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CARGO LOADING/DISCHARGING AND EMERGENCY PROCEDURE TRAININGS FOR DECK OFFICERS DEPLOYED ON BOARD CHEMICAL TANKERS USING TANKER SIMULATORS AT TRAINING FACILITIES

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by

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ABSTRACT

Transporting chemical cargo using chemical tankers is often associated with several hazards. For instance, it may present a fire hazard especially if flammable chemical cargo is being transported. This fire hazard is determined using boiling point, flashpoint, auto-ignition temperature, and flammability limits of the chemical product being transported using the tanker. Another hazard may associate with marine pollution hazard. This hazard is dependent on several factors which may include bioaccumulation and attendant risk to the human health or aquatic life or polluting the life at sea.

This study aims to investigate to provide a better solution for the simulator based training for chemical tankers' crew so as to provide safety on board the chemical tankers for these officers. Creation of more effective scenarios that ensure the achievement of the training objectives for the loading, discharging and application of emergency procedures will be achieved at the end of this study.

Meta-synthesis method was applied. This was then supported by structured interviews with relevant people. The research starts with literature review and conducting meta-synthesis from the previous studies. Following that the findings of the structured interviews to realize proposals from the experienced seafaring officer and port operators.

Key Words: Chemical Tankers; Chemical Tanker Emergencies; Simulator Training for Chemical Tankers; Tanker Safety

ÖZ

Kimyasal tankerler aracılığıyla kimyasal yüklerin taşınması birçok tehlikeyi içinde barındırır. Örnek olarak yangın, yanıcı madde taşıması sırasında ortaya çıkan tehlikelerden biridir. Yangın tehlikesini belirleyen ise taşınan kimyasal ürünün kaynama noktası, parlama noktası, kendinden tutuşma ve alev alma limitleri değerlendirilerek belirlenir. Ortaya çıkan diğer bir tehlikede deniz kirliliği tehlikesidir. Bu tehlike içerisinde insan sağılığı, biyo çeşitliliği ve deniz yaşamını riske sokacak birçok faktör barındırır.

Bu çalışmanın amacı kimyasal tankerlerde görev yapacak olan zabitlerin simulator tabanlı eğitim kaynaklarının kullanılmasını sağlayarak daha emniyetli bir çalışma ortamının oluşturulmasını amaçlamaktadır. Bu çalışmanın sonunda uygulanacak senaryolar ile yükleme, tahliye ve acil durum prosedürlerinin uygulanmasını içeren eğitim hedeflerinin başarılması amaçlanmaktadır.

Bu sonuçlara ulaşmak için meta-sentez metodu kullanılmış olup, konusunda deneyimli kişilerle yapılan mülakatlar ile desteklenmiştir. Mülakat için seçilen sorular araştırmanın ilişkili olduğu literatür taraması sonrasında elde edilen sonuçlar doğrultusunda hazırlanmıştır.

Anahtar Kelimeler: Kimyasal Tankerler; Kimyasal Tanker Acil Durumları; Kimyasal Tankerler için Simulator Eğitimleri; Tanker Emniyeti

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LIST OF SYMBOLS /ABBREVIATIONS

ARPA	Automatic Radar Plotting Aid
BIQ	Barge Inspection Questionnaire
CDI	Chemical Distribution Institute
DWT	Deadweight Tonnage
FSS	International Code for Fire Safety Systems
GMDSS	Global Maritime Distress Safety System
IBC	International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk
IMDG	International Maritime Dangerous Goods
IMO	International Maritime Organisation
ISGOTT	International Oil Tanker and Terminal Safety Guide
ISM	International Safety Management
ISPS	International Ship and Port Facility Security
LFL	Lower Flammable Limit
LSA	Life Saving Appliances
MARPOL	International Convention for the Prevention of Pollution from Ships
MEG	Mooring Equipment Guidelines
MEPC	Marine Environment Protection Committee
MLC	Maritime Labour Convention
MSC	Maritime Safety Committee
NC	Non Conformity
OCIMF	Oil Companies International Marine Forum
OOW	Officer of the Watch
PSC	Port State Control
SIRE	Ship Inspection Report
SOLAS	International Convention for the Safety of the Life at Sea
STCW	Standards of Training Certification and Watchkeeping
STS	Ship to Ship
TMSA	Tanker Management Self-Assessment
UFL	Upper Flammable Limit
VIQ	Vessel Inspection Questionnaire

1. INTRODUCTION

In modern days, range of chemicals are shipped to various destinations around the world in bulk. Owing to the special nature of these chemicals (hazardous nature), a special class of modern ships have been developed specifically for this purpose. These ships are known are chemical tankers. These chemical tankers are designed to handle hundreds of the hazardous chemicals and are now covered by the International Maritime Organization (IMO) Bulk Chemical Codes.

Some trainings are dangerous and hazardous; it is not possible to conduct on board. So, this type of trainings should be conducted in the shore as simulator trainings.

Before any chemical tanker is cleared to carry chemical cargo, it must undergo vetting. This (vetting) is the process by which major oil and chemical companies (charterers) assess whether or not a vessel is suitable for chartering for chemical cargo transport. The process mainly includes the physical inspection of the vessel by accredited Chemical Distributors Institute (CDI) and Ship Inspection Reporting System (SIRE) inspectors. It also involves reviewing of the classification records and terminal feedbacks and reviewing of port state reports.

Additionally, the ship crew (the deck officers) need to understand the nature of the cargo they are carrying, and hazards associated with it. As result, they need to be sufficiently trained on chemical cargo handling (loading and discharging) and emergency procedures associated with it. One of the ways though which an effective training can be achieved is by using tanker simulators at the training facilities. Simulations gives the crew an opportunity to experience instances that rarely occur in reality but are necessary to trained on so as to have the needed training to act correctly and safely in case of an emergency. Simulation also gives crew the opportunity to extend their knowledge beyond the specific experience. It also provides the crew (deck staff) with the basic knowledge about self-examination as well as offering them opportunity to explore alternative solutions to problems they encounter as they carry out their day to operations. This in turn enhances the safety of working environment and increases the deck crew’s ability to react accurately and safely to different unknown situations.

The general types of the chemical carriers tankers are: specialised chemical carriers, sophisticated parcel chemical tankers and product / chemical tankers. These have been discussed below.

The aim of this study is to define emergency training requirements for tanker crew in particular deck officer and propose basic simulator trainings including sample scenarios.

1.1. Chemical Carriers

Before discussing the general types of chemical tankers, it is important to understand what chemical tankers are. Chemical tankers are liquid cargo ships (carriers) whose specialization is to carry chemical compounds and materials in bulk. They are often rigged with specialized facilities or equipment on board for loading and discharging their load. They are amongst the major types of cargo ships in the maritime industry. It is important to note that they only chemical cargo in liquid form. A number if types of chemical tankers exist, these include:

1.1.1. Sophisticated Parcel Chemical Tankers

Sophisticated Parcel Chemical Tankers consist of up to 40000 tonnes of dead weight. Additionally, they have a number of small cargo tanks that are majorly used for carrying high grade liquid chemicals. These tankers also have their own cargo pump, individual pipeline as well as a separated manifold entrance. It is important to note that the number of these multiple small tanks can be up to 54. Additionally, these tanks are built in such a way that they enhance flexibility so that maximum amount of cargo can be carried, and safety of the carried cargo is assured. The tanks are mainly made of stainless steel (Chemical Tanker Guide, 2011).

1.1.2. Product / Chemical Tankers

Another type of chemical tanker is Product / Chemical Tankers. This tanker category is similar to the sophisticated parcel chemical tankers, but it has fewer a number of cargo tanks and the structure is made of coated steel instead of stainless steel. Additionally, the configuration of the chemical pumps, pipeline and manifold are not as complicated as those of sophisticated parcel chemical tankers. Even though they can heavy chemicals just like sophisticated parcel chemical tankers, their cargo is not as heavy as that of the sophisticated parcel chemical tankers (Chemical Tanker Guide, 2011).

1.1.3. Specialised Chemical Carriers

Specialised Chemical Carriers have specialised features for handling special cargo as per the trade agreements. They usually carry one type of cargo at a time. Additionally, their cargo is not specialising in any way. This cargo may include heavy acids, vegetable oils, fruit juice, molten sulphur, methanol, wine and molten phosphorus (Chemical Tanker Guide, 2011).

1.2. The Basics Requirements for The Tanker Ship Operations

Loading Operations

Loading operation mainly involve transfer of the cargo to the vessel from the terminal. Chemical tankers have specialised loading equipment to ease this operation. Loading of chemical cargo into a vessel require utmost care and due diligence right from the beginning to the end of the operation. This due to hazardous nature of the chemical products. These chemicals can cause injury to the deck crew, damage the ship itself, pollute the sea water and kill sea life. Therefore, careful consideration is always needed to ensure safe operation during loading. (House, 2005).

Discharging Operation

Discharge operation mainly involve transfer of cargo from the tanks of the vessels to other vessels or to the terminal. Also, owing the toxicity, corrosivity, flammability and other properties of the chemical cargo, chemical tankers are fitted with equipment specialised in discharging the cargo from the ship (ISGOTT, 2006).

Cargo Sampling and Ullaging

Another important aspect of the cargo is Cargo Sampling and Ullaging. Cargo Ullage mainly involve measuring the cargo so as to determine the volume and mass of cargo. This is important since it enables relevant authority to know the exact volume and weight of the cargo the ship the is carrying there averting any potential overloading (ISGOTT, 2006).

To ensure that reliability of the equipment and devices used should be calibrated, tested and certified once a year by authorized company or technicians (Strofades, 2012).

Inerting

This operation mainly involves introduction of inert gas into the tank carrying the chemical cargo so as to attain an inert condition (ISGOTT, 2006). This prevents the cargo from reacting with elements. This ensures that the quality of cargo is maintained throughout the journey (ISGOTT, 2006).

Ballasting

Ballasting mainly involves pumping of sea water into the vessel (special ballast tanks) so as to ensure that the ships stability, structural integrity and trim is maintained throughout the journey. Ballast (also known as ballast water) is just sea water pumped into the ballast tanks (ISGOTT, 2006).

Gas Freeing

This involves introduction of sufficient amount of fresh air into the compartment of the tanker or container so as to lower toxicity, flammability, or inertness of the compartment (ISGOTT, 2006). This is often done for a specific purpose. It is occasionally defined that this operation most hazardous and dangerous period of tanker operations (Roberts, 1995).

Tank Cleaning

Another important operation associated with tankers is tank cleaning. This involves removing of residue, liquid or hydrocarbon vapours from the tank. This is often done when access to the tanks is needed for hot work or for inspection purposes (ISGOTT, 2006).

The additional risk created by cargo gases discharged from tanks cannot be overemphasized. Depending on the final load carried in the tanks to be cleaned, toxic, flammable, and corrosive vapours should be opened on and around the cargo deck area. Therefore, all possible care should be taken during all operations related to tank cleaning and degassing, and operations should be carried out using procedures and regulations approved for the ship (Tanker Safety Guide Chemicals, 2002).

1.3. The General Hazards Associated with Chemicals Transported by Chemical Tankers

The chemicals transported by these chemical tankers can be in a number of physical states on depending on pressure and temperature under which they are stored or needed. Chemicals often behave differently are different physical states. For instance, in liquid state, methanol can release poisonous gases which can be health risk as they can cause suffocation and subsequent death. The general hazards that may associated with these chemicals are:

1.3.1. Toxicity

Toxicity of a chemical substance is its ability to damage the nervous system, human tissues, skin and cause death when it comes into contact with skin, inhaled or adsorbed into the body through all manner routes. It is, however, important to note that the toxicity of a chemical or biological substance mainly depend on the quantity exposed to and duration of exposure. Because of this, toxicity can be categorised as chronic toxicity and acute toxicity. Chronic toxicity is as a result of long-term exposure while acute toxicity is because of short-term exposure.

1.3.2. Flammability

Another hazard that may be associated with chemicals that are transported by the chemical tankers is flammability. As explained flame is the event in which the flammable gases in a material catch fire if the atmospheric and heating conditions are right. If the material (chemical) is too thin or too thick it cannot catch fire. The flammability of the substances is defined as upper flammable limit (also known as UFL) and lower flammable limit (LFL) (Roberts, 1995).

Explosimeter and multi gas detectors are devices that is used to determine the content of hydrocarbon flammable gases in the atmosphere of pump room or tank spaces on ships. The sample should be taken from as many places as possible particularly from tank bottom to provide an accurate result (Marine Insight, 2019).

