Initiatives for Ship Fire Safety Measures

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1. INTRODUCTION

Fire safety measures for ships are provided in the SOLAS Convention and have been revised repeatedly up to the present. The provisions related to the increasingly large-scale container carriers of recent years have also been revised, but because multiple fire accidents resulting in serious damage have occurred, a review will be conducted in the IMO to further improve safety. In addition to the fire safety measures for roll-on/roll-off (RORO) passenger ships which are currently under discussion, issues related to fire safety requirements for vehicles which are equipped with lithium ion batteries or use new fuels such as hydrogen, natural gas, methanol and ethanol have also been raised in the IMO, and study is planned in the future. Separate from those issues, fire accidents have also been reported in large vehicle carriers, which mainly transport gasoline-fueled vehicles, and a study on safety measures for these vessels was carried out by a working group in Japan led by the Ministry of Land, Infrastructure, Transport and Tourism (MLIT), which compiled "Measures for effective use of fixed foam fire-extinguishing systems."

This paper provides an overview of the trends in fire safety measures for container carriers and vehicle carriers under discussion in the IMO, and introduces the ClassNK initiatives in response to the additional fire safety measures voluntarily being taken by ship owners and ship management companies which operate container carriers, and the above-mentioned fire safety measures developed by the working group in Japan in advance of future revisions of the SOLAS Convention.

2. FIRE SAFETY MEASURES FOR CONTAINER CARRIERS

2.1 Trends in the IMO

While the SOLAS Convention has been revised repeatedly in the IMO up to the present to secure and improve the fire safety of the increasingly large size of container carriers, fire accidents still occur and further enhancement of the fire safety measures is being discussed at IMO. Specifically, a group composed of the Marshall Islands, Singapore, the World Shipping Council (WSC) and the International Association of Classification Societies (IACS) and another group composed of the Bahamas, Germany, the International Union of Marine Insurance (IUMI) and the Baltic and International Maritime Council (BIMCO), both submitted joint proposals for new work plans to develop new requirements for fire safety measures for container carriers.

These proposals were approved as new outputs for fire safety measures for container carriers at the 103rd session of the MSC (MSC103) held in May 2021 with a view to having concrete discussions on safety measures for the cargo holds and on-deck cargo areas of container carriers from the 8th session of the Sub-Committee on Ship Systems and Equipment (SSE8), which is to be held in March 2022. Under this plan, discussions on revisions of SOLAS Chapter II-2 and the International Code for Fire Safety Systems (FSS Code) are to be completed by 2025 with the aim of its entry into force in January 2028.

2.2 Fire Safety Measures in Cargo Areas of Container Carriers

Following are the brief of problems raised at the IMO in connection with fire safety measures for container, which are planned to be focused on in the IMO discussion.

(1) Fixed fire-extinguishing systems of cargo holds

There are some cases where, even with their proper operation, fixed carbon dioxide gas fire-extinguishing systems installed in cargo holds fail to extinguish the fire due to the nature of the cargo and there needs to fill the affected hold with water. For these cases, secondary means such as a fixed fire-extinguishing device or an alternative fire-extinguishing system is needed.

Figure 1　Container carrier

(2)　Fire-extinguishing equipment for on-deck cargo areas

For fires in containers stacked on the exposed weather deck, at least one water mist lance and two or four mobile water monitors are required on ships constructed on or after January 1, 2016. However, currently, there are no established performance standards for water mist lances that penetrate through the container wall for spraying water into the container and the materials and penetration methods vary among devices. Thus, standards that ensure a certain level of effectiveness in water mist lances are necessary. Even in mobile water monitors, for which standards exist, the required number and the effective positioning requirement may be insufficient. In addition to these problems, installation of remotely operated water-type fire-extinguishing devices may be necessary.

(3)　Communication equipment for fire-fighter

All ships are required to provide some means of communication for fire-fighters by the first periodical survey on or after July 1, 2018. However, there are no requirements for them in respect of the communication range or a hands-free function to enable effective firefighting.

