

Guidelines for  
establishing fire-fighting strategies  
of individual ro-ro passenger ships

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Committee for the prevention of fire on  
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# I Purpose of the Guidelines

In considering a fire occurs on a ship, it is extremely important to carry out appropriate fire-fighting at an early stage. For the reason that a fire would spread extremely fast in the ships because ships, made of steel or aluminium alloy, have higher heat conductivity than onshore houses, made of wood or concrete. It is also noted that evacuation from a ship in the event of a fire would be dangerous and difficult.

Time for finding out appropriate fire-fighting methods is very short in case of actual event of fire and it is important to establish fire-fighting strategies for individual ships to enable rapid fire-fighting. The fire-fighting strategies should specify:

- .1 assumption of place of fire;
- .2 which actions should be taken in which order; and
- .3 which equipment should be used by whom.

In addition to establishing fire-fighting strategies, it is important to maintain operational readiness of fire-fighting, e.g. by means of drills of regular intervals, in order to enable swift and effective fire-fighting following the established strategies.

These guidelines are a summary of key points for establishing fire-fighting strategies by ro-ro passenger ship operators. In creating fire-fighting strategies, it is necessary to have sufficient knowledge, e.g. fire behaviour, fire-fighting on ships, and the characteristics and methods of use of fire extinguishing equipment. In order to learn such knowledge, it would be worth acquiring experience through training at external specialized institutions on fire-fighting. In addition, it is recommended to consult with an expert for identifying hazards and examining fire-fighting methods.

Furthermore, a fire-fighting strategy should inevitably be different in each ships since whose structure, equipment, crews, knowledge and skills are different respectively. You should establish your fire-fighting strategy in accordance with these guidelines using drawings and documents of your ship. You can use the example fire-fighting strategies, attached in these guidelines, as a reference.

Please keep in mind that an actual fire may not always occur or develop as expected. Established fire-fighting strategies are solely based on certain scenario. Therefore, in the actual event of a fire, it is necessary to respond to it by adapting the most appropriate fire-fighting strategy based on established strategies. This can be achieved by fully understanding the established fire-fighting strategies and conducting training and drills based on it. It is also important to acquire skills for appropriate judgment in respond to actual situations when conducting aforementioned training and drills.

In addition, there are many things that those are not possible to know unless you have experienced them yourself, such as how to operate a portable fire extinguisher effectively, and how much you can prevent radiant heat using a water fog applicator. It is effective to conduct fire-fighting training and drills by using portable fire extinguishers and water fog applicator. Considering the difficulty of conducting these training and drills internally at a company or onboard a ship, it is recommended to receive a training at an external specialized institutions. Those involved in the establishment and review of fire-fighting strategies should receive practical training for fire-fighting including actual experience of the heat and smoke of flames. Otherwise, it would be an irrelevant fire-fighting strategy which has recklessness or allows to easily giving up on fire-fighting.

Although these guidelines are intended for the fire-fighting in vehicle spaces as an example, a fire may also occur in locations other than the vehicle space. It is also necessary to create fire-fighting strategies for engine rooms and accommodation spaces in addition to vehicle spaces so that appropriate fire-fighting can begin from an early stage if a fire occurs in any location.

We sincerely hope that these guidelines will contribute to safe operations of ro-ro ferries.

## II Structure of guidelines

### Basic knowledge essential for establishing fire-fighting strategies

- Basic knowledge of fire and extinguishment
- Basics of fire-fighting



### Preparations for establishing fire-fighting strategies

- Preparations of drawings of vehicle spaces
- Understanding of fire protection systems
- Understanding of fire-fighting equipment
- Identification of sources of ignition



### Consideration of relevant matters for fire-fighting strategy

- How to correspond to fire situation after recognition of a fire via patrol or fire alarm system
- How to determine a method for fire-fighting
- How to manoeuvre a ship and operate machineries at the time of the occurrence of a fire
- How to determine the abandonment of fire-fighting and the initiation of evacuation of all passengers and crew



### Establishing fire-fighting strategies

- Styles of fire-fighting strategies to be established
- Validation of fire-fighting strategies



### Education, training and drills

- Education, training and drills in a company and on board a ship
  - Education and training at external specialized institutions
- (Appendix) Example of fire-fighting skills

