Fighting Fire on Containerships

FIGHTING FIRE ON CONTAINERSHIPS

INTRODUCTION

As part of its mission, ABS maintains a close relationship with vessel owners and operators around the world. The most valuable part of this relationship is the feedback we receive from professional and experienced shipowners and operators through our Technical, Regional and National Committee processes. ABS is committed to using that feedback to take action to promote the safety of life and property and to preserve the natural environment.

A topic regularly brought up by industry representatives is the need for enhanced firefighting arrangements in containership cargo deck areas. Container fires continue to be a critical hazard for all containership operators, and as vessel size and stack heights continue to grow, the task of container deck firefighting becomes even more challenging.

As a technology leader in the containership sector, ABS has taken a proactive position on this issue. In 2013, in recognition of where the International Maritime Organization (IMO) was headed and to provide forward-looking knowledge to shipowners, designers and yards, ABS published its *Guide for the Class Notation for Fire-Fighting Systems for On-Deck Cargo Areas on Container Carriers* (FOC Guide) with notation FOC and FOC+. The 2013 FOC notation was focused on pending changes to the International Convention for the Safety of Life at Sea (SOLAS). The FOC+ notation brought in additional requirements to enhance the protection provided.

HISTORY

Continuing unease within the marine industry with respect to fire protection arrangements on ships carrying large quantities of containers in open-top container holds and on or above the weather deck, prompted the IMO to amend SOLAS Regulation 10 – Firefighting through resolution MSC.365(93), adopted May 22, 2014. The amendment's focus is on providing firefighting arrangements for the purpose of containing a fire in the space or area of origin and cooling of adjacent areas to prevent fire spread and structural damage. Specifically, the amended SOLAS regulation for all new ships constructed on or after January 1, 2016, requires:

- All new ships designed to carry containers on or above the weather deck, in addition to the other previously required equipment and arrangements, to be fitted with at least one water mist lance. The water mist lance shall consist of a tube with a piercing nozzle which is capable of penetrating a container wall and producing water mist inside a confined space (container, etc) when connected to the fire main.
- All new ships designed to carry five or more tiers of containers on or above the weather deck shall carry, in addition to the existing equipment and arrangements, mobile water monitors as follows:
  - ships with breadth less than 30 m: at least two mobile water monitors; or
  - ships with breadth of 30 m or more: at least four mobile water monitors.
- A sufficient number of fire hydrants shall be provided such that:
  - all provided mobile water monitors can be operated simultaneously for creating effective water barriers forward and aft of each container bay
  - the two required jets of water can be supplied at the required pressure
  - each of the required mobile water monitors can be supplied by separate hydrants at the pressure necessary to reach the top tier of containers on deck.

Further, MSC.1/Circ.1472 provides guidance for the design, performance, testing and approval of mobile water monitors used for the protection of on-deck cargo areas of ships designed and constructed to carry five or more tiers of containers on or above the weather deck.

Although the revised SOLAS regulation is applicable to new ships, it is reasonable that, given the continuing concern within the industry, these amendments may be extended to existing ships or that progressive shipowners may voluntarily adopt many of the provisions for their fleet.

PATH FORWARD

In response to industry feedback, ABS has updated its 2013 FOC Guide to reflect additional understanding and to provide an enhanced service to our Members and clients. A review of the SOLAS Regulation 10 – Firefighting amendments was the starting point for the update. As an IMO Recognized Organization (RO) and a trusted industry advisor, ABS built on the intent of the IMO SOLAS amendment providing further interpretation (often following engagement with appropriate Flag Administrations) and criteria typically backed by detailed analytic study.

It is clear that IMO has identified needed additional capabilities to effectively handle fires in the cargo areas of containerships. However, in researching the information IMO utilized in the development of the amended regulations, it became obvious that containerships have grown much larger and the volume of cargo carried on deck has expanded drastically during the time period that the IMO deliberated. As a consequence, when ABS discussed the SOLAS requirements with owners and operators of containerships, it was clear that the SOLAS requirements may not be adequate for today's larger container carriers. It was also noted that there were certain fire safety arrangements not included in the SOLAS Regulations. Therefore, the ABS 2016 FOC Guide focuses on providing the crew with additional tools needed to combat a fire in the cargo area, regardless of the size of the containership.

