FLARE
FLOODING ACCIDENT RESPONSE

NEWS-LETTER

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Flooding Accident Response

The establishment of a "European transport system that is resource-efficient, climate and environmentally friendly, seamless for the benefit of all citizens, the economy and society" has been a continued aspiration of the EU. Such transport system must additionally be safe, both for people using it and for the surrounding environment. In line with the EU 2011 Transport White Paper and the Horizon 2020 transport programme aim to "reduce accident rates, fatalities and casualties", as well as with the Strategic Research Agenda of the Waterborne^{TP} aiming for zero-loss of life and zero-pollution to the environment, FLARE contributes to ongoing efforts to increase the safety of shipping by reducing the risk of flooding incidents post collision and grounding incidents, which is of paramount importance for passenger ships. Taking into consideration the IMO specific procedures for risk assessment and existing instruments (such as the Formal Safety Assessment), the main overriding objective of FLARE is to develop a Novel Risk-Based methodology beyond the existing state-of-the-art of 'live' flooding risk assessment and containment in line with IMO high-level goals.

CONCEPT

The innovative approach of FLARE consists of:

- An approach for effective flooding risk management equally applicable to new and existing ships;
- The consideration of susceptibility to flooding due to collision, contact and grounding in order to better understand cause and effect of accidents and hence widen the scope for flooding risk management;
- The study of the relationship between active and passive measures of risk mitigation and control on the one hand, and risk prevention measures on the other, in order to render risk-control measures post-accident more effective;
- The consideration of both "static" and "dynamic" risk reduction, mitigation or control measures;
- The development of methods to quantify the effect of all pertinent measures.

The project has received funding from the European's Horizon 2020 research and innovation programme (Contract No.: 814753)

AMBITION

FLARE has the ambition to tackle the following specific objectives:

- Cover gaps in the statistics of passenger ship accidents concerning frequencies of serious flooding accidents and impact;
- Develop a method to rapidly determine the breach size after collision or grounding while considering crash worthiness;
- Improve accuracy and reliability of existing numerical flooding simulation tools in realistic large-scale flooding scenarios;
- Develop a flooding risk model and demonstrate its application;
- Develop relevant cruise and RoPax ferry ship designs for testing, benchmarking and validation of models;
- Use appropriate KPIs for the severity of flooding scenarios and develop flooding mitigation measures minimising loss of life;
- Develop recommendations for amending or updating IMO provisions.

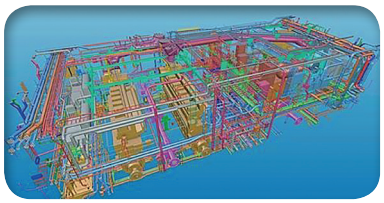
WORKSPACES

FLARE works on eight areas of attention throughout the lifetime of the project to achieve its goals.

1 Initial data collection, collation, analysis and management

In this workspace, relevant basic input data is provided to be used in the other workspaces. In particular, the provision of sample ships, analysis of operational data, as well as the analysis of real traffic data and the review of the risk model form the basis for the developments to be achieved in FLARE. The work is divided into following main parts:

- The provision of sample ships which reflect actual designs of passenger ships;
- The review of operational data targeting a better understanding of actual loading conditions;
- The measurement and calculation of permeabilities and comparison with the assumptions in SOLAS;
- The analysis of operational patterns of cruise ships and RoPax ferries with regard to potential for collision, contact and grounding;
- A review of the existing risk model to remove any inconsistencies and to allow for the replacement of historical accident data with results from this project;
- The establishment of an accident database for easy future use.

