor Gilks sustained a spinal injury when his chair toppled over and he died of his injuries four days later. Compared to similar previous incidents, the percentage of injured passengers on board was one of the highest.

This section of the report will discuss the accident and the contributing safety issues, including the loss of propulsion in heavy weather; voyage planning and execution; securing of the vessel's fixtures and furniture; the crew's emergency response; and the medical treatment that Trevor Gilks received.

2.3 LOSS OF PROPULSION

2.3.1 Initial loss of propulsion

Spirit of Discovery was pitching heavily and rolling violently in 8m to 9m waves when its port pod automatically shut down, followed shortly afterwards by its starboard pod. After shutting down, each pod then automatically rotated and parked at 90° to the vessel's heading.

Given the weather conditions at the time, it is almost certain that *Spirit of Discovery*'s pitching caused the propellers to come out of the water. This caused a sudden reduction in torque on the propulsion motor and led to a very rapid increase in the motors' rpm. The engine alarm and monitoring system recorded that, immediately before their shutdown, the rpm of each pod's propulsion motor very rapidly increased and exceeded the preset overspeed limitation. The pod's PCS therefore automatically tripped the power to its motor to prevent it being damaged.

Spirit of Discovery's engineers could likely have quickly reset the port and starboard motors and restored the vessel's propulsion had the propulsion motor overspeed trips been the only issue. However, with the WLS sequence request active on both pods, when the propulsion motors tripped the pods automatically parked at 90° to *Spirit of Discover*y's heading and the vessel quickly lost speed and steerage. This left the bridge team doing their best to control the vessel's heading using its bow thrusters. As a result, *Spirit of Discovery*'s bow was quickly swung to port by the wind, placing the sea and swell on its port bow and the wind just abaft its port beam,

which caused the vessel's motion to become even more violent. This reduction in speed to below 5kts and the use of the bow thrusters meant that the vessel's stabilisers became ineffective and were automatically housed, further increasing the severity of the vessel's motion.

The effect of *Spirit of Discovery*'s loss of propulsion was exacerbated by the initiation of the WLS sequence request shutdown, which led to the crew losing control of the vessel. *Spirit of Discovery*'s heading then swung to port so that it was almost beam on to the prevailing wind and waves, increasing the severity of the vessel's rolling motion as it did so.

2.3.2 Vessel motion

The SOLAS regulation required *Spirit of Discovery*'s propulsion systems to be designed to operate when the vessel was dynamically rolling up to 22.5° and pitching up to 7.5°. However, the PCS records for the day of the accident showed that pod overspeed caused the vessel to lose propulsion on 10 occasions when the vessel was operating well below these limits.

The implications of this control measure on the safe operation of *Spirit of Discovery* were not identified during the vessel's design. The IACS UR M46 Revision 1, in force at the time, required the classification society to apply the SOLAS dynamic motion limits to the vessel's main and auxiliary machinery. However, while the propulsion system manufacturer had assessed that their equipment operating in isolation met or exceeded the SOLAS requirement, its performance when fitted to the vessel had not been fully evaluated.

The IACS UR that guided the classification society's assessment had been updated due to the investigation into *Viking Sky*'s loss of power in heavy weather (see section 1.16.3). However, the UR's revision did not require the shipbuilder to dynamically model the safe operation of the vessel's propulsion and other critical systems across the range of inclinations (pitch and roll). Additionally, while the shipyard had conducted an FMECA to ensure that the vessel met the SOLAS requirement for the vessel's ability to safely return to port after a fire, there was no requirement to adopt a similar assessment to assure its compliance with the SOLAS motion limits.

It is apparent that, while *Spirit of Discovery* was operating in rough sea conditions where the propellers came out of the water, the PCS was unable to react quickly enough to reduce the motor speed and prevent the overspeed threshold being reached. The PCS was therefore unable to prevent loss of propulsion when *Spirit of Discovery* was operating within the SOLAS requirements.

2.3.3 Water leakage stop sequence

Spirit of Discovery's WLS was designed to provide an early warning and shut down in the event of seawater ingress into the pod or contamination by lubricating oil. In principle this was an entirely sensible precaution to protect the high voltage pod motor from damage. However, the low position of the bilge sensor meant that it could be activated by a relatively small amount of liquid that accumulated within the pod. Since the bilge suction probably did not extend low enough for the automatic bilge pumps to effectively pump the water out, it is likely the vessel's motion in heavy weather caused the small amount of liquid to contact the bilge sensor and activate the WLS sequence request.