As an example, SOLAS Reg. II-2/10.7.3.2 requires a containership with a breadth of less than 30 m to carry two portable water monitors; and vessel with a breadth of 30 m or more to carry four portable water monitors. However, when considering the sizes of the surface areas that need to be covered, the limited coverage that any one monitor may provide, the possibility of restricted angles of attack limiting vertical reach, the possible interference due to lash bridges and the number of monitors being carried would likely need to be split between the area forward and the area aft of the bay engaged in fire, having additional monitors available would be important. Therefore, the optional ABS FOC notation calls for at least four mobile water monitors for ships with a breadth up to 30 m (98 ft), at least six mobile water monitors for ships with a breadth of more than 30 m (98 ft) up to 45 m (147.6 ft), at least eight mobile water monitors more than 45 m (147.6 ft) up to 60 m (197 ft) and ten mobile water monitors for ships having a breadth greater than 60 m (197 ft).

In addition, arrangements needed to address the possibility of damage to the fire main are not considered in the SOLAS Regulations. In the ABS FOC Guide, the fire main piping serving the cargo weather deck area is required to consist of two lines, one on each side of the vessel and connected at the forward and aft ends of the vessel, creating a loop fire main system. Further, isolation valves are required every 40 m (130 ft) providing the ability for a damaged portion of the supply piping to be isolated and the crew to still have the capability to fight the fire.

The 2016 ABS FOC Guide also incorporates specific requirements for the arrangements of the hydrants, including:

- requiring sufficient hydrants to be provided forward and aft of each container bay to allow each required mobile water monitor to be supplied from a separate hydrant;
- requiring at least one hydrant to be located immediately outboard on each side of the space between the container bays; and
- specifying that the locations of hydrants on the lashing bridge are to allow monitors to be evenly distributed along the width of the space between the container bays.

The 2016 ABS FOC Guide also requires that where monitors are to be used on a lashing bridge, arrangements such as davits or hoists are to be provided on the port and starboard sides of each lashing bridge to assist in raising and lowering the monitors.

The firefighting systems and arrangements identified for the FOC notation provide an enhanced set of firefighting capabilities when combating a container fire. However, there is also a concern by some that prolonged exposure to excessive heat of a fire could weaken the hatch covers leading to their possible failure.

To address this concern, ABS offers the FOC+ notation. The FOC+ notation identifies specific requirements for a fixed water spray hatch cover cooling system. When the FOC+ notation is applied, water spray nozzles are required to be placed and spaced in a pattern that is able to maintain an average application rate of not less than 5 liters/min/m^2 (0.12 gpm/ft^2) over the hatch cover area. The nozzles and supply piping are required to be fixed on the hatch covers and suitably protected from mechanical damage that could occur due to the handling or operation of the hatch covers or containers. Further, quick connect arrangements are required for connecting the supply piping on the hatch covers to the fixed supply piping on deck.

When the FOC+ notation is obtained, the owner, operator and crew are provided with an additional level of protection that reduces the risk of the fire from spreading downward and engaging the containers located inside the holds.

In addition to the above, there are other arrangements specified in the 2016 ABS FOC Guide, above and beyond those in SOLAS, intended to enhance and improve the firefighting capability of the crew.

ANALYTIC SUPPORT

As part of ABS development of these revised Guides, detailed analyses have been performed to investigate and establish further understanding of the practical ramifications of the SOLAS amendments.

In Regulation II-2/10.1.2, SOLAS indicates that the requirements are "...for the purpose of containing a fire in the space or area of origin and cooling adjacent areas to prevent fire spread and structural damage." Therefore, ABS utilized a 3D computational fluid dynamics (CFD) numerical modeling approach to evaluate the concept of a water curtain and the effectiveness of a water barrier in preventing fire spread to adjacent bays.

In order for such an analysis to be useful, it was critical that appropriate parameters be identified. Not detailed in the IMO SOLAS amendment, numerous variables can impact the potential fire spread from one bay to another, including but not limited to:

- The materials that are burning. Containers may be carrying a multiple range of products from cellulosic materials that have a heat release rate (HRR) of 150 kW/m^2 to highly combustible plastics like ABS, PR, PP and PS, with HRRs in the range of 2,000 kW/m^2. Consequently, identifying a reasonable fire load to utilize in fire analysis is challenging.
- The fire growth and spread rate in the bay engaged in a fire. If a fire is localized, then the surface areas of the adjacent bays will be relatively small. But if a fire spreads throughout one bay, then there would be large surface areas of the adjacent bays that need to be protected.
- Consideration of the type of materials within the containers of the adjacent bays that may ignite. Again, containers may be a carring range of materials, including some plastics that have an auto-ignition temperature in the range of 400° C (752° F) to 500° C (932° F) to materials such as paper, fiber board and woods that can have an auto-ignition temperature in the 100° C (212° F) to 150° C (302° F) range.
- Location of the materials within the container of the adjacent bay and their packaging materials.
- Separation distance between the fire and the materials in the adjacent bay (40-ft vs. 45-ft containers).
- Water curtain vs. water drenching (i.e., placing a wall of water between containers versus impacting the surface of the adjacent containers).
- Water spray pattern created by the monitors, especially on the faces of the higher level containers.
- Locations of the mobile water monitors, angle of attack, achievable water density and run-off.
- Impact of the lashing bridge and other structures on the water spray pattern for containers below the lashing bridge level.
- Weather conditions such as wind, speed and direction.

