SUB-COMMITTEE ON SAFETY OF NAVIGATION
50th session
Agenda item 11

LARGE PASSENGER SHIP SAFETY: EFFECTIVE VOYAGE PLANNING FOR LARGE PASSENGER SHIPS

FSA - Large Passenger Ships - Navigational Safety

Submitted by Norway

SUMMARY

Executive summary: This document gives a summary of the conclusions from the Norwegian FSA study on Navigational Safety of Large Passenger Ships

Action to be taken: Paragraph 7

Related documents: NAV 49/INF.2, MSC 72/21, SLF 46/INF.5 and MSC 78/4/2

1 When the Secretary General initiated the work on Large Passenger Ship Safety at MSC 72 in May 2000, it was emphasized that a holistic approach should be chosen and that potential measures should focus on the prevention of accidents from happening in the first place.

2 As stated on previous occasions, Norway would have preferred that a broad study was carried out to identify and evaluate potential risk reducing measures in a holistic way. However, this was not the view of the majority of the Member States. The second best option, in our opinion, is to conduct part analysis on important areas of the construction and operation of large passenger ships which, to some extent, can substitute the broad analysis in providing a decision making platform.

3 Following up on this second option, with focus on prevention of accidents, Norway decided to undertake an FSA-study on navigational safety of large passenger ships. Navigational safety was chosen due to the fact that relevant statistics show that collision and grounding account for a substantial part of the losses due to ship accidents. The risk of not surviving a flooding of a large passenger ship has now been documented to be unacceptably high (SLF 46/INF.5); hence the consequences of a collision or a grounding may be unacceptably high.

4 Trying to identify measures to reduce the frequency of collisions and groundings is in our opinion important to increase the overall safety of large passenger ships. In addition it is recommended to increase the required index R when calculating the damage stability. It should be noted that in documenting the cost efficiency of the different risk control options, it is assumed that the required index R for the ships in question is 0,90. If the required index is kept on today’s level, or somewhere in between these two figures, all the risk control options will be even more cost efficient. However, bearing in mind the potentially very serious consequences, a combination of higher survivability and lower frequencies should be preferred.
In the FSA Main Report\(^1\) paragraph 4.5 Step 5 – “Recommendations”, the following risk control options (RCO) have been documented to be cost efficient and representing a considerable potential for reducing the frequency of collision and grounding:

1. ECDIS (Electronic Chart Display and Information System)
2. TCS (Track Control System)
3. AIS (Automatic Identification System) integration with radar
4. Improved bridge design
5. Improved navigator training

In addition, the following risk control options are cost efficient, but with limited risk reduction effects:

1. Automatic logging of information
2. Implementation of guidelines for BRM (Bridge Resource Management)

All the recommended risk control options have net economic benefits. This implies that the reduction in economic consequence exceeds the investment. Viewed this way, the safety benefits are additional benefits.

All recommendations can also be made based on safety considerations alone, as the gross cost of averting a fatality (GCAF) is lower than the decision criteria used for safety interventions.

A detailed description of the risk control options may be found in ANNEX III to the main report.

At annex, please find a summary of the results of the Cost Benefit Assessment, as well as more details on each RCO investigated.

**Action requested of the Sub-Committee**

The Sub-committee is invited to consider the information provided and take action as appropriate.

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\(^1\) The full FSA report with all annexes and appendices, including NAV 49/INF.2 can be downloaded from http://research.dnv.com/skj/FSALPS/FSA-LPS-NAV.htm
ANNEX

Result of Cost Benefit Assessment

The main result of the cost effectiveness assessment of each risk control option are listed in the following table (Table 1.1 in ANNEX III)

<table>
<thead>
<tr>
<th>No</th>
<th>Risk Control Option</th>
<th>Gross CAF [($)</th>
<th>Net CAF [($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Onboard Safety and Security Centre</td>
<td>$9,200,000</td>
<td>$7,200,000</td>
</tr>
<tr>
<td>2</td>
<td>Automatic logging of information</td>
<td>$2,000,000</td>
<td>&lt; 0</td>
</tr>
<tr>
<td>3</td>
<td>Two officers on the bridge</td>
<td>$9,400,000</td>
<td>$7,600,000</td>
</tr>
<tr>
<td>4a</td>
<td>ECDIS</td>
<td>&lt; 0</td>
<td></td>
</tr>
<tr>
<td>4b</td>
<td>ECDIS (no track control)</td>
<td>$3,000</td>
<td>&lt; 0</td>
</tr>
<tr>
<td>5</td>
<td>AIS (Integration with radar)</td>
<td>$5,000</td>
<td>&lt; 0</td>
</tr>
<tr>
<td>6</td>
<td>Track control system</td>
<td>$1,000</td>
<td>&lt; 0</td>
</tr>
<tr>
<td>7a</td>
<td>Improved bridge design (above SOLAS)</td>
<td>$340,000</td>
<td>&lt; 0</td>
</tr>
<tr>
<td>7b</td>
<td>Improved bridge design (above average)</td>
<td>$350,000</td>
<td>&lt; 0</td>
</tr>
<tr>
<td>8</td>
<td>Improved Navigator Training</td>
<td>$350,000</td>
<td>&lt; 0</td>
</tr>
<tr>
<td>9</td>
<td>Implementation of guidelines for BRM</td>
<td>$870,000</td>
<td>&lt; 0</td>
</tr>
<tr>
<td>10</td>
<td>Navigation system reliability</td>
<td>$7,100,000</td>
<td>$4,800,000</td>
</tr>
</tbody>
</table>