1.3.3. Corrosivity & Corrosion

Chemical substances (chemical cargos) may also be associated with corrosiveness. Corrosive hazard of chemical cargo (specifically to people) is the rapid destruction of the human tissue. These tissue destructions are often irreparable and irreversible.

It important to note that in each type of cargo there are various types of hazards that can cause injury to human health, and the material which the tanker is made of. Therefore, IBC (International bulk chemical) code is often observed when these corrosive materials are being manufactured.

Corrosion is defined as the destructive and unintentional degradation of a material caused by its environment A common type of corrosion is rust, which is found on iron and steel structures. In this type of corrosion, the iron is reacting with oxygen to form iron oxide compounds (School of Materials Science and Engineering Faculty of Science, 2013).

1.4. International Conventions Related to Chemical Tanker Operation on Standards of Training, Certification, and Watchkeeping for Seafarers (STCW)

Since 1978, Standards of Training, Certification, and Watchkeeping for Seafarers (abbreviated as STCW) has been establishing international basic requirements needed by the seafarers in order to be certified of the safety standards. Before International Convention on Standards of Training, Certification and Watchkeeping for Seafarers was established, the certification, safety standards and ratings were being carried out by individual governments as well as individual certification offices. This was done without reference to what is being carried in other nations. This means that before the establishment of the convention, standards and procedures regarding the safety of the seafarers varied widely. Because shipping industry is an international affair, a standard covering all the nations was necessary and this where STCW comes in. STCW is tasked with setting the minimum requirements (regulations) for watchkeeping, certification and training practices and rules. It also sets the type of causes the seafarers need to undergo before beginning to carry out their duties.

These regulations (minimum requirements) are contained in the convention and supported in the STCW (2010) code. These requirements are explained in different sections of the STCW code: Part 1 and Part 2. Part 1 of the code mainly contains mandatory regulations while Part 2 of the code contains details of the recommended requirements. This is mainly to help the trainees and the trainers understand all the aspects of the code they are interested in. Measures that are suggested as guidance but are not mandatory are included in the convention.

1.5. Tanker Vetting and Inspections

Vetting involves assessment as to whether or not a vessel is suitable for chartering services by major chemical cargo companies. It is the process by which major oil and chemical companies (charterers) assess whether or not a vessel is suitable for chartering for chemical cargo transport companies. It is mainly applied so to maintain the safety of the operators of vessel (tanker). The main objective of those carrying out vetting is to provide additional safety observation and perspective of the vessel. Another intention of the vetting process to prevent pollution of the maritime environment as well as protecting sea and marine life. When these vetting requirements are met, the vessel is relatively safe to the operators, sea life and the maritime environment in general.

Inspection (vetting) of tankers can be done in a number of ways. Initially, this process was being done by an experienced mariner who used his or her knowledge to make their own judgement on the worthiness of the vessel they are inspecting. Since then tremendous development has been made in the recent years and the process is now complex and techniques such as decision modelling are now applied.

Since commercial decisions in the chartering departments are often quickly made, the vetting process of the vessel has been designed to quick thereby meeting the demand of the chartering department. It is, however, important to note that achieving this milestone has been a walk in the park (has not been easy). To meet this objective, information required for the vetting process is always gathered in continuous process and updated in a database such that when information about the worthiness of a specific vessel is needed such when the vessel is offered for charter, it is easily accessed. This is because such data is already in possession of the vetting department of the various charterers department (Knowles, 2010).

A number of authorities usually offer tanker inspection services. These authorities are: Port states, Flag states, Coastal States (for MARPOL related issues), shipping companies, Tanker Vetting Companies (such as SIRE and CDI), Insurance Companies (especially in case of any damage or lose), Shipping companies and Classification societies. It is however important to note that these inspections are based on International Convention for the Prevention of Pollution (MARPOL) and Safety of Life at Sea (SOLAS) and are usually supported by International Ship and Port Facility Security (ISPS) and Institute for Supply Management (ISM). Of these inspections two are usually applied to the tankers, they are: Chemical Distribution Institute (CDI) and Ship Inspection Report (SIRE). They have discussed in detail as shown below.

1.5.1. Major Tanker Vetting Companies

Number of institutes normally provide vetting services to tankers. Here, two vetting inspections are discussed in the Chemical Distribution Institute (CDI) and Ship Inspection Report (SIRE). It is however important to note that some tanker companies often apply additional vetting to their vessels. They also do this additional vetting to vessels they are planning to charter. Some of these companies are: Shell, Total, Exxon and BP.

Chemical Distribution Institute (CDI): This inspection is specifically designed for vetting or inspection of gas tankers and chemical tankers. The main intention of this inspection is to provide a complete report of the vessel being inspected with a scoring system of the vessel being vetted. These scores are usually considered after vessel inspection and it indicates how the vessel has complied to the set safety and quality standards of the maritime industry. It is important to note that a higher score is only given when the vessel being inspected has complied with the industry standards (Pac Marine, 2011).

Ship Inspection Report (also known as SIRE). This is inspection program that was launched in 1993 to address the issues associated with substandard shipping. It is a unique risk assessment tool which is of great value to the stakeholders of the shipping companies such as the ship operators, government departments, charterers, terminal operators and other bodies concerned with the safety of the vessel being inspected. The program has a wide database whose content (risk assessment) is available for access by the relevant government bodies. The database often contains up to date information regarding the safety of barges and tankers. The up to date information about many vessels are stored in the database making it very big and very reliable.

The focus of the SIRE program is to ensure that tankers are safe and satisfactory safety guidelines are maintained. The intension of this is to ensure that enhance awareness of the of the vital safety elements associated with a specific vessel.

The program is generally accepted and has been assimilated in the shipping industry since its introduction into the industry. It has been accepted by the various stakeholders of the shipping industry ranging from ship owners to Oil Companies International Marine Forum (OCIMF) members, and to program recipients. Today, even small vessels and barges have accepted the program. As result, these vessels (barges and small vessel) have been under SIRE inspection since 2004 (SIRE, 2006).

1.5.2. Non-Conformities Related to the Cargo Systems of Tankers

The reports on non-conformities related to the cargo systems of tankers are often prepared by port and flag states, tanker operators, and classification societies. The non-conformities and deficiencies are often done with regard to the criteria below:

i. Non-conformities associated with the deck crew
ii. Non-conformities associated with equipment; and
iii. Non-conformities associated with cargo operations.

Human error costs the maritime industry $541 million per year, as per the findings of the United Kingdom Protection and Indemnity. A study of 6091 major accident claims (i.e., over $100,000) associated with all classes of commercial ships, conducted over a period of 15 years by the UK P & I Club, revealed that 62% of the claims were attributable to human error (UK P&I Club, 2013).

1.5.3. Regulations Which Regulate the Tanker Operations

The various regulations that guide the operations of tankers are:

- Safety of Life at Sea (SOLAS)
- International Convention for the Prevention of Pollution from Ships (MARPOL)
- Standards of Training Certification and Watchkeeping (STCW)
- Bridge Procedures Guide (BPG)
- International Oil Tanker and Terminal Safety Guide (ISGOTT)

- Maritime Labour Convention (MLC 2006)
- Convention on the International Regulations for Preventing Collisions at Sea (COLREG)
- International Ship and Port Facility Security (ISPS CODE)
- Marine Environment Protection Committee (MEPC)
- International Code for Fire Safety Systems (FSS CODE)
- Life-Saving Appliance (LSA CODE)
- International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC CODE)
- IMO Maritime Safety Committee (MSC) recommendations, resolutions and communiques
- Mooring Equipment Guidelines (MEG)

1.6. Tanker Simulators

In the past, training the deck crew members was accomplished theoretically but things have changed with technological development. Technology today has revolutionised training of the deck crew about their safety. Simulations have allowed trainees to exposed to real events making them ready for actual emergencies. This not possible in the past as most of the training were just in theory. It was only during emergency the deck crew were exposed to real life events. Simulators are capable to providing all the standard operations of chemical tankers, including:

i. Ship to ship (STS) operations.
ii. Operations associated with tank cleaning.
iii. The simultaneous discharging and loading of the parcel cargos.
iv. The real-time monitoring of tank and ballasting
v. Real time monitoring of atmospheric conditions with gas freeing, inerting, purging or nitrogen padding.

2. RESEARCH METHOD

2.1. Justification of the Research

Chemical tankers are a type of cargo ships built or modified so as to transport any liquid chemicals. Due to the nature (flammability, toxicity and corrosiveness) of the chemicals they are carrying special safety aspects need to follow to ensure that these chemicals are safely handled. Because handing these chemicals may challenging, deck crew may require special training which should not only be done theoretically but also practically. Offering practical and real world training on handling such chemicals can be achieved through training in simulators. In the simulators, the crew can experience real world situations and accidents that might encounter in future while carrying out their duties and how to effectively handle these situations.

The training of deck crew in chemical tankers is aimed at guaranteeing safety and have less environmental impact while loading, transporting, and discharging chemical cargo. Training through simulators offers the crew an opportunity to face situations and provide solutions to these problems as if they were occurring in real world. This enhances the response of the crew in case such problems occur in real world. Additionally, simulation makes the crew familiar with faults they encountered during training and how to effectively tackle the faults when they occur in real world situations.

2.2. Research Aim

This study aims to investigate to provide a better solution for the simulator based training for chemical tankers' crew so as to provide safety on board the chemical tankers for these officers. Creation of more effective scenarios that ensure the achievement of the training objectives for the loading, discharging and application of emergency procedures will be achieved at the end of this study.

2.3. Research Objectives

The objectives of this study are:

i. To identify the major training deficiencies if simulation is not applied in training

ii. To propose how simulators can be used to enhance the training the deck crew and how it can be effectively applied.
iii. To provide recommendations for the design of the simulator instructional process for deck crew, in particular deck officers.

2.4. Methods

To achieve the above objectives, Meta-synthesis method was applied. This was then supported by structured interviews with relevant people. The research starts with literature review and conducting meta-synthesis from the previous studies. Following that the findings of the structured interviews to realize proposals from the experienced seafaring officer and port operators. Observation of respective organizations such as IMO (International Maritime Organization), MAIB (Marine Accident Investigation Board), NK (Nippon Classification Society), OCIMF (Oil Companies International Marine Forum), CDI (Chemical Distribution Institute) etc. are also considered.

3. RESEARCH

3.1. Simulation

Simulation gives trainees an opportunity to experience rare real-life dangers associated with their areas of workers and thus enhancing safe working atmosphere. It also enables the crew to respond in a correct manner when such occurrences happen as they have already experienced it, though in a simulation set up. Going beyond the normal theoretical training and experiencing the consequences of the certain acts gives the trainees a better understand of the situations and training experience. Additionally, simulation helps improving their decision making and problem-solving skills. The problem of skills is sharpened by exposing them to real problems that require their input to be solved. Testing and training of the crew in certain problems may not be possible real world setting as when they in ship they occur for real and survival of the vessel (ship) depends on the crews' reactions and actions during the emergency. Therefore, simulation is extremely important.

Even though STCW-95 does not make mandatory simulator training in all instances, simulator-based training is suitable in all the activities being carried out on board. Therefore, subjecting the crew to the simulator training makes all round individuals who effectively react to many problems facing the ship in case of distress. It is also important in enhancing the ability of the crew members to make the right decisions in high stress conditions.

Finding: In other jobs, those involved have opportunity to make mistakes and gain relevant knowledge and experience from it. This is not the case for chemical tanker crew members. These crew members cannot learn from mistakes as these mistakes may sink the whole ship, cause dangerous spills into the ocean thereby affecting marine life, cause fire or toxic gases or liquid may affect those on board. Therefore, when it comes to training of seafarers, simulation training is extremely important.

3.1.1. Developing an Effective Training Program

One of the most important aspects in simulation training is how to use simulators and how the training is delivered. Even if the latest simulation technology is adopted and there are no proper training programs put in place, the simulation training may not provide any extra benefit. Therefore, the most important thing in simulation training is assessing whether the simulation training is providing extra benefit or not. An efficient training program takes into consideration student needs regard to their knowledge and experience. (Drown and Mercer, 1995)

Such training entails all aspects of training from the computer-based training of the personnel to simulation-based training. An example of training process is shown in Figure 1.

