MONALISA 2.0 – Activity 3

Requirement Specification of the SES (Safe Evacuation System)

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1. Objective of the document

The objective of this document is to explain all the requirements and technical characteristics that the SES (Safe Evacuation System) must fulfill in order to perform the emergency launching operations for which it has been conceived.

This document corresponds to the deliverable D3.4.1 and it reports the conclusion of the “Requirement Specification of the SES”.

2. Introduction

The SES, is a safe, effective, efficient and reliable system, intended to perform evacuation operations on board passenger ships in extreme sea, weather and stability conditions (specially high wind speed and high heel values). Such system, is capable to work in situations where conventional ones cannot work properly (as they are conceived and designed to be operative with values of heel up to those established by IMO’s Safety of Life at Sea convention (SOLAS), namely 20° heel – 10° trim is not limitation for these kind of vessels).

3. Acronyms

SES: Safe Evacuation System
IMO: International Maritime Organization
SOLAS: Safety of Life at Sea

4. Rules

The system, whose technical specifications are set out in this document, complies with the following rules and regulations:

- IMO Resolution MSC 81(70), Recommendation on Testing of Life-Saving Appliances (adopted on 11 December 1998).


- IMO Resolution MSC CIRC. 811

- IMO Resolution MSC CIRC. 1006

- IMO Resolution MSC.320(89)

- IMO Resolution MSC.321(89)

5. Introduction to launch operations according to SOLAS

In order to clearly explain the technical requirements that the SES system meets, firstly, will be mentioned all the requirements established by IMO for launching systems on passenger ships and then, the additional requirements that this system satisfy, will be exposed. Those specific requirements that the SES meets, make it capable to operate at heel conditions for both sides, much higher than conventional ones.

Chapter III. Part B – Requirements for Ships and Life-Saving Applicances; Section I – Passenger Ships and Cargo Ships

Regulation 11 - Survival craft muster and embarkation arrangements

This regulation gives requirements for location of lifeboats, liferafts and muster stations; requirements for lighting of alleyways, stairways and exits.

1. Lifeboats and liferafts for which approved launching appliances are required shall be stowed as close to accommodation and service spaces as possible.
2. Muster stations shall be provided close to the embarkation stations. Each muster station shall have sufficient space to accommodate all persons assigned to muster at that station.

3. Muster and embarkation stations shall be readily accessible from accommodation and work areas.

4. Muster and embarkation stations shall be adequately illuminated by lighting supplied from the emergency source of electrical power required by regulation II-1/42 or 43, as appropriate.

5. Alleyways, stairways and exits giving access to the muster and embarkation stations shall be lighted. Such lighting shall be capable of being supplied by the emergency source of electrical power required by regulation II-1/42 or 43, as appropriate.

6. Davit-launched survival craft muster and embarkation stations shall be so arranged as to enable stretcher cases to be placed in survival craft.

7. An embarkation ladder complying with the requirements of regulation 6.1.6, in a single length, from the deck to the waterline in the lightest seagoing condition under unfavorable conditions of trim up to 10° and with the ship listed not less than 20° either way shall be provided at each launching station or at every two adjacent launching stations. However, the Administration may permit such ladders to be replaced by approved devices to afford access to the survival craft when waterborne, provided that there shall be at least one embarkation ladder on each side of the ship. Other means of embarkation may be permitted for the liferafts required by regulation 31.1.4.

8. Where necessary, means shall be provided for bringing the davit-launched survival craft against the ship's side and holding them alongside so that persons can be safety embarked.

**Regulation 12 - Launching stations**

This regulation gives advices for launching stations in order to provide safe launching of survival craft.

Launching stations shall be in such positions as to ensure safe launching having particular regard to clearance from the propeller and steeply overhanging portions of the hull and so that, as far as possible, survival craft, except survival craft specially designed for free-fall launching, can be launched down the straight side of the ship.

If positioned forward, they shall be located abaft the collision bulkhead in a sheltered position and, in this respect; the Administration shall give special consideration to the strength of the launching appliance.

**Regulation 13 - Stowage of survival craft**
This regulation gives requirements for where and how survival raft should be kept on board ship. Survival craft should be stowed "in a state of continuous readiness so that two crew members can carry out preparations for embarkation and launching in less than 5 minutes".

