

# Effectiveness Evaluation on Fire Drills for Emergency and PSC Inspections on Board

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**ABSTRACT:** The paper evaluates effectiveness of fire drills for emergency and responding to PSC inspections on board. A brief background about the PSC inspection on fire drills on board is introduced in the beginning. Then the significance of effectiveness evaluation on fire drills is presented. Next, legal ground is discussed on International Conventions, including regulation of related regional group, national maritime laws and rules and Concentrated Inspection Campaign (CIC). Furthermore, PSC New Inspection Regime (NIR) for Paris MOU and Tokyo MOU are also discussed, and many deficiencies related to fire safety measures found in the PSC inspection are statistically analyzed. More importantly, the paper introduces System Engineering Theory, presents the principle and method of effectiveness evaluation, focuses on the preparation, performance and rehabilitation of fire drill and develops the Criterion of Effectiveness Evaluation. Finally, some suggestions are raised to carry out effectiveness evaluation for emergency and responding to the PSC inspection.

## 1 INTRODUCTION

Tokyo MOU PSC New Inspection Regime (NIR) has come into effect in Asia-Pacific area on January 1st 2014[1]. For the sake of passing the PSC inspection and reducing the frequency of being inspected in the future, putting out fire on board timely and successfully, and enhancing the emergency response capabilities of ship's master and crews, every ship must comply with fire drills to meet the requirements of the SOLAS Convention. As an important part of ship management, effectiveness evaluation on fire drills should be carried out on board. The effectiveness evaluation should be implemented under the leadership of the master and related officers to learn a lesson from the former fire drills and further improve operations as much as possible in the next drill, in order to put out fire in an emergency.

Something undesirable could be found in the effectiveness evaluation based on the author's experience on board: many officers don't understand who should be in charge of effectiveness evaluation, what should be evaluated and how to evaluate. NIR of Tokyo MOU and Paris MOU PSC impose more requirements on fire safety, which put greater pressure on ships to respond to the PSC inspection [1], especially fire drills in some Port States. Therefore, it is more advantageous to win in the PSC inspection if ships carry out effectiveness evaluation efficiently in advance.

## 2 THE LEGAL GROUND FOR PSC INSPECTION OF FIRE DRILLS

### 2.1 *The related regulations of the SOLAS convention [2]*

Specific regulations concerning fire drills have been developed in the International Convention for The Safety of Life at Sea (the SOLAS convention). According to the provisions of Regulation II-2/15 "Instructions, on-board training and drills", fire drills shall be conducted and recorded in accordance with the provisions of regulations III/19.3 and III/19.5 as general requirement 2.2.5 provided. For passenger ships, "in addition to the requirement of paragraph 2.2.3, fire drills shall be conducted in accordance with the provisions of regulation III/30, having due regard to notification of passengers and movement of passengers to assembly stations and embarkation decks" as additional requirements 3.1 provided.

Furthermore, the SOLAS convention has also developed special requirements for helicopter facilities on some related ships, such as Regulation II-2/18.8 "Operation manual and fire-fighting arrangements", which provides "fire-fighting personnel consisting of at least two persons trained for rescue and fire-fighting duties, and fire-fighting equipments shall be immediately available at all times when helicopter operations are expected" on the basis of provision II-2/18.8.3; it also provides that "on-board refresher training shall be carried out and additional supplies of fire-fighting media shall be provided for training and testing of the equipment "as regulation II-2/18.8.5 provided. In the Regulation II-2/30 "drills" for all passenger ships, "an abandon ship drill and fire drills shall take place weekly. The entire crew need not be involved in every drill, but each crew member must participate in an abandon ship drill and a fire drills each month as required in regulation II-2/19.3.2", and "all passengers shall be strongly encouraged to attend these drills".

