Activity 4 – Sub-Activity 4.6

Final Report on Training on Firefighting & LNG

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**Document status**

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### Review

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### Document History

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# 1 List of abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
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<tbody>
<tr>
<td>BLEVE</td>
<td>Boiling Liquid Expanding Vapour Explosion</td>
</tr>
<tr>
<td>EBS</td>
<td>Emergency Breathing System</td>
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<tr>
<td>EMSA</td>
<td>European Maritime Safety Agency</td>
</tr>
<tr>
<td>ESD</td>
<td>Emergency Shut Down</td>
</tr>
<tr>
<td>GMDSS</td>
<td>Global Maritime Distress Safety System</td>
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<tr>
<td>GPS</td>
<td>Global Positioning System</td>
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<tr>
<td>HUET</td>
<td>Helicopter Underwater Escape Training</td>
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<tr>
<td>ICAO</td>
<td>International Civil Aviation Organisation</td>
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<tr>
<td>ICS</td>
<td>Incident Command System</td>
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<tr>
<td>IMO</td>
<td>International Maritime Organisation</td>
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<tr>
<td>IMDG</td>
<td>International Maritime Dangerous Goods</td>
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<tr>
<td>MSC</td>
<td>Maritime Safety Committee</td>
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<tr>
<td>ISC</td>
<td>International Shore Connection</td>
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<tr>
<td>LNG</td>
<td>Liquefied Natural Gas</td>
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<tr>
<td>LPG</td>
<td>Liquefied Petroleum Gas</td>
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<tr>
<td>MARPOL</td>
<td>International Convention for the Prevention of Pollution from Ships</td>
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<tr>
<td>MRCC</td>
<td>Maritime Rescue Coordination Centre</td>
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<tr>
<td>MRO</td>
<td>Mass Rescue Operation</td>
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<tr>
<td>MST</td>
<td>Maritime Safety Training</td>
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<td>NFPA</td>
<td>National Fire Protect Association</td>
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<tr>
<td>PPE</td>
<td>Personal Protective Equipment</td>
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<tr>
<td>RPT</td>
<td>Rapid Phase Transition</td>
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<tr>
<td>SAR</td>
<td>Search and Rescue</td>
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<tr>
<td>SCBA</td>
<td>Self Contained Breathing Apparatus</td>
</tr>
<tr>
<td>STCW</td>
<td>International Convention on Standards of Training, Certification and Watchkeeping for Seafarers</td>
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<tr>
<td>VHF</td>
<td>Very High Frequency</td>
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2 Scope and purpose

MONALISA 2.0 is a European project, which includes 39 partners from 10 different countries. The partnership involves the cooperation of private, public and academia sectors, and it is co-financed by the European Union. The main purpose of the training within the MONALISA 2.0 project is to implement a practical set of courses covering operational safety with special focus on passenger and LNG fuelled vessels’ crisis, in order to get a standardised and certified master program.

MONALISA 2.0 represents a paradigm and challenge for the maritime industry in the coming years and beyond 2020. The next generation of maritime transport will become more efficient, sustainable, safer and profitable by means of the emerging Information and Communication Technology (ICT) solutions based on the Internet. Nevertheless, the challenge of properly implementing and using such ICT tools on board ships, the safety management operations or critical situations at sea and in ports solutions, make the international maritime authorities focus on the important role of the human element in maritime safety. Statistics show that in the vast majority of maritime incidents and accidents, the human element is involved as the primary contributing factor.

As a result, the increasing attention on training has been addressed by the international community, expecting that maritime training and education contribute significantly to maritime safety improving not only from the ship’s point of view but also from the search and rescue operations and port preparedness in case of incident/accidents.

