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Maritime Safety and Security Challenges – 3D Simulation Based Training

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ABSTRACT: Maritime Safety and Security on board ships very much depends on well trained crews. That is why training and exercising emergency response procedures as well as efficiency in reliable management are extremely necessary. On the other hand research as well as technological development in safety and security, tools and other kinds of technical and organizational systems contribute to further improvement and guarantee high levels of safety and security in maritime transportation. Simulation facilities are essential for both exercising and training but also for research and technological development. This paper introduces the innovative concept of a safety and security training simulator (SST7) and describes research work related to the implementation of training scenarios. Selected results of a case study will be presented. A shorter version of this paper was originally presented at the International Conference on "Marine Navigation and Safety of Sea Transportation" at Gdynia in June 2013.

1 INTRODUCTION

Maritime Safety and Security requires adequate response to any kind of emergency, quick and reliable planning and assignment of crew resources and finally, efficient crisis management. These themes are some of the most important in maritime education and training and STCW Manila Amendments applied since 2012 (see [4]-[6]) reflect a major priority for training ship's officers and crews of cargo and passenger ships in sufficient skills and appropriate procedures. The best way to attain experience and to gain the necessary skills are practice runs on specially designed simulators which realistically represent the complex ship conditions on board such vessels after an emergency alert occurs.

Although there are many rules and regulations already in place – e.g. SOLAS, STCW, ISM, and ISPS - it is still necessary to ensure a permanent process of correction and improvement in safety and security precautionary measures both in port as well as at sea. This is done by testing and improving modern safety and security equipment and also includes a constant review of training and drills. Training is vital for creating a permanent high level of safety and security awareness on board to guard against human complacency on duty and to better motivate ships' crews.

In their collaborative research work of Wismar University's research group (HSW-ISSIMS) and the Maritime Simulation Centre in Warnemuende (MSCW) with the World Maritime University's Maritime Risk and System Safety (MaRiSa) research group are improving training possibilities, e.g. with the development and integration of simulation based modules into training units and course schemes. Furthermore other studies, e.g., to investigate the effectivity of safety and security plans and planning

procedures or new safety devices, are carried out to assess how they stand up under varying conditions and during different courses of events in a selected series of simulation runs. To this end a Safety & Security Training simulator (SST7) was developed and is used also in combination with other simulators.

2 SIMULATION ENVIRONMENT FOR SAFETY &SECURITY TRAINING AND RESEARCH

The Maritime Simulation Centre Warnemuende (MSCW) is one of the most modern simulation centers worldwide encompassing a full mission Ship Handling Simulator (SHS), Ship Engine Simulator (SES) and a Vessel Traffic Services Simulator (VTSS) as well as a new type of simulator called the Safety and Security Trainer (SST7) see Figure 1. This integrated simulation platform complex with four full mission simulators enables the trainee to simulate the entire system ship and offers concrete challenges to officers and crew on board. The simulator arrangement (MSCW) comprises

- a Ship Handling Simulator SHS with four Full Mission bridges and 8 Part Task Bridges,
- a Ship Engine Simulator SES with 12 Part Task station and
- a Vessel Traffic Services Simulator VTSS with 9 operator consoles
- a Safety and Security Simulator with 10 operator consoles

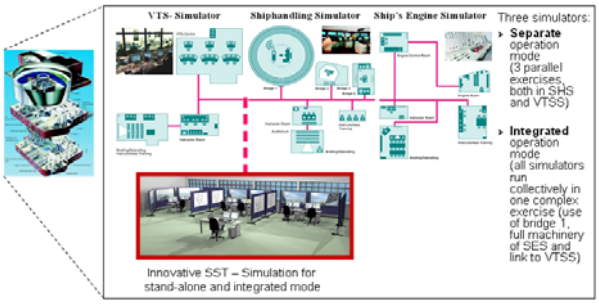


Figure 1. Maritime Simulation Centre Warnemuende (MSCW)

At WMU the combined SST7 - Desktop SHS is installed and used for training and research into specific human error factors ([11]-[13]).

2.1 *Integrated use of Safety and Security Simulation for training and research*

The new SST7 simulator was designed by the manufacturer Rheinmetall Defence Electronics Bremen (RDE) in co-operation with Wismar University, Department of Maritime Studies. The simulator was originally designed in a basic 2D version and is now being developed into a 3D interface. The simulator can be specifically used for "stand-alone" exercising as well as for exercises incorporating both the SHS and SES. Together with the full training material set-up, and including all ships safety plans, it was introduced as the "mars7" concept [1], [2]. The simulation system can be applied to specific simulation based studies and has the potential to help in upgrading existing safety and security procedures in training.

The situation on board ship regards emergency preparedness is generally affected by the following problems:

- crew capability and experience in the event of „disturbed" operation on vessels is limited or even non-existent
- multi-lingual crews cause communication problems in an emergency situation
- reduction of crew members causes lack of manning available
- complexity of emergency equipment is permanently developing, but training in emergency handling is not on a par with these developments

New management systems and regulations of the IMO (ISM/ISPS) mean that new methods in technology for emergency training are necessary. HSW offers simulation based training courses in safety and security at varying levels of complexity; for ratings at a basic level, for officers and masters at management level – all in accordance with IMO standards.