### 2.2 *The related regulation of the STCW code [3]*

Chapter II of the STCW code has developed standards regarding the master and deck department as section A-II/1 and section A-II/3 provided. Chapter III has developed standards regarding engine department as section A-III/1 provided. These provisions focus on the "Prevent, control and fight fires on board" and provide criteria for evaluating competence in table A-II/1, A-II/3 and A-III/1. Firstly, the type and scale of the problem is promptly identified and initial actions conform to the emergency procedure and contingency plans for the ship. Secondly, "evacuation, emergency shut-down and isolation procedures are appropriate to the nature of the emergency and are implemented promptly". Thirdly, "the order of priority, and the levels and timescales of making reports and informing personnel on board, are relevant to the nature of the emergency and reflect the urgency of the problem".

In chapter V, we can find standards regarding special training requirements for personnel on certain types of ships, such as mandatory minimum requirements for the training and qualifications of masters, officers and ratings on oil and chemical tanker and liquefied gas tankers in section A-V/1-1

and A-V/1-2 respectively. Minimum standard of competence in basic training for oil and chemical tanker cargo operations and that for liquefied gas tanker cargo operations are listed in table A-V/1-1-1 and table A-V/1-1-2. Criteria for evaluating competence on carrying out fire-fighting operations, including that initial actions and follow-up actions on becoming aware of an emergency, must conform with established practices and procedures, actions taken on identifying muster signals must be appropriate to the indicated emergency and comply with established procedures, clothing and equipments must also be appropriate to the nature of the fire-fighting operations, similarly, the timing and sequence of individual actions must be appropriate to the prevailing circumstances and conditions, and extinguishment of fire should be achieved using appropriate procedures, techniques and fire-fighting agents.

Additionally, chapter VI, table A-VI/1-2 "Specification of minimum standard of competence in fire prevention and fire-fighting" develops criteria for evaluating competence on "minimizing the risk of fire and maintaining a state of readiness to respond to emergency situations involving fire", that is "initial actions on becoming aware of an emergency conform with accepted practices and procedures" and "actions taken on identifying muster signals are appropriate to the indicated emergency and comply with established procedures"; and this table also lists details of criteria for evaluating competence on fighting and extinguishing fires, which focus on clothing and equipments, timing and sequence of individual actions, extinguishment of fire, breathing apparatus procedures and techniques. Table A-VI/1-4 "specification of minimum standard of competence in personal safety and social responsibilities" provides the criteria for evaluating competence with emergency procedures of "the master and deck department in charge of a navigational watch on ships of 500 Gross Tonnage or more". The criteria include "initial actions on becoming aware of an emergency conform to established emergency response procedures" and "information given on raising alarm is prompt, accurate, complete and clear". Table A-VI/3 shows minimum standard of competence in advanced fire-fighting, in the table, criteria for evaluating competence on controlling fire-fighting operations aboard ships are related to actions taken to control fires, the order of priority, timing and sequence of actions, transmission of information and personal safety during fire control activities. In the aspect of organizing and training fire parties, composition and organization of fire control parties must ensure a prompt and effective implementation of emergency plans and procedures. Operational effectiveness of all fire systems and equipments must be checked out during inspection and maintenance. Causes of fire are identified and the effectiveness of countermeasures must be evaluated when investigating and compiling reports on fire.

### 2.3 *The related regulation in some regional PSC agreements*

Port State Control involves enforcement activities controlled over the vessels and carried out by the

government of the foreign port in which the vessels operate to ensure compliance with applicable domestic and international requirements to ensure safety of the port, environment and personnel [4]. The Port State, upon identifying a substandard vessel, was authorized to detain the vessel until corrections to eliminate hazards to the port and return to a seaworthy condition were achieved, and ultimately, to eliminate substandard ships from the waters of participating countries. The regulations of Port State Control were adopted in the amendment to the SOLAS in 1994, which confirmed the legal position of PSC inspection on international vessels.

Besides, the International Maritime Organization has also encouraged some regional PSC meetings to conduct PSC inspections by the same standard. In January 1982, 14 European States agreed to establish a system of control, which resulted in the signing of the Paris MOU. In the early 1990s the Asia-Pacific (Tokyo MOU) came into being in the Far East, which largely includes western Asia-Pacific rim States.