The removal of this residual fluid from the pod was not straightforward and required *Spirit of Discovery*'s engineers to rig portable pumps to remove sufficient liquid to reset the bilge sensor. Although effective, this delayed the restarting of the vessel's propulsion.

The low position of the pod bilge sensor caused the WLS sequence to be triggered by a small amount of water, which delayed the crew regaining control of the vessel.

2.3.4 Operating instructions

The shipyard and propulsion manufacturer had both provided *Spirit of Discovery*'s crew with vessel operating instructions. While Meyer Werft's manoeuvring booklet and DSP provided a short description of the propulsion system and vessel's seakeeping, the Siemens Energy instruction manual provided the detail on the propulsion system's operation.

The Siemens Energy instruction manual warned that a WLS shutdown would result in the pod being parked at 90° to the vessel's heading; however, it incorrectly stated that the shutdown would only be initiated if the *Stop Prop* push button was pressed. The instruction manual did not warn that a WLS shutdown would automatically follow an overspeed trip when the WLS sequence alarm had already been initiated. On the day of the accident the WLS shutdowns were initiated without the *Stop Prop* buttons being pushed, when both pods experienced overspeed following WLS sequence alarms. This took *Spirit of Discovery*'s crew by surprise and, as the PCS did not allow the crew to override the shutdown sequence, the resultant loss of propulsion was inevitable.

Meyer Werft's seakeeping and manoeuvring DSP provided guidance to *Spirit of Discovery*'s crew on how the vessel would perform in various wave heights. However, none of the zones shown on the DSP's polar diagrams indicated the risk of propeller exposure and potential for pod motor overspeed and shutdown.

Spirit of Discovery's operating instructions provided by the shipyard and propulsion manufacturer did not advise the crew on how to effectively manage the vessel's propulsion in heavy weather. These omissions and inaccuracies meant that the crew were unaware of the associated risks to *Spirit of Discovery*'s propulsion when operating in heavy weather.

These deficiencies in *Spirit of Discovery*'s technical manuals were not identified during build by the vessel's classification society, which at the time was DNV. It is possible that this was because while the IACS guide listed the manuals that should be supplied, it did not provide guidance on how best to format these instructions so that they could be easily and quickly understood and used by the crew.

Spirit of Discovery's operating instructions for its propulsion system were incomplete and incorrect, resulting in the vessel's crew being unaware of the risk of loss of propulsion when operating in heavy weather.

2.3.5 Mode of operation

After *Spirit of Discovery*'s initial loss of propulsion, the vessel's pods intermittently oversped and shut down a further eight times. It is almost certain that these events were caused by vessel motion leading to propeller exposure and overspeed; however, the change of the PCS's mode of operations from sea mode to manoeuvre mode might also have been a contributing factor.

The change to the more responsive manoeuvre mode after the initial loss of propulsion meant that the pod motor's rpm could be increased more rapidly. However, a consequence of this change was that when the vessel's propellers left the water the pod motor's rpm would reach overspeed more quickly.

2.3.6 Previous heavy weather incident

Spirit of Discovery's crew had experienced an automatic loss of propulsion due to pod motor overspeed in heavy weather in February 2023, 8 months before this accident. The propulsion manufacturer had analysed the vessel's data following the earlier incident and concluded that the PCS had performed as designed to prevent pod motor damage. The manufacturer had also suggested that the overspeed threshold for the propulsion motor could be increased. However, at the time of the accident, these changes were still being considered and the overspeed threshold had not been changed.

Before the accident *Spirit of Discovery*'s crew had correctly identified and reported their concerns about pod motor overspeed trips in heavy weather and had also highlighted the unexpected initiation of the WLS sequence when the pods were manually shut down alongside. Post-accident, Siemens Energy implemented an increased overspeed threshold for both pod motors and updated the WLS sequence software once its mechanical evaluation of the system confirmed that it was safe to do so. It is unknown whether this change in overspeed allowance would have allowed the PCS sufficient time to reduce pod motor rpm and prevent an overspeed trip. However, the delay in successful implementation of an agreed technical solution might have limited the crew's ability to effectively manage the risk of WLS sequence initiation and pod overspeed shutdown.