1) Each survival craft shall be stowed:

1. so that neither the survival craft nor its stowage arrangements will interfere with the operation of any other survival craft or rescue boat at any other launching station;
2. as near the water surface as is safe and practicable and, in the case of a survival craft other than a liferaft intended for throw-overboard launching, in such a position that the survival craft in the embarkation position is not less than 2 m above the waterline with the ship in the fully loaded condition under unfavorable conditions of trim and listed up to 20° either way, or to the angle at which the ship's weather deck edge becomes submerged, whichever is less;
3. in a state of continuous readiness so that two crew members can carry out preparations for embarkation and launching in less than 5 min;
4. fully equipped as required by this chapter and the LSA Code;
5. as far as practicable, in a secure and sheltered position and protected from damage by fire and explosion.

2) Lifeboats for lowering down the ship's side shall be stowed as far forward of the propeller as practicable. On cargo ships of 80 m in length and upwards but less than 120 m in length, each lifeboat shall be so stowed that the after end of the lifeboat is not less than the length of the lifeboat forward of the propeller. On cargo ships of 120 m in length and upwards and passenger ships of 80 m in length and upwards, each lifeboat shall be so stowed that the after end of the lifeboat is not less than 1.5 times the length of the lifeboat forward of the propeller. Where appropriate, the ship shall be so arranged that lifeboats, in their stowed positions, are protected from damage by heavy seas.

3) Lifeboats shall be stowed attached to launching appliances.

**Regulation 15 – Stowage of marine evacuation systems**

This regulation gives requirements for location of marine evacuation systems, which should be positioned to ensure safe launching "having particular regard to clearance from the propeller and steeply overhanging positions of the hull".
1. The shipside shall not have any openings between the embarkation station of the marine evacuation system and the waterline in the lightest seagoing condition and means shall be provided to protect the system from any projections.

2. Marine evacuation systems shall be in such position as to ensure safe launching having particular regard to clearance from the propeller and steeply overhanging positions of the hull and so that, as far as practicable, the system can be launched down the straight side of the ship.

3. Each marine evacuation system shall be stowed so that neither the passage nor the platform nor its stowage or operational arrangements will interfere with the operation of any other life-saving appliance at any other launching station.

4. Where appropriate, the ship shall be so arranged that the marine evacuation systems in their stowed positions are protected from damage by heavy seas.

Regulation 16 - Survival craft launching and recovery arrangements

This regulation gives requirements for provisions for launching and recovery of survival craft. Survival craft must be fitted with launching and embarkation appliances that comply with the requirements in the LSA Code, with certain exceptions, such as survival craft carried in excess of survival craft for 200% of the total number of persons on board ship.

1) Launching appliances complying with the requirements of section 6.1. of LSA Code shall be provided for all survival craft except:

1. survival craft which are boarded from a position on deck which is less than 4.5 m above the waterline in the lightest seagoing condition and which either have a mass of not more than 185 kg; or

2. survival craft which are boarded from a position on deck which is less than 4.5 m above the waterline in the lightest seagoing condition and which are stowed for launching directly from the stowed position under unfavorable, conditions of trim of up to 10° and with the ship listed not less than 20° either way; or

3. survival craft having a mass of not more than 185 kg and which are carried in excess of the survival craft for 200% of the total number of persons on board the ship; or

4. survival craft having a mass of not more than 185 kg and which are carried in excess of the survival craft for 200% of the total number of persons on board the ship and which are stowed for launching directly from the stowed position under unfavorable, conditions of trim of up to 10° and with the ship listed not less than 20° either way; or
5. provided to be used with a marine evacuation system complying with the requirements of section 6.2. of the LSA Code and which are stowed for launching directly from the stowed position under unfavorable, conditions of trim of up to 10° and with the ship listed not less than 20° either way;

2) Each lifeboat shall be provided with an appliance which is capable of launching and recovering the lifeboat.

3) Launching and recovery arrangements shall be such that the appliance operator on the ship is able to observe the survival craft at all times during launching and for lifeboats during recovery.

4) Only one type of release mechanism shall be used for similar survival craft carried on board the ship.

5) Preparation and handling of survival craft at any one launching station shall not interfere with the prompt preparation and handling of any other survival craft or rescue boat at any other station.