#### 2.4 *Some national maritime laws and rules on fire drills*

Unlike other major maritime countries, the United States has not participated in any regional MOUs grouping. Under the US Coast Guard's Port State Control (PSC) Program, it undertakes control measures on a unilateral basis. According to US Coast Guard, Navigation and Vessel Inspection Circular (NVIC) was adopted to provide guidance on the enforcement of the 1995 Amendments to the STCW Convention and Code. Coast Guard Port State Control Officers (PSCOs) used the provided guidance and procedures to conduct PSC inspection in ensuring compliance with the requirements of the STCW Convention and Code. [5]

Related to the fire drills inspection, the PSCOs will examine the specific new crewmember familiarization procedures in the first stage, which is the general examination. During the general examination, if the PSCOs find a situation which indicates that the fire drills cannot meet the requirements due to the inability of crewmember(s) to perform their assigned duties during fire drills, or the drill poses a danger to persons, property or the environment, the examination will be transformed into an expanded examination which focuses on correcting the apparent deficiencies. The PSCOs will provide an opportunity and permit the master to correct the deficiencies at that time; for instance, they allow the crew to receive instructions and repeat a fire drill after failing the first time or to replace one crew member by another who is qualified to hold that position. If the situation can not be corrected, ships may be detained under the STCW Convention and Code.

#### 2.5 *Concentrated Inspection Campaign (CIC)*

In 2012, the Paris MOU and Tokyo MOU on Port State Control have launched a joint Concentrated Inspection Campaign (CIC), which started on September 1st 2012 and lasted for three months [6,7]. The CIC verified fire safety systems to ensure compliance with SOLAS Chapter II-2/ Construction - fire protection, fire detection and fire extinction

arrangements on board ships. The Indian Ocean, Black Sea and Viña del Mar MOUs on PSC had also conducted a CIC covering compliance with the same regulatory requirements during the same period. In addition to the physical inspection and testing, the crew may be required to demonstrate their familiarity with the fire-fighting systems and appliances, and may also be called upon to conduct a fire drills for the benefit of the PSCOs [5], according to the 12 items in the provided checklist, which is "where a fire drills was witnessed; was it found to be satisfactory?" [8]

### 3 THE NEW INSPECTION REGIME AND STATISTICAL ANALYSIS OF DEFICIENCIES

#### 3.1 *NIR for Paris MOU and Tokyo MOU [1]*

The Paris MOU introduced a new inspection regime (NIR) in January 2011. Both NIR for Paris MOU and Tokyo MOU are risk-based and have been implemented since January 1<sup>st</sup> 2014.

Under the background of NIR, Ship Risk Property (SRP) is one of the most important parameters to determine the rating of ship. Once a ship has more than 5 deficiencies one time in the previous 36 months, then the number of inspections which recorded over 5 deficiencies is the weighting points, which account for at least a quarter of the 4 points corresponding to High Risk Ship. These deficiencies fall into the category of ISM related deficiency and other deficiencies. When calculating the Deficiency Index, ISM deficiency is assigned 5 points and other deficiencies only one point. The emergency management such as fire drills are related to ISM, so the deficiencies of fire drills are important to the ranking of Ship Risk Profile.

If the number of detention within previous 36 months is 3 or more in Tokyo MOU, the ship will be given one point, which is a quarter of the 4 points corresponding to High Risk Ship. The Deficiency Index and Detention Index form company performance matrix that determines the performance level. If one ship-owned company performance is on a low or very low level, the weighting points are 2, half of 4 points corresponding to High Risk Ship. High Risk Ship will be periodically inspected by Tokyo MOU PSC according to time window, which is 2 to 4 months since previous inspection, trigger inspections on HRS might be carried out between periodic inspections.

#### 3.2 *The statistical analysis of detention deficiencies of fire drills*

Statistical data from Tokyo MOU PSC inspection on ship from 2010 to 2013 is showed in fig 1. During the 5 years the rate of deficiencies of fire safety measures is the highest according to the table. Particularly, the rate of deficiencies reached 20% in 2012.

