SafePASS

Evolving Cruise vessel design - How the Life Saving Appliances (LSA) will adapt

Introduction

Evacuation of large passenger vessels is a complex operation that involves multiple inputs and decisions made in the face of what has now become a dynamic catastrophic situation.

In order to make the process of evacuating the vessel safer for all involved, the SafePASS consortium are developing the tools to automate and reduce the crew actions to undertake the evacuation, while also reducing the stress on the passengers involved.

A key workstream within the project has been to look at the life saving appliances and how they can be designed to work with the vessels of the future.

The challenge with the evolving design of large passenger vessels, with increasing number of persons onboard, there is a need for the life saving appliances (LSA) to also evolve to be adaptable to the vessel designer needs.

These potentially radical designs coupled with increasingly diverse backgrounds and high number of crew onboard, the ability to be able to train and operate the LSA safely is paramount, therefore any automation or simplification of the LSA is of benefit to the safety of all onboard.

Through the project a number of LSA designs have matured which answer the needs of flexibility, reduced crew training, automated actions, with the designs being tested at model scale to ensure their viability.

Background

Vessel and LSA design are governed by the IMO (International Maritime Organisation) requirements in SOLAS (Safety of Life at Sea) and are based around the conventional lifeboat and liferaft style of LSA.

As vessel design has started to evolve more radically in recent years, the traditional layouts inside the vessel have been challenged by the designers with many novel arrangements and distinctive brand features being developed for a particular cruise line. However, LSA design has evolved with iterative designs to the traditional lifeboats and liferafts –with them generally becoming larger, and more aesthetically pleasing when stored onboard.

As well as looking at the potential future LSA that could be installed onboard a vessel the SafePASS Consortium have developed a Common Operating Platform (COP), which is a management tool for use during an Evacuation by the Crew, as it takes all the conditions and parameters around the vessel – passenger locations, vessel condition, damage location etc and advises the Evacuation Team of the most effective and efficient way to abandon the vessel. As it can be linked to the LSA, the toll will also be aware of how far the evacuation has progressed with the number of persons onboard the survival craft.

Solution

In order to understand what could be required of the LSA manufacturers for the large passenger vessels of the future, the stakeholders involved – LSA OEMs, owner, yard, regulatory bodies took stock and identified the key requirements and needs of the future LSA.

These requirements led to a large number of potential design solutions, some very radical, ranging from individual escape systems through to methods which ensure the vessel never can sink.

As the worst might actually happen, with the vessel having to be abandoned no matter how good the solution to keep it afloat may be, the designs were down selected and evolved to two key designs, one based around inflatable (softshell) technology and one around the rigid (hardshell) hull boat style.

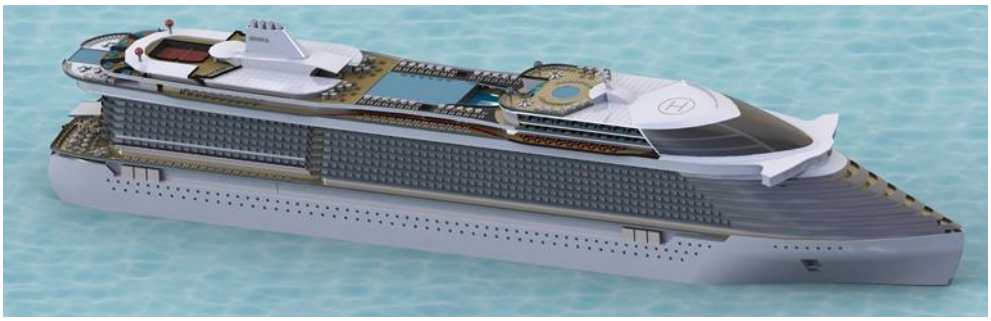
Softshell Solution

Th project conceptualized a mobile LSA system which offers dynamic access points for evacuees along the ship's side on a specific deck, with each offering an escape way to a novel survival craft. The escape way units are stored away from the embarkation point and are brought into position once evacuation needs have been defined by the SafePASS COP. The escape way units move to the required position horizontally along the deck used for LSA access, to give the most efficient and effective evacuation of the vessel.

