MARITIME SAFETY: MORE ENCOURAGEMENT OF THE BEST USE OF SIMULATORS[1]

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ABSTRACT

Importance of the safety at sea has been increased in the operations of the ships during last decades. To achieve a safe navigation, ships are equipped according to the International regulations and standards. Effective and safe performance in such environment requires both highly skilled individuals and a high degree of team coordination. Therefore, the training of the seafarers for updated information and for better skills also became a very crucial issue. Nowadays, marine engineers should have a wide range of professional knowledge and skills: from work with a hand tools to the use of computer technologies. In order to achieve the standard of competence, the trainee needs to be trained and evaluated continuously in the marine simulator on the basis of competence based training and assessment strategy defined in STCW 95 convention. Simulation is a powerful training tool because it allows the trainer to systematically control the schedule of practice within a safe and controlled learning environment. In the past, simulation training was perceived to be simple and computer based; it was focused largely on the acquisition and assessment of individual technical skills. But now besides the technical skills, the role of simulations in training is being acknowledged with greater degree on behavioural skills. Trainees work from basic through advanced skill levels and learn how to operate specific navigational equipment, to advanced scenarios that require the simultaneous use of several instruments in order to navigate along a safe path and avoid collisions. In this paper models are useful for simulation as well as design of optimal power management systems that involve system reconfiguration and load shedding.

Keywords: electric power system, risk of human error, safety procedure

1 INTRODUCTION

Recent years higher professional level is quite essential for marine engineers to operate safety and properly a merchant vessel equipped with advanced automation system. Nowadays, tremendous changes are taking place in computing, information technology and simulation. Maritime education and training is not isolated from such changes and should benefit from these tendencies. For this reason, ship simulators are increasingly used in maritime academies as a valuable asset for educational processes. The application of ship simulators is also recommended by the STCW 87/95 Convention. It is worthwhile mentioning at this point that ship simulators and computer based training (CBT) programs also have some basic disadvantages in that they include many simplifications, abbreviations and schematic presentations of machinery systems. As a result, a trainee with perfect knowledge of simulator operation can have serious problems with real ship power plant operations, primarily because

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the graphical presentation and operating procedure of simulator are distinct from the reality [1].

Mariner training basically takes place along two different paths, each serving a specific purpose in the initial training and continuing professional development process. For most mariners, the educational process is clearly task oriented. It has been developed in response to the needs of the industry and to a long-standing tradition of service to the ship and its cargo that still dominates the seafarer's attitude toward the job and education. Training programs vary in purpose and population and include a full range of programs, from subject specific refresher courses to complete programs leading to a marine license. Traditionally, mariners have prepared to qualify for their first marine license through two basic professional development paths:

- structured marine education (faculties),
- learning by experience (i.e., on-the-job training).

The first of these approaches—the structured approach—is the predominant route for initial training and licensing. This approach includes a comprehensive education program that satisfies minimum sea-service requirements, while exposing the future officers to the full range of technical knowledge needed to serve as officer in.

Learning by experience, the second path, involves service aboard ship or other vessels. This experience is sometimes supplemented by short training courses at training facilities or specialized license-preparation courses, such as those given at commercial license-preparation schools. Both approaches are in the use throughout the world. Each has advantages and disadvantages. In the structured education approach prevails for deck officers, while on-the-job learning dominates in the towing industry. Learning by experience also prevails in the piloting profession, although many marine pilots are recruited from the pool of licensed deck officers in the shipping and towing industries. This practice can result in a beneficial combination of formal education and extensive practical experience.

2 SAFETY TRAINIG

There are two major categories of human error, that is, slips or laps of skill based behaviour caused by absent-minded and mistakes of rule or knowledge based behaviour. The latter errors often lead to a serious accident and disaster. This type error is caused by creating incorrect mental models and by taking strongly it in one’s mind. Once an operator goes into this mode, he or she can never escape from it. Only other co-workers can help. From this point of view, the practical theory to keep accordance among operators is proposed.