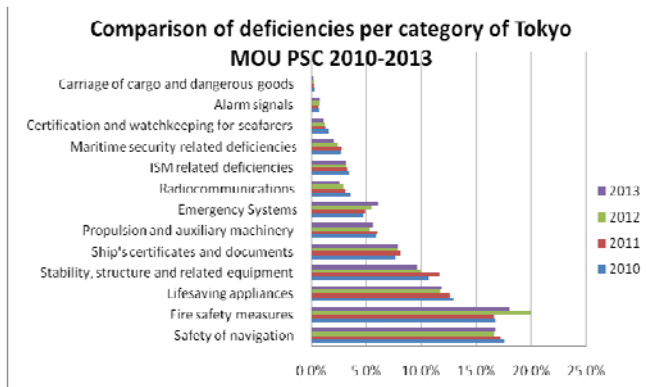


Figure 1. Comparison of deficiencies per category of Tokyo MOU PSC from 2010 to 2013[9-11].

Figure 2 reveals the details of deficiencies from Paris MOU Inspection. Based on the seven-year statistic data, fire safety measures is among the top 5. Especially, the rate of deficiencies of fire safety measures has an obvious growth in 2012. The reason of this growth is the joint CIC on fire-fighting system in 2012. According to the final report from CIC-FFS, 74 ships were inspected on fire drills, 34 ships were detained [6,7], and the rate of detention is top to 46%, it is so regrettably to know that result of fire drills.

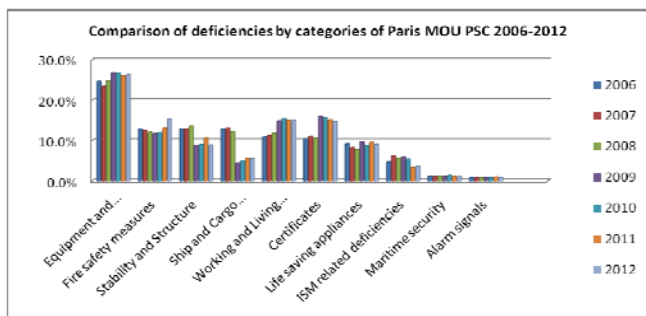


Figure 2. Comparison of deficiencies per category of Paris MOU PSC from 2006 to 2012[12-17].

It can be seen from figure 2 statistical data of deficiencies from the Paris MOU PSC inspection in 2012, the rate of fire fighting system deficiencies is at the second position, as is high to 17% of total deficiencies.

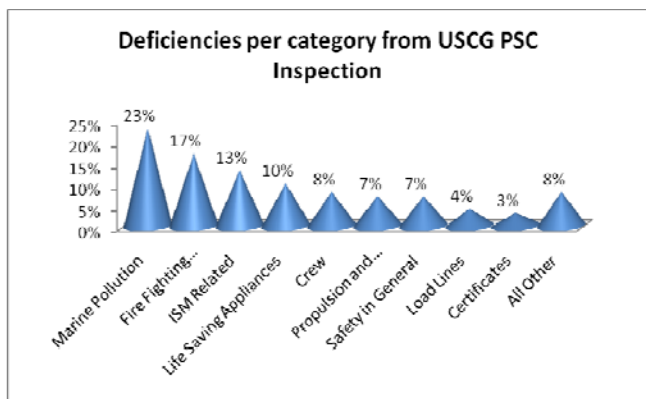


Figure 3. Comparison of deficiencies per category from USCG PSC inspection in 2012[18].

There were 46354 deficiencies were found in by PSC offices of China in 2012, of which the number of Fire Safety related deficiencies was 9386 (20.2% of total deficiencies), Safety of Navigation 7810 (16.8% of

total deficiencies), Lifesaving appliances 5654 (12.2% of total deficiencies). The deficiencies of other years were listed in Fig. 4. In the four year, the rate of fire safety deficiencies is always number one.