2.2 *Integration of a new 3D- visualization model into the SST7*

One of the most innovative elements at the MSCW is demonstrated on the new three-dimensional draft of a RoPax-ferry M/V (FS "Mecklenburg-Vorpommern") on the SST7-simulator. The 3D-model application has been created based on the relevant ship's safety plans and closely adheres to a series of photo sessions taken on the vessel and used for design within the software system "3D studio – max". For the simulator safety training all available safety equipment on board and safety systems (e.g. CO2, sprinkler system and water drenching system) have been drafted into the 3D visualization. Figure 2 illustrates the ship's plan of M/V.

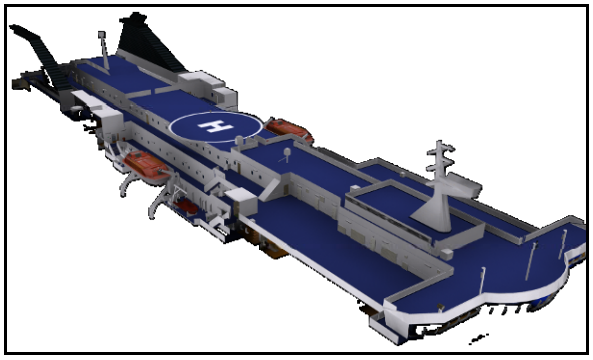


Figure 2. Visualization 3D M/V deck 9

In addition to the RoPax ferry another complete model of a container vessel, type CV4500, was drawn up separately as well as a part task model of the passenger vessel "AIDAdiva". Figure 3 and Figure 4 present a sample visualization of the part task model of the passenger vessel "AIDAdiva" - ship's bridge and safety & security console behind bridge. The bridge and engine control room (ECR) of all modeled vessels in 3D visualization are equipped with

interactive training consoles on bridge and in ECR. Meanwhile three different types of vessels have been test drafted for complex simulation based Safety and Security training. The modeling process is finished to the highest standard of detailed reality and enables efficient handling of all safety equipment and -systems on board and took six months for each vessel.

Figure 3. Visualization Bridge AIDA

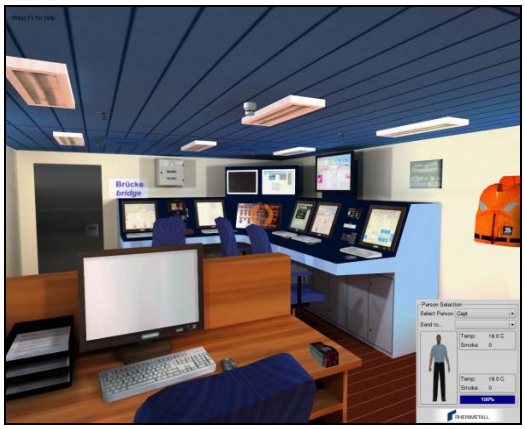


Figure 4. Safety-/security console AIDA

2.3 *Simulation based modules and system for Safety & Security Training*

Generally the SST7 is designed for procedure training in emergency management. Two modules have been integrated into the SST7, a complete fire and fire fighting module as well as a water inrush module.

The fire model (visually adapted) has a module with a number of realistic effects for easy orientation incorporated into the simulation. A modern fire alarm management system with smoke detectors and manual calling points is built into the ship's interior and easily flammable materials are protected by fire resistant A60 walls and doors. This model includes smoke visualization, a fire fighting system with equipment such as fire extinguishers, water hoses and hydrants, breathing apparatus, CO2 systems and foam. This enables the trainee to simulate a realistic fire fighting situation and interact with support teams as well as the management teams on the bridge and in the engine room. During the simulation a strategic figure's health condition is monitored with regards to oxygen, smoke, temperature and other health influencing parameter. Both modules, fire- and water inrush module see Figure 5 and Figure 6.

Figure 5. Fire module in SST7 (flash over)

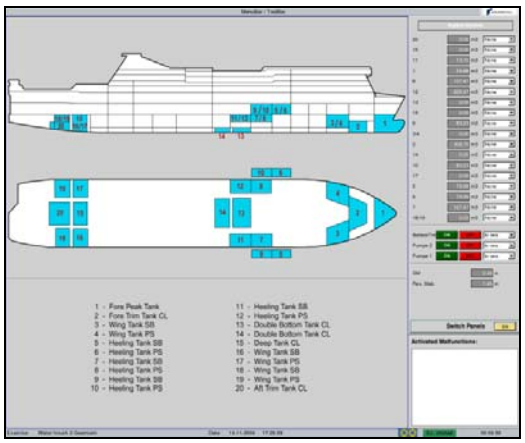


Figure 6. Stability module in SST7 (ballast tanks)

One further feature of the SST7 is the module for calculating water inrush and its influence on ship stability. A water ballast system is included and can be called upon during simulation of an emergency in order to stabilize the ship. The trim and stability calculator is adjusted to predict the effect of a water inrush and show the stability parameter. Water-tight doors are built into the modelled vessel. The ballast and stability measuring system can be implemented on the simulator prompting the trainee to take the appropriate counter measures (Figure 6).