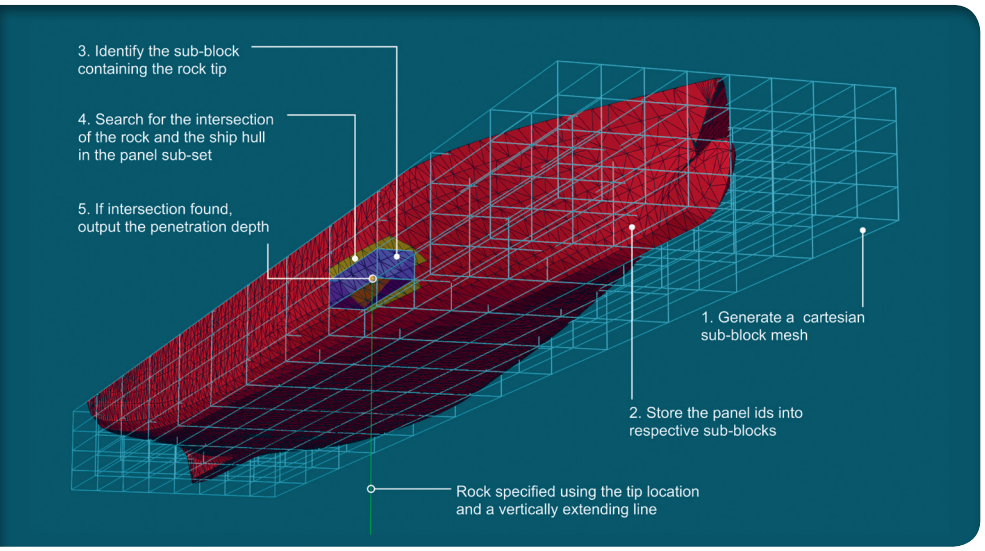


Most of the work has already been completed with high-quality outcome. Beside the design of 8 sample ships to be used as benchmark for the work in this project, more than 25 existing ships have been analysed to understand the daily operation of passenger ships. Not surprisingly this collection of real life data is now challenging some basic assumptions defined in SOLAS. Default values for permeability for engine spaces, stores and tanks should be reviewed by IMO as well as the probabilities of draughts as initial conditions.

Traffic data has been analysed as well and the foundation has been laid to predict the risk of collisions and grounding not only based on historical accident data anymore, but also considering the traffic situation in areas with high density of traffic.

The existing risk models have been reviewed and restructured so that future outcome of the FLARE project may be incorporated directly into the model to evaluate the overall consequences.

2 Damage accident modelling beyond current statistics



The purpose of this workspace is to combine ship navigation risk models with methods combining computational structural dynamics and evasive ship hydrodynamics to better understand the cause and effect of accidents on crashworthiness and hence widen the scope of flooding risk management. Multi-physics methods with variable configuration and complexity make use of state-of-the-art knowledge.

Existing databases do not include sufficient data on accidents involving mega cruise liners and RoPax vessels. FLARE therefore envisages to develop a rapid assessment tool that will cover gaps in the statistics of passenger ship accidents.

In the first six months of FLARE, the development of a contact model bringing together principles of ship manoeuvring (for the assessment of external mechanics) and a basic internal mechanics model to understand the influence of environmental actions and operational decision on grounding dynamics has been a key activity. In addition, probabilistic models for the assessment of grounding dynamics based on real data and the safety zone approach have been developed. All these models are novel from both deterministic and probabilistic safety perspectives and their practical use is founded on key risks reflecting passenger ship operations in the Gulf of Finland, the English Channel and the Gibraltar straight.

In the forthcoming period, the project aims to develop a method to rapidly determine the breach size for realistic scenarios and contribute to future SOLAS regulations by introducing a new crashworthiness factor.

3 Numerical simulations and verification

The main objective of this workspace is to test and improve accuracy and liability of existing numerical flooding simulation tools in realistic large-scale flooding scenarios. This will be achieved by:

- Verifying numerical models using model tests for “knowledge-gaps” such as the effect of large open spaces and the internal arrangement;
- Benchmarking numerical models using dedicated model test results;
- Generating input for probabilistic approach to be developed in workspace “Flooding Risk Model”;
- Generating input for mitigation measures developed in workspace “Mitigation of Flood Risk”.