(4)　Fire detection

Sample extraction smoke detectors (devices which detect smoke) in cargo holds required under current SOLAS are not able to detect the transmission of heat in the stage where a fire is spreading inside a container, therefore, fires are detected at the point when the smoke has generated in the cargo hold consequential to deformation or destruction of the container wall. Moreover, it is difficult for such devices to identify the exact position of the container where a fire has occurred. For earlier discovery of fires, further consideration, for example, on requirements for supplementary heat detection devices is needed.

(5)　Container cargos

Particularly in case of dangerous cargos, heat may trigger a chemical reaction that causes a fire or explosion. To prevent these situations, correct information on the cargos in containers must be provided and the containers must be stacked appropriately onboard based on a proper understanding of the types of cargos, etc. On the other hand, inaccurate information on the cargo may cause a fire to start or spread. Additional discussion on the handling of container cargos, including their identification and packing information sharing, etc. is necessary.

2.3　ClassNK Initiatives

As described above, discussion of fire safety measures for container carriers in the IMO will begin shortly. In advance of this, some ship owners and ship management companies that operate container carriers have shown an intention to respond voluntarily, and in fact, there have also been the moves to implement additional fire safety measures independently.

The IUMI, which presented the results of an analysis of fire accidents on container carriers to the IMO, has proposed an original concept of measures to strengthen fire safety (see Fig. 2). For details, please refer to the IUMI Position Paper “Firefighting systems on board container vessels” released in 2017. Some of large container carriers have already been constructed based on a design concept close to the IUMI concept.

In line with these trends, there have been requests for evaluation of fire safety measures which were taken voluntarily. To respond to these requests, ClassNK is considering a revision of its rules to add notations to the ship’s character of classification for evaluating ships on which additional fire safety measures have been implemented. The following presents several examples.

(1) Additional fire detection devices for cargo holds

For example, for ships equipped with, in addition to the conventional sample extraction smoke detectors, heat detection systems utilizing thermographic cameras, optical imaging, or temperature monitoring devices to detect a container in which a fire has occurred, notation showing such additional devices would be provided.

(2) Additional water-spraying devices

For ships installed with water-spraying fire-extinguishing system arranged with nozzles in cargo holds, the end walls of the deckhouse, end walls of the engine casing, container lashing bridges and the like, notation indicating installation of that equipment would be added (see Fig. 3).

(3) Water-flooding to cargo holds

For ships that provide a means of water-flooding to the cargo holds, and verify that there will be no problems with hull strength or stability in case of water flooding is carried out, the notation that the said additional action can be implemented would be added.