A graphic display with selected environmental parameter (temperature, oxygen, gas and other parameter) enables the instructor to control the exercise and evaluate the trainee's awareness and to present his performance after simulation in the replay mode. For implementation of specific scenarios according to emergency management procedures on board, it was necessary to provide a complex process simulation system with a bi-directional interface for the safety simulator and ship-handling simulator. With these features and combining all simulator resources at the MSCW (SHS/ SES/ VTSS/ SST7) it is now possible to visualise the entire complex system ship and to provide training in ship handling and engine simulation processes in 3D quality for most simulation processes in safety and security [3].

2.4 *Decision Support System MADRAS*

The simulation platform includes a new support and decision system called MADRAS. The system was tailored for the SST simulator and superimposes the sensor data from the SST. The control module

selection contains the following elements for automatic survey: FIRE, EXPLOSIVES, SECURITY, EVACUATION, GROUNDING and FLOODING. In the event of any sensor alarm the Madras menu opens and displays the affected deck/area with the activated alarm sensor. MADRAS is an interactive system and a helpful tool in critical situations for the Master. Both the SST7 simulator and the MADRAS system were successfully implemented and tested over the last three years within the context of the research project VeSPer (funded by the German Ministry of Education and Research). First pilot courses have been carried out for end-users at the MSCW and are presented in the next chapter.

3 APPLICATION OF TRIAL COURSES ON THE SAFETY & SECURITY TRAINER

In co-operation with the shipping company F.LAEISZ an introductory simulation safety course was held in 2010 and two further trial courses carried out at the MSCW in 2011 and 2012.

3.1 *Introductory course for Shipping Co. F.LAEISZ on RoPax TRANSEUROPA in 2010*

The aim of the first training course on board was to introduce the Safety and Security Trainer and to carry out trial simulation courses on the SST7 generally. The scenario chosen for this simulation was a fire emergency on a RoPax ship using the available fire extinguishing equipment (CO_2, foam, water drenching). The main objective was to offer emergency procedure practice for the officers, crew and service personnel, especially measures needed for communication and the evacuation of passengers.

During the 7-day trip several courses were given to the entire crew and finally a "dry training" was carried out on board, mirroring simulation training at the monitor. The result was that the Captain and his crew were able to appreciate a real improvement in the standard of the dry exercise after their experience from the simulation. The company then booked two further demonstration courses at the MSCW during their ships management courses organized by the Warnemuende Technical Academy (WTA) in 2011.

3.2 *Safety Trial courses for F. LAEISZ Shipping Co. at MSCW in 2011 and 2012*

Company specific emergency scenarios were chosen for the demonstration courses to F.LAEISZ' specifications and were simultaneously run together with the SHS as well as a second trial which included the SES (engine simulator). The courses were tailored to improve emergency management organization on board. The courses at the MSCW with more than 60 participants per course were organized and conducted by MSCW staff in conjunction with a student team and in co-operation with network partners ISV and MARSIG, tailored to requirements of the shipping company (Figure 7). The training was conducted as recommended by the STCW Convention, Manila Amendments and developed and using the required Standard Marine Communication Phrases (SMCP), [4] - [7].

Figure 7. Briefing SHS, bridge 1

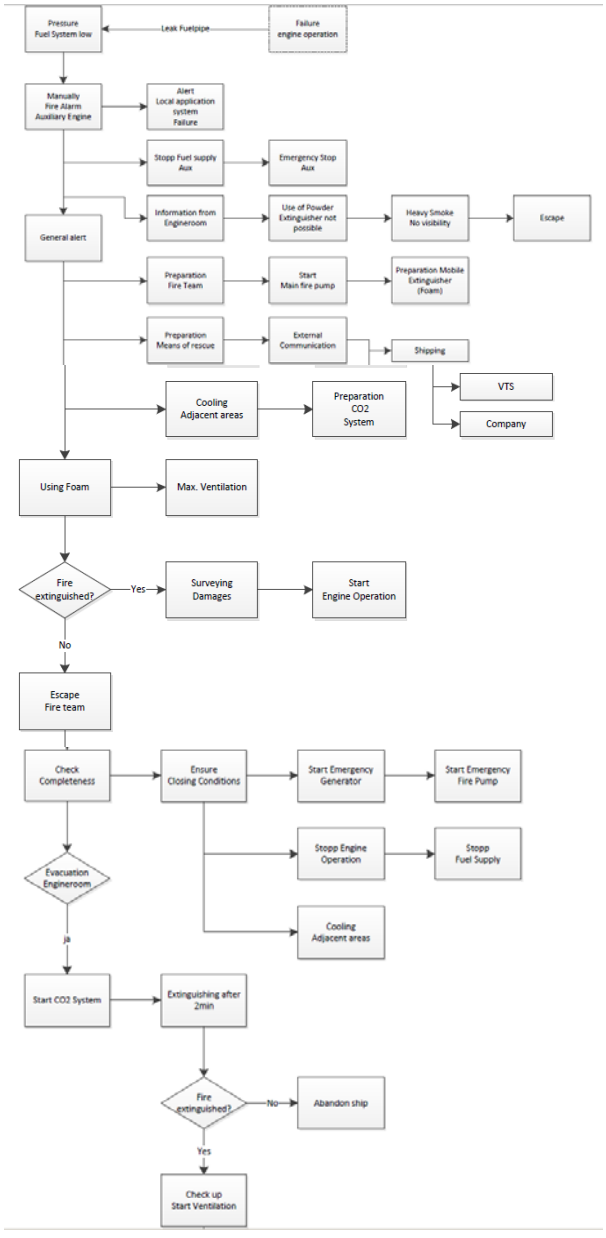


Figure 8. Concept Emergency Plan

The Emergency Management Course was carried out using prepared scenarios. As a sample the schedule of a fire scenario is described starting with an emergency plan tailored for the CV 4500 prompting trainees to follow the safety regime during the exercise exactly. Standard materials were provided to each trainee when performing simulation exercises. Event Schedule Fire Auxiliary E.R. –

training was carried out according to Emergency Plan (Figure 8).