This final report explains the definition of the training on “Firefighting & LNG”. The report also account for the results from actual training courses as well as the experience of fire fighters, trained on “Firefighting & LNG”, during the SAREX exercise that was held on June 15th in the Valencia coastal waters. The results of this training and exercise action, will contribute to improving and optimising the fire response where large passenger ships, LNG tankers or LNG fuelled vessels would be involved, minimising the loss of lives, maritime environment damage and finally, the ship and the goods loss.

3 Introduction to Marine firefighting & LNG emergencies

A fire on board a ship is the worst nightmare of a seafarer. The vessel’s own crew is well trained to control the emergency, but if they are not able to extinguish that fire and rescue the casualties, external assistance (land-based fire-fighters) would be required.

The use of LNG as fuel in the maritime industry has a great future due to recent restrictions imposed by the IMO (MARPOL ANNEX VI) on the control of emissions and air pollution from
LNG is basically a safe fuel but the knowledge and an understanding of its potential dangers is critical.

4 Purpose of Firefighting and LNG Training

Apart from northern European (Dutch, Belgian, French and English) fire brigades, which join forces in a Specialised Maritime Incident Response Group (MIRG-EU), other rescue teams lack standardised procedures and training for marine fire-fighting, which results in firemen being untrained in this area.

Due to the significant increase in the movement of passengers by sea and the recent fires on vessels, the importance of this training has been highlighted. Recent fire related accidents have also confirmed the need for a permanent training on fire fighting at sea.

5 Training Contents

5.1 General syllabus

The methodology of the course is based on the teaching-learning procedure.

The great value of this course was the practical part that had previously been explained in the classroom during the theoretical part.

We have divided the training into four modules:

**FIREFIGHTING MODULE**

The aim is to provide firefighters with knowledge and skills to act in case a vessel that is moored alongside in a harbour, or that is anchored or sailing through waters, is in distress due to fire.

**LNG MODULE**

The aim is to provide firefighters with knowledge on the properties of LNG and special risks associated with this fuel in potentially predictable scenarios, as well as the technical options and tactics to mitigate any incident.

**SEA SURVIVAL**

The aim is to provide firefighters with knowledge of the actions that should be taken in case of
abandoning a damaged ship and also the access techniques that should be used to transfer personnel and equipment to the distressed ship if that is necessary.

**HUET MODULE**

The aim is to provide firefighters with knowledge and skills and with the safe working practices that are appropriate to the aircraft being used. They must practice helicopter winching in a realistic scenario and know and practice the actions to be taken in preparation for a helicopter ditching and emergency landing using Emergency Breathing Systems (EBS).

### 5.2 Training topics

- Sea Survival. Lifesaving appliances.
- Rescue boat embarkation operations and procedures in the water.
- The role of the shore-based firefighting services.
- The fire control plan on board vessel.
- The ship stability.
- The firefighting system on board ship.
- Heliborne operations. Material and personnel transfer to the distressed vessel.
- The IMDG Code.
- LNG fires control using water, foam and dry chemical powder.
- Firefighting techniques and tactics in various parts of the ship.
- Types of incidents involving LNG.
- LNG characteristics and LPG comparison.
- Helicopter travel; the procedures and requirements for pre-boarding, safe boarding, in-flight and safe disembarkation.
- Helicopter emergencies: In flight procedures, aircraft escape routes for ditching and emergency landing.
- Actions in preparation for a helicopter ditching and emergency landing.
- Emergency equipment on board the helicopter.
- Stowage location of helicopter life-raft.
• Deploying, operating and breathing from the Emergency Breathing System (EBS).
• Dry evacuation, escaping through a window opening which is under water from a capsized helicopter (with/without deploying EBS system)

5.3 Training delivery and management plan

Methods for the Course Delivery:
Theoretical part – classroom (16.5 hours)  
Practical part – fire-ground, swimming pool, HUET simulator (23.5 hours)

Course intake limitations:
The maximum number of trainees will be 16 in order to allow each trainee to take part of each hands-on exercise.  
The HUET simulator has a limitation of 8 trainees, and that’s why a group of 16 delegates must be separated into two groups during the HUET and Sea Survival training sessions.