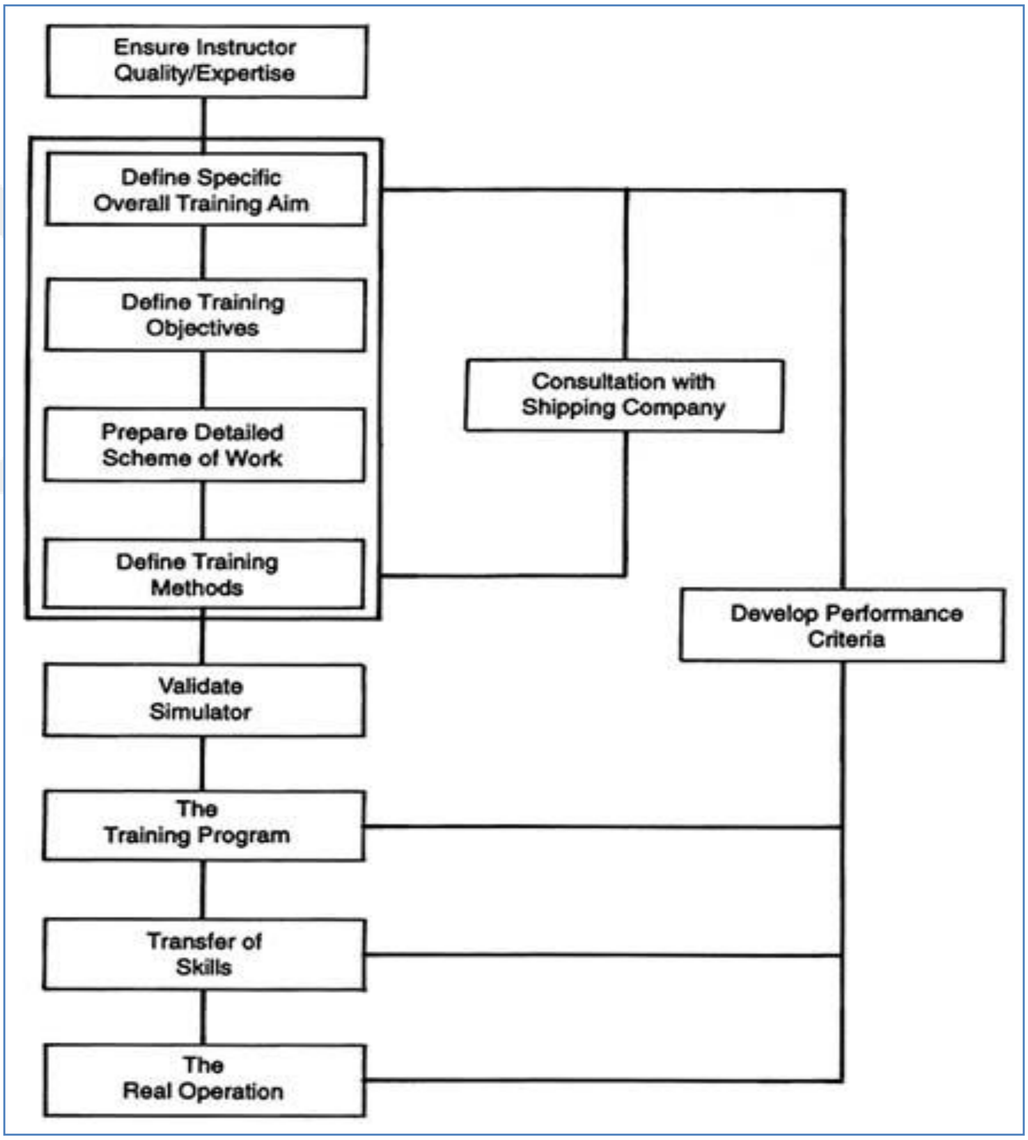

Figure 1: The Training Process Table

(Source: https://www.nap.edu/read/5065/chapter/5#69)

Finding: Through literature and surveys, it was found that even though simulator training may enhance experience and knowledge of the crew members, the design of the of the training process is equally important. However how latest the simulation technology can be, the success of training only depends on how that knowledge is delivered to the intended recipients. Because of this training programs should be well designed. The research, therefore, one of the objectives (aims) of the study is to provide recommendations for the design of the simulator instructional process. It is proposed that the instruction design should be developed in such a way that it improves the training process by the instructors. This is proposed to include: continuously adding new information to the training programs and examining the performance of the existing system so to identify areas that may need improvement. Figure 1 above shows the plan for the proposed training program. It is hoped that the proposed approach of administering the simulator training programs will have positive effect on the trainees and training in general.

3.1.2. Elements of Instructional Design Process

The success of the any training depends on the design the instructional process. In this regard, the major elements of instructional design process include:

i. Understanding the specific training needs and the student's knowledge background.
ii. Identifying objectives of the training.
iii. Determining the training material and content need in order to successfully complete the training.
iv. Determining methods of training
v. Identifying the relevant sources of knowledge and using them in training.
vi. Identifying and understanding the experience of the students and trainees.
vii. Understanding the experience and knowledge of the trainers (instructors) and assigning instructors to instruct in the areas they have knowledge in.
viii. Training media to be used.
ix. Training the instructors so as to ensure that they are qualified in their fields.
x. Ensuring that the instructors are certified with the relevant certification bodies.

xi. Carrying out cost benefit analysis and effectiveness of the proposed training program.

Additionally, the development of the training program should consider a number of factors such as:

i. Cost-benefit analysis
ii. Experience of the students
iii. The media to be used in the training the students
iv. All the elements of the training program which in this case is elements associated with simulator-based training.

Finding: As mentioned earlier, the success of training programs depends on the design the instructional process. In this regard, it was found that design the training programs involve several steps and steps to be taken should take into account real facts on the ground. These have been explained previously.

3.1.3. IMO Simulator Types

According IMO's simulator acceptance, the chosen simulator should be able to adapt to the continuous upgrades of the marine simulators. In this regard, IMO records 4 categories of simulator (Board, 1996)

which includes:

i. Limited-task simulators
ii. Special-task simulators
iii. Full-mission simulators; and
iv. Multi-task simulators

These have been discussed below.

Category I: This category includes full duty (task or mission) simulators. These simulators can provide a simulation of visual navigation bridge (Rojas, 2002). The simulation is also capable of simulating advanced manoeuvring as well as offering necessary training on pilotage in restricted waterways That is, the simulation is capable of simulating the real bridge with its full operations including pilotage

Category II: This category includes multi-task simulation. Just as category I (Full mission simulation), this simulation can simulate the full visual navigation bridge. It is, however, not cable of simulating advance manoeuvring in restricted waterways. That is, this simulation is similar to simulation in category except operations.

Category III: This includes limited simulation: This type of simulator can simulate a blind navigation and avoidance of collision. That is, it mainly used in simulating environment with limited instrumentation.

Category IV: Special Task Simulation: This type of simulation is capable is simulating bridge operations. It is also capable of simulating limited navigation situations. It is, however, important to note that operator is located out the simulation environment. This means that it mainly involves the using of a desktop simulator in simulating bird-eye of the ship operations or operating area. That is, this simulation only includes some of the equipment from third person view.

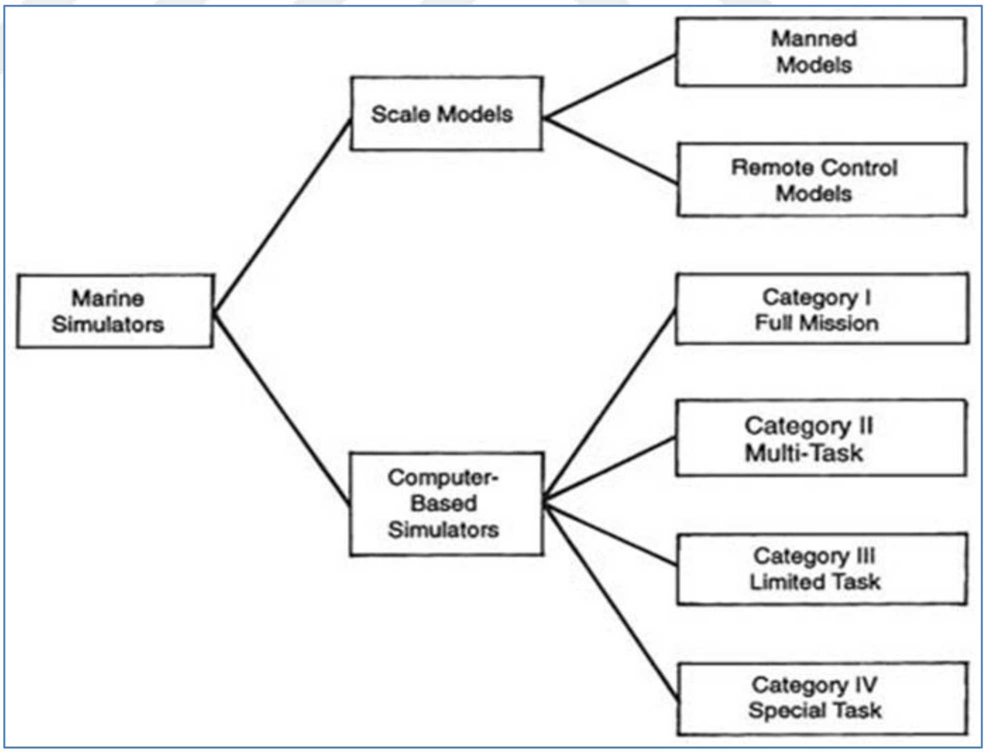

Figure 2: Types of Marine Simulators

(Sources: https://www.nap.edu/read/5065/chapter/4#41)

Findings: Through meta-analysis and literature review, it was found that even though IMO does not regulate STCW guidelines, STCW guidelines include development and certification progress which include performance standards and guidelines associated with marine simulations. It was found that international Maritime Lecturers Association which is a professional organization of marine trainers and educators, and International Marine Simulator Forum are working to prove and support the STCW guidelines. As a result, it is expected that IMO and STCW standards will contain the minimum requirements for simulation of safe cargo handling and operations. Therefore, the simulation trainings will be do in according with IMO International Maritime Standards and STCW guidelines.

3.1.4. STCW Requirements on a Simulator Based Training

STCW examines simulators in three topics, namely:

a) Training and assessment.

b) Use of simulator.

c) Minimum standards of competencies.

Under training simulators and assessment of the seafarers, STCW has outlined guidelines using the following regulations:

• Regulation-I/6-Training and Assessment.

• Section A-I/6-Training and Assessment (Mandatory).

• Section B-I/6-Guidance regarding Training and Assessment.

These have been discussed as below.

3.1.4.1. Regulation-I/6-Training and Assessment

This regulation requires that all parties (trainers and trainees) to ensure that training as well as assessment of the seafarers are done in accordance to STWC Code A, and that all trainers and instructors are appropriately competent and qualified to carry out their tasks (STCW 78, 2017).

3.1.4.2. Section A-I/6-Training and Assessment (Mandatory)

This section provides guidelines on training using simulator. According to the section, in case training is being done or to be done using simulator, the following guidelines should be adhered to:

- The trainer should take an appropriate guidance in instructional techniques including the use of simulators

- The trainer to have practical operational experience on the particular type of simulator being used for the training.

Additionally, the trainer should have appropriate and sufficient training on the practical assessment on a particular simulator under the supervision of an experienced instructor (IMO Model Course 6.10, 2012).

3.1.4.3. Section B-I/6-Guidance Regarding Training and Assessment

This section gives guidance to comply with Code A. It also gives explanation on IMO Model Courses for the Instructors as well as seafarer's training and certification. Under this guidance, there is special section on the which gives guidance and regulation on the use of simulators. These have been given under the following topics:

- Regulation-I/12-Use of simulators.

- Section A-I/12-Standards governing the Use of Simulators (Mandatory).

- Section B-I/12-Guidance regarding Use of Simulators

3.1.4.4. Regulation-I/12-Use of Simulators

This regulation provides necessary guidance for the performance standards of the simulators that are used for the purposes of training and certification of the seafarers and their compliance with STCW (STCW 78, 2017).

3.1.4.5. Section A-I/12-Standards Governing the Use of Simulators (Mandatory)

This section is divided into two parts: Part 1 and Part 2.

Part 1**:** This part gives guidance on the performance standards of the simulators can be used to train of seafarers. Under this regulation, STCW requires realism for both behavioral and physical from the simulators for appropriate training and assessment objectives. Possible errors and capabilities should take place within the simulation.

Additionally, it is required that simulators used for training purposes should be able to simulate unusual, emergency and hazardous situation so as to ensure that training environment is effective. It is also required that the instructor is able to control system.