3.2.1 *Scenario description:*

On board the container vessel CV4500, Pos. Singapore Strait westbound, loading condition C6 (Hand Out), break out of fire after oil leakage in generator engine room deck 04 PS forward. Ship/ shore communication SST carried out by VHF channel 13. Fire alarm is indicated on the alarm panel on the Bridge (SST7 & MADRAS-system) and ECR. Internal communication held between Bridge and ECR (Master/ 2nd Officer/ Ch.Eng. and 2nd Eng.) with reference to preparation of fire fighting team wearing protective equipment (breathing apparatus, heat protection suit). Check that fire dampers are closed. Ventilation of affected area cut off to prevent fire spread.

From control point ECR follows advice to start fire fighting. Simultaneously bridge starts preventive evacuation of superstructure while preparation of water and foam supply begins (e.g. fire hoses). VTIS Singapore has to be informed immediately after fire break out via VHF channel 13. VTIS gives order to leave TSS in north direction and for anchorage at „E-Boarding Ground". After the fire fighting team is set up (report ECR to Bridge) fire fighting begins in the engine room. Due to fire spreading intensely (as simulated based physical model indicates) further measures are necessary, e.g. fire fighting with foam. After failure of bilge pump 1 respectively fire pump 1 (malfunctions) start of replacement pumps and repair work (ECR and SST7).

Due to intense fire spread the control point (ECR) gives order to the bridge to start evacuation. The fully equipped crew sent to assembly station EGR aft of superstructure. After evacuation is completed in alignment with communication and evacuation procedures according to Bridge Resource Management (BRM) and Crisis Management, crew gathers at assembly station with personal protective suit/life vest. Crew roll call made by 3rd NO and the master gives order to release CO_2. In the event of missing persons a search team is sent throughout all decks. After a delay of two minutes the engine room is doused with CO_2. Using the graphical model and Fire Editor (SST) as well as from the MADRAS working station (ECR) several parameters (temperature, fire spreading, fire fighting) can be checked and adapted. After report back of „fire is extinguished" and an adequate time lapse (20min) the area is checked by a fully equipped fire fighting team (after ventilation of area CO_2), before the signal "all clear" can be given. Further fire watches must be set up.

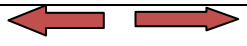
Depending on training standards and different human element risks and in order to insure awareness for a better understanding of team emergency management on board applicants should repeat simulation exercise with exchanged duties and replaced roles in security implementation at different SST stations and with reference of EUS MADRAS system to be followed up, see chapter 2.4, 4.3 and Table 2.

Tab. 1 gives an overview about a combined emergency simulation exercise tested at the SST7/ SES. Tab. 2 illustrates the overview of the integrated decision support system MADRAS. Both tables give the trainees support and are used as a guideline to follow up during the exercise procedure.

Table 1. Overview Scenario

Chapter	Arrangement	Use stations
Stations	1 Instructor + 6 SST7 workstations incl. Communication	4 ECR/ ER workstation
Objective	Management + fire fighting measures after fire outbreak D04 PS GR room forward, POS: Spore Strait, W-bound	ECR camera view D04 PS, control of fire fighting, supervisory EUS – system
affected area	DO4 Cell 077, material oil, amount 50kg, extinguish with Water/Foam In case of uncontrolled fire propagation preparation for release CO_2 and fore evacuation measures	ECR workstation camera view. MADRAS: Decision menu Fault tree analysis acc. Bridge management
Documents for Trainees	Safety plan CV4500, ship's particulars, loading and stability manual, ISM/ISPS code, MADRAS manual	
Navigation staff, stations	Master – SST8 OAC 1. NO – OSC SST 7 2.NO – external communication 3. NO Support SST 6 Support staff distributed to SST stations	EUS- System MADRAS: EUS Fault tree analysis– Malfunctions Leakage D00 PS after 15s. Failure bilge pump1 at 30 cm water level. Failure fire pumps at temp. Cell 77 >800°. Failure ME after 10 min. Contr. alarms, ECR/ SST7: Crisis Management &evacuation
Technical staff, stations	C.E. Command ECR (CO_2 release) 2. TO – Deputy 3. TO –FF Leader SST 5 EL. Eng. – Supp. ECR Fitter fire fight SST2	
Graphical display of parameter	Temp. cell 77/ 67 Smoke C.77/ 67 CO_2 C.077 WI - Water Level ER, cell 067/ 077	
Briefing	Familiarization SST7: movement algorithm, orientation, safety arrangement, evacuation, communication, criterion malfunction parameter MADRAS/ SES	
Exercise duration	2X45 min. = 90 min. Recording of exercise	
De-Briefing	Replay / Evaluation of exercise, Assessment	

