Appendix H:

Utilisation of resources and technical measures to avoid running aground

APPENDIX H: UTILISATION OF RESOURCES AND TECHNICAL MEASURES TO AVOID RUNNING AGROUND

H.1 INTRODUCTION

In the main report the sequence of events was described based on the crew's perception and understanding of the situation. This section goes on to address the resources and technical measures that were available in the situation, without the crew realising or understanding that this was the case. The purpose of such an assessment is not to point out what the crew should have done, but to consider what safety lessons can be learnt by the Navy.

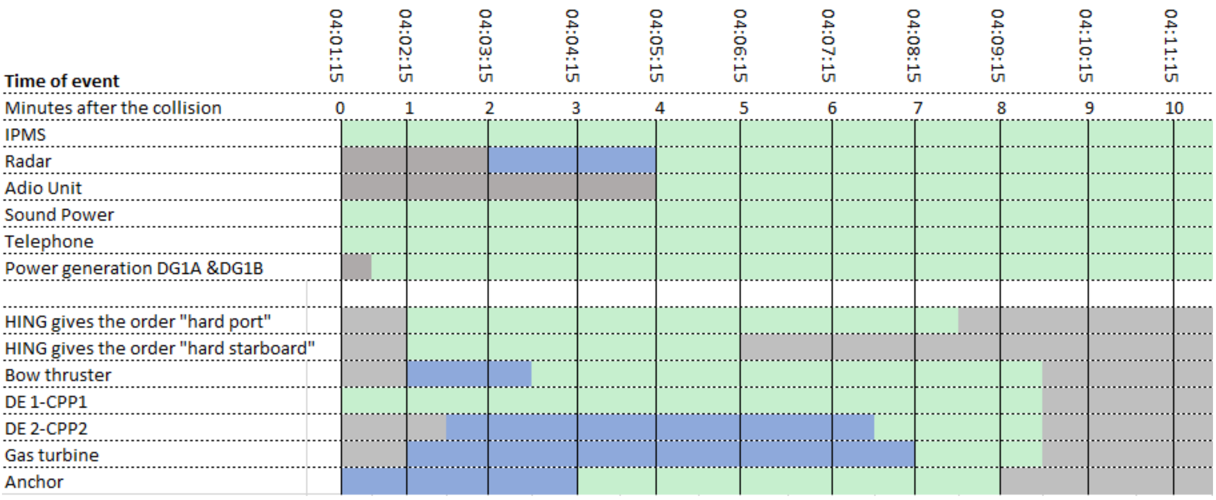
When the tanker and the frigate collided, no one on board was certain whether anyone had died. Furthermore, it was not clear what had happened, how much damage had been sustained or whether the frigate would sink. Other stress factors were the impact force of the collision and the frigate's heeling, the damage to means of communication, steering and propulsion, and the many alarms that went off simultaneously. It was also dark, and the situation was more chaotic and unpredictable than anything the crew were trained to tackle. Interviews with the crew have confirmed that many experienced the situation as dramatic and potentially dangerous. There is therefore little doubt that many crew members experienced considerable stress during and after the collision.

The NSIA sees the actions of the crew in light of this. It is likely that the problem-solving capacity and cognitive flexibility of many crew members were reduced after the collision. As an example, acute stress, combined with insufficient training, probably contributed to the possibilities of preventing the frigate from running aground were not fully utilised.

H.2 AVAILABILITY OF PROPULSION, STEERING AND COMMUNICATION RESOURCES

Table 1 provides an overview of propulsion, steering, navigation and communication resources that were available and that, if used, would have increased the likelihood of not running aground. See also section 2.9.7 for technical findings. In the following sections, the NSIA considers how likely it is, in light of the situation at the time, that one or more of these unused resources could in actual fact have prevented the frigate from running aground. Several of these resources were described as part of the emergency procedures.