Description of the risk control options

RCOs to reduce the distraction level for the navigators

The navigator on watch is often exposed to many distractions and has also tasks that are not related to navigation. These distractions and tasks take away some of the attention from the navigation and thus increase the risk for the vessel. The following RCOs are proposed to minimise the level of distractions for the navigators.

RCO 1: Introduction of Onboard Safety and Security Centre

The bridge is a “continuously manned central control station”, as defined in SOLAS, and the bridge has therefore a number of functions that are not related to navigation. These non-navigational functions might take away the attention towards navigation from the officers on watch. The non-navigational functions include:

- Fire safety system
- Damage Control Equipment
- Decision support system
- Non-navigational external communication
- Enquiries from passenger

The non-navigational functions could be reorganized into a continuously manned safety centre, located separately from the bridge. The centre could e.g. be located next to the bridge or close to the hotel reception, which on many ships is already continuously manned.
The operation of such a centre would require one additional officer on watch at any given time. Furthermore, space is needed for repeaters and other equipment. The space required is here assumed to be the same size as one passenger cabin of the smallest size. Space on the bridge may be reduced due to transfer of equipment and tasks to the safety centre.

**RCO 2: Automatic logging of information**

SOLAS specifies the type and frequency of entries into a vessel’s deck log book. Such entries involve most operations taking place onboard the vessel (route details, entering and leaving port, watch information, drills carried out, etc.). The task of manually entering data into the deck log book is time-consuming, and could result in distractions for the operating officer from his observation duties.

A number of the required entries into the deck log book could be done automatically, by adopting an electronic log book (ELB) which could replace the paper versions of log books. ELBs could be connected to bridge navigational equipment and other vital sensors for the vessel’s operation, providing information such as:

- Navigation related (Speed, distance, position, heading, etc.)
- Safety related (Alarms and relevant panels)
- Vessel’s operation related (engine and tank status etc)

Manual entries can be made for other items related to the vessel’s operation, maintenance, drills and training etc., either in text form or by completing a pre-specified table.

Adopting ELBs into the daily operations of a vessel is assessed to make routine work easier, resulting into more dedication to navigational tasks, and thereby contributing to improving safety.

**RCO 3: Two officers on the bridge**

The minimum safe manning of the bridge is regulated by SOLAS Reg. V/14, STCW-Code A-VIII and IMO resolution A.890(21). The resolution defines minimum safe manning for navigation as being able to:

- plan and conduct safe navigation
- maintain a safe navigational watch
- manoeuvre and handle the ship under all conditions
- moor and unmoor the ship safely

As a minimum, the manning will comprise one navigational officer and one lookout on the bridge. However, in the cruise industry it is not uncommon to have two navigational officers on watch, one of which focusing on navigating the vessel and the other focusing on the traffic situation or other additional tasks. The risk for navigational mistakes is reduced by having two officers compared to one officer on watch.

One additional officer on watch requires 6 extra officers per ship, 3 onboard and 3 onshore at any given time. The officers onboard will require 3 additional officers’ cabins, which would reduce the area available for passenger facilities.

**RCOs to liberate more time to observations**

The bridge watch has to keep track of other vessels in the area to avoid collisions and also to carefully observe the position and available draught, in order to avoid grounding. As the navigators have many time-consuming and distractive tasks, improved navigational aids can make navigation easier and liberate more time to visual observations. The following RCOs are electronic aids that assist the bridge watch in performing their tasks.
RCO 4: Electronic Chart Display and Information System (ECDIS)

Electronic Chart Display and Information System (ECDIS) is a navigation aid that can be used instead of nautical paper charts and publications to plan and display the ship’s route, plot and monitor positions throughout the intended voyage.

ECDIS is a real-time geographic information system. It is capable of continuously determining a vessel’s position in relation to land, charted objects, navigational aids, possible unseen hazards. In daily navigational operations, it should reduce the workload of the navigating officers compared to using paper charts. Route planning, monitoring and positioning will be performed in a more convenient and continuously real time way, enabling the navigator to have a continuous overview of the situation.

ECDIS could be integrated with both the radar system and Automatic Identification System (AIS).

This RCO has been evaluated in two different manners:

A: With ECDIS and track control compared to risk level without ECDIS and track control
B: Without track control. The RCO has been tested by comparing with ECDIS and without ECDIS.