Table 2. Master tree – EUS system MADRAS

MADRAS – Master Tree		
Investigation situation on site		
Feedback – extension of fire, what is on fire?		
Yes	Fire extinguished?	No
Clear location		Fire alarm
Fire watch		Closing procedures
Ventilation		Protection suits

		Communication intern, extern to be secured
		Feedback readiness Preparation of measures outside location
		Control of fire parameter MADRAS
		Emergency power supply to be secured
	Proceeding Fire fighting team	
Yes	Fire extinguished?	No
Evaluation on site		General Alarm
Clear up location		All closing in ECR/ER and superstructure?
Fire Watch		All crew definitely evacuated?
Ventilation		Release CO_2/ Close ventilation
Procedure monitoring parameter	Monitoring fire extension and CO_2 by graphic display SST	
Yes	Fire extinguished?	No
Control fire process: Enter affected area > 20 min CO_2 detector)		Secure Communication intern, extern
Clear up location		Start with evacuation procedure
Fire Watch		All crew on Station, well equipped?
Ventilation	Further procedures advice from bridge	

3.2.2 *Briefing:*

The participants are introduced to the SST[7] as well as to the other work stations (SES). The varying functions and operation algorithms of the strategic SST roles are explained and practiced. The trainees are shown different operational options with their respective parameter (walking, running, turning, crouching etc). The Madras system is sketched out. After the participants' familiarisation with the equipment they are given an outline of the scenario. The aim is to prepare them for specific emergencies that they may encounter on their own ships and to help them achieve awareness of the specific stress of problems ensuing. The training is aimed at management level whereby organization, communication, emergency measures and procedures can be realistically rehearsed.

3.2.3 *Simulation:*

Each trainee is placed at his appropriate work station (6 SST[7] workstations, 4 SES/ ECR work stations, 1 MADRAS station in ECR). Internal communication via headphones and microphone or on board radio or following bridge commands via public address system. The instructor surveys the parameter windows and adjusts where appropriate. Malfunctions, e.g. non-function of bilge- and fire pumps, have been purposely added into the scenario to be dealt with by the trainees self-sufficiently. The procedure is exercised according to precedents listed in the ship's articles (Muster List). Communication on board and external communication [6], organization/ procedures for using safety equipment and -systems (CO_2 system) found as indicated in the safety plan. After the fire has been successfully quenched and the area examined (after sufficient ventilation) the simulation exercise is complete.

3.2.4 *De-Briefing:*

During de-briefing the trainee performance is individually evaluated as well as the team co-operation. During the replay unsatisfactory passages of the exercise, such as orders not correctly interpreted, may be repeated. Extra emphasis is put on adequate communication skills (internal and external). Communication with VTIS, with other ships as well as with the Shipping Co. ("Emergency Reporting System") must be conforming to STCW standards and Standard Marine Communication Phrases (SMCP). The data-base stored parameter and recorded processes of the fire fighting procedures are evaluated in replays together with the participants (Tab.3).

Table 3. Evaluation SST- Training Course 2011

Course:	LAEISZ - Ship Management Seminar May 2011	
	Number of participants:	56
	Number of courses:	4
	Number of questions:	16
	Questions	Average Evaluation
Number of participants	How do you evaluate....	
1	the organisation and support service of the participants?	1,4
2	the handouts?	2,1
3	the briefing including the performance requirements?	1,7
4	your familiarity with the handling of the SST after the briefing?	1,9
5	the ease of operation of the simulator during the exercises?	2,5
6	the hook up of the SST with the ship handling simulator?	1,7
7	the reality of the simulator as an emergency procedure trainer?	1,8
8	the time limit of the simulation exercises?	3,3
9	the SST as an additional training measure?	1,5
10	the fixed installation of the SST inside the MSCW?	2,1
11	the modeled equipment and the safety systems?	2,1
12	the fire model?	2,1
13	the water inrush model?	2,4
14	the communication system of the SST?	2,5
15	the usage of the SST at management level?	1,1
16	the usage of the SST at basic level?	2,3
	Total Evaluation	**1,9**
	Evaluation better than 1,5	
	Evaluation in-between 1,5 and 3,0	
	Evaluation below 3,0	

The analysis, Table 3 (notes in range 1 to 6, best note 1) indicates that the only complaint was the fact that there was not enough time given to fully implement for such a complex simulation exercise. This will be taken into consideration at further courses in future. In summary the SST[7] was well accepted especially at management level.

2014 the HSW has arranged for another training course with well known Shipping Company specifically in security challenges for shipping personnel on management level. The preparation for the forthcoming course is in progress and in close cooperation with the company (CSO) and under surveillance of PPZ (Preventive Piracy Centre Neustadt, Germany), described in chapter 4.

4 SECURITY TRIAL COURSES AT MSCW IN PREPARATION FOR 2014

Specific security scenarios have been developed for further courses at the MSCW in 2014. The following chapter presents a sample of a security scenario which was specifically designed for challenges in maritime security according to STCW and with reference to the Manila Amendments.