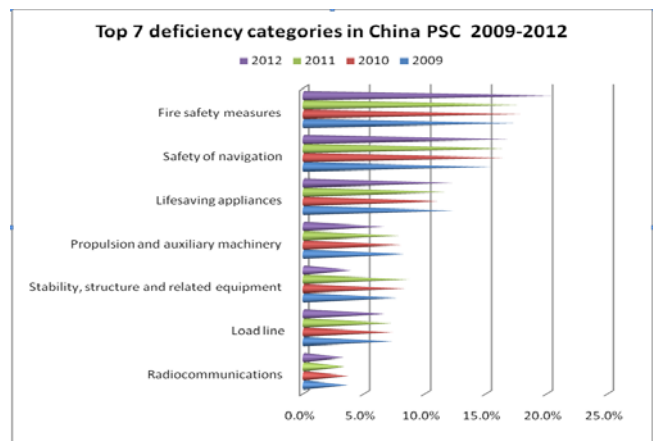


Figure 4. Top 7 deficiency categories in china psc inspection from 2009 to 2012[19-22].

A report on detention deficiencies per category group found on DNV ships from 2006 to 2011 illustrates clearly that the item of fire safety measures plays a leading role in the deficiencies, as detailed in figure 5 [23,24].

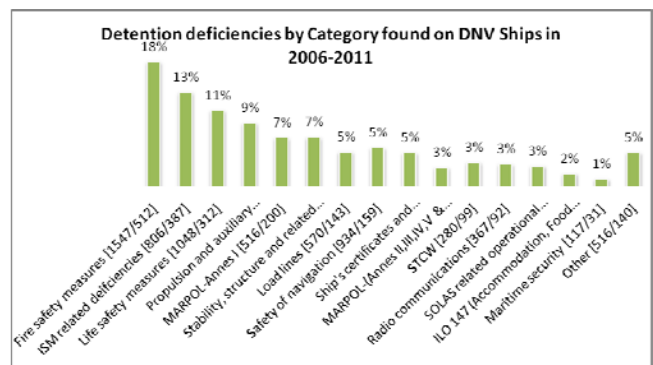


Figure 5. Detention deficiencies per category group found on DNV ships from 2006 to 2011. The first number in square brackets stands for total deficiencies per category, while the last number stands for quantity of detainable deficiencies.

In the six years, DNV ships were found to have 1547 deficiencies on fire safety measures, among which 512 cases, accounting for one third, were detainable deficiencies, which reached 18 percent of all detention deficiencies. [25]

According to a report of detainable and ISM Related Deficiencies noted in PSC inspection reports of Class NK & NK-SMC ships during Jan-Aug 2012 [26], 115 ships in total were detained because of their serious deficiencies. 7 detained ships in port in Japan, USA and Spain were related to fire drills. The most frequent cause was that crews were unable to demonstrate proficiency in fire drills.

Another report on detention of Hong Kong Ships due to fire drills in 2007 shows that two cases of detention were because of fire drills, which were inspected by USCG in USA, while 46 of them were owing to their serious deficiencies [27]. Two other ships inspected in Italy and Spain under the Paris

MOU were instructed to rectify deficiencies before departure because fire drills were hardly sufficient or crew members lack knowledge of fire drills. Through these cases, some points can be gained that the PSC inspection on fire drills under USCG is very strict. If the fire drill does not satisfy the PSCOs of the USCG, they will give deficiencies action code 30 indicating grounds for detention, which is the most serious result in the PSC inspection.

## 4 THE PROCEDURE OF PSC INSPECTION OF FIRE DRILLS

### 4.1 *The procedure of PSC inspection under the Tokyo MoU*

During the Asia-Pacific PSC inspection within the Tokyo MOU [28], the PSCOs may witness a fire drills carried out by the crew assigned to these duties on the muster list.

In the first stage, the PSCOs will consult with the master and then select one or more specific locations of the ship for a simulated fire and assign a crewmember to the location(s) to activate a fire alarm system or use other means to sound alarm.

In the next stage, at the simulated fire location the PSCOs describe the fire indication to the crewmember and observe how the report of fire is transferred to the bridge, which is generally the control center.