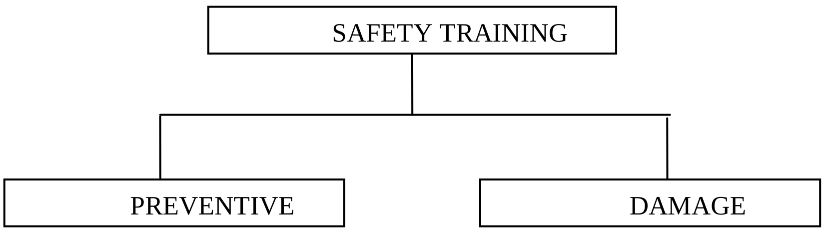

Figure 1: Safety training components

Safety training is concerned with transferring the knowledge and skills needed to encounter abnormal situations with confidence. Such training can be aimed at preventive or damage control measures (see Fig. 1) [2]. The former involves avoiding an emergency situation, by bringing the plant to its normal operating state before the situation can turn into an accident. The latter involves controlling an emergency that has occurred, with the intention of minimizing the damage to personnel, plant, property and environment. A number of training methods has been used within the offshore industry to impart safety knowledge and safe operating skills. These include non-systematic methods, formal instructions, computer-based methods, interactive videos and practical sessions. Each of these methods has its own limitations and merits on the type and extent of knowledge and skill it can impart.

2.1 Preventive training

Today the use of Simulator is an integral part of education of ship engineers. Main aspects in getting better results from trainees are:

- Easy and fast understanding of the requested task
- Exercises with different level of difficulties
- Fair and comprehensible assessment.

The instructor can prepare an exercise in many different ways such as load basic exercise, let the exercise run to the new situation, use this new situation as a start condition for the new exercise and change technical parameters if necessary. The instructor can choose between hundreds of technical parameters for the variation of exercises.

Crews who serve on board modern ships must have technical knowledge of highest standards to be able to operate complicated machinery correctly, efficiently and safely [3]. The educational process should become more available and progressive to ensure the necessary knowledge level of both cadets and existing officers. Simulators offer close to reality training in many important operational and safety related tasks for hazardous environment without physical risks. Effective and safe performance in such environment requires both highly skilled individuals and a high degree of team coordination [4]. In the past, simulation training was perceived to be simple and computer based; it was focused largely on the acquisition and assessment of individual technical skills. Interactive simulators in comparison with educational facilities are equipped with a real on-board hardware and they are obviously becoming a powerful tool to achieve effective and safe performance of crew in hazardous environments.

2.2 Curative training

For damage control exercise it has been chosen ‘Full Ahead Fully Loaded’ preset exercise on simulator. In order to understand the normal operation, the operational procedures on major machineries such as the diesel generator start-up, turbo generator start-up trainees must have base knowledge. After the planning of operational procedures, trainees can comment or discuss on each other and then instructor can confirm the order of conducting the exercise. During the training trainees can acquire appropriate operational procedures on major machinery step by step. Finally trainees can confirm their operational procedure by using the full-mission type engine room simulator over and over again. The aim of any exercise preformed on a simulator is to gain:

- Experience of the teamwork training in the simulated engine room through the utilization of available resources, communication and leadership,
- Experience to cope with accidents/troubles in the simulated engine room systematically as a team, which leads to:
  - Understanding of the concept of human factor engineering, especially human error, verification of the human factor engineering skills using the engine room simulator,
  - Understanding of effective operation and safety voyage by discussion on the training results with team member.

Exercise start-up procedure:

1. Prepare exercise 'Full Ahead Fully Loaded'
2. Induce the failure

Instructor's part of the job

3. Recognize the failure
4. Prevent further disaster
5. Secure normal functioning of power plant
6. Attend the failure
7. Restore power plant to original mode of operation

Trainees' part of the job

2.2.1 Failure recognition

Failure symptoms manifested as up rise in lubricating oil temperature, fresh water temperature and in the end loss of power that was produced at the turbo generator. It was easy to assume that sudden up rise of the temperature of cooling liquid is caused by a clogged valve as shown on Fig. 2 at the lubricating oil cooler.