4.1 *Scenario description:*

RoPax Ferry M/V prior to departure Port Rostock. Boarding and checking Passengers, Cars, Lories, Trailer and Busses. After checking cars (from outside by detector) and spot check of lorries and buses as well as interior of all cars/lorries parked on car and trailer decks 3 to 5 in lane 1 to 5 and segments 1 to 20. All passengers are taken in groups to the cabin decks and public areas decks 5 to 7 (SST). Ship Protection Measures (SPMs) are implemented and ship's personnel act in accordance with Muster List. Among passengers deck 07 one man carrying a suite case enters Rostock lounge and places the suitcase in a corner. The man leaves the lounge unnoticed. After loading procedure completed and clearance given by Warnemuende Traffic the ferry M/V departs from Rostock Port seawards (SHS). Outside the port the ferry proceeds inside the fairway to buoy No.1.

Suddenly a detonation occurs in Rostock Lounge D07. Fire starts and spreads to other cells all over the area. Passengers escape immediately from the affected area to outside open decks. Fire alarm sounds on Bridge (SST7 and MADRAS system) and in ECR. All officers are equipped with portable radios. Internal communication between Bridge, Fire fighting team, support team and ECR carried out according to Emergency Management. Fire Squad equipped with BA and heat protection suits proceed to affected area for fire fighting with water. Some water flooding caused by continued fire fighting in engine room and bilges. Bilge pumps are activated. On scene commander (with gas detector) detects high gas penetration in the lounge and reports to Master. The fire is now under control and can be extinguished after a few minutes. Gas concentration in the affected area increases. Master releases General alarm and activates ventilation. Advice from Bridge: passengers and crew have immediately to proceed to the assembly stations (with life jacket and survival suit). Communication and evacuation procedure carried out according to BRM and emergency procedure regulations. 1. NO checks roll call. In case any person missing search team sent to search all over decks. No missing persons confirmed by 1.NO.

The fire fighting procedure is monitored at the fire editor (SST7) in graphic mode and controlled at the MADRAS working station inside the ECR. After report "fire extinguished" crew has to wait outside the affected area and sufficient time is given for ventilation (20 min). After the area is checked by fire watch team (with BA, heat protection suit and gas detector) the "all clear" may be given. Telemax (remote controlled) integrated to the scenario (deck 07) for optional transport and disembarkation the suspicious suitcase over board (object "disabled"). Further boarding GSG9 by Helicopter and checking procedure according to clipboard (see 4.4). The scenario is designed for six SST working stations and in combination with the Ship Handling Simulator (SHS) including MADRAS.

Support documentation material provided to Trainees, see 4.2. Overview Scenario presented in Table 4.

4.2 *Support Documentation for Trainees:*

- Handout and Muster list
- Emergency plan CV 4500
- Emergency Reporting System
- SST manual and MADRAS manual
- Ships documents:
  - Emergency Plans (ISM/ ISPS)
  - Ships particulars
  - Trim and stability booklet
  - Medical guide for ships
  - IMDG-, ISM-, ISPS- Code

Table 4. Overview Security Scenario RoPax

MV: a) Departure HRO Security Procedure, b) Explosion/ Gas Attack/ Fire/ Water Inrush (WI) in ER		
Chapter	**Stations**	**Procedure**
Stations:	Instructor, 6Trainee-Stations SST7, SHS-Bridge/ ECR Station – internal, external Communication	Bridge and ECR Management
Objective:	General awareness of Security Procedure (boarding HRO) and "Best Management Practice" after incident casualty. Implementation of registration and reporting system as well as "Ship Protection Measures" (SPMs). Ship Security Alarm SSA. POS: HRO outbound, Course NNW fairway Full Load Dep.1 Compartment, 22.745 dwt Draught fwd 6.53 aft 6.52m, GM 3.34, ḍ 1.015 Bilge pumps capacity 620 cbm/h. Security measures during boarding and on departure. Gas attack & defence D07 Lounge Rostock – organization BRM & Crowed Crisis Management. Fire fighting/ water inrush – emergency procedure	ECR Camera View D07 PS EUS – MADRAS system (activated)
Affected area:	Deck 07 PS Lounge Rostock (LR). Fire D07 Lounge Rostock, explosive/gas/fire 25kg Fire Cells LR 02200-5/-7/-3/-1, 022013, 022011 Fire Fighting water/ CO_2, Water Inrush ER 10% (<capacity bilge pumps 620cbm/h). Evacuation tbc Object1 suitcase x pos x 151,39/ y pos 5,0570/ z pos 27,600 Telemax Mooring Deck 05 aft (opt. obj. disabled)	MADRAS Alarm Console Decision Support Analysis, Emerg. Management Effectivity Control
Documentation:	Emergency Plan MV, Ship Plans, registry/report, Trim-/ Stability Docs, ISM Code/ ISPS Code	MADRAS Manual