6) Falls, where used, shall be long enough for the survival craft to reach the water with the ship in its lightest seagoing condition, under unfavorable conditions of trim and with the ship listed not less than 20° either way.

7) During preparation and launching, the survival craft, its launching appliance, and the area of water into which it is to be launched shall be adequately illuminated by lighting supplied from the emergency source of electrical power required by regulation II-l/42 or 43, as appropriate.

8) Means shall be available to prevent any discharge of water onto survival craft during abandonment.

9) If there is a danger of the survival craft being damaged by the ship’s stabilizer wings, means shall be available, powered by an emergency source of energy, to bring the stabilizer wings inboard; indicators operated by an emergency source of energy shall be available on the navigating bridge to show the position of the stabilizer wings.

10) If lifeboats complying with the requirements of regulation III/42 or 43 are carried, a davit span shall be provided, fitted with not less than two lifelines of sufficient length to reach the water with the ship in its lightest seagoing condition, under unfavorable conditions of trim and with the ship listed not less than 20° either way.

Chapter III. Part B – Requirements for Ships and Life-Saving Appliances; Section II – Passenger Ships (Additional Requirements)

Regulation 21 - Survival craft and rescue boats
Passenger ships on international voyages which are not short must carry partially or totally enclosed lifeboats on each side to accommodate not less than 50% of total number of persons on board (in other words, the two sides together must equal at least 100%). Some lifeboats can be substituted by liferafts. In addition, inflatable or rigid liferafts to accommodate at least 25% of the total number of persons on board.

Passenger ships on short international voyages must carry partially or totally enclosed lifeboats for at least 30% of persons on board, plus inflatable or rigid liferafts to make total capacity of 100% with the lifeboats. In addition, they must carry inflatable or rigid liferafts for 25% of total number of persons on board.

All survival craft required to provide for abandonment by the total number of persons on board must be capable of being launched with their full complement of persons and equipment within a period of **30 minutes** from the time the abandon ship signal is given.

**Regulation 23 - Survival craft and rescue boat embarkation arrangements**

This regulation gives requirements for embarkation arrangements.

1) On passenger ships, survival craft embarkation arrangements shall be designed for:

1. all lifeboats to be boarded and launched either directly from the stowed position or from an embarkation deck but not both; and

2. davit-launched liferafts to be boarded and launched from a position immediately adjacent to the stowed position or from a position to which, in compliance with the requirements of Regulation 13.5, the liferaft is transferred prior to launching.

**Regulation 24 - Stowage of survival craft**

This regulation gives stowage requirements regarding bot deck height (recommended less than 15m from sea level to davit sheave).
6. Introduction to launch operations according to the LSA Code & MSC.81(70)

Chapter VI. Part B – Launching and embarkation appliances

4.4.7 Lifeboat fittings

In paragraph 4.4.7.6, the following new subparagraphs .2 to .6 are inserted after the existing subparagraph .1:

".2 notwithstanding subparagraph .7.2 the mechanism shall only open when the release mechanism is operated with the boat fully waterborne or, if the boat is not waterborne, by multiple, deliberate and sustained action which shall include the removal or bypassing of safety interlocks designed to prevent premature or inadvertent release;

.2.1 the mechanism shall not be able to open due to wear, misalignment and unintended force within the hook assembly or operating mechanism, control rods or cables as may be connected to, or form part of the hook assembly and with trim of up to 10º and a list of up to 20º either way; and

.2.2 the functional criteria of 4.4.7.6.2 and 4.4.7.6.2.1 apply for the range of loads, representing 0% to 100% of the safe working load of the lifeboat release and retrieval system for which it may be approved;

.3 unless a release mechanism is of the load over centre type, which is held fully closed by the weight of the lifeboat, the hook assembly shall be designed so that the moveable hook component is kept fully closed by the hook locking parts capable of holding its safe working load under any, operational conditions until the hook locking part is deliberately caused to open by means of the operating mechanism. For designs utilizing the tail of the movable hook component and cam either directly or indirectly securing the tail of the movable hook component, the hook assembly shall continue to be closed and hold its safe working load through rotation of the cam of up to 45 degrees in either direction, or 45 degrees in one direction if restricted by design, from its locked position;

6.1 – Launching and embarkation appliances

6.1.1 General requirements

6.1.1.1 With the exception of the secondary means of launching for free-fall lifeboats, each launching appliance shall be so arranged that the fully equipped survival craft or
rescue boat it serves can be safely launched against unfavorable conditions of trim of up 10° and list of up to 20° either way:

1. when boarded, as required by regulation III/23 or III/33, by its full complement of persons; and

2. with not more than the required operating crew on board.