Table 1: Overview of available resources after the grounding. Green=period during which the resource is available, blue=time of resource utilisation, grey=no longer available/too late to utilise resource. Source: NSIA



H.2.1 Propulsion

With the exception of an emergency stop, none of the actions taken by the bridge would have succeeded, as there was no communication between the IPMS and the starboard main engine. The only way of controlling the starboard propeller was by local air operation from the aft generator sets room. This emergency mode of control was available during the period between the collision and the grounding; see Table 1 The investigation has shown that, from 04:01:15 until approximately 04:09, it would have been technically possible for the bridge and HQ1 to utilise parts of the propulsion system to avoid running aground (see Table 5). Further actions would have had to be taken to achieve the desired effect using propulsion resources.

Several attempts were made to control the propulsion system from the bridge. IPMS data show that the position of the throttles were changed from 04:05:29, and that an attempt was made to use the back-up system at some point. These actions had no effect. The propulsion lines were degraded and could not be controlled from the bridge as a result of the damage; see section 2.9.7.4.

HQ1 was required to report to the CIC on the status of propulsion, steering, the frigate’s stability and power production within two minutes. The bridge was to receive the same information. HQ1 did not report on the status of these resources; at the time, it lacked critical information and an understanding of the situation, and priority was given to damage control rather than to propulsion and steering. The communication problems between the bridge and HQ1 can partially explain why HQ1 failed to communicate with the bridge about propulsion until after they had run aground. The bridge team were thus unable to communicate their perception of having lost control of propulsion, and HQ1 did not get a chance to advise on available resources and actions that could be utilised to regain control of propulsion.

The frigate’s mode of propulsion before the collision is described in section 2.6.7. After the collision, only the starboard propulsion line was in operation.

Technical findings show that the CPP1 could be operated form the aft generator sets room by taking control locally and changing the propeller pitch. In the NSIA's opinion, had the bridge perceived the risk of running aground before approximately 04:09 and ordered an emergency manoeuvre over the PA system in accordance with procedure P-230.01, the impact of such a manoeuvre on the frigate's movement towards the shore could have prevented the grounding. It has been assessed that it would have been possible to stop the frigate at the frigate's distance to shore (420 m) at 04:09.

The port propulsion line was automatically shut down as a consequence of the collision; see section 2.6.7.9. The investigation has shown that the propulsion line could have been reset and put into operation approximately 6 minutes and 30 seconds after the collision; see Table 1. However, that would have required HQ1 to realise at an early stage that the propulsion situation was critical, and several technical criteria would also have had to be satisfied in order to achieve the desired effect. It is therefore considered unrealistic that such action could be taken by the crew within the available time window.

The assessment of IPMS data showed no deviations that would preclude use of the gas turbine. Table 1 shows that, technically speaking, the gas turbine could have been available after 6 minutes. The investigation has shown that use of the gas turbine as a means of propulsion was nonetheless unrealistic, given the time aspect, simultaneous operation from different rooms and communication challenges; see Table 5.

The bow thruster could be operated from the bridge as an alternative to normal propulsion. The procedures in the bridge manual included a description of how the bow thruster was to be prepared in the event of loss of propulsion; see 2.5.2.5.

The investigation has not found any indication that the bow thruster could not have been used to change the frigate's course and speed. In the NSIA's assessment, the bow thruster could have been available from approximately 04:04, provided that HQ1 had been informed that the bridge needed more power to be able to use it as an alternative to the main propulsion line.

A short period of time passed from the bridge ordered 'Hard astern' at approximately 04:09 until action needed to have been taken to prevent the frigate from running aground. In the NSIA's assessment, to realistically avoid running aground, it would have been necessary to determine the correct status of the steering and propulsion systems at an earlier stage.

The technically most realistic way for the bridge to achieve the desired effect from the propulsion lines was to initiate emergency operation of the starboard propulsion line from the aft generator sets room. That would have required direct communication between the bridge and HQ1.

H.2.2 Steering systems

The investigation has shown that the rudder control system was available to the bridge team from approximately 04:02 until the frigate ran aground.

At approximately 04:06, the helmsman reported to the OOW that the rudders were not responding, which led the bridge to mistakenly believe that they were not in control of the steering system; see section 2.9.7.3. According to the the emergency steering procedure, this should have led to the implementation of measures such as NFU. In this case, NFU would not have worked on the starboard rudder; see section 2.9.7.3. The next step of the procedure would have been to use the steering gear in the steering gear room.