Strategic Figures Nautical Personnel, Initial Pos.:	Captain/ (Instructor) – SST1 OAC Command 1. NO – On Scene Comm. SST6 EGR WT 2. NO – management of fire fighting SST1 WT 3. NO – management of support SST 5 WT AB 1 – member of fire fighting squad SST1 OS – member of support squad SST1 Bosun – handling Telemax Mooring aft SST1	Application EUS MADRAS (ECR) Malfunctions: - explosion effect - Fire D07 Lounge Rostock - fire pump fail - ME fail Control alarms, sensors D07 In case of fire spread: training procedure Crises- and Evacuation Management
Strategic Figures Technical Personnel, Initial Pos.:	Ch. Eng. – Command ECR SST3 WT 3.TO – leader fire fighting ECR SST4 WT Fitter – GR SST2, Oiler and support staff SST1 Pax groups and Men 1 (with suitcase) SST1	
Graphic Model Parameter:	Temperature cell 022005 D07 Smoke concentration cell 022005 D07 Temp., CO_2, smoke, gas concentration (detector) WI - Water Level Engine Room ER, malfunction intensity ramp function 10-3%, stability criteria GM	
Briefing:	Familiarization SST: Movement algorithm, orientation, safety/ security equipment, -systems, communication, alarms, parameter, malfunction criteria, fire extension, record parameter, MADRAS- modules.	
Simulation:	60 min incl. Briefing/ De-Briefing, Record exercise and replay SHS/SST	
Debriefing:	Evaluation & replay – Trainee's awareness in Maritime Safety & Security	

4.3 *MADRAS Questionnaire:*

- Explosion and fire in Lounge Rostock
- investigate situation on site
- report: location, size and type of fire
- start fire fighting pumps
- try to extinguish with portable fire extinguisher
- Is fire extinguished?
- no
  - release general alarm
  - shut down ventilation / close all fire flaps
  - prepare und put on fire protection equipment
  - Fire pumps activated (bridge/ECR)?
  - internal / external communication
  - report of readiness of fire fighting unit
  - preparation of support measures
  - ensure power supply
  - survey fire parameters in MADRAS
  - action of fire fighting and support unit (fire fighting and cooling)
- Is fire extinguished?
- yes
  - analyse situation in affected area
  - clean up
  - arrange fire watch
  - ventilation
- no
  - prepare extinguishing with foam
  - shut down ventilation / close all fire flaps ensure completeness of crew on assembly station
  - release CO_2/ monitoring fire parameters and CO2 concentration
- Is fire extinguished?
- yes
  - place fire watch
  - clean up
  - Start ventilation (to reduce gas concentration)!!!
- no
  - prepare evacuation of the vessel
  - external communication
  - clean up
  - place fire watch
- Influence after damage and flooding WI in engine room area
- release general alarm
- closing of watertight doors
- start bilge pumps
- assessment of leakage
- roll call of crew
- check vessel stability, WI criteria
- Is bilge pump capacity sufficient?
  - calculation for bilge pump capacity according to formula Figure 9

$$\dot{V} \leq 620\ \frac{m^3}{h} \ <> \ A_L * \mu * \sqrt{2 * g * h} \leq 620\ \frac{m^3}{h} \ / \ A_L = b * l = 0{,}3 * l$$

$$<> \ l \leq \frac{620\ \frac{m^3}{h}}{\sqrt{2*g*h*3600*\mu*b}}$$

$$<> \ l \leq \frac{620\ \frac{m^3}{h}}{\sqrt{2 * \frac{9{,}81 m}{s^2} * 1m * 3600 * 0{,}6 * 0{,}3m}}$$

$$<> \ l = 0{,}216 \approx 0{,}22\ m$$

Figure 9. Volume calculation to check capacity Bilge pumps

- yes
  - Ensure manoeuvring ability, leak sealing, pump out water
- no
  - GMDSS distress call
  - be aware of loss of manoeuvrability
  - Guide vessel out of traffic zone (anchorage?)
  - monitor free surfaces
  - permanent check of adjacent spaces

4.4 *Clipboard Time Slot*

The preparation and design for a clipboard time slot helps the instructor to control the quality of trainee's performance during the simulation exercise and indicates the time frame for emergency procedures, which should not exceed the allotted time (Table 5.).

4.5 *Debriefing:*

Sufficient time (20 to 30 min) should be calculated for De-Briefing including evaluation, assessment and replay of exercise. The De-Briefing should be followed according to the Clipboard time slot (Table 5). The participants should recognize that permanent simulation training and training on board would improve standards for the Safety- and Security-Regime on board and will encourage a safety culture among the team on board. The result of the training

should be to raise seafarer awareness of risks in Safety and Security with reference to the policy of

- Accept Security
  - **A**pplying risk management
  - **C**ontemporary security knowledge
  - **C**reating security culture
  - **E**nhancing policies and procedures
  - **P**rotective measure (implementing)
  - **T**raining commitment

