



Engine Room Simulator
Training Manual

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Introduction

Training in the simulators is an essential part of maritime education. The simulators are commonly used to illustrate phenomena or provide a favourable learning environment for learning a skill that would otherwise be impossible or dangerous to practice in real situations. An adequately prepared simulator exercise should activate the trainees and guide them to make the correct decisions promptly.

The trainees' should be able to use the simulator as a tool and understand its operating principles and possible limitations as the simulator will present only the reduced description of the real phenomena. The trainees should also be known of the scenarios produced by the simulator and take those into account in the training and work activities.

Educators and trainees must master the use of the simulators as well as possible, that the simulator training can focus on teaching and learning the proper tasks and actions. Furthermore, during the simulator exercise, the trainees should be informed about the deviations to the reality related to the simulator system and the learning environment. After all, the simulator is a machine with some procedures and routines that can work against the logic.

Objectives and exercise characteristics

The purpose of the simulator exercises is to evaluate how the trainees are acting during the routine tasks and during the possible machinery and equipment failures, emergencies and change orders from the master of the vessel.

Simulation exercises should be designed to identify the critical skills that must be mastered to complete the task. Learning objectives should be included in the simulation most naturally and credibly as possible.

The voyage plan is the base for the simulator exercise. The voyage plan should include information about the vessels departure and arrival port, time of departure and arrival, required speed for the vessel to make the voyage in the agreed sailing time. Instructors' duty is to give the guidelines for the voyage plan to the nominated master or chief engineer, that these nominated individuals shall prepare the plan according to given instructions.

Preparation for the sea voyage shall be done under the instructors' guidance to ensure the rightness of the prepared voyage plan.

All tasks and activities during the simulator exercise shall be done in accordance with good seamanship. Any deviation from the good seamanship should be taken under consideration when evaluating the trainees' performance during the exercise.

Simulator pedagogics

With the simulator and other simulation-based environments, such as virtual environments, learning can be done safely and at a lower cost than in a natural operating environment. Learning is about doing the learning, and it happens interactively with the system. Teaching using a simulator should be organised so that the mental model created for the learner is realistic and the transfer of learning is as large as possible. If the simulator cannot learn all the necessary skills, learning situations should consider the features of a natural environment so that the learner's mental model becomes such that the learner performs as well as possible in a real operating environment.

Scenarios that mimic actual events increase the realism of teaching, improve learning outcomes, and transfer learning. When using scenarios, we start from typical situations where basic skills are learned. Then, as skills accumulate, scenarios describing special situations, for example, can be introduced.

Although the simulator is an interactive learning environment that provides feedback to the trainee, it does not provide feedback on nearly everything related to the skills to be learned, such as the principles of work or the order of priority. Operational goals are most often conscious, and they are practical goals that are recorded in education principles. Instead, conceptual goals are often tacit knowledge. They contain policies or principles that help achieve operational objectives.

As the simulator cannot mimic the real environment perfectly, it is essential that the training is designed so that those critical things that cannot be learned with the help of the simulator are included in the learning.

Simulation models also often simplify things, in which case the learner may get the wrong impression of complete mastery of the skill. This impression, or illusion, should take into notice when having the debriefing with the trainee.

Briefing

Briefing for the trainees is essential, as the actual purpose of the forthcoming simulator training has to be clarified for the trainees. Even though the exercise is based on the vessels voyage from port A to port B, the briefing is mandatory to ensure the trainees' act according to the actual situation. The trainer's most important task is to nominate the master or chief engineer for the training vessel. Master or chief engineer takes the command and presents the voyage plan for the trainees that they are entitled to make the engine room preparations for the voyage and make the necessary calculations, for example, for the fuel, water, etc.

If the exercise is planned to be combined with the navigation exercise using a combined simulation, the briefing must be done simultaneously for both groups, deck and engine, of trainees. The nomination of the key persons, the master, chief engineer, officers and engineers, will also define the chain of command during the simulator exercise. This hierarchical system will follow the actual conditions at sea. Also, the trainees must be informed and briefed more straightforwardly if the simulator exercise shall be done together with the navigation simulator. Joined exercise of engine and deck includes the cooperation between the crews.