When the ship is underway, LSA units and escape ways are divided and stowed in different locations on board to provide more flexibility for dynamic embarkation in an evacuation scenario.

When required, the escape way units are connected to vertical evacuation passages, allowing controlled descent transfers for evacuees from deck to a platform located at the ship's side, at sea level. Novel survival craft steer to the escape way platforms autonomously, based on data from the SafePASS COP and positioning technology, then once fully boarded move away from the platform to a safe location.

While technically advanced, the solution draws on practical lessons learned to simplify elements of LSA system functionality for ease of crew use – fewer crew actions to deploy (process sis automated), less maintenance, easier training using new techniques including augmented reality.



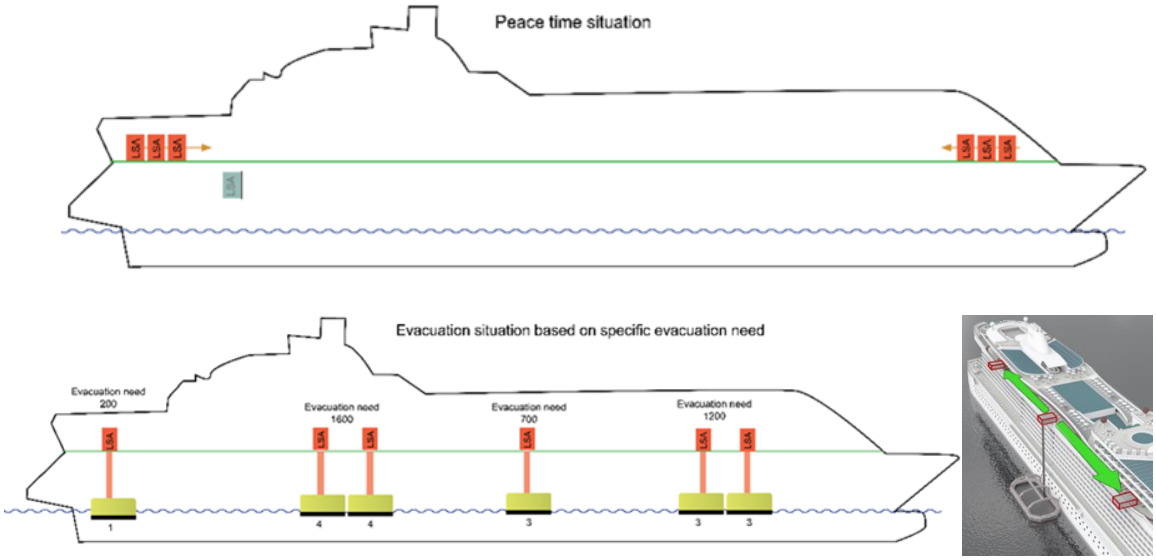
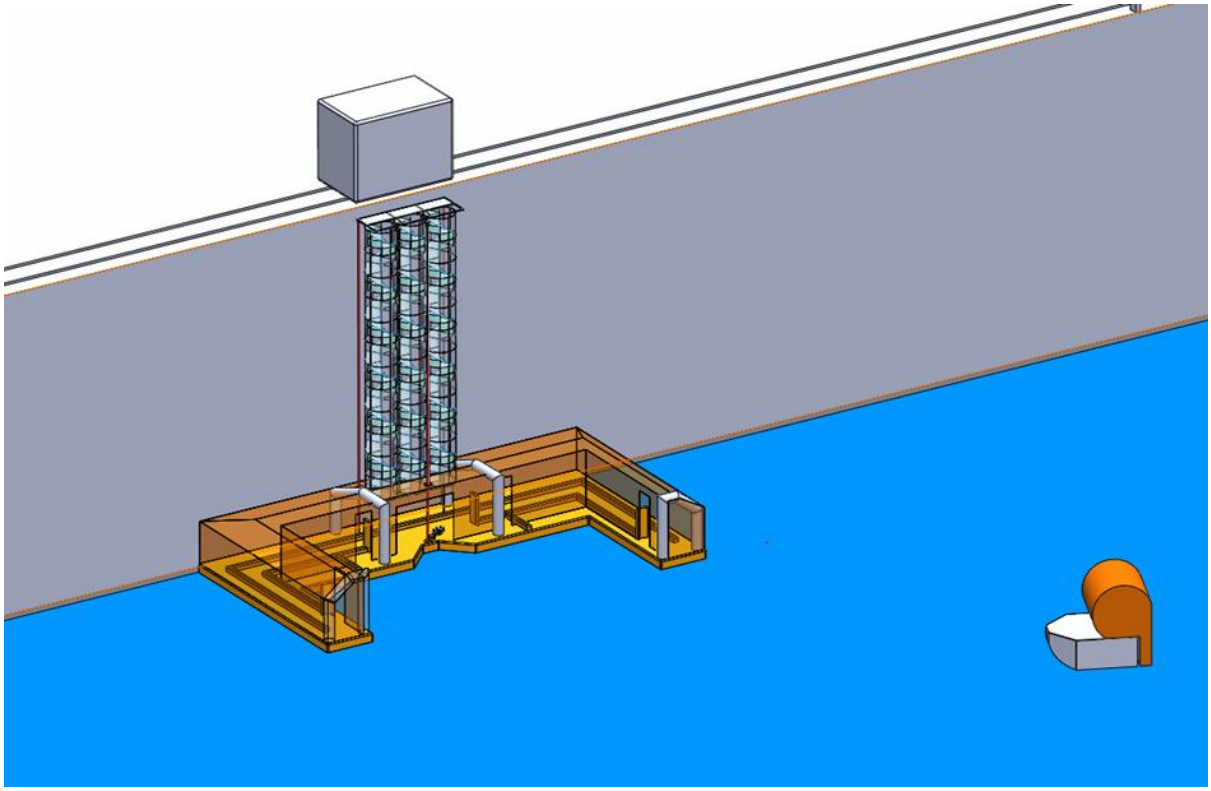
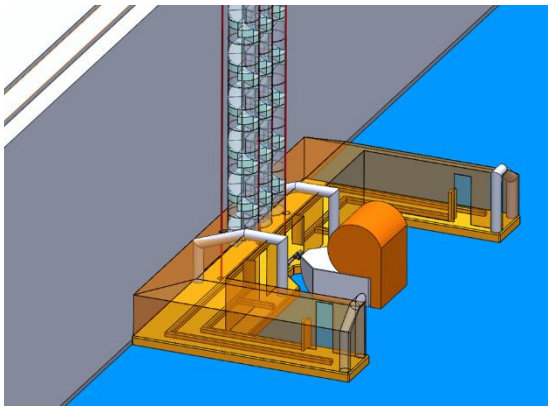