In the following stage, ship will sound the fire alarm to summon the fire-fighting team to their stations. The PSCOs will observe the fire-fighting team arriving on the scene, properly donning their protective equipments and using fire-fighting equipments to fight the simulated fire. The team leaders should be giving orders appropriate to their members and passing the words back to the bridge at the same time.

Moreover, crews should response to personnel injuries by communication and using of stretcher and medical teams. The PSCOs will monitor them handling the stretcher and wounded properly through narrow passageways, doors and stairways, which are difficult and takes practice.

Furthermore, those crewmembers assigned to close manually operated fire doors and dampers should pay more attention to the duties in the areas of the simulated fire(s) during the drill. Those crews assigned to other duties related to emergency equipments will be asked to explain their duties and demonstrate their familiarity possibly in the drill.

### 4.2 *The procedure of PSC inspection under the Indian Ocean MOU*

Under the Port State Control of Indian Ocean [29], the PSCOs will determine whether the crew members are familiar with the duties assigned to them and locations where duties are performed in fire drills on the muster list. Generally, after consultation with the Master, the PSCOs require a fire drill to ascertain the awareness and promptness of the crewmembers in an emergency. During this drill, the PSCOs will ask the

crew members to explain their duties including the procedure. For instance, if a crew is assigned to operate the fixed fire-fighting equipments, which cannot be operated during the simulated drill, the PSCOs will evaluate whether the person required to operate the system can explain the complete procedure.

### 4.3 *The procedure of PSC CIC*

In response to the requirements and practice of a joint Concentrated Inspection Campaign (CIC) launched by Paris MOU and Tokyo MOU on Port State Control, every vessel should confirm the following items before surveys.

The fire fighters' outfits including personal equipments should comply with the SOLAS Ch II-2 /R10.10 & R14.2.2. The Emergency Escape Breathing Devices (EEBD) must comply with the SOLAS Ch II-2/R13.3.4 & 13.4.3. The portable extinguishers ready for use in locations as per fire plan must meet SOLAS Ch II-2/R10.3.2.4. The test of automatic audible alarm should sound prior to the release of a fixed gas fire-extinguishing medium into spaces in which personnel normally work according to SOLAS Ch II-2/R10.5. The fire protection systems and fire-fighting systems and appliances must be maintained ready for use to meet the SOLAS Ch II-2/R14.2.1. The crew must be familiar with the location and operation of fire-fighting systems and appliances so that they may be called upon to use them in accordance with the SOLAS Ch II-2/R15.2.2'.

The test of the sprinkler system should trigger an automatic visual and audible alarm for the section on the basis of the SOLAS Ch II-2/Reg 10.6. The activation of any detector or manually operated call point can initiate a visual and audible fire signal at the control panel on the bridge or control station to meet the SOLAS Ch II-2/R7.4.2. The Emergency Fire pump must be capable of producing at least two jets of water in the drill and emergency to comply with the SOLAS Ch II-2/R 10.2.2.3.1& R2.2.4, and the isolating valves of the fire main must be marked, maintained and easily operable in accordance with the SOLAS Ch II-2/R10.2.1.4.

All the above-mentioned should be demonstrated in the fire drills, which should satisfy the PSCOs when witnessing in the PSC inspection. Once the satisfaction has been achieved, the detention of ship would never happen as a result of the CIC.

## 5 THE EFFECTIVENESS EVALUATION OF FIRE DRILLS ON BOARD

### 5.1 *Definition*

Within the system engineering theory, evaluation is to determine the property of research objects in accordance with some specific purposes, and turn the property into denominated objective quantity or subjective utility. Effectiveness evaluation on fire drills is defined as a series of activities via which ships evaluate their own fire drills, i.e. evaluation of crew performance in fire drills [30]. It is the

continuous process of evaluating all items involved in the preparation, performance, and rehabilitation of the drill.

## 5.2 Principle

In accordance with SOLAS 74/CII-2/R15.2.2.3, crew performance of fire-fighting duties should be evaluated periodically by conducting on-board drills and identifying areas in need of improvement. The effectiveness evaluation of fire drills is to ensure the operational readiness of the fire-fighting organization and that competency in fire-fighting skills is maintained. Effectiveness evaluation should meet the most important principle that is “drill must ensure the safety of involved crews”, which is the key factor in the success of the fire drills.

