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Ships and marine technology — Virtual reality and simulation training systems for lifesaving appliances and arrangements

Navires et technologie maritime — Systèmes de formation en réalité virtuelle et en simulation pour engins et dispositifs de sauvetage

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 8, *Ships and Marine Technology*, Subcommittee SC 1, *Maritime safety*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document provides the criteria for how virtual reality (VR) and simulator technologies can support training and maintenance of lifesaving appliances such as those required by the International Maritime Organization (IMO) International Convention on the Safety of Life at Sea of 1974 (SOLAS 74), Chapter III.

The use of VR and simulator technology is already a mainstay in many traditional maritime schools for bridge management and navigation, and the market is growing for this type of training specific to lifesaving appliances (LSA) installed onboard vessels, mobile offshore drilling units (MODUs) and offshore installations. Through interactions with the virtual world, students develop knowledge, skills, and attitudes related to a wide array of competencies.

This document supports the VR and simulator equipment used in training and drills for operators and maintainers of LSA, where "live" training with the LSA is limited or restricted due to operational factors, company policies, inclement weather, sea-state, operating schedules and port restrictions. This is particularly advantageous for the mariners undergoing pre-arrival training to their next assignment as well as for onboard survival craft and associated appliances and arrangements such as free-fall lifeboats and davit-launched liferafts that are traditionally limited in their "live" training usage.

Additionally, LSA that are technologically advanced and novel may not be practicable for both live training and traditional deployment frequencies. Due to the nature of such alternative designs and arrangements, the need for VR and simulator training equipment for these types of LSA is particularly valuable to provide the necessary, consistent training frequency and familiarity for the mariners who operate them.

Ships and marine technology — Virtual reality and simulation training systems for lifesaving appliances and arrangements

1 Scope

This document provides general provisions and minimum criteria for using virtual reality and simulator equipment and systems instead of live training and drills with lifesaving appliances and arrangements, such as those required by SOLAS and MODU Code. This document is not intended to provide a generic training programme for the purposes of meeting International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW) requirements.

This document serves to support the use of training devices (TD) onboard vessels that can deliver training and drills required by regulation, as well as additional non-obligatory training to crew. It is understood that training devices described in this document are used as an alternative to actual participation with and operations of lifesaving appliances (LSA) products during drills to meet mandatory training requirements.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

International Life-Saving Appliance (LSA) Code [Resolution MSC.48(66)], International Maritime Organization, as amended

International Safety Management Code (ISM Code) [Resolution A.741(18)], International Maritime Organization, 1993, as amended

International Convention for the Safety of Life at Sea, 1974 (SOLAS 1974), as amended

3 Terms and definitions

For the purposes of this document, the terms and definitions given in, SOLAS III, the IMO LSA Code and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
augmented reality
AR
interactive experience of a real-world environment whereby the objects that reside in the real world are augmented by computer-generated perceptual information

3.2
behavioural realism
ability of the *training devices* (3.6) to replicate the functional characteristics of the lifesaving equipment

3.3
degree of freedom
measurement of motion of an object in space when constrained by fingers with or without considering friction forces at contact points

3.4
fidelity
degree to which a model or simulation reproduces the state and behaviour of a real-world object or the perception of a real-world object, feature, condition, or chosen standard in a measurable or perceivable manner

3.5
haptic
input or output device that senses the body's movements by means of physical contact with the user

Note 1 to entry: This includes any technology that can create an experience of touch by applying forces, vibrations, or motions to the user, e.g. providing a "sense of touch" (the sense felt by humans upon touching an object).

3.6
training device
TD
replica of a lifesaving equipment's instruments, equipment, panels, and controls in an open area, an enclosed replica, augmented reality environment, or virtual reality environment

Note 1 to entry: It includes the equipment and computer hardware, firmware, and software necessary to represent some or all of the full range of operations of the actual lifesaving equipment in a simulated environment.

3.7
maintenance
activities, excluding repairs, requiring disassembly of equipment, or any other activities outside the scope of the instructions for onboard maintenance and for emergency repair of life-saving appliances

Note 1 to entry: These activities shall be prepared in accordance with SOLAS 1974 regulations, Chapter III/36.2 and III/35.3.18, respectively.

3.8
multiphysics simulation
simultaneous simulation of different aspects of a physical system

Note 1 to entry: This includes the mathematical models used by the *training device* (3.6)/simulator to replicate the performance of shipboard equipment and systems.

3.9
operating environment
virtual environment simulating the actual environment and conditions in which the lifesaving appliance would be operated

3.10
physical realism
ability of the *training device* (3.6) to replicate the physical appearance of the lifesaving equipment

3.11
positive learning transfer
application of the knowledge and skills acquired from using the *training device* (3.6), whereby the user of the training device can demonstrate increased performance when using the lifesaving equipment

3.12
sensory cue
features of the *training device* (3.6) that can stimulate the senses of the user

3.13
simulation
use of a similar or equivalent system to imitate a real system, so that it behaves like or appears to be the real system

3.14
virtual reality
VR
artificial environment presented in the computer

4 Design

The TD shall be "fit for purpose" by applying the necessary physical equipment, equipment control realism, behavioural realism, fidelity, and operating environment realism to achieve the desired category of learning.