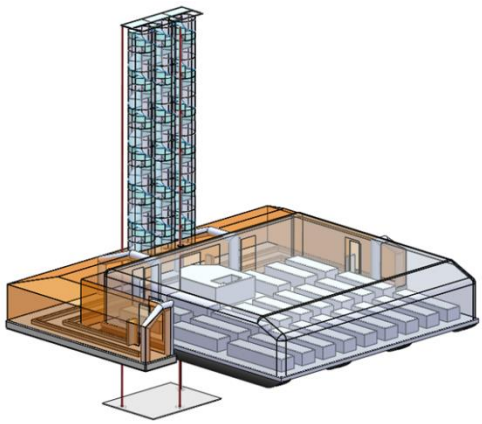
Figure 1: Softshell Mobile System – Stowed & Deployed

The deployment sequence envisaged is:

- Systems move to the desired position along the ship´s side, based on the information given by the SafePASS Operating system.
- System launched; and platforms are inflated at water level.
- The Novel LSA survival craft are deployed from their remote location
- Crew and helmsman descend to the boarding platforms.
- Survival craft automatically swarm and dock to their nominated platform position, based on data from SafePASS Operating system
- Helmsmen and crew inflate and board the survival craft.
- Evacuees board the Novel LSA survival craft until full capacity is reached.
- The survival craft is released from the platform and sails directly away to a safe position.
- Additional Novel LSA survival craft swarm into position connecting automatically to the platform
- Evacuees board the survival craft unit until full capacity is reached.
- Depending on the situation additional craft swarm to the platforms where they will be most needed.







Testing of the system at model scale ins heavy seas has confirmed that the type of system will be safe for persons to use, as the accelerations measured were not at hazardous levels, and the loads experienced by the equipment were manageable.

Hardshell Solution

More in keeping with existing materials and designs, but allowing for a radically different vessel layout, is the hardshell concept which became known in the project as SafeCube. The design is taking the best practice form the Offshore sector and applying the knowledge to the large passenger vessel market, resulting in a “stored energy/ gravity” launch style survival craft which is boarded simultaneously at multiple levels within the vessel, while also reducing the crew actions to release and as it is positioned perpendicular to the vessel, the launching process takes it immediately away from the stricken vessel.

This type of design has the benefit of reducing the amount of movement that passengers have to make through the vessel to get to their escape station, which is particularly suited to mobility impaired passengers who can experience challenges to cover distances at a necessary pace or movement in stairs, especially in an emergency situation – crowd, stress and moving floor due to sea state. This style of evacuation also makes collection for mustering possibly easier as there will be less congestion in the corridors and stairways, particularly if routes are blocked due to a hazard, although it does increase the number of muster areas required, albeit they will be smaller zones.

Even though the SafeCube system occupies space in all decks of the ship, the total required passenger ship volume is lower compared with conventional lifeboat solutions that are installed horizontally.

Simulation results show that evacuation time is significantly reduced for SafeCube solution compared with conventional lifeboats. The shortened evacuation times are mainly due to the reduction of necessary travel distance to embarkation areas.

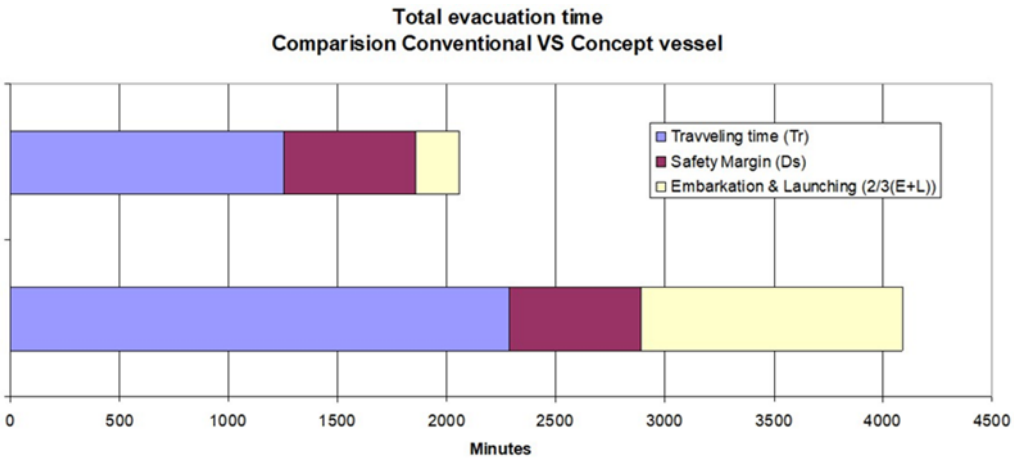


Figure 2: Total evacuation time

During the 'free-fall' launch the passengers are exposed to higher acceleration loads when compared with conventional controlled lowering of lifeboats. However, through model scale testing of multiple scenarios it was demonstrated that the CAR values (Combined Acceleration Values) were found to be well below accepted threshold value of 1.