Each Party shall ensure that any simulator used for mandatory simulator-based training shall include:

1 Be suitable for the selected objectives and training tasks.
2 Be capable of simulating the operating capabilities of shipboard equipment concerned, to a level of physical realism appropriate to training objectives, and include the capabilities, limitations and possible errors of such equipment.
3 Have sufficient behavioral realism to allow a trainee to acquire the skills appropriate to the training objectives.
4 Provide a controlled operating environment, capable of producing a variety of conditions, which may include emergency, hazardous or unusual situations relevant to the training objectives.
5 Provide an interface through which a trainee can interact with the equipment, the simulated environment and, as appropriate, the instructor; and
6 Permit an instructor to control, monitor and record exercises for the effective debriefing of trainees.

Part 2: This part offers other guidelines on training and assessment procedures regarding simulator trainers and assessors. Specifically, it requires that simulator assessors and trainers to have a standard conduct of simulator training. STCW foresees briefing, planning, familiarization, monitoring, and debriefing to be part of any simulator-based exercise. It also shows the importance of guidance and exercise by the instructor during the monitoring and use of the peer assessment technique in the de-briefing stage. Simulator exercises are required to be designed and tested by the simulator instructors to ensure their suitability for the specified training objectives (STCW 78, 2017).

3.1.4.6. Non-mandatory Simulators

STCW has stipulated guidelines for non-mandatory simulator training. These non-mandatory simulator training are:

- Navigation and watch keeping simulator
- Ship handling and maneuvering simulator
- Cargo operation simulator
- Radio communications simulator
- Main and auxiliary machinery operation simulator

Finding: From the STCW review it was found that simulation of cargo handling using cargo handling simulators are not mandatory as per STCW requirements. But owing to the importance of cargo handling (which includes loading and discharging of cargo) and fact handling of cargo carried by chemical tankers is require special attention, cargo handling simulations especially handling of the liquid chemical cargo should be made mandatory. And guidelines for simulation of handling such cargo during training be developed and clearly outlined.

3.2. Fundamental of Tanker Simulator

The main aim of tanker simulator is offer trainees a practical opportunity to apply what leant in theory to practical world setting as required by MARPOL 73/78, STCW 78 and other rules guiding training of the crew responsible cargo operations. It is, however, important to note that STCW does not make mandatory simulator training in all instances. Rojas (2002) that “It is only made mandatory when crew is undergoing radar and Automatic radar plotting aid (abbreviated as ARPA) training. In other cases, approved simulator training may be offered but it is not mandatory. The specific training activities in which the use of simulator is not mandatory are: cargo handling, propulsion, ship handling, auxiliary equipment and Global Maritime Distress Safety System (abbreviated as GMDSS) communication”. Nowadays, more than 86% of all SOLAS vessels are manned with multinational crew (Trenkner, 2007)

Rojas (2002) and Udoh et al (2017) says Further according to STCW-95 (under simulator training), even though simulators need to comply with the required standards, they do not need to be expensive and or have complex electronic gadgets. These simulators can just be ship models and used in training safety aspects such understanding ship stability. Even simple gadgets such as an orange can be used simulators in first aid training. It is important to note as stipulated by STCW-95 simulator training, the instructors in simulator training also need to be qualified in offering training in the equipment they are handling.

Finding: Even though the purpose of tanker vetting is to ensure incidents caused by tankers are decreased by taking all necessary precautions as well as providing provide necessary safety trainings, failure to subject the trainees to simulated “real” situations before going to the sea may make them unprepared in very rare instances especially when they occur. As result it is suggested simulator training guidelines stipulated in STCW make it mandatory that all aspects of training should involve simulator. It is also suggested that all the training and ship vetting be carried in accordance with STCW . Therefore, by considering the importance of real practical experience, this research creates the foundation for adoption of simulation in training of deck crew members.

3.3. Dangerous Goods

There are a number of codes that regulate and provide guidelines for handling and transporting dangerous goods by tankers and container ships. Some of these codes are: The International Maritime Dangerous Goods (IMDG) Code; International Convention for the Prevention of pollution from Ships (MARPOL) and International Convention for the Safety of the Life at Sea (SOLAS). Chapter VII of SOLAS covers the carrying dangerous goods with 3 parts (SOLAS 74/78, 2020). The International Maritime Dangerous Goods (IMDG) Code designed to uniform the international code for the tankers and containers carrying dangerous goods. While International Convention for the Safety of the Life at Sea (SOLAS) and International Convention for the Prevention of pollution from Ships (MARPOL) regulate the carriage of dangerous goods and marine pollutants on board. The International Convention for the Prevention of Pollution from Ships (MARPOL) is the main international convention to prevent of pollution of the marine environment by ships from operational or accidental causes with 6 technical annexes (MARPOL 73/78, 2017)

It is important to note that both SOLAS and MARPOL's relevant parts worked out in great detail and are included in the International Maritime Dangerous Goods (IMDG) Code. This was done so as to make the Code the legal instrument for maritime transport of dangerous goods and marine pollutants. Effective 1st January 2004, the IMDG Code became a mandatory requirement.

It is also important to note that in all modes of transport (including sea, air, rail, road and inland waterways), the classification of dangerous goods (which is done in accordance with by type of risk involved) is carried out by the United Nations Committee of Experts on the Transport of Dangerous Goods (abbreviated as UN).

Finding: With regard to classification of the dangerous chemical tankers, it was found that the most dangerous chemicals that can be carried by chemical tankers are classified under Class 1, 2 and 3 (Explosives; Gasses which can be Compressed, Liquefied or Dissolved under Pressure; and Flammable liquids respectively). It was also found that with regard to pollution, MARPOL Annexes I, II and III (Regulations for the Prevention of Pollution by Oil, Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk, Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form) gives guidelines and procedures are related to these dangerous goods. Thus, scenarios should include measurements for these dangerous goods.

3.4. Chemical Tankers Vetting and Inspections

One of the most important aspects of any sea transport, is the safety of the crew, safety of marine life, safety of the environment in general and safety of the ship. Any defects on the ship or mishandling of situations by the on-board crew members may result in accident. It is for this reason chemical that since 2004, all tankers in the industry are part of SIRE inspections. Additionally, chemical tankers are also subjected to CDI inspections. As discussed earlier, these inspections measure the quality of cargo handling equipment quality so as to ensure the suitability of tanker vessel's cargo handling operations as well as the general safety of the vessel. SIRE also gives guidelines on fresh and essential knowledge about training requirements on-board and on land so as to ensure that the knowledge of officers fresh and up to date. Therefore, it can be said that SIRE inspection investigates officers and vessels for those training requirements.

The report by (Class NK Port State Control, 2019) has shown that in 2016 2.5% of ships detained around the world for failing inspections were oil and chemical tankers. This number dropped to 2% in 2017 and slightly increased to 2.1% in 2018. This has been shown in Figure 3 below.

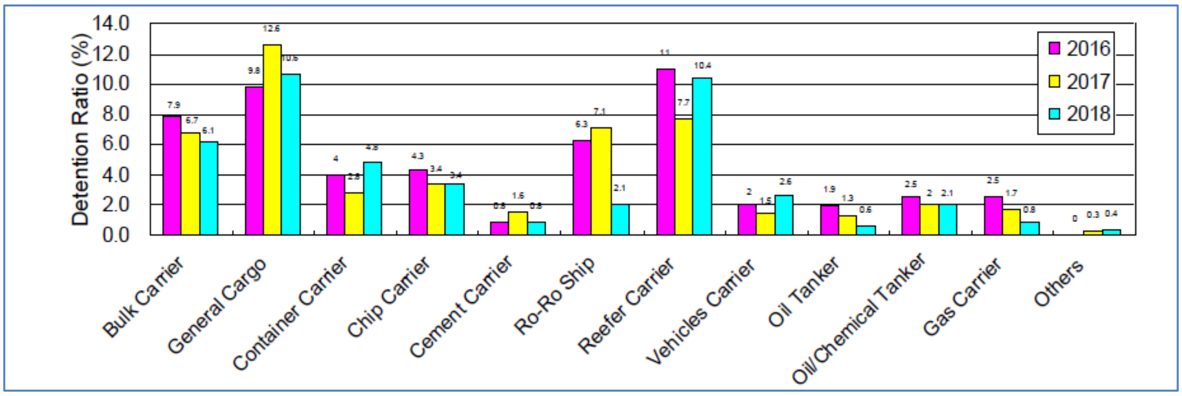

Figure 3: The percentage of the types of ships detained worldwide for failing safety inspection (Source: Class NK Port State Control, 2019).

Some of the safety issues (safety defects) identified during these inspections are shown in Figure 4 below.

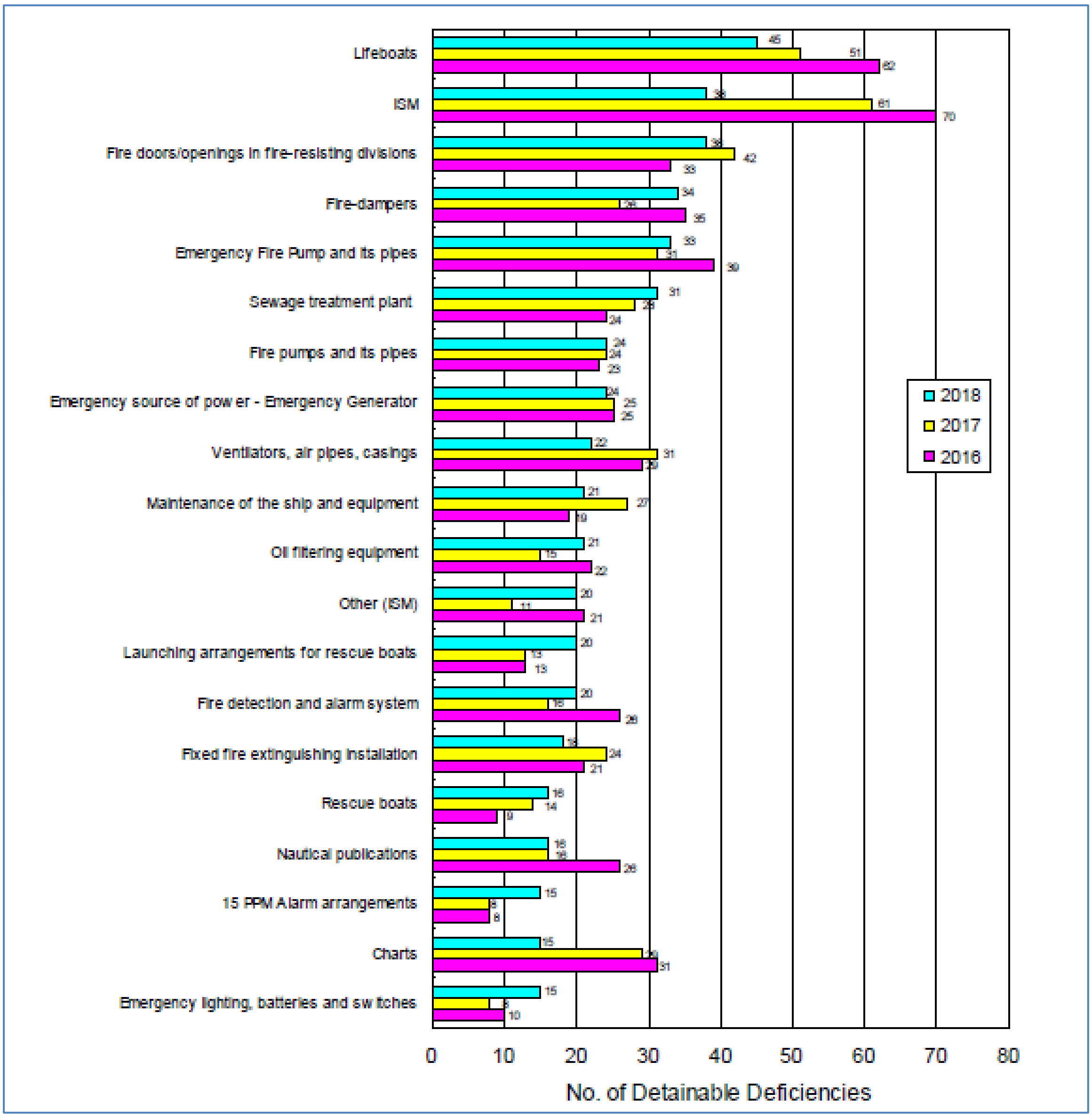

Figure 4: Some of the safety issues identified in ships around the world between 2016 and 2017 (Source: Class NK Port State Control, 2019).