2.3.7 Assessing pitch and roll

While the IMO had produced a performance standard for electronic inclinometers, *Spirit of Discovery* was not required to be fitted with one and did not carry such equipment. This meant that its crew had to estimate the vessel's pitch and roll with only a mechanical roll inclinometer fitted to the back of the bridge to guide them. Post-accident analysis of video evidence and engine management data indicated that the vessel was rolling up to 13° and probably pitching no more than 4°.

The ability of *Spirit of Discovery*'s crew to accurately monitor and record the vessel's pitch and roll in real time was essential to ensuring the safe operation of the vessel. In this case, while the vessel was probably operating within the SOLAS limits for its propulsion, the crew's assessments of vessel motion were subjective and potentially unreliable. Real time measurement of the vessel's pitch and roll might have allowed the bridge team to more accurately assess the risk to those on board, particularly the vessel's more vulnerable passengers.

This conclusion supports the NSIA's *Viking Sky* recommendation (see section 1.16.3) that all vessels of 3,000gt and above carry electronic inclinometers. The *Viking Sky* report also recommended that this data should be recorded by the vessel's VDR to support future safety investigations and improve safety at sea. A similar recommendation was made in the NTSB's *Crown Princess* investigation report (see section 1.16.1).

2.4 VOYAGE PLAN

2.4.1 Revised voyage plan

Spirit of Discovery's cruise programme required passengers to join and leave the vessel in the UK. This meant that it was highly likely that the vessel would encounter heavy weather during its return voyage from the Canary Islands in November. Given the rising number of UK Met Office named storms, it was also likely that the frequency and severity of these weather systems would increase over time.

Spirit of Discovery's captain was alert to this risk and had been monitoring the weather using both the official weather routing information and open-source internet forecasts. The captain's discussions with the Saga team had started before the vessel departed the Canary Islands and had led to the visit to Las Palmas de Gran Canaria being cancelled to try to avoid heavy weather off Portugal. During the late morning and early afternoon of 3 November, *Spirit of Discovery*'s captain revised the voyage plan to proceed directly to Portsmouth, considering the weather forecast, the vessel's seakeeping ability and alternative port visits in their decision-making.

On the morning of 3 November, the forecasts from WRI and Navimeteo received by the ship assumed that *Spirit of Discovery*'s visit to A Coruña would go ahead and did not consequently provide forecast information for the Bay of Biscay. When the visit to A Coruña was cancelled later that morning, the captain used the dynamic BVS data to predict the weather conditions the vessel would experience while crossing the Bay of Biscay. The BVS modelling predicted wave heights of about 7m, which when combined with the DSP polar diagrams **(Figure 10)** indicated it would be possible for the vessel to run safely down sea and pass ahead of the approaching weather system if it maintained a SOG of about 16kts. Significantly, the DSP did not make any prediction of propeller exposure, which was not therefore considered by the captain. When the vessel's revised passage plan to proceed directly to Portsmouth was shared with Navimeteo and WRI, their revised weather forecasts, albeit on the assumption of a slower SOG, predicted that the vessel would experience westerly storm force winds accompanied by higher waves the following day; wave heights that exceeded the DSP's 7.5m maximum.

When *Spirit of Discovery*'s visit to A Coruña was cancelled, the captain had considered several alternative port visits. These had included Oporto and other ports in north-east Spain, all of which were discounted as offering little protection from the weather. The captain also considered Lisbon, which would have provided a sheltered berth. However, a visit to the Portuguese capital was disregarded because the captain had been informed that a port workers' strike might have prevented the vessel sailing.

Spirit of Discovery had entered service 4 years before the accident and had then been laid up for 15 months during the COVID-19 pandemic. The implication of this relatively short operational period, during which the only previous pod overspeed

event had been experienced in heavy head seas, was that the crew were probably unaware of the vessel's vulnerability to overspeed events when running down sea. It was therefore likely that the captain and crew optimistically relied on the DSP and its favourable prediction of the vessel's seakeeping ability in an extremely high following sea when they planned to maintain a SOG of 16kts across the Bay of Biscay.