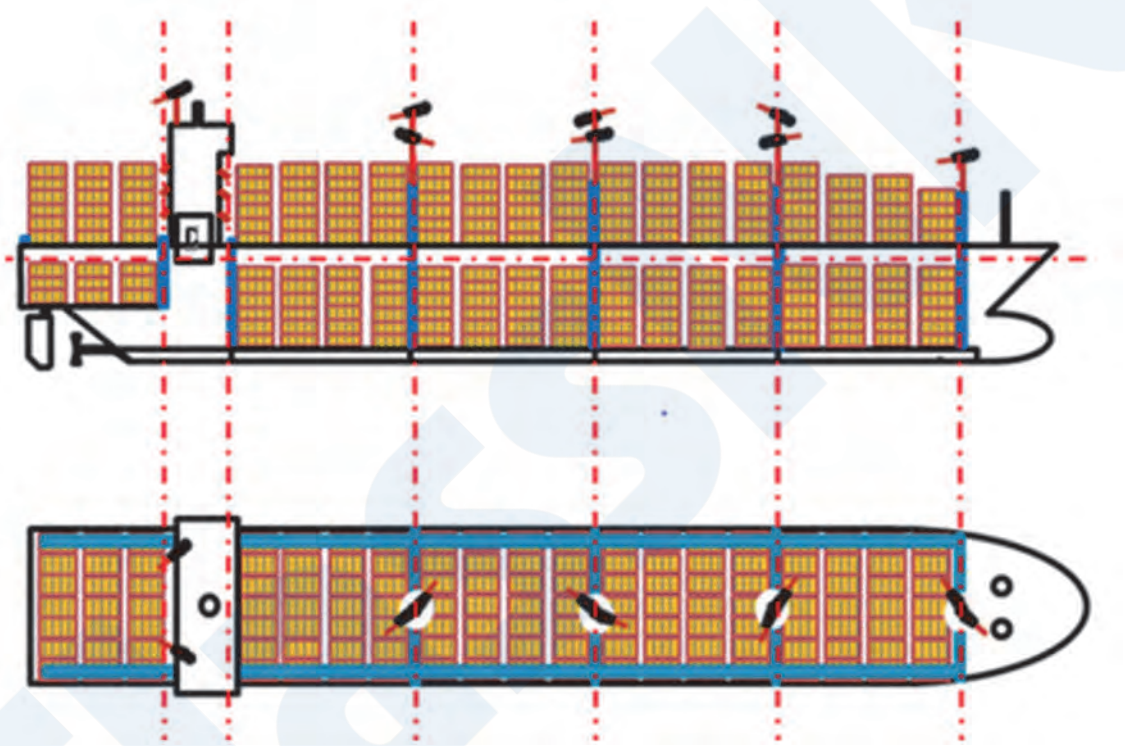

Figure 2 Image of water-spraying system on deck (proposed by IUMI)

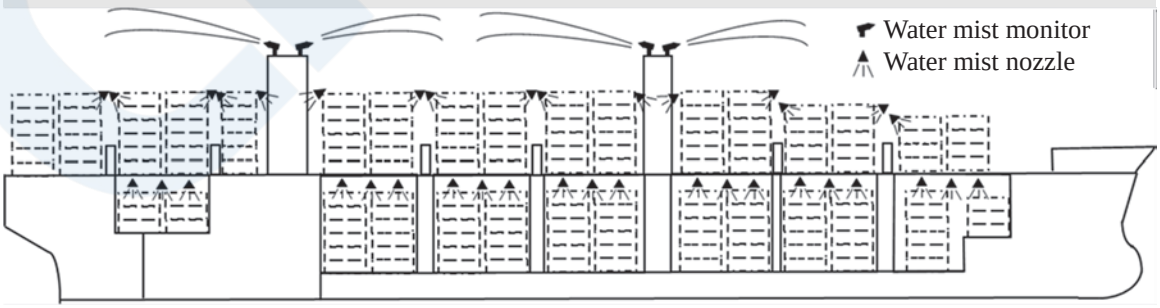

Figure 3 Image of water-spraying system

Figure 4　Large vehicle carrier

3.　FIRE SAFETY MEASURES FOR LARGE VEHICLE CARRIERS

3.1　Trends in the IMO

In the IMO, the development of safety requirements for fires involving vehicles equipped with lithium ion batteries was proposed in the 7th session of the Sub-Committee on Ship Systems and Equipment (SSE7) held in March 2020.

However, it was concluded that a wide-ranging study of this issue is necessary, including not only vehicles using lithium ion batteries, but also other types of new energy vehicles. As of this writing, the future work plan is scheduled to be discussed at the 104th session of the Maritime Safety Committee (MSC104) to be held in October 2021. It will be necessary to keep eyes on future developments in this connection, as a focus may not be limited to only the problem of RORO passenger vessels, which are currently under discussion, but may be on all ships that carry new energy vehicles and are subject to the application of the SOLAS Convention.