5.4 Trainers’ qualifications

The instructor in charge should:

• Hold a nautical Degree/Master.  
• Have underway experience as seaman.  
• Be especially skilled with fire-fighting equipment.
5.5 Course time table

The class schedules were strictly observed to ensure that all content was totally taught. There was no delay which forced to cancel any planned activity. At the beginning of the class, the instructor presented the purpose of the lessons. At the end of the class, the instructors did a short review, highlighting the most relevant aspects. At the end of all the practical exercises a debriefing was held in the fire-ground for all the actors involved.

<table>
<thead>
<tr>
<th>Monday, (GROUP 1) SEA SURVIVAL</th>
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<tbody>
<tr>
<td><strong>0800 – 0830</strong></td>
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<td><strong>0830-1000</strong></td>
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<td><strong>1000 – 1030 Break</strong></td>
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<td><strong>1300-1500</strong></td>
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<tr>
<td><strong>1500-1600 Lunch</strong></td>
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<td><strong>1600-1800</strong></td>
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<tr>
<td><strong>Monday, (GROUP 2) HUET</strong></td>
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<td><strong>0800 – 0930</strong></td>
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<tr>
<td>Time</td>
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<td>0930 – 0950</td>
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<tr>
<td>0800 – 1000</td>
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main differences between a land and a marine fire incident.
The 1405 NFPA Guide.
Vessel familiarisation (types of vessels, fire-fighting equipment, fire detectors, type of bulkheads).

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<tr>
<th>1000 – 1030 Break</th>
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<tr>
<th>1030 - 1500</th>
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<tbody>
<tr>
<td><strong>Practices:</strong></td>
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<tr>
<td>Inner fires: Fire in cabins and accommodation deck.</td>
</tr>
<tr>
<td>The use of positive pressure fans inside a ship.</td>
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<tr>
<td>The BA air pressure control.</td>
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<tr>
<td>Different firefighting techniques on board ships.</td>
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<tr>
<td>Gas fire cooling in rooms with no ventilation.</td>
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<tr>
<td>Fire in the engine room.</td>
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<tr>
<td>The use of low-expansion foam systems.</td>
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<th>1600 – 1800</th>
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<tbody>
<tr>
<td><strong>Theory:</strong></td>
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<tr>
<td>Type of bulkheads.</td>
</tr>
<tr>
<td>The International Shore Connection (ISC).</td>
</tr>
<tr>
<td>Fire fighting fixed systems (dry chemical powder, water, gas, foam).</td>
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<tr>
<td>Ship firefighting strategy.</td>
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**Thursday, (GROUPS 1 and 2) FIRE-FIGHTING**

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<tr>
<th>0800 – 1000</th>
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<tbody>
<tr>
<td><strong>Theory:</strong></td>
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<tr>
<td>Ship stability. Common causes of fire on board.</td>
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<th>1030 - 1500</th>
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<tbody>
<tr>
<td><strong>Practices:</strong></td>
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<tr>
<td>Bund fire during bunkering operations. Rack-manifold fire in a LPG tanker.</td>
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<tr>
<td>Fire in the pump-room spread to engine room.</td>
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<tr>
<th>1500 – 1600 Lunch</th>
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<tr>
<th>1600 - 1800</th>
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<tbody>
<tr>
<td><strong>Theory:</strong></td>
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<tr>
<td>Heliborne operations. Material and personnel transfer to the distressed vessel.</td>
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**Friday, (GROUP 1) HUET**