2.4.2 Operating limits

Spirit of Discovery's voyage planning process reflected the IMO and BPG guidance. However, while the VMS required the crew to consider the anticipated weather conditions throughout the intended passage, it did not require them to assess the vessel's likely motion and its effect on its elderly passengers whose average age was 78.8 years old. Additionally, although the VMS provided the crew with a definition of heavy weather in terms of wind force and wave height, it did not provide them with safe operating limits for the vessel in terms of vessel motion. This meant there was limited guidance on the incremental risk to the vessel and its passengers if these limits were exceeded as they were on the day of the accident. These factors were particularly significant given the vulnerability of Saga's older passengers, as identified in NICE guideline NG249, albeit not specifically targeted at cruise ships, and expressed by a concerned passenger during the captain's presentation the day before the accident.

Spirit of Discovery's voyage planning forms covered the navigational safety of the vessel's planned track but did not require the crew to predict the effect of wave height on vessel performance or motion. While other passenger vessel operators recognised that a list or roll of 5° or more posed a significant risk to passenger safety, *Spirit of Discovery*'s VMS did not prescribe any motion limits for the vessel. Without a set of more detailed weather operating limits to guide the safe operation of the vessel, there was no framework for the captain to formulate their plan or the crew and shoreside operational staff to challenge the decision to cross the Bay of Biscay in very high seas. Further, the potential risk to the vessel's older passengers had not been adequately assessed.

2.4.3 Delayed crossing of the Bay of Biscay

Spirit of Discovery arrived in Portsmouth on the evening of 6 November, about 12 hours ahead of its original planned arrival for the cruise turnaround. The investigation's modelling of the effects of delaying the vessel's voyage, albeit based on actual rather than forecast weather, indicated that there was scope in the vessel's cruise programme to accommodate a potential delay in crossing the Bay of Biscay by up to 24 hours. This would have allowed the passage to be conducted in more favourable weather.

Spirit of Discovery's captain and their team had not formally considered the options to delay the vessel's crossing of the Bay of Biscay. Further, there was no indication that the captain was under commercial pressure from the Saga team to press on with the voyage. However, a risk assessment of possible options, with input from all the weather routing and information providers, might have alerted the crew to alternative passage plans that avoided the worst of the weather.

2.5 VOYAGE EXECUTION

2.5.1 Weather warnings

On the afternoon of 3 November, *Spirit of Discovery*'s crew informed its weather routing and information providers that the vessel would not visit A Coruña but was instead proceeding directly to Portsmouth. The weather routing and information providers sent revised weather forecasts to the vessel in response. These forecasts predicted that the vessel would encounter westerly storm force winds accompanied by up to 13m waves while crossing the Bay of Biscay the following day.

Spirit of Discovery's two weather routing providers also made specific warnings about the new voyage plan. Navimeteo emailed the Saga team, advising recipients that the plan to head north was not a good option and suggesting that the vessel should shelter to the south of Portugal. However, the message was neither forwarded to, nor discussed with the captain or crew as these Saga email accounts were not being monitored at the time. Similarly, WRI's forecast advised the captain and crew that the vessel would *encounter unavoidable, dangerous and very heavy conditions*, and should seek shelter on the Portuguese coast.

Spirit of Discovery's VMS guidance to the captain and officers was to never *remain committed to a pre-planned course of action, if the prevailing circumstances render a departure from the plan necessary for the safety of the ship*. However, despite this guidance the revised weather routing forecasts do not appear to have been discussed by the captain and officers. Indeed, it is unclear whether this weather routing advice was brought to the captain's attention. Even so, it appears that the captain did not take the opportunity to formally re-evaluate the decision to cross the Bay of Biscay the following day in light of the worsening weather forecasts. As a result, the advice to shelter from the weather further south (below 40° north) and then wait for the weather to improve before crossing the Bay of Biscay was not formally considered.

It is unclear why the captain and DPA were not included in the Navimeteo email advising against the plan, particularly as the captain was responsible for the safety of the vessel. Had this email been distributed more widely, it was likely to have provided a further opportunity for *Spirit of Discovery*'s captain, crew and members of the Saga team to challenge and review the plan to proceed directly into the Bay of Biscay.

2.5.2 Risk of injury from unsecured furniture

In line with the CLIA policies *Spirit of Discovery*'s heavy weather preparations included securing of heavy items. However, when *Spirit of Discovery* lost propulsion the violence of its motion suddenly increased. CCTV images and the passenger survey responses indicated that this motion caused many passengers to fall from their chairs, be struck by unsecured furniture, or to lose their balance and fall to the deck.