The SafeCube consists of two major parts, hard shell LSA Craft (1) and davit (2) (Figure 3).

Figure 3: SafeCube – Davit & integrated hardshell Craft

The SafeCube vessel is build up around the 3 circular compartments (cubes) and outer hard shell. Each individual cube has 2 levels and each level in that cube could contain a mustered group of persons (typically 50-70 POB) resulting in a capacity of 100-140 PAX. per Cube and total hard-shall vessel capacity of 300- 420 persons per SafeCube (Figure 4).

Figure 4: SafeCube Breakout view

Each cube has access to top and aft of the Rescue for easy evacuation of passengers from the Lifeboat (SafeCube) after successful evacuation from the passenger ship (**¡Error! No se encuentra el origen de la referencia.**).

All three cubes are integrated and secured to the hard shell with a bearing connection. This allows each cube to rotate freely providing horizontal seat orientation of all seats both in stored position (vertical) and when waterborne (horizontal) (**¡Error! No se encuentra el origen de la referencia.**, Figure 5).

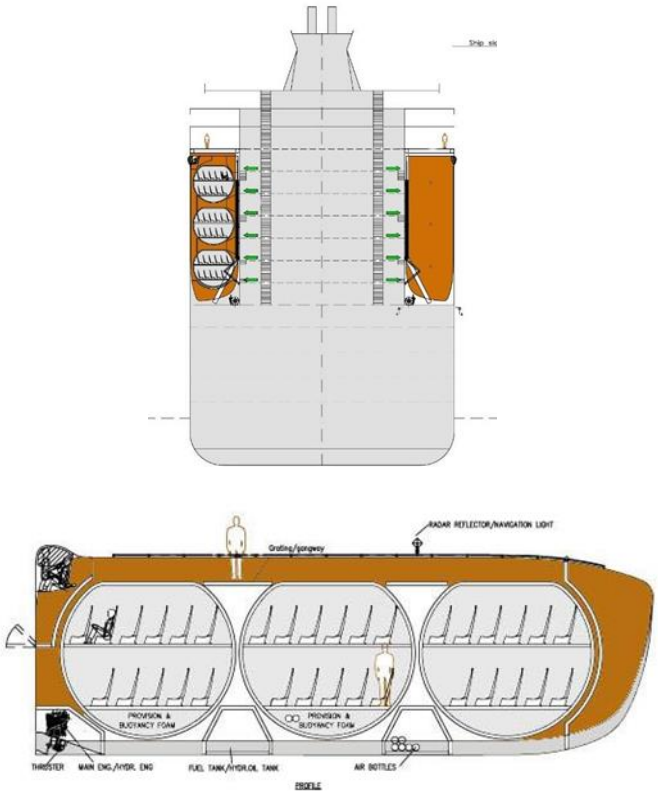


Figure 5: SafeCube – deployed and floating horizontal

The davit/launch structure consists of a skid and a winch (for initial installation and for recovery after test launch/commissioning). The skid is hinged to the ship structure allowing it to rotate from the

embarkation position to the launch position. This arrangement is based on stored hydraulic power and is independent from the ship energy sources so that operation in dead ship condition is also possible.

Launching procedure of the SafeCube (Figure 6):

1. Embarkation of passengers;
2. Embarkation of crew;
3. Release of SafeCube davit from STOWAGE/Stand by position;
4. Lowering of SafeCube to launch position;
5. Gravity assisted launch.