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<tr>
<td><strong>HUET Theory:</strong></td>
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<tr>
<td>Helicopter travel; the procedures and requirements for pre-boarding, safe boarding, in-flight and safe disembarkation.</td>
</tr>
<tr>
<td>Helicopter emergencies: In flight procedures, aircraft escape routes for ditching and emergency landing.</td>
</tr>
<tr>
<td>Time</td>
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</tbody>
</table>
| 0930 - 1430 | **HUET Practices:**  
  - Actions in preparation for a helicopter ditching and emergency landing.  
  - Emergency equipment on-board the helicopter.  
  - Stowage location of helicopter life-raft.  
  - Deploying, operating and breathing from the Emergency Breathing System (EBS).  
  - Dry evacuation, escaping through a window opening that is under water from a capsized helicopter (with/without deploying EBS system). |
| 1430-1510 | **Debriefing. Final considerations. Questionnaires and presentation of certificates. Ending the course.** |
| 0800 – 1000 | **Theory:**  
  - Sea survival (actions to be taken before prior in the water, actions to be taken in the water, actions to be taken on board the rescue boat). |
| 100 - 1430 | **Practices:**  
  - Fire-fighting equipment and personnel transfer operation from the quay to the rescue boat.  
  - Fire-fighting equipment and personnel transfer operation to a distressed ship embarking from a rescue boat by the ship’s pilot ladder.  
  - The use of lifesaving appliances (hand flares, smoke cans, 150N & 275N twin chamber lifejacket).  
  - Recovery methods of personnel from water, appropriate actions in a cold water environment, how to drop into the water from height in a safe manner.  
  - Falling into water whilst wearing full firefighting bunker gear in different situations (with/without SCBA, with/without lifejacket). |
| 1430 - 1510 | **Debriefing. Final considerations. Questionnaires and presentation of certificates. Ending the course.** |

### 5.6 Training place and facilities

The course was imparted at Jovellanos Centre, which belongs to the Spanish Maritime Safety Agency. Inaugurated in 1993, ISO 9001 certification has been given to Jovellanos Centre from Det Norske Veritas (DNV). The building is located in the town of Gijon. Facilities cover an area of 143,000 square metres.
Teaching facilities and equipment:

- LNG pit capable of withstanding temperatures in wide range (from -170ºc to 1300ºc) and protected from heat radiation by water curtains.
- LNG isolated tank with cryogenic pipeline.
- Multipurpose built indoor pool with dunker (helicopter simulator) for helicopter underwater escape training.
- Big multipurpose built outdoor pool for sea-survival training with fast rescue craft, self-contained propeller boat, survival suits, winches, harnesses, inflatable life-jackets and wave generator.
- Ship’s simulator for fire-fighting & hazardous materials simulator.

PPE & FF equipment:

- Dry powder hand-held portable extinguishers.
- Foam equipment (foam concentrate, inline foam inductors, low-med ex foam nozzles, hi ex foam generator)
- Water nozzles, water hoses, hydrants, fire pumps.
- Fire fighter bunker gear (safety gloves, safety boots, VHF communications, intrinsically safe torches, fire-fighting helmet, infra-red thermal camera).
- Self-contained breathing apparatus, Emergency Breathing System.

5.7 Evaluation process

To obtain the course certificate course, trainees must attend ninety per cent of the theoretical part. Absence is not permitted to any practical exercise in the fire-ground.

Total assessment: \( T.A. = 0.4 \times Q + 0.6 \times C.A. \); where:
- \( T.A. \) = Total assessment
- \( Q \) = Quiz (Examination of knowledge)
- \( C.A. \) = Continuous assessment

The Quiz includes 20 multiple-choice / true-false / short answer questions regarding theoretical contents. 80% of correct answers are required.

Continuous assessment will assess work developed during practical training using the following criteria:

1) LNG hazards awareness.
2) Correct use of personnel protective equipment (PPE).
3) Development of firefighting techniques in a safely manner.
4) Active participation during practical training.

6 Who can attend the training – Trainee selection

Land based firefighters or port fire brigades who could have to attend an emergency on board a distressed vessel that might be anchored, moored or sailing underway with special emphasis on whether the vessel is LNG powered.