The CCTV images from immediately after *Spirit of Discovery*'s loss of propulsion showed that passengers were more vulnerable to injury from lighter, less stable furniture whereas heavier, more stable furniture was largely unaffected. This indicated that the risk to passengers from unsecured furniture might have been reduced if the suitability of the vessel's furniture for use in heavy weather had

been risk assessed, and the more hazardous items taken out of use as part of the vessel's heavy weather preparations. The CCTV images also showed that one passenger who was standing in a lift lobby when the vessel suddenly rolled was unable to find suitable handholds to help prevent themselves falling **(**see **Figure 6)**. In contrast to *Spirit of Discovery*'s passageways and stairwells, its lift lobbies were not fitted with suitable handholds. A passenger was therefore thrown to the ground and injured and the ability of older, more vulnerable passengers to safely move about the vessel was compromised.

The MAIB's investigation into the heavy weather injuries on board *Pacific Sun* (see section 1.16.2) also identified the risk to passengers from unsecured equipment in heavy weather. The resultant recommendation led to the creation of CLIA policies for securing heavy objects on board passenger vessels. As demonstrated, while *Spirit of Discovery*'s crew had a system that aligned with the CLIA policies and identified the heavy objects that needed securing in heavy weather, they did not have a procedure that identified which items of lighter furniture could be used safely in heavy weather and those that needed to be secured.

2.6 EMERGENCY RESPONSE

2.6.1 Mass casualty incident plan

Spirit of Discovery's medical team had to rapidly triage and treat over 60 injured passengers when the vessel lost propulsion and rolled violently shortly after midday. This stretched the on board medical capability beyond its normal capacity as defined by the NHS England's Concept of Operations. However, while several members of the crew provided support to the vessel's doctor and nurses, a mass casualty incident was not declared. This was probably because *Spirit of Discovery*'s VMS did not have access to the MCIP and the crew's response to an incident of this scale had never been drilled or exercised.

A passenger vessel's MCIP is an essential part of the crew's response to a range of emergency situations. Frequently accompanied by mass casualties, these emergency situations could include fires, explosions, flooding or a terrorist attack as well as heavy weather. A well-constructed and drilled MCIP that provides for trained crew members to undertake record-keeping and casualty movement activities would increase the medical team's capability to administer timely treatment. Further, an MCIP could also activate specialist shore-based support for the rapid assessment of X-ray and test results to aid on board diagnosis. The limited support that *Spirit of Discovery*'s crew were able to provide to the medical team in the absence of an accessible and drilled MCIP meant that the vessel's trained clinicians were working largely unsupported for over 18 hours.

Spirit of Discovery's violent motion while hove to in heavy weather led to 115 passengers being injured, eight of whom required hospital treatment when the vessel returned to Portsmouth. The lack of implementation of the vessel's MCIP increased the burden on the overstretched medical team.

2.6.2 Spinal injury

Passenger 1 injured his spine when he rolled backwards out of his toppled chair on the afternoon of 4 November. However, despite being quickly examined by one of the vessel's nurses and taken to the medical centre that evening, the full extent of passenger 1's quadriplegia remained undiagnosed for over 36 hours.

The investigation's specialist medical review assessed that passenger 1's age, mechanism of injury and symptoms should have raised the need to consider a spinal injury immediately post-fall. However, in line with ACEP guidelines, only *Spirit of Discovery*'s doctor had completed ATLS training and the attending nurse might therefore have been unaware of the recommended use of the CCR or NEXUS protocols to recognise and triage potential spinal injuries. Further, while the nurse had previously attended older passengers who had fallen they had never had to diagnose and treat a passenger with a spinal injury. The nurse did not consider the possibility of a spinal injury as passenger 1 still had use of his limbs and was content to be helped back into the chair. This led to passenger 1 spending over 4 hours sat upright in a chair rather than lying flat on a spinal board; conditions that might have caused additional neurological damage.

Spirit of Discovery's doctor suspected that passenger 1 had a spinal injury when he arrived in the medical centre unable to lift his head. This led to passenger 1 being fitted with a cervical collar and then admitted to a ward following a neck X-ray. However, the shore-based radiologist's review of the X-rays was unable to diagnosis damage to passenger 1's cervical spine as no lateral X-rays had been taken. It is unclear why no further X-rays were taken. Sadly, passenger 1's condition steadily deteriorated. After 24 hours in the medical centre, he reported tingling in his upper limbs and the following morning the doctor diagnosed paraplegia.