RCO 5: Integration of AIS with radar

An Automatic Identification System (AIS) is designed to transmit and receive information in relation with a vessel’s identity, course and cargo. Current regulations require the information to be presented on an AIS display. The most common type of installed display provides three lines of data consisting of basic information of a selected target (name, range and bearing). Additional information regarding the target can be provided by scrolling. A huge amount of information received by the AIS is hidden behind the small display, and it is time consuming and distractive for the navigator to search for the information.

The AIS can be connected to the radar, and provide all the additional “hidden” data on the radar display. By selecting an AIS target on the radar display, the navigator will be able to see all available information for the particular vessel. Besides the easier access of AIS information through the radar, there are five more areas where the AIS integration improves the radar performance:

- Detection of targets which are in radar shadow areas
- Identification of radar targets into ship’s names
- Takes account of the ships rate of turn, hence predicting the target’s path more accurately
- Distinguishes targets close to shore or other targets
- Clarifies the target intentions

Benefits deriving from the AIS-radar interface, will improve the navigator’s ability to make early decisions based on real-time data, and avoid potential collisions.

(Proposed new Performance Standard for radar equipment set out in NAV 50/9 contains this requirement.)

RCO 6: Track control

Track control and track keeping systems were developed on the basis of continuously comparing the vessel’s actual course with the originally route planned before departure and being entered in the track control system. Through real time information from navigational equipment, the system ensures that the planned route is followed. In case a deviation occurs, e.g. due to environmental forces, the vessel are automatically corrected to follow the track.

Implementation of track control systems will also liberate more time for the operating officer to monitor traffic conditions.
**RCOs for improved human performance**

The following RCOs are suggested to improve the performance of the officers on watch. These are related both to improved working environment, competence, and optimal use of the human resources on the bridge.

**RCO 7: Improved bridge design**

Improved bridge design was decided to be one of the most important RCOs during the HAZID process conducted by navigational experts (NAV49/INF.2). By the term “improved”, it is implied upgrading from a standard/minimum SOLAS bridge, which is equipped with the minimum required equipment and which has a very limited standard regarding bridge layout. It is common for cruise vessels to go beyond the minimum required standards in relation to bridge design, and to upgrade to a more sophisticated level.

In order to quantify “improved bridge design”, DNV’s voluntary class notation NAUT-AW is used for description as input to the cost benefit assessment. The aim for developing DNV Rules for nautical safety was to reduce the probability of a failure, caused by any reason, within the bridge team and therefore enhance safety. NAUT-AW or similar, as an addition to the SOLAS requirements, regulates the following sectors:

- Design of the workspace and the bridge layout
- Navigational equipment
- Human-machine interface

By implementing NAUT-AW or similar, the following aspects of improved bridge design are included:

- Bridge layout and workstation arrangement
- Task specific workstations
- Design and ergonomics of workstations including location of instruments
- Field of vision from workstations
- Bridge physical working environment

**RCO 8: Improved navigator training**

The basic training requirements for the navigators are defined in the STCW Convention. STCW defines what kind of training the navigators should have and how often they need to take refreshment training. The requirements cover all basic navigational skills.

The training as required by STCW is a minimum, and it is expected that improved navigator training would benefit the safety level of the vessel. An example of improved navigator training is advanced ship maneuvering, including training of crisis situations which can only be done safely in simulators. Simulators training give a realistic experience and will thus prepare the navigators in case they face a similar incident.

Improved navigator training is here defined as requiring all crew members forming part of the bridge team to attend simulator training every 5 years in vessel or trade specific topics exceeding today’s STCW minimum requirements.

**RCO 9: Implementation of guidelines for Bridge Resource Management**

Bridge Resource Management (BRM) is designed to ensure efficient use of personnel and equipment during vessel operations. BRM is designed to reduce errors and omissions in bridge operations through a simple system of checks and delegation of duties. The 1995 amendments to the STCW include a requirement for training in bridge team procedures and a recommendation for training in BRM techniques.
The main objectives of BRM are:

- To assist the ship master in managing the vessel’s bridge team for each voyage so that personnel are rested, trained and prepared to handle any situation.
- To help the ship master recognize workload demands and other risk factors that may affect decisions in setting watch conditions.
- To ensure bridge team members are trained and aware of their responsibilities.
- To help bridge team members interact with and support the master and/or the pilot.

The implementation of BRM is assumed to involve some initial preparations of procedures to be followed and definition of relevant responsibilities. In addition, the bridge teams are assumed to go through a BRM course to assist the implementation. For communication and responsibilities that are connected to the onshore personnel, such training should also include key onshore personnel.

**RCOs for improved technical performance**

*One concern raised in the HAZID (NAV49/INF.2) was the technical performance of the integrated bridge systems. Improving the availability of the navigational equipment was therefore investigated.*

**RCO 10: Improved navigational systems availability**

The navigational systems availability is assumed mainly to be influenced by the redundancy of the navigational components.

Navigational equipment, as required by SOLAS, is mostly duplicated on bridges today. The important exceptions are the gyroscopic compass and the GPS. These items are not required to be duplicated and therefore they are most often not. Improved navigational systems availability is here defined as installation of one extra gyroscopic compass and one extra GPS.