## 1 Basic knowledge of fire and extinguishment

### Combustion and extinction

Combustion means the state in which a combustible substance undergoes a rapid binding reaction with oxygen (oxidation reaction), accompanied by heat generation and light emission. This oxidation reaction requires specific thermal energy. For example, if you ignite a candle's wick with a match, combustion begins. This is a state where the wax component, which is combustible, liquefies and then vaporizes with the thermal energy of the burning match, and a rapid oxidation reaction occurs. This combustion accompanies the flame. There is also flameless combustion, such as combustion of a charcoal. This is a state where solids combine with oxygen without liquefying or vaporizing in a solid state. Since no flammable gas is generated, combustion occurs without flame, and it is called "flameless combustion" or "glowing combustion". When you blow strongly on a candle's fire, flammable gas is removed and the fire can be extinguished, while the fire of charcoal cannot be extinguished no matter how strong a wind blows onto it. In addition, in flameless combustion, things burn with less oxygen than flaming combustion.

Most of combustion is flaming combustion and can be extinguished by using cooling solids or liquids to prevent vaporization or thermal decomposition, depriving them of the thermal energy necessary for an oxidation reaction, preventing an oxidation reaction by removing oxygen, removing inflammable gas, or stopping the chain of oxidation reaction. In the case of extinguishing a fire burning substances with an extremely low flash point, such as petrol, it is impossible to cool them to a sufficiently low temperature to stop evaporation of petrol by applying water. It is necessary to select appropriate fire-extinguishing methods, such as using a powder extinguisher to stop the chain of oxidation reaction. Meanwhile, even after extinguishing a fire caused by a solid material using a powder extinguisher, there is still a possibility of re-ignition if the substance has sufficient thermal energy to ignite and is in contact with oxygen. In this case, it must be cooled sufficiently, e.g. applying water.

In a case of flameless combustion, it is possible to extinguish it using methods, such as depriving the substances of the energy for oxidation reaction or eliminating oxygen.

### Sources of ignition

Combustion is caused by thermal energy which derived from sources such as friction, chemical reaction of oxidation, electric resistance and sparks due to static electricity. In addition, it should be noted that amount of thermal energy, which causes combustion, is different for each substance and the minimum ignition energy of flammable liquids and gases with low flash points is extremely small.

### Smoke

Generally, if the amount of oxygen is sufficient, carbon dioxide and water vapor are generated by complete combustion. Carbon dioxide is colourless, while water vapor looks like white smoke because it becomes liquid particle. On the other hand, if the amount of oxygen is not sufficient, carbon, which is a pyrolysis substance, is released as black soot without being combined with oxygen through incomplete combustion, and it appears as black smoke. This black smoke also contains extremely toxic carbon monoxide caused by incomplete combustion.

It is necessary to take care not to aspirate the smoke wherever possible since smoke may contain other toxic pyrolysis substances other than carbon monoxide such as hydrogen sulphide. Carbon monoxide may cause death simply if a person aspirates air two or three times containing small percentage of it.

Furthermore, control of smoke, such as smoke elimination, is extremely important when conducting fire-fighting since smoke would be obstacles in several aspects including reduced visibility.

### **Heat**

The heat generated by fire is transmitted by conduction, radiation and convection.

It can be said that the risk of fire spreading is extremely high in a ship since steel, which comprises the structure of the hull, transmits heat by conduction more quickly than wood. In addition, personnel engaged in fire-fighting suffer from burns, heat fatigue and dehydration symptoms by the convection of air heated by radiation or fire. Even if a personnel is wearing fire-fighter's outfit, the temperature of inside it gradually increases at the site of the fire. Therefore it is necessary to take care of changes in the physical condition when engaging in activities such as fire-fighting over a long period of time.

### **Features of portable fire extinguishers and fire-extinguishing agents**

There are several types of portable fire extinguishers depending on the types of fire-extinguishing agents, such as powder extinguisher, foam extinguisher, fire smothering gas extinguisher, and liquid fire extinguisher. Their fire-extinguishing principles and the fire types for which they work effectively differ from one another. Depending on the methods of releasing fire extinguishing agents and their structure, they are categorized such as the stored-pressure type and the cartridge-operated type and their handling methods are also different.

It is necessary to be fully aware of the indication on each fire extinguisher which shows effectiveness to the type of fire.