Although *Spirit of Discovery*'s doctor had sought medical advice from their employer they had not also sought immediate specialist medical advice from TMAS. Early action might have prompted the doctor to take further steps to better immobilise passenger 1 and to take appropriate X-rays to identify whether a spinal injury had occurred. Further, obtaining specialist medical advice via the coastguard and TMAS might have better informed the discussions about a possible medical evacuation of passenger 1 to ensure that he received specialist care at the earliest opportunity.

SECTION 3 – CONCLUSIONS

3.1 SAFETY ISSUES DIRECTLY CONTRIBUTING TO THE ACCIDENT THAT HAVE BEEN ADDRESSED OR RESULTED IN RECOMMENDATIONS

1. *Spirit of Discovery*'s violent motion when it lost propulsion and hove to in heavy weather resulted in 115 passengers being injured, of which eight required hospital treatment when the vessel arrived in port. One passenger later died due to a spinal injury sustained when his chair toppled over during a period of intermittent propulsion loss in heavy weather in the Bay of Biscay. [2.2]

2. *Spirit of Discovery*'s violent motion in heavy weather caused both propulsion pod motors to overspeed and shut down in quick succession and resulted in the crew losing control of the vessel. [2.3.1]

3. The loss of control was exacerbated by the initiation of the pod's water leakage stop sequence, which led to both pods being parked at 90° to the vessel's heading. This caused the vessel to lose steerage, its bow to swing to port and its motion to become even more severe. [2.3.1]

4. The vessel's propulsion control system was unable to prevent the loss of propulsion when its movement was within the SOLAS prescribed motion limits. [2.3.2]

5. The low position of the pod bilge sensor caused the WLS sequence to be triggered by a small amount of water, which resulted in loss of propulsion and delayed the crew regaining control of the vessel. [2.3.3]

6. The vessel's operating instructions for its propulsion system, provided by the manufacturer, were incorrect and meant that the crew were unaware of the risk of losing propulsion when operating in heavy weather. [2.3.4]

7. Separate incidences of pod overspeed shutdown in heavy weather and an unexpected initiation of the WLS sequence when the vessel was alongside had occurred 8 months before the accident. The changes to the overspeed threshold and updated WLS sequence software were not available until after the accident, which might have limited the crew's ability to effectively manage the risk of WLS sequence initiation and pod overspeed shutdown. [2.3.6]

8. The captain's decision to cross the Bay of Biscay in very heavy weather conditions resulted from their optimistic reliance on the shipbuilder's seakeeping and manoeuvring decision support poster to predict the vessel's ability to maintain SOG in a heavy following sea. [2.4.1]

9. The voyage planning process had not adequately assessed the likely vessel motions and their potential effect on *Spirit of Discovery*'s elderly passengers. [2.4.2]

10. Without detailed weather operating/motion limits for the vessel there was no framework for the captain, crew or operational teams to effectively challenge the decision to cross the Bay of Biscay in very high seas. [2.4.2]

11. The lack of formal consideration of delaying crossing the Bay of Biscay meant there was a lost opportunity to conduct the passage in more favourable weather conditions. [2.4.3]

12. The captain, crew and Saga team did not adequately consider the revised weather routing guidance strongly advising against crossing the Bay of Biscay the following day. [2.5.1]

13. While *Spirit of Discovery*'s heavy weather securing arrangements aligned with industry guidance, the crew had not risk assessed whether the furniture in the vessel's public spaces was suitable for use in heavy weather. [2.5.2]

14. The lack of handholds in lift lobbies contributed to the injury of a passenger and compromised the ability of older, more vulnerable passengers to safely move about the vessel in heavy weather. [2.5.2]

15. The lack of implementation of *Spirit of Discovery*'s mass casualty incident plan almost certainly increased the burden on the vessel's already overstretched medical team. [2.6.1]

16. The lack of advanced trauma training for the vessel's nurses might have led to them not identifying that passenger 1 had suffered a serious spinal injury. [2.6.2]

17. The request for and provision of timely specialist medical advice could have provided the medical team with better guidance on passenger 1's treatment and possible medical evacuation. [2.6.2]

3.2 SAFETY ISSUES NOT DIRECTLY CONTRIBUTING TO THE ACCIDENT BUT RESULTING IN ACTIONS TAKEN OR A RECOMMENDATION

1. Subsequent operation of the vessel's propulsion system in manoeuvre mode rather than sea mode probably increased the vulnerability of its pod motors to overspeed trips. [2.3.5]