The numerical methods will also be used to nurture and support the use of numerical time-domain simulations as an alternative of support for compliance to IMO regulations in ship design and operation, including emergencies. Such numerical tools will be used in a broader sense for risk assessment in the design stage of ships, and also on-board in an acute situation where rapid answers are required.

4 Flooding risk model

The main goal of this workspace is to develop a framework to enable different independent software components and tools to be linked and used under a described process to provide application-specific solutions in support of life-cycle flooding risk assessment and management. To facilitate and achieve this goal, the following specific objectives will be targeted and addressed:

- Set-up a process to link with defined interfaces pertinent software, already available in the FLARE partnership and used by the maritime industry, adding other software as required and made available in the course of the project;
- Develop and implement a tiered system of damage stability and survivability assessment to facilitate and nurture life-cycle flooding risk assessment and management in the EU passenger ship industry with the view to establish a framework to co-ordinate and orchestrate this development;
- Provide this framework with a clear process, guidelines and training to end-users on how to utilize this to address each life-cycle phase, with focus on how each phase will facilitate more effectively crisis management in flooding emergencies;
- Utilize this framework to guide the development and selection of active and passive RCOs in the workspace "Mitigation of Flood Risk" and to enable the development of live risk monitoring on-board ships within that workspace for more effective risk management and control in emergencies;
- Make available this framework to end-users, namely yards and operators;
- Assist the yards in workspace "Risk-Based Design Demonstrators" to select and evaluate cost-effectiveness of the FLARE derived RCOs for ship design (yards) and operation (ship owners) with emphasis on emergencies as well as workspace "IMO recommendations for a risk-based regulatory framework" in the preparation of suitable documents for submission to IMO, incorporating both active and passive RCOs to support life-cycle flooding risk assessment and management.

5 Mitigation of Flood Risk

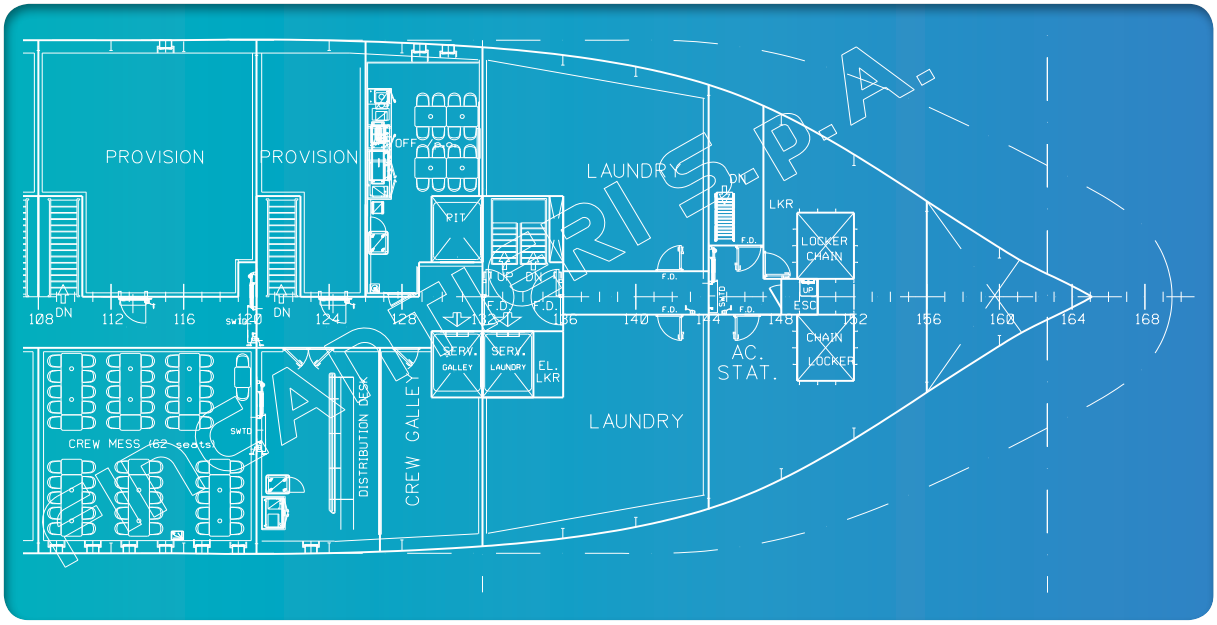
The activities in this workspace focus on the operational aspects of life-cycle vulnerability of intact ship as well as in flooding accidents and considering the impact of different risk control options.