The TD manufacturer shall determine the appropriate training categories of the device and LSA applications to demonstrate that the system has sufficient realism to produce the positive learning transfer desired.

5 Safety

Regardless of the category of training, the training setup may include simulating the real environment including the use of virtual reality (VR) or augmented reality (AR), physical or virtual controls, motion platforms or any moving training equipment. It is important that the trainee can safely train in the training setup even when the trainee performs the wrong action or gets disoriented. Safety measures shall be in place to ensure trainees cannot get physically hurt during training.

6 General requirements of the TD

6.1 General

A TD shall address the following:

a) the TD shall have a unique identifier (i.e. name, model number);

b) training category or categories provided by the TD shall be clearly stated;

c) TD configuration;

d) TD software name and version;

e) equipment operation;

f) equipment and facilities for instructor/evaluator functions when included in the TD;

g) motion system, if applicable, e.g. number of degrees of freedom;

h) visual system;

i) sound system, if applicable;

j) power requirements;

k) internet connectivity requirements to include using the TD, evaluating results, and recording training, etc;

l) Recording or other record keeping of the training performed. If electronic record keeping is used, it shall provide for the preservation and retrieval of information with appropriate security or

controls to prevent the inappropriate alteration of such records after the fact. See DNVGL-ST-0033: 2017, 2.2.1.4 for an example.

Records of drills and training shall be stored in logs and generated automatically from the TD at the completion of each session. Records shall include at a minimum:

1) TD unique identifier;

2) start and completion date and time of the drill, muster, or training session;

3) LSA used in the drills;

4) identification of crewmembers participating in drills or training sessions;

5) subject of the onboard training or drill session:

— EXAMPLE 1: Abandon ship drill, lifeboat lowering, full drill,

— EXAMPLE 2: Abandon ship drill, lifeboat preparation, part of the full drill,

— EXAMPLE 3: Abandon ship drill, liferaft davit operation, full drill;

6) the role/assigned duty to which the drill or session corresponds (i.e. lifeboat muster or boat crew); and

7) optionally, the TD can manually record any feedback by the participant, trainer, supervisor or assessor.

When a TD shall be used for additional non-regulatory training onboard, more records may be stored such as:

— assessment score, and

— fail/pass result;

m) Where a TD requires training area and space to deploy, an installation and deployment manual shall be supplied. This includes installation requirements, the TD layout and training area space layout, and required space, weight, and force to the floor;

n) operation and maintenance manual.

6.2 TD administration mode

6.2.1 General

The TD shall have an administration mode that allows the designer/instructor to create or modify a training scenario. It also allows the designer/instructor to administrate the access of the systems and other parameters required to manage the training.

The following functions shall be provided:

a) launch of a training scenario;

b) stop of a training scenario (this function should be accessible to trainers and trainees);

c) use of communications between the instructor/administrator and the trainee or trainees;

d) how to use the simulator;

e) retake the last training scenario;

f) training scenario log; and

g) assessment report.

The following functions shall be optional:

h) replay the last training scenario; and

i) replay a stored training scenario.

6.2.2 TD maintenance administration mode

The TD shall have a maintenance administration mode that allows the users to monitor the performance of the simulator system including the states of the simulator equipment and review simulator logs. It also allows for remote maintenance functions, software and training scenario updates by local or remote means.

6.2.3 Maintenance and upgrades to the TD

The maintenance and updating method of the TD software and hardware shall be defined by the manufacturer with a reference in the maintenance manual, including:

a) spare parts;

b) periodic replacement parts;

c) inspection items;

d) methods, interval, instruments and tools for each inspection item;

e) internet connectivity and computer support requirements.

6.2.4 Technical assessment of a TD vs a real LSA product

The TD maker seeking an approval (see Annex A) to replicate a specific product (make and type, series or model) shall receive a technical assessment comparing the system to the exact LSA product. That technical assessment should be evaluated by a third party (e.g. classification society member), irrespective of whether the LSA maker (original equipment manufacturer) is in business or no longer in business. The focus of this assessment shall be on objectives affecting training and drill requirements and no other technical similarities. The systems or components listed below shall be given particular attention in category 2 and category 3 TDs (see 7.2.3 and 7.2.4):

a) release gears;

b) marine evacuation system;

c) launching appliances; and

d) novel LSA.

6.2.5 Functionality and competence compliance verification

Before seeking approval of a TD (see Annex A) for meeting any training requirement, the TD shall be practically assessed by a third party (e.g. classification society member or Administration). The TD maker when applying for this assessment shall list the training requirements which the TD is expected to fulfil and the tables showing the grades of realism for each learning objective, and shall submit evidence that positive learning transfer occurs from the use of the TD.

If changes are made to training or drill requirements and learning objectives or any upgrades on software or hardware to a certified TD onboard, a new assessment shall take place according to the relevant technical assessment (see 6.2.4) and a new TD certificate should be issued.