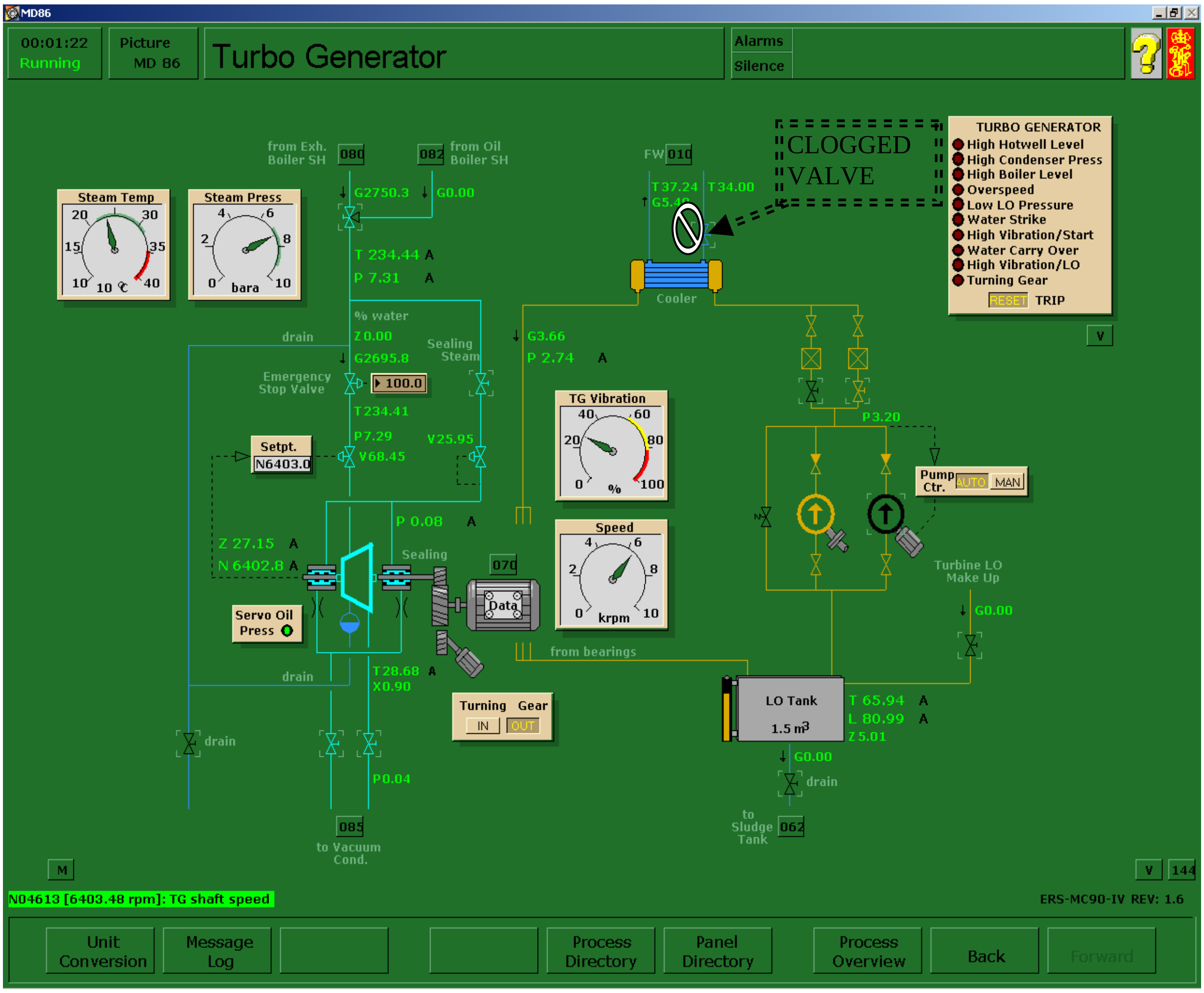

Figure 2: Schematic representation of turbo generator

Diagram presented on Fig. 3 shows the temperature rise of lubricating oil (orange line), the temperature rise of fresh water (red line), current fluctuations of turbo generator (violet line), power fluctuations of turbo generator (green line), current fluctuations of a diesel generator (black line), power fluctuations of diesel generator (blue line) which was in standby mode. X-axis presents time in which exercise is conducted and Y-axis presents percentage of total value of each variable.

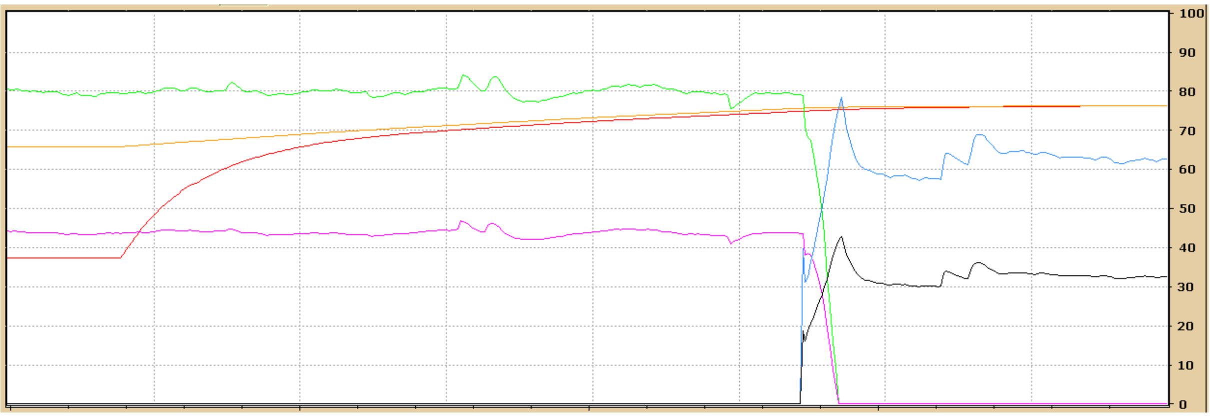

Figure 3: Behaviour of observed variables

2.2.2 Further failure spread prevention-normal functioning

In order to minimise further failure spread it was necessary to disconnect the turbo generator from main bus bar and connect the diesel generator on bus bar so as not to disturb electric network balance which is shown on Fig. 4.