In recent years, some shipping companies have experienced a number of serious accidents during fire drills. Many guiding documents from the shipping industry provide advices and instructions to help prevent accidents during fire drills. Fire drills are covered by the provisions on occupational safety and health on board, which should be planned, organized and performed so that they are safe in every respect. Before the drill, possible hazards to crewmembers in the execution of the drill should be identified and respective risk should be mitigated [31]. Additionally, fire drills prescribed by national laws and regulations and by international instruments should be conducted in a manner that ensures the disturbance of the rest period is minimized and does not induce fatigue. [32]

## 5.3 Keys of effectiveness evaluation

### 5.3.1 Preparation stage

Firstly, crew participation should be maximized. Personnel arrangements should include every crew member except on-duty crews. In particular, those crew members assigned to other duties related to fire drills, such as the manning of the emergency generators, the CO<sub>2</sub> room, the sprinkler and emergency fire pumps, should also be involved in the drill. In the second, all related equipments must be in good order and readily available in an emergency. The persons in charge, such as third officer and engineer, should maintain the fire-fighting equipments and devices regularly. Another key point is that the type and position of the fire scenario should be varied in a well conceived sequence, which covers most parts of the ship and all types of fire-fighting. For the purpose of a fire drill, the alarm should be activated and the requisite actions be taken in accordance with the ship's safety and health policy.

### 5.3.2 Performance stage

The first step: time and place of fire drills should be kept as a secret until the noticed crew activates the fire alarm that delivers the signal of fire location, which is helpful to improve the awareness and promptness of the crew members during an emergency. The best time and location should be determined through coordinating with the Master

and/or ship's safety officer. The master should hold drills considering locations where the ship is most likely to experience a fire, where most recent drills have been held, and while minimizing disruptions to cargo operations [33].

Point 2 is planning a realistic emergency [34]. The drill should, as far as practicable, be conducted as if there were an actual emergency. All involved crews must participate in the fire drills with a positive attitude and be fully confident of a realistic fire-fighting other than a simulation. Available resources (such as smoke-generating machine) should be utilized to make drill as realistic as possible [33]. For example, in order to prevent unnecessary risk and gain realistic effectiveness, the recovery of a hoist stretcher should be carried out without persons on the stretcher, where a similar load can be used instead [35]. And fire drills should be planned in such a way that regular practice depends on the type of ships and cargo in various emergencies.

The third point is to keep a timeline of events. Certain emergency situations require timely response, without any delay during the whole drill. As an example of that, when hearing the warning of fire doors remote released, which is announced on the public address system, crew should run away from the fire area as far as possible because the remote controlled release of fire doors can also involve a risk of personal injury [36].

Moreover, checking the necessary arrangements for subsequent abandoning of the ship must be implemented according to muster list. Many ships generally neglect abandon ship drills or conduct fire drills several minutes after abandon ship drill. This situation should be avoided.

### 5.3.3 Rehabilitation stage

In the rehabilitation stage, equipments used during drills should be immediately brought back to its fully operational condition and any faults or defects discovered during the drills be remedied as soon as possible. The effectiveness of the drill will be evaluated. The master should hold a meeting or discussion to get feedback together and conduct a thorough debriefing of the lessons learned. This is the most important element of the drill or exercise as it allows crewmembers to identify those areas in which they can improve their respective response efforts [37]. For instance, the master can give some comments on incapacitation of crewmember and malfunctions of simulated equipments including radios, fire-fighting equipments, and lighting.

## 5.4 The criterion of effectiveness evaluation

The criterion of effectiveness evaluation on fire drills on board would be found in the following table 1. The master can apply this reference table to effectiveness evaluation, and obtain a score of the whole drill after having graded every item in the checklist. The checklist designs 25 kinds of items belonging to 7 stages. The highest score will run up to 125 points if 25 points have been performed perfectly. If the score is lower than 100, this drill would be not satisfactory, and the whole drill must be redone. The crews require

supplemental training and corrective action should be taken in the shortest possible time to respond to the seriously defective drill. If the drill gains a higher score with only several items not at good level, the

corresponding knowledge and skill must be checked carefully and the related roles must be well disciplined.