Table of the briefing items

| Item | Contents |
|-------------------------|---|
| Purpose of the exercise | <ul style="list-style-type: none"> - Learning objectives for the exercise - Competences tested during the exercise |
| Type of the exercise | <ul style="list-style-type: none"> - Learning / Practising / Display of Competence - Instructor assistance allowed or not |
| Nomination | <ul style="list-style-type: none"> - Person in charge, Master, Chief Engineer, etc. - Chain of command during the exercise |
| Voyage plan | <ul style="list-style-type: none"> - Exercise voyage plan presented to the trainees - The voyage plan review and reproduce if necessary |
| Schedule | <ul style="list-style-type: none"> - Timeline for the exercise - Times for the preparation tasks should be stated (mirroring to actual vessels' preparation time) |

Simulator exercise

The simulator exercise shall be commenced only after the briefing. All of the exercise participants should be aware of their roles and duties during the exercise. Educators have to ensure that the briefing has been done correctly and that the exercises' purpose and expected timeline is determined.

Depending on the exercises' purpose, the exercise timeline can be ordered to be fixed to simulate the vessel's actual departure and arrival procedures and schedule. This fixed schedule will prepare the trainees for the actual work life where the re-runs are not possible, and time for the preparation and other tasks usually are quite short.

During the exercise, the trainer can launch different phenomenons from the instructor panel to simulate the possible faults or misbehaving equipment functions for trainees to solve out. These worst-case scenarios will test the trainees' capability to solve difficult situations and their pressure tolerance.

The exercise shall follow the voyage plan given during the briefing. Any deviations from the voyage plan should be informed to the trainees to avoid confusion. If the deviation is planned to be part of the exercise, the situation handling for sudden change should be evaluated.

The nominated people should thoroughly conduct the exercise according to their roles assigned in the briefing. All tasks and activities during the simulator exercise shall be done in accordance with good seamanship, and this criterion should be emphasised to the trainees.

Table of the exercise tasks and actions

| Task / Activity | Contents / Actions |
|--|---|
| Preparation | <ul style="list-style-type: none"> - Preparation tasks for vessels' departure or arrival depending on exercises' plan and timeline - If calculations are required, engineering officers shall prepare those during the preparation time |
| Commands | <ul style="list-style-type: none"> - Chain of command to be followed - Nominated people are in charge and responsible for the rightness of the given commands - All commands should be logical and follow the good seamanship |
| Consistency | <ul style="list-style-type: none"> - Maintaining the consistency of the exercise progression - If any deviations for the consequent flow of the exercise occurs, there must be an argument for those |
| Execution of the engine room routine tasks | <ul style="list-style-type: none"> - Engine room routines shall be arranged to adapt the routines in the seagoing vessel - Engine spaces logbook, routine walkarounds, collecting local instrument values, etc. |

| Task / Activity | Contents / Actions |
|--------------------------------------|---|
| Reactions for unexpected phenomenons | <ul style="list-style-type: none"> - Testing the trainees and their reactions for sudden fault or deviation - Testing the trainees' reactions and actions to solve the situation - The timeline from the start of the phenomenon to the solution for the problem - Recording the timeline tasks and actions |
| Decision making | <ul style="list-style-type: none"> - Testing the trainees' decision-making skills during the exercise - Decisions made in an abnormal or dangerous situation shall be recorded and discussed in debriefing - Is there knowledge and logic behind the decisions, or are the trainees working with "hunch"? |
| Communication | <ul style="list-style-type: none"> - Communication inside the engine crew - Communication between engine and deck crews. This will be highlighted when proceeding with a joint exercise. |

Training scenarios

Basic scenarios for the simulator exercise are to have control of the vessels' equipment for preparation the vessels' departure and arrival, engine room routines during the sea voyage, preparedness for possible failures and solving equipment issues that might affect the vessels' safety and functionality.

The simulator allows the instructor to launch different phenomenons and faults during the exercise. From the instructor panel, there is a possibility to affect the standard functionality of the simulated equipment. The faults simulation aims to test the trainees' capability to understand, react, and solve the vessels' safety and manoeuvrability problems.