6.1.1.2 Notwithstanding the requirements of paragraph 6.1.1.1, lifeboat launching appliances for oil tankers, chemical tankers and gas carriers with a final angle of heel greater than 20° calculated in accordance with the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto and the recommendations of the Organization*, as applicable, shall be capable of operating at the final angle of heel on the lower side of the ship taking into consideration the final damaged waterline of the ship.

6.1.1.3 A launching appliance shall not depend on any means other than gravity or stored mechanical power which is independent of the ship's power supplies to launch the survival craft or rescue boat it serves in the fully loaded and equipped condition and also in the light condition.

PART 1- PROTOTYPE TEST FOR LIFE-SAVING APPLIANCES

8 LAUNCHING AND EMBARKATION APPLIANCES

8.1 Testing of davits and launching appliances

8.1.1 For lifeboats other than free-fall lifeboats, davits and launching appliances, except the winch brakes, should be subjected to a static proof load of 2.2 times their maximum working load. With the load at the full outboard position, the load should be swung through an arc of approximately 10° to each side of vertical in the intended fore and aft plane. The test should be done first in the upright position, followed by tests simulating a shipboard condition of list of 20° both inboard and outboard. There should be no evidence of significant deformation or other damage as a result of this test. For free-fall lifeboats, the launching appliances for lowering a free-fall lifeboat by falls, except the winch brakes, should be subjected to a static proof load of 2.2 times the maximum working load at the full outboard position. There should be no evidence of significant deformation or other damage as a result of this test.

8.1.2 For lifeboats other than free-fall lifeboats, a mass equal to 1.1 times the maximum working load should be suspended from the lifting points with the launching appliance in the upright position. The load should be moved from the full inboard to the full outboard position using the means of operation that is used on the ship. The test
should be repeated with the launching appliance positioned to simulate a combined 20° inboard list and 10° trim.

The existing paragraphs 6.9.3 and 6.9.4 are replaced by the following:

"6.9.3 With the operating mechanism disconnected it should be demonstrated when the lifeboat is loaded with its full complement of persons and equipment and towed at speeds of 5 knots that the moveable hook component stays closed.

Furthermore, with the operating mechanism connected, it should be demonstrated that the lifeboat when loaded with its full complement of persons and equipment when towed at speeds of 5 knots can be released. Both of the above should be demonstrated as follows as follows:

.1 a force equal to 25% of the safe working load of the hook should be applied to the hook in the lengthwise direction of the boat at an angle of 45° to the vertical. This test should be conducted in the aftward as well as the forward direction;

.2 a force equal to the safe working load of the hook should be applied to the hook in an athwart ships direction at an angle of 20° to the vertical. This test should be conducted on both sides; and

.3 a force equal to the safe working load of the hook should be applied to the hook in a direction halfway between the positions of tests 1 and 2 (i.e. 45° to the longitudinal axis of the boat in plan view) at an angle of 33° to the vertical. This test should be conducted in four positions.
7. Technical specification

The proposed system try the focus on the big problem that appears when the heel of the damaged vessel is over this 20º considered as a general in the IMO rules, but that could be more for the most of the modern passenger vessels before final sinking. Problems for the operation itself, but also for the equipments involved: boat, release mechanism, davit.

With the vessel in such dangerous situation, the most probably and safe would be to use the lifeboat from the “upper part” of the heeled vessel.

Considering all the requirements that launching appliances must satisfy, which have been already mentioned in previous points, and after a deep study of evacuation methods and the main existing problems during such operations (on passenger vessels), it have been defined all the specific technical features that the system SES must meet:

- Reducing the friction between the hull of the lifeboat and the passenger vessel side during the evacuation, in order to maintain the angle between the hook and the davit throw at small values. This critical factor is usually guilty of prevent the release systems to work with heel angles above 20º. (please see notes in below drawings)

- The system must guarantee that the lifeboats can be positioned along the shipside in order to launch them to the sea.