Vetting of tankers was mainly carried out by an experienced mariner who used their own opinions and judgements to decide whether or not tanker was worthy for chartering purpose it has applied for. With technological development, and expansion of education and expertise, the vetting of tankers is no longer an individual affair but tasked to specific institutions specialised for vetting. As result, the current tanker vetting process is detailed and employs up to date technology which enhance the decision being made.

Since commercial decisions in the chartering departments are often quickly made, the vetting process of the vessel has been designed to quick thereby meeting the demand of the chartering department. It is, however, important to note that achieving this milestone has been a walk in the park (has not been easy). To meet this objective, information required for the vetting process is always gathered in continuous process and updated in a database such that when information about the worthiness of a specific vessel is needed such when the vessel is offered for charter, it is easily accessed. This is because such data is already in possession of the vetting department of the various charterers department (Knowles, 2010).

The vetting process is often carried out in a few stages in accordance with Knowles (2010), these stages are:

Stage 1: This involves identification of all vessels available for intended voyage and cargo operations.

Stage 2: After vetting group has identified each tanker offered for a particular cargo/voyage in stage, stage 2 involves linking the data of the identified tanker with the information given in database.

Stage 3: Vetting staff them start the examining the identified vessel if is still included to charter by the company, not banned or excluded. Exclusion may result from circumstances such as:

a. Overall poor fleet performance.
b. Failure to supply relevant vetting data
c. Involvement in an incident, the causes, corrective and preventive action of which have not been accepted by the charterer
d. Poor inspection results of the tanker or fleet
e. Ongoing mechanical problems
f. Unresolved issues raised by a terminal
g. It is a tanker operator that has not yet been reviewed by the charterer.
h. Banned from a terminal or port at intended voyage

Having passed stage, the vetting goes to stage 4 which is described below.

Stage 4: After the identified vessel has been accepted, risk assessment is carried out which includes examining the vessel compatibility with laid down procedures and guidelines. If any deficiency founded, the evaluation report is prepared to notify the ship owners. Additionally, the information about the identified deficiency is then passed to the chartering department for their necessary action. Based on the report recommendations, the chartering may proceed with the vessel or abandon it for another seaworthy vessel.

Stage 5: As explained earlier, based on the vetting report, the vetting department may decide to reject a vessel for the intended purpose. If this is the case, the reason for rejection is clearly stated. Additionally, all available actions that can be considered so as the make vessel seaworthy again are also clearly stated in the report. These actions should be agreed upon by all parties and usually will be included in the charter party conditions. (Knowles, 2010).

Finding: These stages can be used for creation of the stages/ sequences of scenarios.

3.4.1. CDI Inspection

CDI Inspection Goals

Since chemical tankers and liquified petroleum gas tankers carry dangerous goods, they need to be continuously inspected so as to eliminate or significantly reduce risk that may be associated with handling these dangerous goods. It is important to note that these tankers can be categorised using a number of criteria: intended area where the vessel is supposed to sail; their purpose; and according to the type of cargo they designated to carry. During the operation of these chemical tankers, CDI inspections are continuously carried out so as to control risk that may be associated with handling these types of goods.

Inspection is usually carried out to determine whether a chemical tanker is suitable for the purpose it is assigned. The main aim these inspections is to identify any defects to the tanker which may include: fire safety such as fire dampers, fire detection, fire pumps and its associated pipeline; ventilation; fire extinguishing system and so on; Lifesaving appliances such as life boats, rescue boats, inflatable life crafts, embarkation arrangement survival craft, launching arrangements for rescue boats, and launching arrangements for survival craft; emergency system; safety of navigation; alarms; ship structural conditions;

compliance with MARPOL Annex I, MARPOL Annex IV, and so on (Class NK Port State Control, 2019).

It is, however, important to note that owing to the dangerous nature of cargo being carried chemical tankers, majority of the above discussed inspections as well as other inspections (not discussed here) are carried on them on the behalf of the Charterer or carrier in all means, and inspection can be carried out with reference to single parcel and single voyage (Snaith, 2011)

It shouldn’t be forgotten that multiple inspections are not only expensive on considerable level and time consuming during vessel’s loading or discharging operations and responsible officers from these operations; they are also putting considerably much pressure on officers and related sea workers such as deck cadets or engine cadets.

One of the main goals of CDI as an inspection provider, reduce the number of these inspections to acceptable levels and numbers but replace them with the single and regular inspection as a standard for all related vessels. The philosophy behind this aim is defining fundamentals of risk management onboard which is already under application on liquid bulk carriers, also CDI aims to apply this philosophy on terminals too. (CDI, 2009).

As aforementioned, CDI has been found in 1994 by the industry of chemistry for the industry of chemistry and all of the elements of the industry to be safer and with more high quality under any circumstances and with proper risk management system with the commitment to Responsible Care and the Code of Distribution Management Practice regulations and also provides to chemical companies controlled risk assessment, scheduled and cost-efficient.

In conclusion. CDI’s role at maritime industry is serving to merchant maritime industry, providing inspection reports in periodical order to the merchant maritime industry on the world fleet of chemical and liquid petroleum gas (LPG) tankers with over 900 ship owners and over 5000 ships participating in the scheme. The inspections of CDI are run by over globally CDI-M Accredited inspectors, all around the world, located at ship terminals and ports. CDI-M provides a single set of reliable and consistent inspection data which chemical companies can use with confidence in their risk reduction process (Introduction of CDI, 2010)

3.4.2. SIRE Inspection

SIRE inspection system, as aforementioned, is one of the biggest and most experienced Programme about tankers and barges. SIRE also has a very large and up-to-date information about the tankers and barges all around the world. As CDI, SIRE is also focused on tankers and after 2004 on barges for their assurance of their awareness about the importance of quality and safety and make sure them to meet the standardized qualification and the level of satisfactory. From the times it has been found to today SIRE Programme, accepted by all members of OCIMF and all members of industry.

The System of Functioning of SIRE

OCIMF member companies commission vessel inspections and appoint an accredited SIRE inspector to conduct an inspection. During this process, vessel should provide a full access to the inspectors for them to have ship particulars, or the inspectors can provide the full vessel particulars from the wide database of SIRE along with the related and appropriate Vessel or Barge Questionnaires (VIQ/BIQ), before the commencement of inspection on-board in a wide range of measurements from pollution prevention policy of the ship and company to cargo handling operations and risk assessments. After the inspection concludes, the related ship's report also includes related ship's owner company's risk assessment in advance of charter. A related report gets uploaded by the assigned inspector for the vessel to the database of SIRE and the old report of the vessel gets replaced by this up-to-date report. The related up-to-date database is accessible by registered companies to the system for a nominal fee. Since its introduction, more than 180,000 inspection reports have been submitted to SIRE. Currently, there are over 22,500 reports on over 8000 vessels for inspections that have been conducted in the last 12 months. On average Programme Recipients access the SIRE database at a rate of more than 8000 reports per month. (SIRE Process, 2014) (ocimf.org/sire/about-sire/). Figure-3 shows increased number of vetting handled by SIRE.

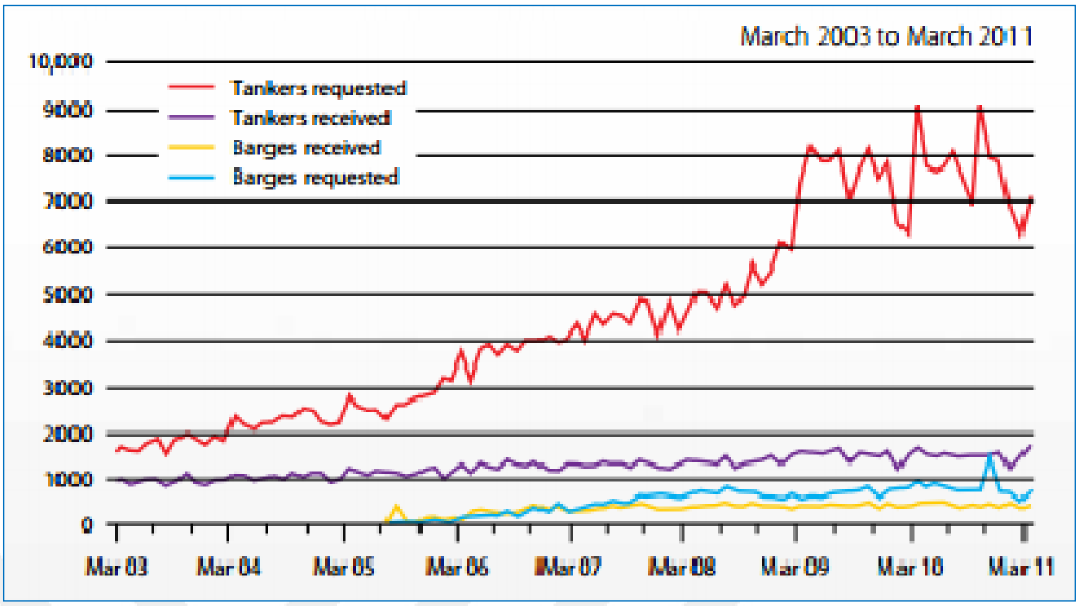

Figure 5: SIRE Reports received and requested per month

(Source : https://www.ocimf.org/media/8874/SIRE.pdf)

SIRE's standardized objectives and running process' aims a systematically examination and inspection over tanker operations and shares these inspections with other OCIMF members and other authorized participants. From the day it has been found till today SIRE, is an instrument to carry out and go beyond the general expectations and behaviours related with operational and safety standards. Until today, SIRE, also contributed to:

- Improved operational standards and a reduced number of incidents.

- The establishment of uniform standards and training for ship inspectors.

- A reduction in the number of repeat inspections on the same vessel, thereby reducing the burden on the vessel's crew (SIRE Process, 2014).

Finding: Both CDI and SIRE are important programmes for vetting for the safe operation of chemical tankers and barges. After every commencement of inspections on-board, officers can collect the outcomes of the inspection and see the deficiencies and shortcomings on board and take actions due to those outcomes. The successful inspection report is an official documentation for a vessel's safety and an assurance that the related ship can for the safe operation of chemical tankers and can run cargo operations in safer environment and less likely to have any emergency during operations.

3.5. Tanker Management Self-Assessment System (TMSA)

The actions taken by OCIMF (Oil Companies' International Maritime Forum), today the tanker industry is more stable and in way more higher standards under the guidelines of Tanker Management and Self-Assessment (abbreviated as TMSA).

TMSA's goals are establishing the best practice and guide to tanker and tanker operators itself to provide the advantage of being the backbone of the oil majors' and, presumably, other oil company's vetting programmes (Gardiner, 2006).

The most important value of TMSA is that tanker operators will inspect their own operational, safety, quality and environmental procedures with the aim of demonstrating continuous improvement. TMSA is based on 'the foundations of the ISM Code. ISM Code provides an international standard for the safe management and operation of ships at sea (ISM Code, 2018).

The aforementioned programme under this title (TMSA) assessed four levels as grade as 1 is lowest and 4 as highest and due to level system, TMSA assesses, if the vessel passed or failed. On the other hand, a company to get '4' out of 4 does not releave the company and its management from further improvements and renovations in its management and operations. After all, a tanker operator, regardless to, perform a clear and continuous improvements on quality on management approach and move forward systematically to safety and better quality (Gardiner, 2006).

Operators should develop their performance in 12 operational areas. TMSA monitored performance areas are shown in the Figure 6 (Drewry Shipping, 2006)

1.	Management, leadership and accountability.
2.	Recruitment and management of shore-based personnel.
3.	Recruitment and management of ship personnel.
4.	Reliability and maintenance standards.
5.	Navigational safety.
6.	Cargo, ballast and mooring operations.
7.	Management of change.
8.	Incident investigation and analysis.
9.	Safety management.
10.	Environmental management.
11.	Emergency preparedness and contingency planning.
12.	Measurement, analysis and improvement.

Figure 6: TMSA monitored performance areas

(Source: Drewry Shipping, 2006)

Vetting of tankers is a process and inspection about its risk assessment and the importance for major oil companies and tanker charterers is undeniable. These inspections are carried out in purpose by major oil companies and tanker charterers for them to find cargo and clients for their vessels to carry their clients' goods. The main and only purpose of tanker vetting is avoided to use of deficient tankers or barges when goods are transported by sea or by inland waterways. Tanker vetting system is the main source for gathering information and data about tankers which has been inspected and have an idea about the related vessel's risk assessment and have an idea to make an evaluation on their system. After this consideration and inspection over vetting system, the tanker will be accepted, rejected or accepted with subjects. Tanker accepted by subjects means that the accepted vessel should improve required conditions and take actions to reduce the risk on-board and improve the safety on-board (Nigro et al., 2005).