It is also useful to add surprising but realistic events to the scenario that challenge the trainees to try different solutions or force them to make decisions with partially incomplete information. The mental pressure can be increased to an appropriate extent in the simulation by surprise, time and group pressure.

The simulated fault does not have to be a critical failure that causes a dangerous situation for the vessel, but the failure will escalate to a significant hazard without trainees' actions. Selecting too complex and multifactoral scenarios for the exercise will take the learning point out from it. Selected scenarios in the simulator exercise should be plausible also in reality that the trainees can use the practised and learned information in their future work.

Table of the scenarios and actions

| Scenario | Contents/Actions |
|------------------------------------|---|
| Preparation for departure | In the scenario, the trainees shall prepare the vessels' machinery from the cold status to ready to start and begin the departure from the port. <ul style="list-style-type: none"> - Basic exercise where the learning focuses on the engineers' routine tasks during the departure |
| Sea voyage procedures and routines | After the departure, the vessels' equipment is set to the sea voyage mode, and routine tasks are commenced. <ul style="list-style-type: none"> - Basic exercise where the learning focuses on the engineers' routine tasks during the sea voyage - Usage of the engine automation systems, monitoring the machinery, collecting data from the automation systems - Usage of the engine spaces logbook, routine walkarounds, collecting local instrument values, etc. |
| Preparation for arrival | In the scenario, the trainees shall prepare the vessels' machinery from the sea voyage to ready to arrive in the port. <ul style="list-style-type: none"> - Basic exercise where the learning focuses on the engineers' routine tasks during the arrival |

| Scenario | Contents/Actions |
|--|---|
| Failure; equipment anomalies | In the scenario, one or more of the vessels' equipment or machinery are giving anomalous readings through the automation system <ul style="list-style-type: none"> - Reading the alarms on the engine automation and identifying the faulty equipment according to the alarm. - The decision of the corrective actions - Communication among the engineers and if it is necessary between engine and deck crews (joint exercise) |
| Failure; loss of steering gear (joint exercise) | Vessels' steering gear fails. The vessel is not able to manoeuvre. <ul style="list-style-type: none"> - Communication among the engineers and between engine and deck crews - Arrangements for the emergency rudder operations - The decision of the corrective actions to restore the steering gear functionality |
| Failure; loss of electric power (joint exercise) | Black Out drill. The vessel loses electricity due to power generation failure. <ul style="list-style-type: none"> - Communication among the engineers and between engine and deck crews - Arrangements to prepare for emergency anchoring or drifting if the conditions apply - Corrective actions to restore the power to vessels' systems |
| Failure; loss of propulsion (joint exercise) | The vessel loses propulsion due to main engine failure. <ul style="list-style-type: none"> - Communication among the engineers and between engine and deck crews - Arrangements to prepare for emergency anchoring or drifting if the conditions apply - Corrective actions to restart the main engine |

Debriefing and evaluation

The post-simulation learning discussion, debriefing, is the essential step in learning in simulation practice. A debriefing helps the trainee organise information to be retrieved and applied to practical engine room situations. This reflective learning process requires that trainees have to canvass and evaluate their performance during the simulator exercise in the debriefing.

After the simulator exercise, the instructor has to present the exercise summary, including the timeline and all the events during the exercise. This summary allows the trainees to compare the exercise results to the actual plan and purpose given at the pre-exercise briefing.

The immediate exercise feedback of the events, actions and results is not done to criticise the trainees but to give a large picture of the exercise entirety. This instructors feedback works as an outsiders point of view about the trainees' performance. The trainees can and should use the feedback as an opportunity for learning.

The inquisitive and reasoning question layout also helps students identify the connection between the events, actions, and a solution or failure. The trainees must be given time to think about the answer to bringing out their reflective thinking. Reflection should be more collaborative and more based on the learning objectives of the simulation, not an assessment of trainees own performance.

If the exercise is a display of competence, the simulator exercise evaluation will be given after the simulator exercise directly to the trainee. The assessment discussion must occur with each trainee in person, and the arguments and criteria for the evaluation must be presented.