## 2 Basics of fire-fighting

### Securing safety

The most important issue when conducting fire-fighting is to ensure the safety of human lives. Depending on situations, it is sometimes necessary to abandon fire-fighting and decide to evacuate all crew members from the ship by taking necessary measures such as activating fixed fire extinguishing equipment and closing fire doors to prevent secondary disasters.

### Wearing fire-fighter's outfit properly

As those who engage in fire-fighting may be exposed to radiant heat and toxic gases generated by flames, they are required to wear fire-fighter's outfit such as protective clothing and self-contained breathing apparatus (SCBA) in accordance with the risks that they may encounter when conducting fire-fighting. It is essential to carry out thorough inspections of fire-fighter's outfit and training on wearing it regularly as well as testing the crew's skills since failure to wear SCBA properly or check the remaining air volume can lead to fatal accidents. In addition, it is also important to ensure how to use means of communication such as transceivers and equipment such as torches and emergency breathing apparatus through training and drills preparing for various situations that you can expect to encounter at the fire site.



Self-Contained Breathing Apparatus (SCBA)

### Fire-fighting in a group

It is important to keep their calm to maintain sound judgement and action in an emergency. At the fire-fighting site, where individuals tend to have difficulty keeping themselves calm, it is necessary to act in a group by helping one another within the group instead of acting alone. It is also necessary to establish a system that allows people in the group to take care of one another in terms of their behaviour and change of physical condition.

### Initial fire-fighting

In these guidelines, fire-fighting is categorized into two stages, i.e. "initial fire-fighting" and "full-scale fire-fighting". "Initial fire-fighting" is fire-fighting with portable fire extinguishers.

In the case of initial fire-fighting, it is always necessary to judge whether to continue the initial fire-fighting or shift to full-scale fire-fighting while checking the fire behaviour carefully. At the same time, while carrying out initial fire-fighting, it is necessary to prepare gathering fire-fighter's outfits and fire-fighting equipment to the staging base for the fire-fighting operation, wearing fire-fighter's outfits, extending fire hose and connecting water fog applicators in preparation for full-scale fire-fighting.

In the case of fire-fighting with portable fire extinguishers, even if the fire is extinguished, there is a possibility of re-ignition if the parts which were combusting have not been cooled down. It is necessary to sufficiently cool down the heated parts by applying water from a hydrant in order to prevent re-ignition.

In the case of a fire whose source is not exposed, such as a fire inside a bonnet or a casing of refrigerator unit of a vehicle, it is necessary to destroy a structure covering the fire with a crow bar or an axe to expose the fire source and apply fire extinguishing agents inside the structure.

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During patrol of a vehicle space, please check the appearance of refrigerator units of vehicles by thinking about how to destroy the casing of them if a fire occurs there.

### **Prevention of fire spread**

Combustible materials nearby a fire may be ignited by heat transfer from the fire. Prevention of spread of fire is an essential part of fire-fighting because fire-fighting with a limited number of personnel becomes impossible if a fire spreads or fire occurs at multiple locations. Spread of fire may be prevented removing nearby combustibles and/or discharging water for cooling surroundings. The heat will be transferred rapidly through the hull and the fire will spread easily if a fire occurs in a ship made of metal such as steel. To prevent spread of fire owing to conduction of heat through hull structures, it is necessary to cool down the hull structure until steam is no longer generated in the locations onto which water is discharged.

### **Isolation**

We call a suppression and containment of fire into a small area as "isolation". This is an important preparatory work to perform full-scale fire-fighting safely and steadily. In this isolation, it is effective to use spray water with a nozzle of dual-purpose type (i.e., spray/jet type) or a water fog applicator.

### **Full-scale fire-fighting**

If initial fire-fighting with portable fire extinguishers fails, it is necessary to swiftly changeover to an effective execution of fire-extinguishing using hydrants. We call this stage of fire-fighting as "full-scale fire-fighting".

In full-scale fire-fighting, it is important to protect the crew who are engaged in fire-fighting and approaching fire source, from radiative heat from the flame by using water fog applicators.

In the case of a fire of flammable liquid having a low flash point, such as leaked gasoline, it is difficult to extinguish the fire by a water fog applicator, although it is possible to suppress the fire by spraying water. If you can suppress and contain of a fire of flammable liquid having a low flash point, it is effective to use portable fire extinguishers for extinguishing this kind of fire completely. It is recommended to use portable fire extinguishers effectively according to the circumstances, even in full-scale fire-fighting.