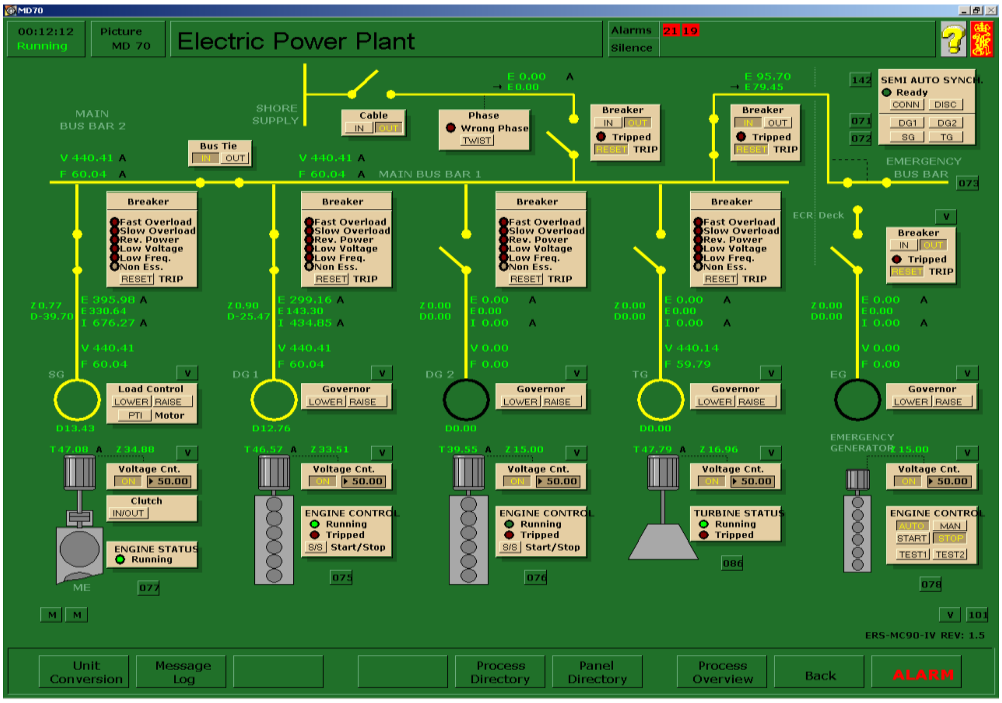

Figure 4: Schematic representation of a electric power plant

2.2.3 Failure attendance and restoring power plant

Failure attendance on a simulator exercise is basically turning on a valve, on which failure is simulated, according to table 1 open valve high flow input. After the failure is attended it is expected that lubricating oil will cool down because there is enough of cooling fresh water, now it is matter of resetting turbo generator and then reconnecting it on main bus bar before disconnecting the diesel generator. Figure 5 presents the overview of power chief and normal functioning of a turbo generator after the completion of exercise.