6.1 Target staff

- Firefighters
- Maritime Incident Response Groups
- Port fire brigades.
- Fire engineers.
- Marine Deck and Engine Officers

6.2 Selection process

The selection process was performed by the Valencia Port Authority.

All the firefighters who were chosen had relevant experience in firefighting; rescue and they were familiarized with the maritime environment.

All of them showed an excellent disposal for learning and training and they perfectly knew how to work in a team.

7 Training delivery and results

7.1 Training attendance

All trainees attended the total of both theoretical and practical lessons. Trainees had to sign in on the attendance sheet at the beginning and at the end of the day. This is a copy of the attendance sheet on the first day of training.
## CONTROL DE ASISTENCIA DIARIO

### CURSO
Formación en Lucha Contra Incendios y GNL / Training on firefighting and LNG

### CÓDIGO
1580415 FCIG

### FECHA
20 DE ABRIL DE 2015

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<th>Firma SALIDA</th>
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<td>1. ANDRÉS CEREZO, SANTIAGO</td>
<td>33600174W</td>
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<tr>
<td>2. BADEAS ROYERO, EMANUEL</td>
<td>26482009H</td>
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<td>6. CATALÁ POVEDA, JOSE LUIS</td>
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<td>10. MERINO MORINO, ANTONIO JAVIER</td>
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<td>12. NOLINA PARDO, FERNANDO</td>
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<td>13. ORTIZ LINARES, JOSE ANTONIO</td>
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<td>14. ROGER CERDANA, SERGIO</td>
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<td>15. RUIZ CARBA, VICENTE</td>
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<td>16. VILLANUEVA GONZALEZ, ANTONIO JOSÉ</td>
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Fdo.: TOMÁS GONZÁLEZ MORÁN

Fdo.: BARBARA ALTAÑES DÍAZ

Fdo.: JAIMÉ BUITRE VICARIO

Fdo.: BIENVENIDO AGUIÑADO

**MONALISA 2.0 - TRAINING ON FIREFIGHTING & LNG**
## 7.2 Evaluation and results

All the trainees passed the theoretical quiz

<table>
<thead>
<tr>
<th>EVALUATION RESULTS</th>
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<tbody>
<tr>
<td>COURSE NAME</td>
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<tr>
<td>TRAINERS NAMES</td>
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<td>DATES</td>
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<table>
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<tr>
<th>STUDENT/QUESTION</th>
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6.3 Evaluating the training efficacy

The training centre must provide a training evaluation form to be completed by the trainees.

JOVELLANOS CENTER
Training evaluation form

<table>
<thead>
<tr>
<th>Name (optional):</th>
<th>Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date:</td>
<td>Location:</td>
</tr>
<tr>
<td>Have you attended a FF-LNG training program before?</td>
<td>Yes</td>
</tr>
</tbody>
</table>

JOVELLANOS Center is always aiming to improve the training services we provide, therefore, we would appreciate your comments confirming the points that have met your expectations and the areas where you feel improvements could be made. Please help us to improve and be excellent.

Please evaluate the following questions by placing a ✔ in the relevant box

<table>
<thead>
<tr>
<th>Poor</th>
<th>Fair</th>
<th>Good</th>
<th>Very Good</th>
<th>Excellent</th>
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</thead>
<tbody>
<tr>
<td>Location and facilities</td>
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<tr>
<td>Relevance to your job place</td>
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<td>The quality of presentations and teaching material used?</td>
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<td>The relevance/usefulness of questions and discussions following the presentations?</td>
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<tr>
<td>What did you think of the format of the training course</td>
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<tr>
<td>Improvement and updating of your skills/knowledge/promotion and the Trainer?</td>
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<tr>
<td>Course duration?</td>
<td>Too short</td>
<td>Just right</td>
<td>Too long</td>
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</tbody>
</table>

Please use the following section to give your opinions, good or bad and overall assessment of the training course. Use simple sentences as you consider.
7.3 Nomination of candidates to participate in the Valencia pilot exercise

The selection was carried out by the Valencia Port Authority and consisted of 6 Valencia firefighters who had previously attended the course at the Jovellanos Centre. Four of whom were embarked from a rescue boat and two others from a helicopter.