Outcomes: TMSA monitored performance areas are important for safety training. These areas will be included in the training programme.

3.6. Expert Views, Risk Assessment and Management

3.6.1. Expert Views

In order to reach the experiments and application of chemical tanker operation five interviews are conducted the experienced, qualified crew working on bord chemical tankers and chemical tanker terminals. The structured interviews used to focus on the emergencies and major deficiencies. Our primary goal was to analyse the problems occurring in chemical tankers and we reached our aim.

The interviews are conducted based on the following questions. Not all but significant parts of interviews are introduced in the following paragraphs.

Interview with OOW M. C. S. **(**2 years sea experience on board chemical tanker**)**

Question 1: What are the main problems during loading and discharging operations?
Answer 1: During loading and discharging operations, without good handling and proper expertise, an error is inevitable. There are some major danger areas which requires special attendance which are: ballasting operations during loading/discharging operations, gauge failure, valve failure, static electricity, failure at executing the cargo plans, slackness at the effectiveness of able seaman on watch, failure at high level/overfill alarms, failure at cargo pumps, generator failures due to over-heat, spillage.

Question 2: What are emergency actions requires during loading and discharging operations?
Answer 2: Gauge changes, manual interventions to non-responding valves, emergency pump usages, constant checks of tank level, and besides the usage of MMC/UTI. Emergency stops are some of the emergency actions that should be investigated.

Question 3: What are the problems related to the ISGOTT application?
Answer 3: Mainly problems are personnel-related which who are not well trained. Problems occurs mainly when applying the guidance such as: gas-freeing, tank cleaning, insufficient

use of fire prevention applications, un-authorized hot work on deck, insufficient knowledge about cargo, use of improper tools (iron hammer instead of a plastic hammer), improper treating and storing cargoes as directed.

Question 4: What is your proposal to solve the main problems?
Answer 4: To prevent these important failures, ships and ship owner companies should keep their ships well maintained and hire experienced officers or train their junior officers to avoid any emergency situations. Planned maintenance and the existence of spare materials for maintenance on-board are also vital. The officers who are responsible for loading/discharging, should be given a briefing about the loading/discharging plan for initial cargo and give the safety meeting for related cargo as well as every crew member who is going to take participate operations..

Question 5: Which emergency operations can be simulated at a tanker simulator? (example system at İTU, PRU, 9EÜ)
Answer 5: Unexpected oil spills, tank radar failures, generator emergencies and fire can be simulated.

Question 6: Is there a need to conduct training for the monthly ISGOTT/CDI/SIRE checklist?
Answer 6: No, because there are several checklists to be followed to train the personnel for these inspections already. If those are properly applied, there may be no need for an extra checklist.

Question 7: Is there a need to provide specific training for junior officers before juniors they embark on board?
Answer 7: Fire and safety application training before joining to ship is not given by companies to Junior officers and they are embarking to the ship without any experience. This situation causes hard times for junior officers to get used to the applications. Also, a complete familiarization training must be given to junior officers before they join to ship, such as ship's loading discharging systems, ballast systems, instructions in SOLAS and MARPOL, ship's muster list and specific emergency procedures, ship's basic plan, Ship's Fire Plan,

Ship Security Plan, guidelines for every kind of emergencies onboard (Emergency Check List), etc.

Question 8: Explain content of specific training for junior officers before juniors embark on board.

Answer 8: Type-specific ECDIS training, SMS, and ISPS training, and personnel safety training are the content of the before embarkation.

Interview with Master Mariner O. K. K. (17 years sea experience on board chemical tanker)

Question 1: What are the main problems during loading and discharging operations?

Answer 1: Static electric (for flammable accumulator cargoes), initial loading rate, maximum loading/discharging rates, ballasting/deballasting times and sequences -especially for loading /discharging of heated cargoes which have a high melting temperature-, trimming, listing, especially exposure limits of toxic cargoes and compatibility of cargoes are some of the main problems on tanker type vessel.

Question 2: What are emergency actions requires during loading and discharging operations?

Answer 2: A risk assessment should be prepared before each operation. All emergency equipment, signals should be checked before the operation. Before the operation loading/ discharging protocol should be prepared between ship and shore representatives, all items of SSCL should be checked on deck by visually with witnessing of shore representative. Each foam guns should be positioned in the correct direction. During the initial rate and after commencing of planned loading/ discharging rate or pressure all lines should be checked for any leakage by an officer or an able staff. Opening and closing operations of critical valves should be checked visually via position indicator on valves by a crew with OOW's instruction.

Question 3: What are the problems related to the ISGOTT application?

Answer 3: ISGOTT is implemented by tankers. Inert gas or nitrogen application and sometimes some safety requirements of gas-free operations are not found applicable by the companies or ship officers. Owners prefer to avoid inerting due to some extra expenses of subject applications. And in general, chief officers and sometimes companies avoid gas-free operation according to the ISGOTT directive. They aim to save some time. For this purpose, they skip some safety steps during gas-free operations.

Question 4: What is your proposal to solve the main problems?
Answer 4: Especially companies should be aware of their officers need some training. Most tanker companies have a training department for this purpose. Some critical operation plans should be checked by the experienced company inspector before application. Risk assessment should be prepared by ship and should be approved by the company before each critical planning and application. Timesaving is very important due to its relation to money; this is one of the major factors in accidents. Most of the tanker crew cannot arrange resting hours according to the STCW rules due to working under time-saving psychology. This psychology has extra stress over the crew. Companies should be aware of these extra stress factors on crew.

Question 5: Which emergency operations can be simulated at a tanker simulator? (example system at İTU, PRU, 9EÜ)
Answer 5: Contamination of cargoes and cargo vapours (full segregation of cargoes).
Excessive list, failure of cargo and/or ballast system and valves, failure of PV valves, failure of inert/N2 system, failure of cargo/ballast pumps are the ones

Question 6: Is there a need to conduct training for the monthly ISGOTT/CDI/SIRE checklist?
Answer 6: Not necessarily because ISM applications on tankers, meets such checklist requirements. The checklist offered in question has only meaning as additional paperwork for the officer.

Question 7: Is there a need to provide specific training for junior officers before juniors they embark on board?
Answer7: Yes, there is a requirement for junior officer's specific training before embarking on a vessel.

Question 8: Explain content of specific training for junior officers before juniors embark on board.

Answer 8: Cargo/ballast handling and ECDIS type-specific training should be supported. Specific and important rules of MARPOL, SOLAS, and STCW should be reminded to the junior officers before their embarkation

Interview with Chief Officer M. A. (12 years sea experience on board chemical tanker)

Question 1: What are the main problems during loading and discharging operations?
Answer 1: Insufficient safety information exchange between ship and shore before the operations start. Poor familiarization of officers to the cargo operation and equipment. Lack of knowledge regarding emergency actions required in case of any unforeseen situations. Lack of knowledge about the handling of IMDG cargoes and their specifications and actions to be prevented during operations required in ISGOTT, IBC, and other codes. Poorly planned cargo operation plan, steps, and insufficient follow up by watch officer. Unfollowing of ship-shore safety checks in regular times indicated in the list by the ship officer or the responsible Person Ashore. The unexpected failure of operational equipment such as cargo pumps, remote-controlled cargo valves, ballast pumps, damage on flexible cargo hoses due to the unexpected high pressure or vacuum

Question 2: What are emergency actions requires during loading and discharging operations?
Answer 2: Unexpected overflow of cargo and spillage, loose of ship stability and listing, failure of pumps or leak on cargo-related lines such as hydraulic supply lines, cargo lines and spillage, fire and explosion, leakage of cargo to the side compartments, spaces, double bottoms, or cofferdams, polymerization or decontamination of highly sensitive chemical cargoes can be counted as emergencies and their precautions should be commenced by seamen under the supervision of OOW and should be checked by SSO.

Question 3: What are the problems related to the ISGOTT application?
Answer 3: Common problems related to the application of ISGOTT are; poor familiarization of ISGOTT requirements by the officers and crew, non-follow up of ship-shore safety checks during operations. Since the checklist almost covers all requirements by ISGOTT during the operation of cargoes and non-followed of requirements by the Safety Management System (SMS).

Question 4: What is your proposal to solve the main problems?

Answer 4: A direct and detailed understanding of the cause of the problem and possible results is very important. Because, without having detailed information regarding the problem itself and the causes of the problem, it will not be possible to solve it, or at least it is going to take too much time to solve completely. Then listing corrective actions to be required is also very important to come through. If possible, teamwork has to be applied instead of a single application

Question 5: Which emergency operations can be simulated at a tanker simulator? (example system at İTU, PRU, 9EÜ)

Answer 5: Cargo overflow during loading or discharge and failure of the inert gas system during discharge

Question 6: Is there a need to conduct training for the monthly ISGOTT/CDI/SIRE checklist?

Answer 6: Yes, definitely. Since the interval of CDI / SIRE inspections are about 6 months, keeping the vessel and the crew updated for these inspections is vital. Instead of preparing the vessel at the last month to inspection, keeping all the time updated the vessel is much better to prevent unwanted remarks and deficiencies.

Question 7: Is there a need to provide specific training for junior officers before juniors they embark on board?

Answer7: Yes, junior officers should take prior training before embarking or attending the job. Generally, most of the junior officers can be regarded as inexperienced at any job onboard. Especially Cargo operations require more experience to maintain the safe process on board. A well familiar officer to the general operation of ship and company rules will be much more effective and beneficial to the ship as well as the company.

Question 8: Explain content of specific training for junior officers before juniors embark on board.

Answer 8: Familiarization with the Company Safety management system should be commenced. Specific training about Company vessel operations, Equipment of ships such as Framo or Marflex/Hamworthy Cargo pumping systems, ECDIS system used onboard the ships of company, cargoes carried, and equipment used during these operations should be given. The planned maintenance system used on boards should be explained briefly Usage of LSA and FFA equipment that is specific to the ships such as if the vessel has a freefall lifeboat or closed type lifeboat etc. should be explained.

Interview with Loading Master P. S. (8 years' experience on BP Oil Terminal KWINANA / AUSTRALIA)

Question 1: What are the main problems during loading and discharging operations?
Answer 1: Oil pollution, cargo contamination, and personal injuries are the main problems.

Question 2: What are emergency actions requires during loading and discharging operations?
Answer 2: On the first hand stopping the operation is the most important. Later, calling the master and acting are the steps. There might be a need of using the emg. buttons or pumps need of entering an enclosed space to rescue a crew.

Question 3: What are the problems related to the ISGOTT application?
Answer 3: These rules are a waste of time and money for some of the owners/charterers. So, the main problem is, not thinking the safety as required

Question 4: What is your proposal to solve the main problems?
Answer 4: If the vessel and terminal follow the written rules although it costs more, every operation has its problems and solves in the book. There would not be any need for other solutions.

Question 5: Which emergency operations can be simulated at a tanker simulator? (example system at İTU, PRU, 9EÜ)
Answer 5: Oil pollution and personnel injuries can be simulated

Question 6: Is there a need to conduct training for the monthly ISGOTT/CDI/SIRE checklist?
Answer 6: If the training conduct with a checklist, it's easier to follow and comply with it.

Question 7: Is there a need to provide specific training for junior officers before juniors they embark on board?
Answer7: It would be good if the job-related training can be obtained before embarkations. It would provide awareness to personnel when on board.

Question 8: Explain content of specific training for junior officers before juniors embark on board.
Answer 8: Specific equipment training usually carrying out. For example, a company has 20 vessels and work with 3 different types of ECDIS system. All the deck officers should be aware of the ECDIS system for planning the voyage on board before joining the vessel. The company must provide suitable type training for deck officers for safe and smooth bridge operation

Interview with OOW N. O. B. (3 years sea experience on board chemical tanker)

Question 1: What are the main problems during loading and discharging operations?
Answer 1: The main problems can be thought of in two different dimensions which are human-related, and equipment related problems. Equipment related ones are alarm system failures, ventilation system failures, cargo system failures, and/or in Framo based vessels framo pumps or hydraulic system fails, or valve fails. All these equipment failures have a different type of countermeasures and preventive actions to take. Lack of knowledge and/or focus problems are other important issues. In case the operating officer does not comply with the operation plan BM/SF values can reach critical limits and thus vessel happens to has problems. Wrong ballast operation, or not following the instructions can spoil cargoes. Communication failures also might result in serious problems.