3.2　Study of Safety Measures in Japan

3.2.1　Study of Response When a Fire Occurs

Discussion on vehicle areas and RORO ships that are loaded with new energy vehicles in the IMO are scheduled to begin shortly. On the other hand, multiple fire accidents have also occurred in recent years in the vehicle loading areas of large vehicle carriers in service mainly transport gasoline-fueled vehicles. Based on this situation, a study of safety measures to reduce the damage of this type of accidents was initiated by Japan's Ministry of Land, Infrastructure, Transport and Tourism.

While discussions on the fire safety of new energy vehicles (vehicles equipped with lithium ion batteries, etc.) are scheduled to begin in the IMO, based on the facts that the new energy vehicles are not yet a high percentage of the cargo, gasoline-fueled vehicles have accounted for the majority of cargos in the reported fire accidents, and that vehicles have the highest heating value in the vehicle loading area, even though the ignition source is unclear, the aforementioned study in Japan was conducted on the assumption that conventional gasoline-fueled vehicles are the ignition source.

Concretely, in December 2019, the "Working Group on Prevention of Recurrence of Fire Accidents on Vehicle Carriers" (hereinafter, "working group") was organized with the Japan Ship Technology Research Association (JSTRA) as the Secretariat and related Japanese parties (shipping companies, shipyards, manufacturers of fire extinguishing/detection systems, national research and development agencies, universities, national government agencies, etc.) for a study of the above-mentioned safety measures. ClassNK also participated in the working group as a member.

First, the working group collected information on actual fire accidents, verified scenarios of fire spread and extinguishment and extracted issues for reducing the damage caused by such accidents. The group then conducted experiments and investigations of these results and established concrete improvement methods. The experiments conducted by the group consisted of two types: experiments on fire detection performance to investigate the effect of the distinctive deck back structure of vehicle carriers on smoke detection, and vehicle fire experiments to identify the mechanism of vehicle fires and fire spread in the vehicle areas of vehicle carriers, where the height between the decks is low and cars are tightly parked, as can be seen in

Figs. 5 and 6, which show the condition of vehicle fire experiments.

Figure 5　Photograph of a vehicle fire experiment: Condition of horizontal arrangement

Figure 6　Photograph of vehicle fire experiment: Condition of vertical arrangement

The working group compiled the results as “Improvement measures for effective use of fixed foam fire-extinguishing systems.” The Ministry of Land, Infrastructure, Transport and Tourism (MLIT) then issued a request dated June 10, 2021, to the Japanese Shipowners’ Association to make further voluntary efforts for improvement of the safety of ships of large vehicle carriers by utilizing the improvement measures, and notified this to the registered ship classification societies, including ClassNK.

This Society released ClassNK Technical Information TEC-1239 on June 11, 2021, taking into account its active contribution to the working group from the standpoint of securing safe operation as a ship classification society and requested for ship owners and management companies involved in the operation of large vehicle carriers to consider introducing these improvement measures.

3.2.2　Improvement Measures for Reducing Damage

The purpose of the above-mentioned “Improvement measures for effective use of fixed foam fire-extinguishing systems” is to reduce the damage in fire accidents through more effective use of the fixed foam fire-extinguishing systems which are now commonly installed in the vehicle loading areas of large vehicle carriers. These measures summarize concrete safety measures

based on the new knowledge obtained by the vehicle fire tests used gasoline-fueled vehicles. Here, the content of the measures will be introduced.

In cases where fire that happened in vehicle loading areas cannot be extinguished by the initial fire-fighting action, the fire will spread from vehicle to vehicle. However, if the scale of the fire expands beyond a certain size as a result of the fire spreading, it will be impossible to stop the spread with the fixed fire-extinguishing system installed in the ship. The purpose of the measures mentioned below is to enable more effective functioning of the fixed fire-extinguishing systems required by the SOLAS Convention and FSS Code.

(1) Target ships

The target is large size vehicle carriers that use fixed foam fire-extinguishing systems in vehicle loading areas. Here, it is assumed that the loading condition is full-load and a ship with a gross tonnage of approximately 60,000.