- According to commercial issues, the system should be compatible, with small adaptations, with commercial launch appliances for lifeboats, and should be installed at different sort of vessels.

- The system must be capable to operate at heel conditions, either way bus mostly to opposite side, much higher than conventional ones (> 20º).

- The system should be compatible with both telescopic and tilting launching devices.

- The system should be able to work also with empty lifeboats.

At this point of the explanation, in which are already known all the requirements that the SES system satisfies, two equally valid solutions are proposed:

1.- One to prevent the boat to be lowered over the deck, and so guide it to the hull/vessel side. This with two options: one based on straps, and the other based on telescopic arms.
2.- Other with the technical proposal for minimizing the friction between the hull of the lifeboat and the ship-side of the passenger vessel, the slide system.

For a better sea next paragraph “SES General Arrangement” (drawings No. 46583 & 46584)

1.-a) A system based on straps

- This system essentially consists of 2 or 3 straps that tighten at the time that the davit tilts/or its boom makes a telescopic movement (it depends on the sort of davit), in order to put out the lifeboat to prevent it from falling on the deck of passenger vessel but directly on the shipside.

- Those 2-3 straps (it depends on the lifeboat) must have their ends anchored to the edge of the deck before starting the launch operations. On the deck of the vessels they will be already placed special clamped devices for an easy clamped operation when an evacuation is needed.

- The maximum tension that the straps will, support will be equal to the weight of the boat by the sine of 30° and divide by the number of straps (depending on the boat).

- Must be noted that the hull of the lifeboat will rely on the ship’s hull with a force 45% higher than what the law requires, due to the increased angle of heel that the SES will work.

1.-b) A system based on telescopic booms

- This system essentially consists of 2 telescopic arms that make a telescopic movement in order to put out the lifeboat to prevent it from falling on the deck of passenger vessel but directly on the shipside.

- The maximum tension that the booms will, support will be equal to the weight of the boat by the sine of 30° and divide by the number of straps (depending on the boat).

- Must be noted that the hull of the lifeboat will rely on the ship’s hull with a force 45% higher than what the law requires, due to the increased angle of heel that the SES will work.

2.- Once the lifeboat is down the deck level and against the shipside, it starts to slide down. To facilitate this part of the launch operations, sliding pads will be fitted on the hull of the lifeboats in order to minimize the friction between those surfaces. With the
lower friction, we get to minimize, the angle formed by the hook and davit throw, down to design values.

Sliding pads are also designed to distribute the effort on the hull of the lifeboat (as we said, 45% over the design ones). These sliding pads will be placed no damaging the lifeboat’s hull surface and adapting to the specific hull forms/shapes for each type of lifeboat. They will be also placed with minimum affect the hydrodynamics of the lifeboat in navigation.

8. SES General Arrangement
CHARACTERISTICS

Max. heel: 30°
Max. trim: 11°
anti-heeling removable straps system for launching with 30° heel

TWIN TELESCOPIC DAVID

SLIDING RUBBER

ANCHOR POINTS FOR REMOVABLE STRAPS

REMOVABLE STRAPS FOR LAUNCHING WITH 30° HEEL

CONTROL PANELS

CORRECT

RISK

CORRECT

VESSEL HULL

SLIDING RUBBER

MONALISA 2.0 - REQUIREMENT SPECIFICATION OF THE SES
MONALISA 2.0 - REQUIREMENT SPECIFICATION OF THE SES

CHARACTERISTICS

Max. heel: 30°
Max. trim: 10°

Telescopic anti-heeling arms
for launching with 30° heel
9. Prototyping and testing

In order to verify the main features of SES system in a real test, Industrias Ferri, S.A.is currently defining, together with Jovellanos Center and Compass (Ferri’s subcontractor), the objectives and resources which will be available/needed for the testing phase of this sub-activity. Therefore, although the SES system has to satisfy all the above mentioned requirements, the prototype to be developed, will be probably target into a real test at Jovellanos Center, and such prototype/s will be designed in order to minimize the time of inoperability of that Center.

10. Bibliography

- IMO Resolution MSC 81(70), Recommendation on Testing of Life-Saving Appliances ((adopted on 11 December 1998).
- IMO Resolution MSC CIRC. 811
- IMO Resolution MSC CIRC. 1006
- IMO Resolution MSC.320(89)
- IMO Resolution MSC.321(89)
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