Question 2: What are emergency actions requires during loading and discharging operations?
Answer 2: Cargo pumps can fail, and it can be needed to use an emergency cargo pump. There can be a need to interfere with any overflow so Wilden pumps can be used. In any potential emergencies, emergency pushbuttons can be used. Cargo can leak to the ballast tank or any cofferdams because for various reasons so the place contaminated should be thought of as a cargo tank and PV s should be placed to the tank for example. There can be

a fire or explosion so foam guns and fire hoses should be ready to interfere. Unexpected lists can occur so there might be a need to implement worst-case scenarios.

Question 3: What are the problems related to the ISGOTT application?
Answer 3: Wrong PV set values and not followed ventilation procedures, potential sparks caused by unthought water or static electricity, not applied initial rate and/or first-foot load steps, not applied naked light limitations could be the real-life situations. Ignoring safety while trying to save some time is a big problem also. If I need to be general, not following the rules and poor knowledge about them can be the answer.

Question 4: What is your proposal to solve the main problems?
Answer 4: For to prevent equipment-based problems, the main precaution is the maintenance of course. All PMS requirements need to be done in time and properly so that unexpected fails reduce to a minimum. Related personnel should be able to solve the problem. Preventing personnel-based problems is a different type. The main precaution is training. A well-trained crew -both individually and together via drills and training- is the key to the solution. The communication problem is another issue. Work and rest hours should be followed and should be ensured that all instructions and risk assessments are clearly understood before any kind of operation. Back up or emergency plans should be held ready and all officers in charge should be familiar with these procedures

Question 5: Which emergency operations can be simulated at a tanker simulator? (example system at İTU, PRU, 9EÜ)
Answer 5: Cargo overflow & ballast problems and overflowing can be used as an emergency operation scenario.

Question 6: Is there a need to conduct training for the monthly ISGOTT/CDI/SIRE checklist?
Answer 6: Yes, there should be. Checks keep personnel ready and aware.

Question 7: Is there a need to provide specific training for junior officers before juniors they embark on board?

Answer7: For sure. There should be a training system that includes ECDIS, ARPA and cargo systems for specific ship designs. Also, training for special equipment if any, need to be done.

Question 8: Explain content of specific training for junior officers before juniors embark on board.
Answer 8: All junior officers having training about introducing the company and its ISM implementation, alcoholmeter use, charter parties, ISPS, risk assessments and circulars from the company, and general maritime.

Findings of the Interviews

The answers that participants have given to the interview questions are evaluated below and reached the common results.

What are the main problems during loading and discharging operations?

The main answer is to keep the vessel and cargo under safe condition. And most common ones are poor communication, lack of knowledge, mistakes caused by the crew's fatigue, and equipment failures. Static electric, cargo rates, trimming, listing, and cargo temperatures should always be under observation. Gauge failure, valve failure, High/Overfill alarm failure, cargo pump, and generator failure kind of emergencies are the emergencies of ship equipment failures which have been determined by the research group. Besides these failures, the research attendants also mentioned slackness at the effectiveness of able seaman on watch, inexperienced and/or uninformed, unrested officers, inefficient cargo planning may cause emergencies as well.

What are emergency actions requiring during loading and discharging operations?

Attendants' common thought is using emergency stops, use of emergency pumps and/or Wilden pumps, and taking immediate action according to prepared plans and risk assessments. Also, attendants mentioned about planned maintenance are important to follow to prevent emergencies. During operations, UTI and MMC devices should be kept ready to do double checks with the ship's tank radar or any other loading measuring devices. Any potential emergencies, emergency pushbuttons can be used to stop the loading/discharging operation. Crew related emergencies may occur (falling/fainting etc.). Fire/explosions may occur. To prevent all of these, ship and shore should be agreed that every necessary precaution is commenced via commencing ship shore safety checklist.

What are the problems related to the ISGOTT application?

The general idea of attendants is focused on personnel-related problems such as inexperience, poor familiarization of ISGOTT requirements, and slackness of attention. Nowadays, companies and ship owners are pressing the crew to save some money and time which leads to emergencies, loss of money, time, and sometimes life. And even some personnel and companies find the guide as unnecessary, so they ignore the rules.

What is your proposal to solve the main problems?

Attendants' general idea about solving these problems is starting from following the planned maintenance system and ISGOTT. Training junior officers are also really important to prevent any main problems. Good communication is essential to keep operations well supervised and controlled. To prevent spillage, monitoring activities are also should be double-checked and all personnel on duty should be well-rested, informed about the cargo, and should know what to do in case of any fire or spillage situation. Equipment should be held ready to prevent any spreading in case of occurrence of spillage or fire. Spare parts should be provided by the company to keep the ship equipped so that the ship can follow-up maintenance better. Before and while operations, earthing must be done to keep the ship and shore safe from explosions. The ship shore safety checklist should be done by the chief officer with a qualified shore attendant.

Which emergency operations can be simulated at a tanker simulator? (example system at İTU, PRU, 9EÜ)

Attendants answered this question with variety such as spillage, an unexpected fire, list, overflow during loading, failure of the inert gas system, failed ballast operations, cargo and/or ballast pump shutdown, generator failure, personnel injuries, explosions, tank radar failures can be simulated.

Is there a need to conduct training for the monthly ISGOTT/CDI/SIRE checklist?

The general idea between attendants shows that there is a need for an additional checklist for the personnel to be ready and aware of any kind of emergencies since SIRE/CDI inspections commences every 6 months. Attendants' ideas are changing between it should be commenced during or before on-board period.

Is there a need to provide specific training for junior officers before juniors they embark on board?

The answers of attendants show that there is a need for pre-joining safety familiarization should be provided for junior officers to make them more ready for any safety-related conditions on board. Also, ballast systems, cargo systems, generators, and emergency system familiarization should be provided to junior officers. These pre-board training can provide to the ship and crew synchronized, fast and safer response to emergencies and loading/discharging operations. Also with this, all personnel would have enough knowledge and this would provide a crew to save time to handover of cargo loading/discharging operations.

Explain the content of specific training for junior officers before juniors embark on board?

General answers of attendants are ISM training, personnel safety training, LSA and FFA safety equipment used onboard, cargo operation equipment familiarizations, ISM implementations, ISPS, risk assessment circulars, SMS implementation training commences for junior officers before juniors embark on board.

3.6.2. Risk Assessment and Management

Definition of Risk is a measure of hazard’s significance involving simultaneous examination of his consequence and probability of occurrence using a combination and practical experience and relevant information on the system and its operating environment (Kuo, 1998)

By nature, vetting is also a risk assessment process. This is because the aim of vetting is determining the risks may be encountered in the vessel and exploring ways of minimizing possible harms on human life, on vessel and to the environment that may be caused by the risk. It is, therefore, important that all necessary information regarding risk that may be associated with the vessel are collected and assessed. The larger the information collected about the risk the more the risk are identified and mitigated. Additionally, appropriate mitigation plans should also be developed to help in preventing the occurrence of the risks.

It is, however, important to note that it is usually very difficult to analyse large quantity of data collected during risk assessment procedure. As result, it is difficult to effectively determine the condition (with regard to the risk) of the vessel based on this large quantity of data. However, the advent of computer systems capable of analysis big data, has easen risk the assessment. Using these computers, the vetting department can easily filter out unnecessary data, clear repetition and redundancy in the data.

The computer systems are capable of reviewing the huge risk assessment data, and organise the data into meaningful forms such as operator rating, hull type, age of the vessel, inspection results, performance and rating of the crew members, and any other needed during vetting and inspection. It is important to note that elements that may affect the charter are also mathematically determined using computer programs from collected data. Reason behind using computer systems in risk management is to ensure that chartered ship is best possible condition to handle the chemical cargo it is chartered to handle.

As result, the analysed data gives more accurate results on the type of risk that the vessel may be subjected to. Additionally, the data processing period is extremely shortened and information regarding the sea worthiness of a vessel is readily uploaded in database for access by the vetting departments. Accessing vetting data about a ship is extremely that in a large vetting group, which could be processing up to 90,000 vetting requests each year (Knowles, 2010).

Finding: During risk assessment process; information gathering has vital importance in sense of to be see risks clearly. Computer systems can be used to analyse large quantity of data to be able to assess all risks by using mathematical determination and statistical data.

3.7. The Commercial Impact of Training

The main objective a simulator training program is to improve the mariner's current job performance and maintain their current ability. But with the changing technology, simulator training should be continuous so that the deck crew's knowledge about the technology are always updated. Studies have shown that as result technological progress, certain jobs in the vessel just as in other fields are now being taken by machines especially robots. This means a today's training may not applicable in future. Therefore, any crew member whose knowledge does not change with technology may rendered jobless in future. It is for reason that continuous training is needed, and crew should be up to date with all the new innovations and inventions related to their fields. This is usually made earlier with simulators as different scenarios including the latest technology can just be programmed and the crew get trained on them. Therefore, the outcomes of a simulator training should be well understood by the mariner especially when it involves a new technology related to their areas of specialisation.

Finding: The outcome of simulator training is that officers who have been completed the any tanker simulator will gain a perspective and capability of reducing financial cost associated with any incident. Additionally, gaining full access of new systems of training helps the trainee keep up to date with the current technology.

3.8. Simulator Scenario Design

After designing simulator training program and its objectives, the next step is the creation of real-life scenarios which are to be uploaded into the simulators. Several factors need to be taken into consideration when creating real-life simulator scenarios. To achieve the goals of the simulator training the followings should be considered and applied.

i. Type of simulator to be used (e.g., special task, full mission)
ii. Suitable Database
iii. Design of generic ship(s) suitable for scenarios

iv. The aim and the objective of the training.
v. Duration of the exercise.
vi. Briefing and debriefing methods.
vii. Providing cost effectiveness.
viii. The scenarios must be designed to provide to support training objectives and
ix. Validation of provision of requirements.

It is important to note it is essential to create a beneficial scenario that optimizes the training program. It is these real scenarios creates an effective training program to the trainee (IMO Model Course 1.37, 2007)

Finding: Exercise scenarios should be checked after designed. This process is important to prevent unwanted deviations from the task and the objective due to human nature. Trainers should be careful about the cues are present.

4. DISCUSSION

This chapter includes tanker sector and its alternative solutions for problems observed during inspections. This discussion section tries to provide potential training scenarios or creating ways of them for the authorities.

4.1. Training for Which Simulations Is Well Suited

From the results which were discussed in the previous chapter it was found that simulation can play important role in enhancing the training and performance of the deck crew members of chemical tankers. In particular it was found that simulation may enhance training and performance of these individuals by:

i. Showing the real-life dangers associated with handling the dangerous cargo their ship carry. This improves their problem-solving capabilities, and they will have appropriate solutions to problems they encounter at the port or on voyage.
ii. Offering play back and replay function. This helps the trainees and their trainers review situations repeatedly.
iii. Allowing the trainees to learn from mistakes and accidents without casualties.

It was also found that the training environment usually consists three parts, namely: hardware, software and result. This means that simulation training should also consist of these elements. But unlike the aerospace industry where virtually everything associated with aircraft can be simulated (software, hardware and results), marine simulations only concrete on showing improvements and how these can be used to enhance performance and language standardisation. This shows that a lot need to be done on simulation training of the seafarers. This is because it is the best way to experience potential emergencies. Also, due to the fact that chemical tankers carry dangerous goods, it would be very risky to handle and stay them on board without appropriate experience. For this reason, companies should train their officers with certain designed scenarios in simulators.

4.2. Training Method

Because chemical tankers carry extremely dangerous cargo, a lot of caution need to be taken while handling loading and discharging operations of these types of tankers. Mistakes while handling these chemicals may lead spills which may kill marine life by suffocation, poisoning, pollution or even reducing visibility in the marine environment or even of these. Mistakes may also lead to injury of the personnel, fire explosion, damages to the ship or even oil pollution. To prevent these mistakes and their associated dangers, it is proposed that simulation training of the deck crew members should include (IMO Model Courses 7.01, 7.03 1.03 and 1.37)

which include:

i. Obtaining the necessary information for the goods to be carried
ii. Tank preparations
iii. Preparing the stowage plan
iv. Preparing the lines for the loading
v. Starting the loading operation
vi. Loading and cargo calculation
vii. Heating operation according to the cargo requirements
viii. Starting discharging
ix. Efficient stripping
x. Cleaning and disposal operations
xi. Oil/cargo record book recording
xii. Emergency situations

Education offers a wide range information to the trainees and those who already have experience in the field before tending to benefit more than the freshers. Therefore, the crew members who already have experience in seafaring can have a greater understanding of the consequences associated with their actions (mistakes). Simulator training comes in handy in providing experience to rare situations. As result, it is very important that the trainers have the experience and required knowledge as much as the trainees. Thus, it is recommended that this simulator training should be provided by the crew who worked on board before as a responsible officer or master.