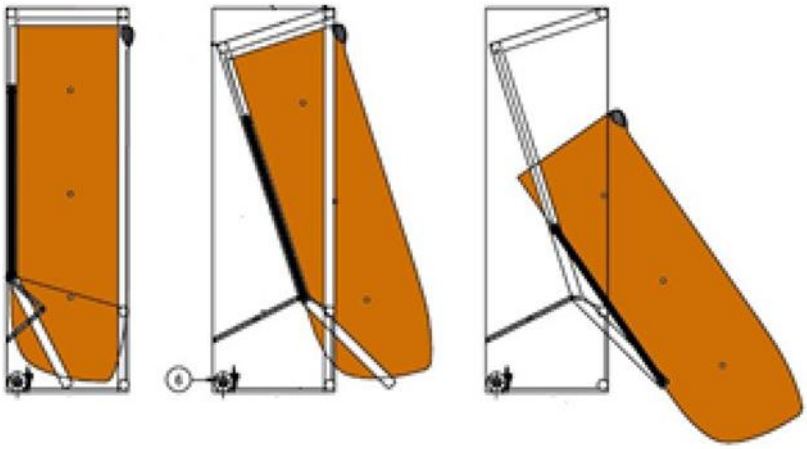


Figure 6: Launching Sequence

To incorporate redundancy in the release system, two separated yet identical systems are installed, both capable of deploying the SAFECUBE individually. This means that the SAFECUBE can and will be used with one system only. Should that system fail, a redundant secondary option is available. The release system can be tested and trained on safely by using the simulated launch procedure which is used to show and document proof of purpose of the release system functionality without physically launching the SafeCube. With the simulated launch feature, the risk related to annual testing of the LSA is significantly reduced.

Conclusion

Each of the concepts challenges the prescriptive requirements detailed in SOLAS. To introduce them into service onboard a vessel, they would have to follow the ADA (Alternative Design Appraisal) process detailed through SOLAS Ch. III Reg 38. This process allows the engineering analysis of the novel system or equipment (qualitive and quantitative) to be undertaken, while also assessing its suitable integration onboard a vessel.

SafeCube

The SafeCube System is taking the knowledge and experience gained in the offshore Oil and Gas sector, where higher levels of safety are normally implemented than those prescribed in SOLAS, and applying it the commercial sector of large passenger vessels.

In addition to increased safety levels due to the reduction of evacuation time (time to muster and boarding time), the SAFECUBE systems also have an advantage related to the increased serviceability with reduced accidental risk related to conventional lifeboat hooks and winch systems. Furthermore, the effect of stored kinetic energy which is transferred to forward motion during the free-fall launch gives a positive effect of safe sail away phase and speed.

From the model testing conducted, it has been shown that the forces experienced by the persons onboard the SafeCube will be not dangerous, even at different angles of launching when the vessel is listed to the high or low side. With the orientation of the SafeCube perpendicular to the sideshell, when launched it is automatically sailing away, further reducing the risk associated with such a system.

Based on the above results, it is reasonable to assume that SafeCube systems provides significantly higher safety level compared with conventional lifeboat solutions. In addition to reduction of evacuation time, the SafeCube systems have also advantages related to increased serviceability with reduced accidental risk related to conventional lifeboat hooks.

Softshell

The use of the Softshell LSA instead of conventional LSA allows for flexibility in the location of the evacuation station, allowing for a dynamic evacuation situation, allowing the efficiency of the evacuation to be maintained or not significantly reduced due to the incident which has forced the evacuation. The use of a bowsing system to control the position of the system against the sideshell of the vessel which is not connected to the side of the vessel allows the System independence to positioned where it is most effective for the evacuation, while the automation of the positioning of the System and the deployment reduces the crew actions involved, reducing the risk of error and reducing the training burden.

The tank testing has determined that the forces on the system and the persons onboard are all within reason – loadings on the inflatable structure are manageable, while the motions on the persons onboard are not excessive or dangerous. The ability to escape is enhanced due to the crafts being orientated perpendicular to side of the vessel, meaning there is no manoeuvring to escape a stricken vessel. Due to the design of the System, as the launching sequence has been automated where possible and there are fewer crew actions, there is a lower risk of the System being available to board and to escape safely from the stricken vessel when compared to conventional LSA.

References

- SOLAS