The monitoring and evaluation of ships vulnerability on- board is crucial to ensure that the designed safety level can be achieved in daily operation. The current tools for vulnerability assessment focus solely on the status of open watertight doors. A new approach will be developed to extend the assessment to account for the effect of the surrounding environment. For example, traffic density

and bathymetry in the actual operation area will be considered. Special attention will be paid to the clear communication of the current safety level.

In addition, the concept of survivability will be studied from the operational point of view. Consequently, it is vital that the severity of the situation is quickly detected and assessed. The location and size of the breach in the hull have a considerable impact on the outcome, and this is critical information for decision-making on-board. Effectiveness of flooding detection on-board will be studied, including both the placement of the sensors and the breach size estimation method. Furthermore, evacuation analyses in flooding conditions will be conducted. Finally, shore-based accident response and decision support will be considered, with the focus on effective information transfer between the ship in distress and the support team.

Risk mitigation actions may have a significant effect on the outcome of a flooding incident. This workspace will also consider risk control options and their technical requirements. These RCOs will include both passive systems as well as active systems. The findings of this work will be further analysed with cost-benefit-analysis in the following workspace.



6 Risk-based design demonstrators

The main objective of this workspace is to demonstrate the applicability of the FLARE Framework developed in workspace 4 and the implementation of the mitigation measures of the flooding risk identified for designs in workspaces 2 and 4. This will be done by calculating the flooding risk for all the sample ships defined in workspace 1, taking also into account draughts, permeability, etc.

In this regard, the costs for implementation of flooding mitigation measures are to be evaluated for on-board measures (operational) and tools investigated in work space 5, as well as for designs measures.

Furthermore, the management of the operational/accidental flooding risk over the life-cycle of the vessel will be demonstrated in the second part of this work package, by means of two virtual demonstrators, using one cruise ship and one RoPax.

As a parallel activity, an enhanced CBA tool will be implemented. The new tool will allow putting safety, cost and environment into one picture in order to allow wider perspective in decision-making when assessing risk control options.

7 IMO-recommendations for a risk-based regulatory framework

In order to achieve the highest benefit from the developments that will be made in the FLARE project, amendments and updates to the international regulations and the regulatory framework of the International Maritime Organisation (IMO) will be suggested. To ensure transparent development of new regulations, respectively, amendments to existing ones, IMO has agreed on the process of Formal Safety Assessment (FSA, MSC-MEPC.2/Circ.12/Rev.2) that specifies the main elements of analyses and justification for recommendations by means of risk-based methods as well as the reporting to IMO.

Workspace 7 has the honourable task of collecting the results of the other FLARE workspaces and developing the recommendations to be submitted to IMO, which means that this workspace will be active towards the end of FLARE. Previous FSA-based IMO submissions on damage stability have focused mainly on the aspects of life-cycle vulnerability of intact ship as well as in flooding accidents and considering the impact of different risk control options. FLARE will address also the evaluation process itself. These recommendations will be justified according to the FSA process, i.e. determining for a risk control option (RCO) the risk reduction for people on board and environment, related costs and benefits.

8 Dissemination and Exploitation

The overall aim of this workspace is to enable and optimize the impact of FLARE and pave the way to market-uptake of the project results. In this respect, the main objectives of this workspace are:

- Coordination of project dissemination and communication activities aimed at society and general public in broad terms and the maritime industry in particular;
- Liaison with the European Commission, the International Maritime Organisation as well as the Advisory Board;
- Develop and sharing of experiences and innovative solutions with external stakeholders and end-users;
- Coordinate the efforts for dissemination within the FLARE consortium.

INFO

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