These are just a few of the variables that can impact the potential fire spread from one bay to another.

After the variables were evaluated in a risk matrix, various fire scenarios were selected for detailed analysis. The various fire scenarios included different fuel and target materials, different water spray patterns and water densities, and each were evaluated utilizing 3D CFD modeling.

As a result of this study, valuable insight was obtained into the effectiveness of water barriers to prevent the propagation of a fire from one bay to another. For example, depending upon the fire loads, fire growth rate, target materials and environmental conditions, as well as the size of the container bay stacks involved, the minimum number of monitors identified by SOLAS Reg. II-2/10.7.3.2 may not be sufficient. To address this concern, ABS increased the minimum required number of mobile water monitors, as well as expanded on the required hydrant arrangements for the FOC notation, while at the same time keeping the requirements practical.

WORKING WITH OPERATORS

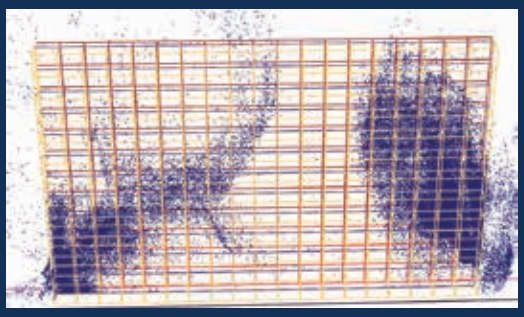
A key aspect of Rule development is our need for the review and input by the vessel operators who will rely upon these systems to protect them and their vessels at sea. ABS is currently working with vessel owners and operators to review and refine these enhanced requirements, utilizing the professionalism and experience of the industry to ensure that these systems provide reasonable and reliable support at sea.

At ABS, we are continuously developing and improving Rules & Guides because we know that industry is changing and that for a classification society to add value, our Rules & Guides have to be relevant and appropriate. Our continuing program of Rule development is integral to the class-centric focus ABS pursues in helping the offshore industry improve safety, efficiency and reliability.

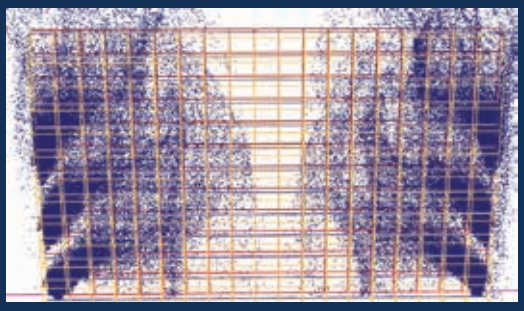
Our goal is to advance technology innovation to secure safer seas for future generations. Every day stakeholders look to us to help them protect people and property and preserve the natural environment. That is our mission at ABS, and to us, there is nothing more important.

Images illustrating the influence of number and position of monitors on the spray pattern and coverage achieved:

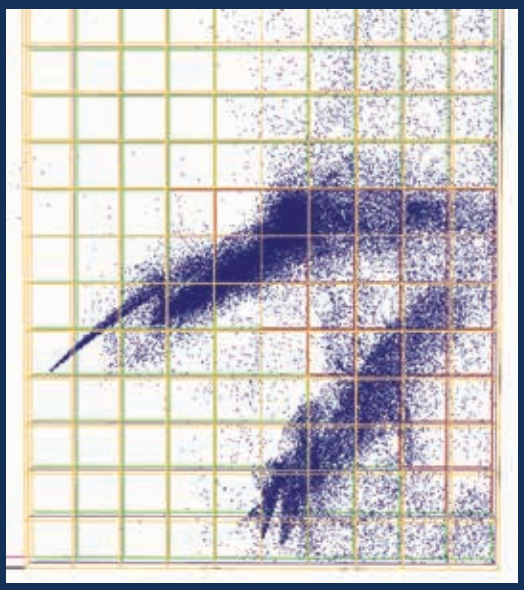
Two monitors at the deck edge, on the deck



Six monitors at the deck edge, differing vertical positioning



Four (4) monitors: two (2) at the ¼ breadth point on the deck and two (2) on the lashing bridge at the deck edge (half model)



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