8 On the field evaluation

This section contains the assessment procedure of the course and its connection between the training performed and the SAREX in order to test the effectiveness of the course.

8.1 Exercise area of performance

The SAREX exercise was held on June 15th 2015 in the Valencia coastal waters. The SAREX’s aim was to simulate a MRO of passengers (about 500 volunteers) from a large ferry vessel (J.J. Sister from Transmediterranea Shipping Company) that had a fire in the engine room.

The exercise was coordinated by the:

- Emergency Control Centre – Valencia Port Authority.
- Emergency Coordination Centre - Generalitat Valenciana.

The units involved in the exercise were:

- Helicopters:
- Airplanes:
  - SASEMAR 101 – Spanish Maritime Safety Agency- SASEMAR.
- Vessels:
  - Rescue Vessel Clara Campoamor – Spanish Maritime Safety Agency – SASEMAR.
  - Rescue Vessel SAR Mesana – Spanish Maritime Rescue Vessel – SASEMAR.
- Calíope Patrol Boat - Spanish Maritime Safety Agency – SASEMAR.
- Tug Boat – BOLUDA – REMSA.
  - Lifeboats:
    - ES Salvamar Pollux - Spanish Maritime Safety Agency – SASEMAR.
    - Patrol Boat – Spanish Customs Authority.
    - Patrol Boat – Spanish Navy.
    - Patrol Boat – Civil Guard.
    - Lifeboats 1 & 2 – Spanish Maritime Red Cross.

The exercise stages were:
  - Stage 1: Fire at sea.
  - Stage 2: SAR operation.
  - Stage 3: Emergency control and tow of the ship.
  - Stage 4: Mass evacuation in the port.
  - Stage 5: LNG Emergency.

### 8.2 Role within the exercise

The role of SA 4.6.6 leader was to assess the access and the embarkation of the Valencia firefighters from a rescue boat and helicopter, the intervention performed on board, and the skills that had been learned at the Jovellanos Centre.

### 8.3 Key performance indicators matrix

This matrix evaluates the efficacy of the training module according to the experience acquired during the exercise. Key Performance Indicators are a series of measurements to check how the trained staff applied the knowledge in the exercise shortly after the training. Operational managers use these indicators to find out how they are performing and what they can do to improve the operations in general. Training evaluators and assessors also use them when making decisions about improvements of the training program.

The matrix reflects the strength or weakness of different aspects of the knowledge acquired. Furthermore, it also aims to improve the performance and response carried out during the exercise. The values of the key performance indicators are:

- **D – Disagree**
• MA – Moderately agree
• A – Agree
• CA – Completely agree
• NA – No answer

<table>
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<tr>
<th>Key Performance Indicator</th>
<th>D</th>
<th>MA</th>
<th>A</th>
<th>CA</th>
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<tr>
<td><strong>Exercise is suited to the following situations:</strong></td>
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<tr>
<td>• Prerequisite knowledge sufficiency</td>
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<td>• Target skills trained have considered the exercise requirements</td>
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<tr>
<td>• The exercise setting has been easily replicated during training</td>
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<tr>
<td>• The target skills involve real life situations</td>
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<tr>
<td>• Training tasks closely match tasks in the exercise</td>
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<tr>
<td>• Enables to use new technologies/gadgets</td>
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<td><strong>Exercise is not best suited to the following situations:</strong></td>
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<td>• to develop the training received</td>
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<td>• to interact with different staff positions</td>
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<td>• Situations designed restrict the efficient performance of skills</td>
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<tr>
<td>• Skills require more considerable practice before this type of exercise</td>
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<td>• large numbers must be trained at the same time</td>
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<td>• Measure the errors or time loses during response</td>
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<td><strong>Exercise made possible to improve:</strong></td>
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<td>• Reducing the panic situations</td>
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<td>• Coordinate evacuation/rescue actions with crew members</td>
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8.4 Final assessment

The SAREX was an exceptional opportunity to test the contents of the training course, as well as its validity and efficiency. We believe that these types of exercises are essential for anyone who could be involved in such types of incidents.