Table 5. Overview Security Scenario RoPax Clipboard time slot

Procedure Simulation Exercise SST7			**Script hints**		**Clipboard time slot**
To do before exercise:			Master/2.NO with Walkie-Talkie Channel 1/2 for external communication, Instructor Ch.1/2		Sound check
			SST7-stations internal communication head set	6 stations	Sound check
M/V Engine control to Bridge			Load graphical data, prepare fire cells, malfunctions, Connect EUS MADRAS to the SST7-system All stations provided with documentations?		Check by Instructor
Step	**Action**	**Done by**	**SST – remarks**	**Evaluation – clipboard remarks**	
1	Start exercise	Instructor	Check moderate sound level SST7	M/V prior departure from HRO, Check traffic and passengers	Start stop watch!	Exercise started
2	Situation-/ Action Monitor	Trainees	Orientation ship plan/ Consoles	*Cars/lorries parked on car and trailer decks 3 to 5 in lane 1 to 5, segments 1 to 20.*	*Passengers groups decks 5-7 (10min)*
3	Bridge (SHS) and SST7	Master and 2.NO on Bridge, 1./2.Eng. in ECR	Report/ Clearance to/ from Traffic Control	Boarding procedure completed, 1.NO/ Bosun close all car decks crew clear all stations fwd and aft	Procedure on SHS/ SST7? Departure Procedure SHS?	Within 5 min
4	Bridge (SHS) and SST7	Master/ 2. NO on Bridge, 1./2.Eng. in ECR	Manoeuvring on Bridge, Control ECR	Departure Port Rostock One passenger*) with suitcase to Lounge Rostock (SST1)	Procedure SHS/ SST7?	Within 5 min
5	Bridge (SHS and SST7	Master/ 2. NO on Bridge, 1./2.Eng. in ECR	Manoeuvring on Bridge, Control ECR	Ferry passes breakwater Public areas crowded. One passenger*) leaves lounge	Procedure SHS Communication Traffic Control?	Within 5 min
6	Detonation Lounge Rostock	Instructor	Fire spreading and Gas penetration	Passengers escape from Lounge Rostock to open decks	Fire Alarm to Bridge?	Within 2 min
7	General Alarm	Master/ Bridge	Initiate General Alarm. Activate Silent Alarm. Info to RCC	Passengers and Crew advised to proceed to assembly station, Ch. Eng. Informed for reduced speed	Alarm and announcement? Procedure?	Within 2 min
8	Reduce Engine	Master/ 2. NO/ ECR	Info to Traffic control	Advice to OSC to collect gas detector. Fire and bilge pumps activated	Internal/ external communication? Procedure?	Time level 2 min
9	OSC: completeness crew at assembly station. Closed status accommodation. confirmed				Procedure?	Time level 2 min
10	Navigation Control	Master, 1.NO/Ch.Eng./ CSO	Safe Manoeuvring/ Navigation. Fire Squat Team 1/2 with full safety equipment (BA's, Heating Suits) collect fire hoses and proceed to lounge. Cooling team prepares/activates cooling around affected area and open decks. Bosun/ 3. Mate/ TO prepare lifeboats			Time level 4 min
11	Control camera view	Master/ Ch.Eng./ECR/Instructor	Observing procedure on deck, lounge and assembly stations. OSC checks gas concentration in lounge, increasing. Fire in lounge under control. Ventilation activated. Info to Traffic Control and contact to company acc. to Emergency Reporting System		Crew assist passengers. Search Team checks decks 5 to 7 after passengers	Procedure?
12	Info OSC	Completeness all passengers at assembly station!			Procedure?	Time level 10 min
13	General Alarm	Master	Coordination Master/ Ch.Eng. Head of operations and fire fighting action with water. F-Squad 2 cooling flanking areas. Stop fire fighting, proceed cooling outside. Crew advised to proceed to assembling stations.		Strategically realisation? Gas concentration in accommodation area reduced	Procedure?
14	Advice from Traffic Control	Traffic Control/ Master/CSO/ Ch.Eng.	Phone conference Master/ Traffic Control/ Company (CSO). Advice to Master to stop vessel outside fairway. Master informs Ch.Eng. / reduced speed. Ventilation cont. O_2 level accommodation normal. Gas concentration in LR reduced to Zero		Control strategically realisation? Gas detection?	Decision and initial action within 10 min
15	Failure bilge pump 1		2 bilge pumps are still running		Check stability criteria (GM)	Capacity? bilge pumps
16	Dismantle bilge pump 1 for		2 bilge pumps are still running		Capacity acc. to calculation Figure 9	

	repair		in sufficient range	
17	Vessel stopped outside fairway for anchorage.	Helicopter approaching/ arrived. Passengers informed/ stdby assembly stations. Crew stdby for Helicopter (Fire Squat/ Assisting)	Contact VHF16 Helicopter?	Fire successfully extinguished
18	Embarkation GSG9 on deck 09. After conference on bridge GSG9 check passengers. Identification/ arresting suspicious person/ disembarkation person. Advice M/V to return to HRO. Disembarkation GSG9. Pax transferred to substitute ferry after arrival HRO. End of simulation!		Internal/ external communication? Strategically realisation?	MV returns to HRO
19	Exercise time, replay and thorough study with all participants. Evaluation and Assessment of Trainees			Total 90 min

5 OUTLOOK AND CONCLUSION

The safety and security trainer has provided new impulses for ship's security while dealing with dangerous accidents in the merchant maritime field. New ideas derived from analytical examination of several research projects can be useful in the future development of the SST7 and encourage improved methods for the integration of security measures and safety awareness on board.

To this end there are on-going studies looking into the potential for simulation-based exercises also taking into account training aspects related to port personnel assigned with security tasks. Among other issues, the studies are dedicated to the SST7 simulation models for the port-ship interface. These tests are performed within the frame of the Lifelong learning Program of the European Union, DG Education and Culture and belong to the LEONARDO Project METPROM (Modular Enhanced Training Programme for European Maritime Security Personnel).

The development and application of simulation-based training supports not only optimization of emergency management training, but also improves team performance and collaborative learning [8] as well. Furthermore sophisticated simulation even allows for the identification of unwanted effects or unforeseen impacts [9] of drafted emergency plans.

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