Table 1. The criterion of effectiveness evaluation on fire drills on board

No.	Items	Elements of Evaluation	Criteria of Evaluation Score
1	Reporting	Content of report: the location, size, kind and time of the fire	No Miss=5, Other=0
2	Bridge of fire	The initial caller should be most likely connected to the designated fire source in his job role	Good=5, Average=3, Poor=0
3	Initial actions	Fire-Signal is correct with the Muster list	No Miss=5, Other=0
4		Ship's alarm announcement contains the location, size, kind and time of the fire	No Miss=5, Other=0
5		Proper extinguisher has been used and Local ventilation has been shut	No Miss=5, Other=0
6	Mustering and preparation	Assembling condition after sound emergency alarm:	Good=5, Average=3, Poor=0
7		Each crew wearing condition: the crews should have taken out their personal effects	Good=5, Average=3, Poor=0
8		Wearing time of fireman's outfit	Less 3 min=5, Less 5 min=3, Over 5 min=0
9		Wearing condition of fireman's outfit	No Miss=5, Other=0
10		Starting time of Emergency Fire Pump	Less 5 min=5, Less 10 min=3, Over 10 min=0
11		Condition of Emergency Pump Presser with two hoses	Over 12 min=5, Less 12 min=0
12		Starting time of Electrical supplies and lighting	Less 5 min=5, Less 10 min=3, Over 10 min=0
13		Time of listed damper close	Less 5 min=5, Less 10 min=3, Over 10 min=0
14	Entry into the fire zone and fire-fighting	Each team reporting level during drill	Good=5, Average=3, Poor=0
15		The condition of check and report about the fire team to the bridge (BA pressure/Time of entry/Name/Mask secure and Safety Lanterns are in all good order)	No Miss=5, Other=0
16		The condition of the fire hose(proper length, boundary cooling)	No Miss=5, Other=0
17	Rescue operation	The report of the injured (Name/location/status)	No Miss=5, Other=0
18		The condition of transference of the injured person to a safe location	Good=5, Average=3, Poor=0
19		The condition of monitor and first aid the injured person(s)	Good=5, Average=3, Poor=0
20	Use of a Fixed Fire Extinguishing System	All ventilation and opening been closed	No Miss=5, Other=0
21		The Roll call has been reported to the Bridge	No Miss=5, Other=0
22		Any crew can explain the manual operation method	Good=5, Average=3, Poor=0
23	Master's Comments	Condition of each team action to be taken:	Good=5, Average=3, Poor=0
24		Each crew attitude for drill	Good=5, Average=3, Poor=0
25		Whole performance	Good=5, Average=3, Poor=0
1	Suggestion	Crews required supplemental training	Yes / No
2		Corrective Action	Yes / No

## 6 CONCLUSION

Some suggestions are raised to carry out effectiveness evaluation on fire drills in order to respond to the PSC new inspections regime. Firstly, sufficient knowledge and understanding of the legal background about the PSC inspection on fire drills on board are needed. More research should be conducted by ship owners, ship operators, ship class association and some related maritime research institutions, focusing on the SOLAS convention and code, the STCW convention and code, regulation of related regional PSC agreements, some national maritime laws and rules on fire drills. The master and crews should be proficient in the procedure of the PSC inspection on fire drills, whatever PSC agreements are, including main maritime administration, the Paris MOU, the Tokyo MOU, the Indian-Ocean MOU and USCG. Most importantly, each ship had better do research and analyze the detention deficiencies in recent years whatever regional PSC agreements are, and discipline master and crews regularly and efficiently. Certainly the related pre-post training should be carried out on

land to meet requirements of the PSC inspections. In order to pass the PSC inspection on fire drills, what have been mentioned above should not be neglected or omitted.

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