Table of the debriefing tasks and actions

| Task/Activity | Contents/Actions |
|---|---|
| Exercise summary | <ul style="list-style-type: none"> - A complete overview of the exercise events based on the recordings made during the exercise - The events which affected the exercise progress significantly shall be highlighted (positive and negative) |
| Immediate feedback | <ul style="list-style-type: none"> - The trainees' performance during the exercise and its effect on the results |
| Successes | <ul style="list-style-type: none"> - Point out the tasks and actions that were correctly done and contributed to the successful completion of the exercise. |
| Failures | <ul style="list-style-type: none"> - Point out the tasks and actions that were not done correctly and slowed down completing the exercise. - Correct ways of working should be presented for the trainees to enhance the learning. |
| Trainees' summary and feedback about the exercise | <ul style="list-style-type: none"> - The trainees' summary and feedback about the exercise events and evaluation of their performance, successes and failures. |
| Evaluation | <ul style="list-style-type: none"> - Exercise evaluation for the trainees' achievement will be given after the simulator exercise |

Simulator training cards

1. Simulator training card 1
 - Engine room preparation tasks for departure and arrival
2. Simulator training card 2
 - Engine room routines during the sea voyage (preparation tasks included)
3. Simulator training card 3
 - Equipment anomalies during the sea voyage
4. Simulator training card 4
 - Loss of propulsion
5. Simulator training card 5
 - Loss of steering gear
6. Simulator training card 6
 - Power loss failure during the sea voyage

Simulator exercise card 1: Engine room preparation tasks for departure and arrival.

| TRAINING INFORMATION |
|---|
| <p>Training day topic: Engine room preparation tasks for departure and arrival. Recommended training day duration: 7,5 hours Recommended number of exercises: 2 - 4 Recommended number of instructors: 1 instructor</p> |
| STCW REFERENCES |
| TBD |
| TRAINING OBJECTIVES |
| Understanding the equipment control, procedures and basic actions during the vessels' departure and arrival |
| TRAINING OVERVIEW |
| Basic exercise where the learning focuses on the engineers' routine tasks during the departure and arrival |
| TRAINING EXERCISE |
| <p>Exercise 1: Prepare the vessels' machinery from the cold status to ready to start and begin the departure from the port. Exercise objectives: Focuses on the engineers' routine tasks during the departure Recommended exercise duration: max 1 hour Simulator: Engine room Recommended training methods: TBA</p> <hr/> <p>Exercise 2: Prepare the vessels' machinery from the sea voyage to ready to arrive in the port. Exercise objectives: Focuses on the engineers' routine tasks during the arrival Recommended exercise duration: max 1 hour Simulator: Engine room Recommended training methods: TBA</p> |
| BRIEFING AND DEBRIEFING NOTES |
| |
| ASSESSMENT NOTES |
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Simulator exercise card 2: Engine room routines during the sea voyage

| TRAINING INFORMATION |
|---|
| <p>Training day topic: Engine room routines during the sea voyage (preparation tasks included)</p> <p>Recommended training day duration: 7,5 hours</p> <p>Recommended number of exercises: 2</p> <p>Recommended number of instructors: 1 instructor</p> |
| STCW REFERENCES |
| TBD |
| TRAINING OBJECTIVES |
| Understanding the equipment control, procedures and basic actions during the vessels' sea voyage |
| TRAINING OVERVIEW |
| Basic exercise where the learning focuses on the engineers' routine tasks during the sea voyage, departure and arrival |
| TRAINING EXERCISE |
| <p>Exercise 1 & 2:</p> <p>Exercise objectives: Usage of the engine automation systems, monitoring the machinery, collecting data from the automation systems</p> <p>Usage of the engine spaces logbook, routine walkarounds, collecting local instrument values, etc.</p> <p>Recommended exercise duration: 2 hours</p> <p>Simulator: Engine room</p> <p>Recommended training methods:</p> |
| BRIEFING AND DEBRIEFING NOTES |
| |
| ASSESSMENT NOTES |
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Simulator exercise card 3: Equipment anomalies during the sea voyage