The navigators also did not collect other available information on the bridge that could have altered their perception that the rudders were not working, despite degradations in some of the systems. After the collision, the helmsman received no rudder or course orders up until this point. This may be related to the bridge team not being aware of the risk of running aground.

Several of the systems on the bridge displaying status and information about the steering had been dimmed or covered up to maintain night vision during the preceding voyage. The bridge team had to physically remove the temporary covers to see that the pumps were up and running. This would also be necessary in the case of the MFD, to enable retrieval of necessary information about the steering system; see Figure 1. If the bridge team had been able to utilise this information about the rudder control system on the bridge, it would have helped to correct the incorrect perception that the steering system did not work after the collision.

Figure 1: MFD9 in front of the helmsman on SSC. The photo was taken after the refloating of HNoMS 'Helge Ingstad', with the cover on the display removed. Photo: NSIA

The communication problems between the bridge and HQ1 also prevented the bridge from communicating their perception of having lost control of the steering, and HQ1 from clearing up the misunderstanding.

After the general alarm was raised, the steering gear room was manned in accordance with the damage control roster. Personnel in the steering gear room reported to the bridge using the communication system (SPT), but were unable to establish two-way communication. Hence, the bridge's incorrect perception was not corrected and necessary rudder orders were not issued to manoeuvre the ship away from danger.

H.2.3 Communication systems

After the collision and the subsequent black ship situation, the frigate's primary communication system (AU) was unavailable for a while. If the CIC had used the PA system to inform the crew about the status of the primary communication system and ordered use of the secondary system at the same time, this could have helped to establish that the audio unit was not working and made the need for reallocation and use of the secondary system more manifest.

The lack of communication between the bridge and HQ1 during the period after the collision and until they ran aground had major consequences for the actions that could have been taken to prevent the frigate from running aground.

The investigation has shown that it was technically possible for the bridge and HQ1 to communicate using the secondary communication system (SPT) from the time of the collision until the frigate ran aground; see section 2.9.7.2. This would have enabled coordination of critical information about the situation and the measures to gain control of propulsion and steering between the bridge and HQ1.

The engine order telegraph was described as one of the means of communication in emergency procedure P-230.05. There are no indications that the engine order telegraph was damaged, and it is unlikely that it was used by the bridge; see section 2.9.7.4. The engine order telegraph was a technically available means of communication between the bridge and HQ1 and could have been used to communicate the bridge's need for propulsion.

In a damage control situation, several means of communication could have been used for communication with the steering gear room. The AU and SPT were normally used between the bridge and the steering gear room in a damage control situation. The AU did not work during the first minutes after the collision. Attempts were made to use the SPT, but they were unable to establish two-way communication. Why this did not succeed is unclear to the NSIA; see section 2.9.7.2. The port rudder angle telegraph was available and could have been used to issue rudder orders.

No findings in the investigation can explain why the crew were unable to use the secondary communication system or alternative means of communication more effectively. Possible causes are discussed in more detail in section 3.10.3.

H.2.4 Radar

The investigation has shown that the radar was available to the bridge team from approximately 04:05 until the frigate ran aground. A restart of the radar rotation was decisive to be able to re-establish active radar transmission. In the NSIA's assessment, active radar transmission would have given the bridge team clearer information about the frigate's course towards the shore. No findings in the investigation can explain why the crew did not use the radars more effectively. Possible causes are discussed in more detail in section 3.10.3.

H.2.5 Anchor

The use of anchor in an emergency situation is described as a measure in several of the emergency procedures. One of the bridge manual procedures (P-253.02.06 Nødankring (‘Dropping anchor in an emergency’)) describe emergency situations in which letting the anchor go is a relevant option. The starboard anchor was technically available after the collision, but was manned too late in the sequence of events to be dropped before the frigate ran aground. If the emergency procedures had been implemented at an earlier stage, the anchor would have been manned and could probably have been used when they became aware of the risk of running aground. Possible causes are discussed in more detail in section 3.10.3.