(2) Basic policy

Based on the knowledge obtained by the above-mentioned working group, the target time for activating the fixed foam fire-extinguishing system is set to enable more effective use of the system, and measures are implemented in both the “intangible” and “tangible” aspects in order to achieve this.

- The target time is set in the “Procedure to activate foam fire-extinguishing systems,” which is part of the “Procedure for fire extinguishing” related to the Safety Management System (SMS) based on the International Safety Management Code (ISM Code). The procedure sets a target time (standard time: 14 minutes) from the alarm is given to press the button to activate the fixed foam fire-extinguishing system, and states that the target time should be announced to the crew.

  The above-mentioned “standard time” of 14 minutes is a guideline, and the actual target time is set by the ship owner or shipper, etc. themselves based on the specifications and structure of each ship, the type of cargo, the cargo loading condition and other relevant considerations. For vessels other than the 60,000 gross tonnages the improvement measures can be applied in a similar manner by appropriately setting the time required for on-site confirmation of the fire, considering the size of the vessel concerned, etc.

  The 14 minutes mentioned here is the total time, premised on implementation of all the measures in Table 1 and based on the speed of the spread of fires involving vehicles obtained from the results of vehicle fire experiments, and consists of 10 minutes for the crew to move to the lowest cargo level furthest from the bridge after an alarm is given and confirm the condition of the fire on the spot, 1 minute to issue instructions to the firefighting department, and 3 minutes to call over the crew.
- The measures in Table 1 should be implemented to achieve the target time for activating fixed foam fire-extinguishing. The measures may be applied to both new building and existing ships by establishing and/or modifying the fire extinguishing policy, procedure etc.
- The operation matters (e.g. Omission of the fire extinguishing action using fire hoses and hydrants etc.) should be specified in “Procedure for fire extinguishing”.

Table 1 List of measures for effective use of fixed foam fire-extinguishing systems

Item	Content
The measures to be implement	The automatic (remote) start of generators (To secure the required electrical power rapidly for the use of fire-extinguishing system) *1
	Normally-open or automatic ventilators (To shorten the starting time of the fire extinguisher) *1
	Omission of the fire fighting action using fire hoses and hydrants *2
The measures recommended to implement (Option)	Remote monitoring of cargo holds using CCTV (To detect the fire rapidly)
	Securing the safety of crews with RFID tugs etc. (To shorten the time to roll-call)
	Installation of one smoke detection to each frame spaces of car deck ceiling (To detect the fire certainly)
	Installation of the additional boundaries to prevent the spread of the fire in cargo holds (To prevent the spread of fire and to remove the psychological obstacles to activate the fire extinguisher) *3

*1 Alternatively, activation of generators and operation of ventilators can be manually done by each team(s) formed by crews, provided that there is no adverse effect for achieving the target time (standard time: 14min) for activation of fixed foam fire-extinguishing systems.

*2 Except for cases where the fire may be certainly extinguished by fire hoses and hydrants such as: the fire in the vicinity of wheelhouse, the fire happened to be discovered by crew during fire patrol. In this case, if the enough number of crews onboard are forming multiple firefighting teams, firefighting by hoses and hydrants can be tried provided that the fire is being monitored onsite in parallel. However, there should be no adverse effect for achieving the target time (standard time: 14min) for activation of fixed foam fire-extinguishing systems.

*3 This measure is supposed to be applied only to newly built ships.

4. CONCLUSIONS

This paper has introduced the current status of activities in IMO related to container carriers and vehicle carriers, the activities and initiatives by ClassNK in connection with container carriers, and the fire safety measures for vehicle carriers proposed by the Japanese working group.

In the future, discussions on new requirements for fire safety measures for container carriers and vehicle carriers will be held in the IMO, but several years will be necessary to complete that work. ClassNK is to continuously keep eyes on the work and to consider safety measures, either by itself or jointly with the maritime industry as necessary.

We will also announce newly established fire safety measures through ClassNK guidelines, etc. so as to contribute to the industry.