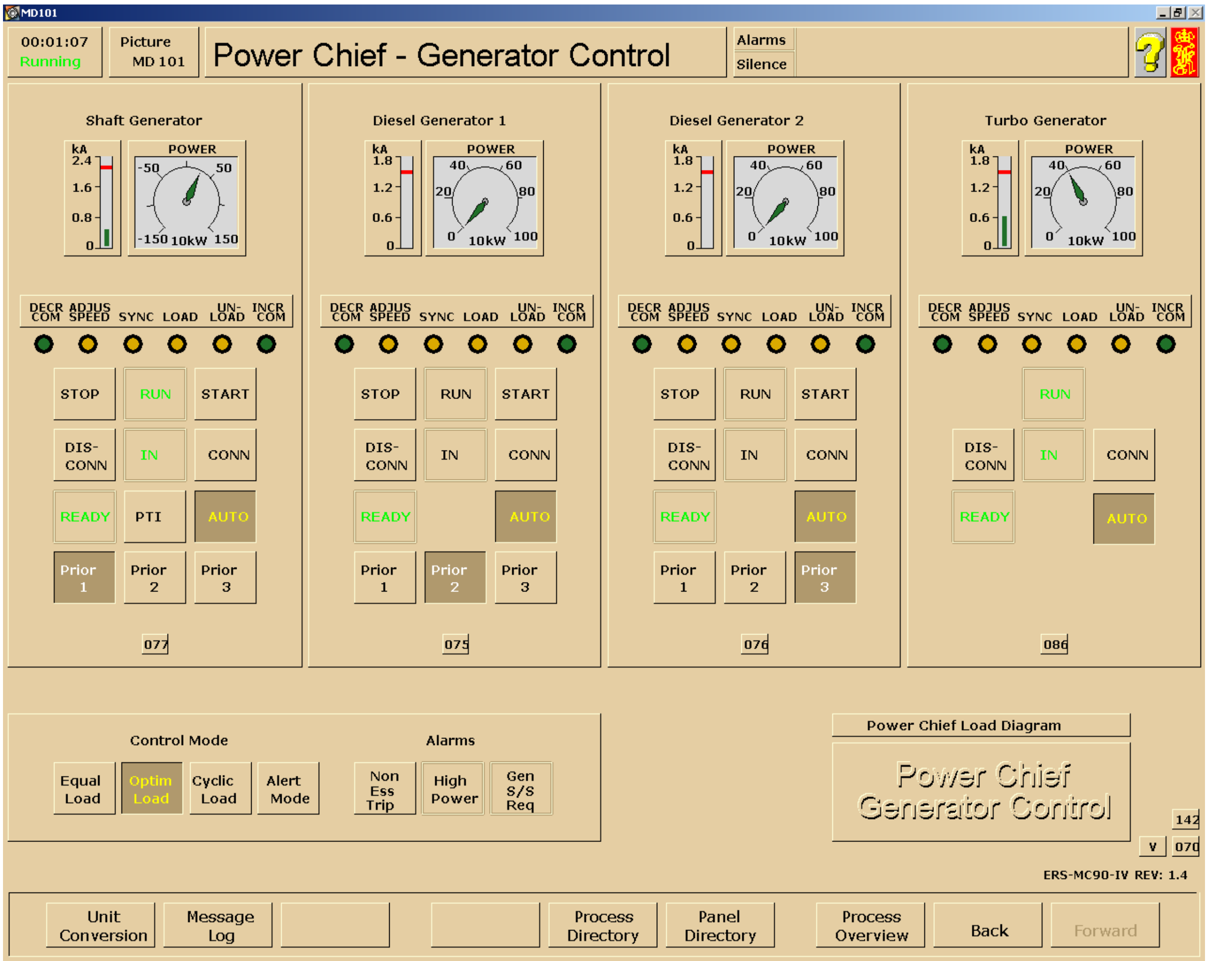

Figure 5: Generators control panel

3 EVALUATION AND CERTIFICATION

The nature of fully automated ship systems is also changing the role of traditional engineering officers from technical perspective to managerial levels. The expected raise in the level and extent of training of the engineer ratings such as technical high school/higher school graduates may also alleviate maintenance and operational responsibilities of the engineering officers while allowing them to perform officer of watch duties. Automation has been reported to have qualitative consequences and does not simply replace human work with machine work. It changes the task it is designed to support and creates new errors and error pathways and often shifts the error occurrence into some time in the future and may hide the error and make it more difficult for it to be identified and rectified. Of course they should be given certain maritime safety and operational knowledge before they are allowed to serve onboard ship.

Innovative concepts of marine education, a shift from a knowledge-based to a competency-based training, and the need for constant professional updating and recertification have brought maritime training institutions out from under the shadows of the maritime administration and industry. The process by which mariner competence is maintained and overseen includes:

- professional development practices by individual mariners and the organizations with which they are affiliated or employed,
- marine licensing by regulatory authorities, and the establishment of accountability for performance through professional and official discipline.

4 CONCLUSION

On the engine room simulator participants experience the workings of the different power plant systems with different emergency situations, as well as how the crews behave under stress. Such simulated scenarios range from minor defects to serious breakdown of the main engine or its particular mechanisms. Future engineers, through these simulated experiences, are able to learn appropriate responses and necessary routines to master these situations and to resolve the stressed behaviour of the crew. Quick and successful fault diagnosis during the operation of complex dynamic system such as turbo generator depends on the problem solving skills of the human operator. Problem solving skills are developed via a combination of a system procedures knowledge and operational experience acquired on actual and simulated systems. Computer aids with varying amounts of intelligence are increasingly used as integral components of training programs. For these aids to be effective and efficient in imparting useful problem solving skills, the aids must be designed based on a thorough understanding of a process at fault diagnosis.

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