9 Conclusions

9.1 Added value for staff skills improvement

A fire on board a ship is completely different from an urban or an industrial fire. It could be both situations at the same time and made more complicated by the fact that the scene of the fire also potentially is in continuous movement as the sea is an ever-changing environment. Firefighters do not know the techniques to be used under such conditions because they don’t have the “know-how” of marine firefighting. That’s why training becomes so critical.

9.2 Added value for the improvement of Marine Firefighting & LNG Emergency Response

There is no standardised training for Marine firefighting & LNG in most of the countries, so the value of this training is based on the Centro Jovellanos experience and reputation in emergency training. Fortunately marine fires are not common but sometimes happen and on furthermore, the lack of marine incidents, does not allow firefighters and institutions accumulate experience in these incidents.

The use of LNG as a fuel for ships is seen as one of the main options to address the present and future environmental and commercial challenges in the shipping industry. The aim is to develop the most comprehensive training with hands on “hot fire” training to cover any
emergency situation.

9.3 Potential impact on a future Master of Science in Maritime Safety Training

The desired outcome of the future Master would be to prepare people to take the right technical decisions in crisis scenarios involving marine fires or LNG emergencies. The Jovellanos centre belongs to an organisation in charge of responding to maritime incidents (SASEMAR), so we are in a privileged position to identify training needs regarding maritime search and rescue operations.

10 References

- LNG shipping suggested competency standards (SIGTTO).
- DNV standard for certification no. 3325 – Competence Related to the on board use of LNG as fuel.
- Resolution MSC 285(86) - interim guidelines on safety for natural gas-fuelled engine installations in ships.
- International Code of safety for ships using gases or other low flashpoint fuels (IGF Code).
- (EMSA) Study on standards and rules for bunkering of gas fuelled ships (Germanischer Lloyd)
- Various sources and technical documentation (Jovellanos Centre, Resource Protection International, Classification Societies)
Annex

Slide example

Sub-activity 4.6.6.

TRAINING ON FIREFIGHTING AND LNG

Co-financed by the European Union
Trans-European Transport Network (TENT)
39 partners from 10 countries
taking maritime transport into the digital age

By designing and demonstrating innovative use of ICT solutions
MONALISA 2.0 will provide the route to improved

SAFETY - ENVIRONMENT - EFFICIENCY

Swedish Maritime Administration ◦ LFV ◦ Air Navigation Services of Sweden ◦ SSPA ◦ Viktoria
Swedish ICT ◦ Transas ◦ Carmenta ◦ Chalmers University of Technology ◦ World Maritime
University ◦ The Swedish Meteorological and Hydrological Institute ◦ Danish Maritime
Authority ◦ Danish Meteorological Institute ◦ GateHouse ◦ Navicon ◦ Novia University of
Applied Sciences ◦ DLR ◦ Fraunhofer ◦ Jeppesen ◦ Rheinmetall ◦ Carnival Corp. ◦
Italian Ministry of Transport ◦ RINA Services ◦ D’Appolonia ◦ Port of Livorno ◦ IB SRL ◦
Martec SPA ◦ Ergoproject ◦ University of Genua ◦ VEMARS ◦ SASEMAR ◦ Ferri Industries ◦
Valencia Port Authority ◦ Valencia Port Foundation ◦ CIMNE ◦ Corporacion Maritima ◦
Technical University of Madrid ◦ University of Catalonia ◦ Technical University of Athens ◦
MARSEC-XL ◦ Norwegian Coastal Administration

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