It is further suggested that simulator training simulator training should be offered to 2nd and 3rd officers so as to gain the necessary experience about loading and discharging operations. The chief officers, on the other hand, should have appropriate training and experience on emergency operations possible and how to act in case such emergencies occur.

4.3. Why Do Tanker Companies Support the Training Simulator?

From the investigations, it was found that:

i. Simulation training are critical for the deck crew members as it may help them understand the consequences of actions in case, they chose to make wrong decisions. It also helps the crew members have a real-life experience without endangering the lives of those board or destroying the ship or without subjecting to the ship to extreme conditions.

ii. Simulation trainings should be carried out on regular basis (continuously) as technology changes day by day and it is important for the crew members to be up to date with the technology.

iii. Training provides self-confidence for the deck crew members as they have already experienced different situations in simulators. He/she adapts the environment easier and would not feel humiliated in front of his colleagues due to lack of experience. And it opens the door for the system work efficiently.

iv. The committees in charge of health and safety can continuously update, improve and inspect the system. Additionally, regular checks need to be carried out so as to keep the system in good order which is important for safety of lives and ship.

v. CDI and SIRE inspections should develop necessary guidelines for simulator training. by this way costs caused by incidents will decreased and potential emergency situations can be seen before occurring by the OOW. In addition to that, a good and safe cargo handling operation also makes the ship’s life longer and owner can have his/her ship longer. So the companies will also have the gains in the long term.

5. CONCLUSION

The findings are discussed, and results are obtained in the previous section. Based on the results which are applicable, suitable, and acceptable proposals are introduced

Results

The time on board for officers working in chemical tankers provides an increased experience with each operation. Much as in the working environments outside chemical tankers, many tasks are usually learned as part of routine tasks without structured training. Deck officers learn these skills and knowledge by aboard the ship without any extra costs to the ship or the company, but this method is the most dangerous and costly way for chemical tanker-type vessels in a possible emergency. Because if the shift officer does not have sufficient knowledge and experience it is difficult to prevent a possible emergency.

Simulator training will be conducted in accordance with the IMO International Maritime Standards, Certification and Surveillance (STCW) guidelines.

The use of a simulator is not mandatory for cargo handling trainings organized by STCW. However, trainers working in chemical tankers should be provided with simulator trainings in order to be able to adapt to the cargo system on ships and to reduce the emergency situations that may be caused by lack of experience.

Proposals

According to the controversy light and findings, if tanker operators want to operate their vessels more professionally and safely, officers working on the chemical tankers must take cargo handling training through simulators. The tanker operators should make more efforts to train the officers they are working on job and the officers they will be working on in the future. Tanker operators must make training deficiencies of the officers working on the vessel. Tanker operators should pay attention to these shortcomings to prevent loss of money and loss of prestige. An example for a composite scenario for the simulator training planned for the officers who will work in the chemical tanker is introduced the Appendix.

The officer who successfully completes this simulator training will have gained experienced in handling various liquid chemical cargoes and will make a more effective contribution to cargo operation safety of the ship in normal and emergency situations.

All planned junior officers must be trained in this simulator training before joining each ship, aiming to refresh their knowledge and increase cargo handling experience. Chief Officers are the primarily responsible officers of the cargo operations on the ships. So chief officers are required to study simulators especially on emergency scenarios. This ensures that the responsible officer can make the right decision in a possible emergency.

All scenarios need to be applied in order for the simulator training to be efficient. Therefore, full attendance is required for successful completion of the course. A Scenario Example is introduced in the Appendix. All simulated trainings should be assessed to evaluated success of the training and participants.

This simulator is planned to be two days of training. On the first day, trainees will be trained on chemical tankers, cargo transported in chemical tankers and damage to these cargos, inspections carried out on chemical tankers and cargo operations in chemical tankers. On the second day, before the simulator training, the participants will be informed about the scenarios and the simulator system and then the simulator training will be realized. After the training, an evaluation meeting with the trainees will be held.

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APPENDIX

SCENARIO EXAMPLE

According to the studies done, a composite scenario for the simulator training planned for the officers who will work in the chemical tanker is as follows;

GENERAL SHIP INFORMATION

Tonnage and dimensions	
DWT (9.80/9.95)	21 570 / 22 150 tons
Displacement (9.8)	28 921 tons
Length Overall	161.12 m
Length B.P.	149.80 m
Breadth moulded	23.00 m
Depth moulded	13.40 m

Cargo handling	
Cargo tanks	23 731 m^3
Slop tanks	1 241 m^3
Cargo hydraulic pumps	28 x 300 m^3/h
Ballast hydraulic pumps	2 x 500 m^3/h
Heating system	Thermal Oil, 80°

Figure 7: Ship General Information

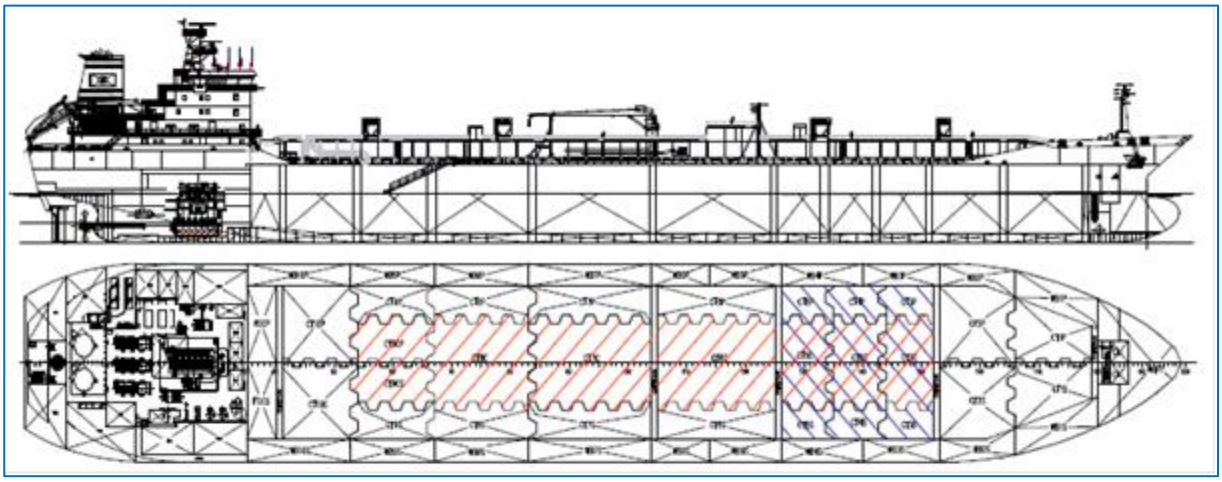

Figure 8: Ship General Arrangement Plan

CARGO OPERATION STEPS

Cargo operation scenarios prepared from easy to difficult.

STEP 1: Single parcel loading operation and ballast operation during to loading. (15 min)
Phosphoric acid loading rate 900 m^3/h
Beginning values of cargo tanks; 6P %43, 6S %41, 8P %50, 8S %0

STEP 2: Two different parcel loading and ballast operation during to loading. (15 min)
Phosphoric acid loading rate 900 m^3/h
Beginning values of cargo tanks; 6P %73, 6S %87, 8P %90, 8S %70
and
Ethanol loading rate 900 m^3/h
Beginning values of cargo tanks; 10P %0, 10S %0, 3C %0

STEP 3: Two different parcel loading and one parcel discharging operation with ballast operation during complete all cargo operation. (20 min)
Phosphoric acid topping off
Beginning values of cargo tanks; 6P %91, 8S %90
and
Ethanol loading rate 900 m^3/h
Beginning values of cargo tanks; 10P %85, 10S %85, 3C %79
3C level up to %85 open 2P and 2S
10P and 10S level up to %92 open 5C
and
Toluene discharging rate 400 m^3/h
Beginning values of cargo tanks; 4P %93, 4S %96

STEP 4: Three different parcel loading and one parcel discharging operation with tank heating operation and ballast operation during complete all cargo operation. (20 min)
Molasses loading rate 300 m^3/h
Beginning values of cargo tanks; 5P %0

and

Ethanol loading rate 900 m^3/h

Beginning values of cargo tanks; 5C %76, 2P %75, 2S %76

Ethanol topping off

and

Toluene discharging rate 400 m^3/h

Beginning values of cargo tanks; 4P %19, 4S %16

and

Mono ethylene glycol loading rate 900 m^3/h

Beginning values of cargo tanks; 3P %0, 3S %0, 8C %0

STEP 5: Two different parcel loading operation with tank cleaning operation and ballast operation during cargo operation and emergency situation (cargo pump failure, cargo valve failure etc.) (20 min)

P-xylene loading rate 300 m^3/h

Beginning values of cargo tanks; 5P %75

P-xylene topping off

and

Mono ethylene glycol loading rate 900 m^3/h

Beginning values of cargo tanks; 3P %75, 3S %71, 8C %90

STEP 6: Assessment

The scenario used should fulfil the following these details.

1. Check the various pages of the vessel display and especially the location and activation of the emergency stop function.
2. Locate the individual cargo and ballast tank status pages, not forgetting each element of the ballast system including fore and aft peak tanks, if within the ballast system.
3. Familiarise yourself with the draft information, which will be important for arrival status and when stripping cargo and ballast tanks, as well as any draft restrictions.

4. Establish how to co-ordinate power requirements for deck and cargo gear. These requirements will alter depending on the operation, so you need to be familiar with their source and the planning of requirements.
5. Be familiar with general operating parameters in terms of maximum and minimum levels. On the simulator in use can ambient weather conditions be altered.
6. The pages of the simulator screen detailing the cargo tank selection and preparation, valve, level and alarm functions will need close attention.
7. Bearing in mind the number of confined spaces on tankers the gas detection panels will be of particular concern.
8. It is crucial that ballast control, valves, level and alarm functions are monitored frequently during these operations.
9. Some cargoes require accurate cargo temperature control functions, water, steam or thermal oil.
10. Several exercises require the use of tank washing functions, supplying either sea or fresh water.
11. Almost all exercises involve inert gas, nitrogen and venting arrangements. Certain exercises will also include vapour recovery, so a close familiarity with these functions will be necessary.
12. Some tank preparation requirements will involve mechanical ventilation so the function of the fans supplying this is important to master.

13. Pump controls of each type of pump should be mastered early in the programme, which is partly why operation of the ballast pump is included in this familiarity exercise.

14. The functions of the manifold controls require familiarity.

15. Do not forget the tank draining and stripping arrangements for cargo and ballast systems, as they will be utilised during the training.

16. Do not forget either to monitor the status of the ballast tank being worked during this familiarisation exercise.

General view: Tanker operators, if they train the simulators on the vessels that they will run on their ships in the event of such scenarios, the officers will acquire knowledge, skills and experience before they start working on board and may also avoid possible emergencies. In these cases, tanker operators can have high prices in the international tanker field and gain prestige.

Assessment criteria

1. Rapid response
2. Clarity of the action taken
3. Coordination among the bridge team
4. Communication among the bridge team

CURRICULUM VITAE

Name: Cihan

Surname: KURNAZ

EDUCATION

Kocaeli Anatolian Technical High School 1995 – 1999

İstanbul Technical University Deck 1999 -2002

Anatolian University Business Administration Faculty 2005-2009

Pîrî Reis University, MSc Maritime Transportation & Management Engineering 2016-2020

PROFESSIONAL EXPERIENCE

Deck Superintendent

"Geden Lines & Anadolu Uluslararası Taş. ve Tic. A.Ş.".

January 2013 – June 2015

Master

"Hicri Ercili Denizcilik A.Ş.".

July 2016 – Still Continue

Chief Officer

"Hicri Ercili Denizcilik A.Ş".

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Chief Officer

“Geden Lines & Anadolu Ulus. Taş ve Tic. A.Ş.”.

January 2008 – July 2013

Deck Officer

“Geden Lines & Aksay Denizcilik”.

June 2003 – December 2007

Deck Cadet

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LANGUAGE

Advanced writing and speaking English