| TRAINING INFORMATION |
|--|
| <p>Training day topic: Equipment anomalies during the sea voyage</p> <p>Recommended training day duration: 7,5 hours</p> <p>Recommended number of exercises: 2</p> <p>Recommended number of instructors: 1 instructor</p> |
| STCW REFERENCES |
| TBD |
| TRAINING OBJECTIVES |
| Understanding engine automation, alarms and fault identification. |
| TRAINING OVERVIEW |
| One or more of the vessels' equipment or machinery are giving anomalous readings through the automation system |
| TRAINING EXERCISE |
| <p>Exercise 1:</p> <p>Exercise objectives:</p> <p>Reading the alarms on the engine automation and identifying the faulty equipment according to the alarm.</p> <p>The decision of the corrective actions.</p> <p>Communication among the engineers and if it is necessary between engine and deck crews (joint exercise)</p> <p>Recommended exercise duration: max 2,5 hours</p> <p>Simulator: Engine room</p> <p>Recommended training methods:</p> |
| BRIEFING AND DEBRIEFING NOTES |
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| ASSESSMENT NOTES |
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Simulator exercise card 4: Loss of propulsion

| TRAINING INFORMATION |
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| Training day topic: Loss of propulsion Recommended training day duration: 7,5 hours Recommended number of exercises: 2 Recommended number of instructors: 1 instructor |
| STCW REFERENCES |
| TBD |
| TRAINING OBJECTIVES |
| Understanding engine automation, alarms and fault identification. Communication between engine and deck crews due to vessels' non-maneuvrability Emergency procedures |
| TRAINING OVERVIEW |
| The vessel loses propulsion due to main engine failure. |
| TRAINING EXERCISE |
| Exercise 1: Exercise objectives: Communication among the engineers and between engine and deck crews. Arrangements to prepare for emergency anchoring or drifting if the conditions apply. Corrective actions to restart the main engine Recommended exercise duration: 2,5 hours Simulator: Engine room Recommended training methods: |
| BRIEFING AND DEBRIEFING NOTES |
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| ASSESSMENT NOTES |
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Simulator exercise card 5: Loss of steering gear

| TRAINING INFORMATION |
|---|
| Training day topic: Loss of steering gear Recommended training day duration: 7,5 hours Recommended number of exercises: 2 Recommended number of instructors: 1 instructor |
| STCW REFERENCES |
| TBD |
| TRAINING OBJECTIVES |
| Understanding engine automation, alarms and fault identification. Communication between engine and deck crews due to vessels' non-manoeuvrability Emergency procedures |
| TRAINING OVERVIEW |
| Vessels' steering gear fails. The vessel is not able to manoeuvre |
| TRAINING EXERCISE |
| Exercise 1: Exercise objectives: Communication among the engineers and between engine and deck crews Arrangements for the emergency rudder operations The decision of the corrective actions to restore the steering gear functionality Recommended exercise duration: 2,5 hours Simulator: Engine room Recommended training methods: |
| BRIEFING AND DEBRIEFING NOTES |
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| ASSESSMENT NOTES |
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Simulator exercise card 6: Power loss failure during the sea voyage

| TRAINING INFORMATION |
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| Training day topic: Power loss failure during the sea voyage Recommended training day duration: 7,5 hours Recommended number of exercises: 2 Recommended number of instructors: 1 instructor |
| STCW REFERENCES |
| TBD |
| TRAINING OBJECTIVES |
| Understanding engine automation, alarms and fault identification. Communication between engine and deck crews due to vessels' non-maneuvrability Emergency procedures |
| TRAINING OVERVIEW |
| Black Out drill. The vessel loses electricity due to power generation failure. |
| TRAINING EXERCISE |
| Exercise 1: Exercise objectives: Communication among the engineers and between engine and deck crews Arrangements to prepare for emergency anchoring or drifting if the conditions apply Corrective actions to restore the power to vessels' systems Recommended exercise duration: 2,5 hours Simulator: Engine room Recommended training methods: |
| BRIEFING AND DEBRIEFING NOTES |
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| ASSESSMENT NOTES |
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