2. It is unclear whether the increase to the pod motor overspeed limit, implemented post-accident, would allow sufficient time for pod revolutions to be reduced without propulsion being lost. [2.3.6]

3. The ability to accurately monitor the vessel's motion in real time, against predefined limits, would have allowed the crew to better assess the risk to people on board and helped the analysis of the vessel's seakeeping characteristics. [2.3.7]

SECTION 4 – ACTION TAKEN

4.1 ACTIONS TAKEN BY OTHER ORGANISATIONS

V.Ships Leisure SAM and **Saga Cruises V Limited** have:

- Created a case study of the accident and shared the lessons with all Saga captains via the VMS.
- Implemented additional VDR and navigational audits of Saga vessels.
- Updated their vessels' heavy weather risk assessment processes.
- Collaborated with Siemens Energy to improve crew knowledge and operation of the SISHIp eSiPODs system.
- Conducted independent marine and technical investigations into this accident.
- Introduced meteorological operating limits for the Spirit Class vessels that have been captured in a fleet directive.
- Reviewed and improved the Saga fleet's heavy weather checklists to include better guidance on suspension of passenger activities, furniture stability and securing of loose objects in cabins.
- Implemented an MCIP and 3-monthly MCIP drill requirement across their fleet.
- Updated Saga's emergency checklists to reflect the revised SISHIp eSiPODs operation.
- Tasked Vikand to conduct a review of the medical services provided on board Saga vessels.

Siemens Energy Global GmbH & Co. KG has:

- Updated the SISHIp eSiPods software and corrected the operators' manual.
- Updated the PCS to include a revised WLS sequence activation that allows the crew to intervene and prevent the SISHIp eSiPODs parking at 90° to the vessel's heading.
- Increased the SISHIp eSiPODs overspeed activation point following a mechanical evaluation of the systems.
- Improved the position of the SISHIp eSiPODs bilge sensor arrangements.

Meyer Werft GmbH has:

- Created an additional seakeeping and manoeuvring decision support poster and software tool for the Spirit Class vessels that includes propeller exposure in wave heights up to 10.5m.

Lloyd's Register Group Limited has:

- Issued a Condition of Class for *Spirit of Discovery* limiting the operation of the vessel until the overspeed and water leakage issues identified with the vessel's propulsion system had been investigated by the manufacturer and resolved.

Vikand Medical Solutions LLC has:

- Engaged a radiological and orthopaedic support service to provide round-the-clock support to its doctors at sea.

SECTION 5 – RECOMMENDATIONS

The **Maritime and Coastguard Agency** is recommended to:

2026/123 In conjunction with the Norwegian Maritime Authority, make a proposal to the International Maritime Organization that inclinometer information compliant with the technical requirement for inclinometers (IMO Resolution MSC.363(92)) is recorded on the voyage data recorders of all SOLAS ships with a gross tonnage of 3,000 and above.

Siemens Energy Global GmbH & Co. KG is recommended to:

2026/124 Send a service letter to owners of vessels fitted with SIShIp eSiPODs advising them of the appropriate action to take when operating this propulsion system in heavy weather.

V.Ships Leisure SAM is recommended to:

2026/125 Review the operation of the Spirit Class propulsion system in heavy weather to ensure that it satisfies the SOLAS requirement for vessel motion.

Lloyd's Register and **Det Norske Veritas** are recommended to:

2026/126 Propose a review of the International Association of Classification Societies unified requirement M46 to require shipbuilders to demonstrate that equipment has been installed in line with manufacturers' requirements and that modelling has confirmed the vessel can safely operate across the range of required inclinations without any loss of propulsion.

2026/127 Propose amendments to the International Association of Classification Societies Recommendation No.71 – Guide for the Development of Shipboard Technical Manuals to ensure that these manuals are formatted in a manner that enables crews to safely and effectively operate their vessels in all conditions.

The **Cruise Lines International Association** is recommended to:

2026/128 In conjunction with the **American College of Emergency Physicians**, increase the number of medical personnel with an Advanced Trauma Life Support qualification carried on passenger vessels to improve the treatment of those injured during mass casualty incidents.

2026/129 Update its policies on the identification and securing of objects in heavy weather to include furniture.

Safety recommendations shall in no case create a presumption of blame or liability

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