In general, it is necessary to have advanced skills and physical strength for handling a 65 mm fire-fighting hose in a vehicle space because trucks, trailers and other vehicles are loaded onto the space at intervals of approximately 60 cm and there are cargo securing devices. Therefore, it is effective to use 40 mm fire-fighting hoses, which are light and easy to handle. For example, you can extend a 65 mm fire-fighting hose along the ship side from a hydrant to the upwind of the fire site, connect a Y gate valve to this, connect two 40 mm fire-fighting hoses, and then connect an applicator nozzle and a nozzle of dual-purpose type to the ends of the two 40 mm hoses, respectively.

In addition, it would be useful for the purpose of identifying hydrants to assign numbers to hydrants on the starboard side as S1, S2, S3 ... from bow to stern and on the port side as P1, P2, P3 ... in the same way, and to label them with these numbers.

### **Smoke extraction**

Smoke extraction is extremely important, since poor visibility caused by smoke interferes with all fire-fighting operations. Appropriate ventilation is also needed to avoid the aspiration of toxic gases such as carbon monoxide caused by fire and reduce the effect of the convection



of heated air. It is important to ensure that, in principle, fire-fighting operations are conducted from the windward side, and not to enter the leeward side.

It is essential to examine directions of air flows to be created by considering at least the following matters for respective fire cases and by describing results of consideration in the sheets of fire-fighting strategy:

- location of the fire;
- necessity of the exhaust operation or air supply operation in each ventilator; and
- necessity of opening or closing each door.

In addition, if ventilation equipment installed in vehicle spaces is insufficient for smoke extraction, it is necessary to consider installing large blower fans.

### **Water drainage**

When using a large amount of water for fire-fighting, it is necessary to pay attention to the impact of water discharged into vehicle spaces on the stability of the ship. You should also pay attention to the clogging of scuppers with rags, waste, etc.

### **Overhaul**

Even if the flame is successfully extinguished by fire-fighting, there is a possibility to re-ignite if the temperature of a combustible material remains above its ignition temperature. It is necessary not only to extinguish the flame but also to ensure that it is completely extinguished by cooling. Removing the risks of re-ignition and keeping the ship in a safe state is called "overhaul".

In the case of a Class A fire, it is necessary to break up any remaining debris with a crow bar to expose the inside of them, and then cool them down by applying a sufficient amount of water.

### **Salvage**

We call the act of protecting the hull, equipment, cargo and so on from loss due to fire or fire-fighting as "salvage". Salvage includes following matters specifically:

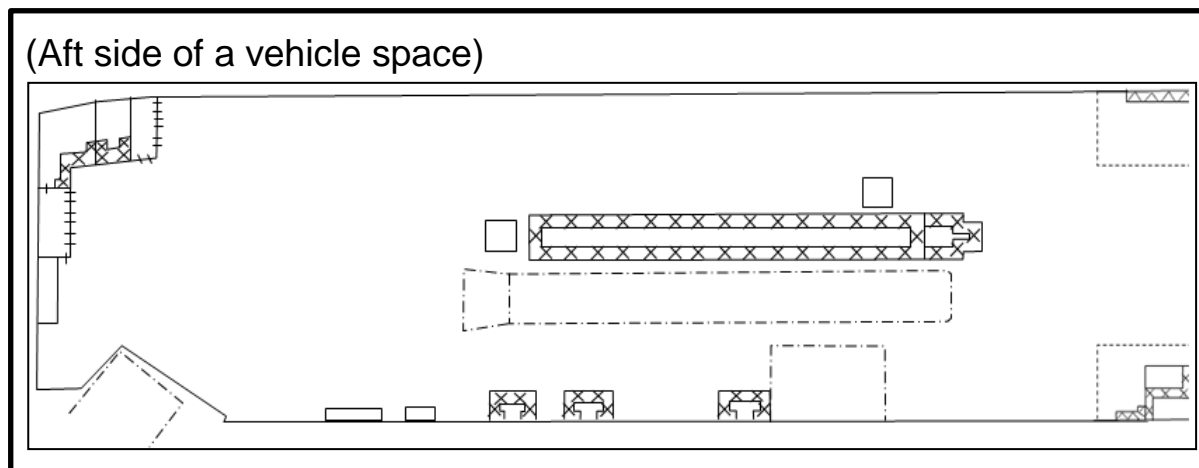
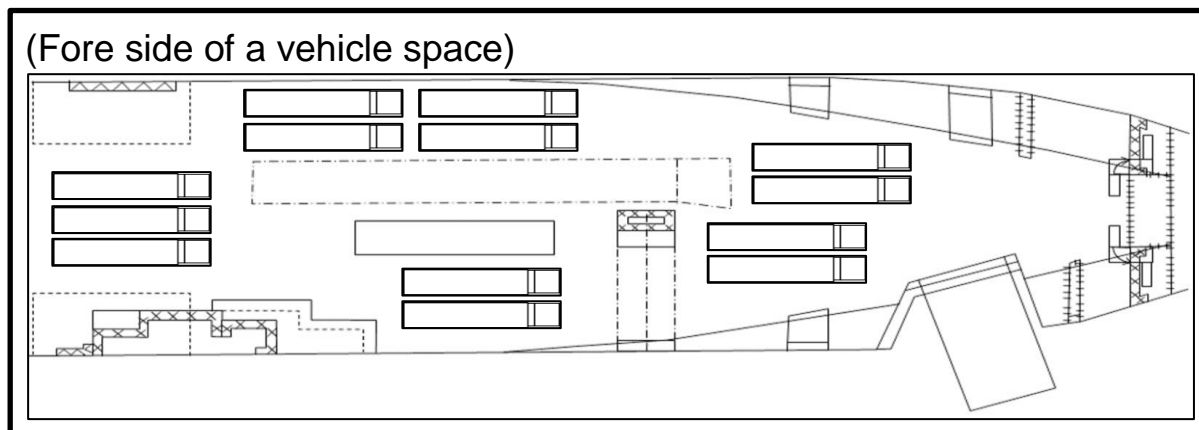
- prevention of damage due to water discharge by covering objects with waterproof sheets;
- release of discharged water to the outside of the ship;
- drying wet equipment;
- discharge of smoke and toxic gases; and
- disposal of debris.

Salvage is carried out not only after extinguishing but also during fire-fighting.

### 3 Preparation for establishing fire-fighting strategies

- (1) Prepare the following drawings related to the vehicle space to collect the information necessary for establishing fire-fighting strategies:
  - General arrangement plan
  - Fire control plan
  - Ventilation system diagram
  - Plan of fire protection structure
  - Electric circuit diagram
  - Piping diagram
- (2) Copy the general arrangement plan onto A3 paper, even if the plan is split onto multiple sheets.

<Example>







## 4 Understanding of fire protection systems



Add information regarding the fire protection structures and equipment of the vehicle space on the drawing(s) prepared at 3(2) of these guidelines (hereinafter simply referred to as “drawing(s)”).

Examples of information regarding fire protection structures and equipment to be added are as follows:

- (1) Arrangement of A class divisions (see SOLAS II-2/3.2) by type

Type	Symbol (example)	Temperature rise prevention time
Class “A-60”		60 minutes
Class “A-30”		30 minutes
Class “A-15”		15 minutes
Class “A-0”		0 minutes

- (2) Arrangement of B class divisions (see SOLAS II-2/3.4) by type

Type	Symbol (example)	Temperature rise prevention time
Class “B-15”		15 minutes
Class “B-0”		0 minutes

- (3) Divisions and/or positions, which should be actively protected from the spread of fire, adjacent to the vehicle space horizontally or vertically
- (4) Locations of air supply inlets and outlets of mechanical ventilation

## 5. Understanding of fire-fighting equipment

- (1) Add the locations of the fire-fighting equipment on the vehicle space to the drawing(s).
- (2) Make a list of the equipment of (1) with quantity, capacity and specifications.
- (3) Make a list of the storage locations of items which will be brought to the staging base for the fire-fighting operation at the time of a fire, such as fire-fighter's outfits, AED (automatic external defibrillator), stretchers and blankets.







(Fire-fighting equipment located on the vehicle space)

Name of equipment	Symbol	Quantity	Capacity and specifications

(Equipment to be gathered to the staging base for the fire-fighting operation)

Name of equipment	Quantity	Storage location

<Example of description>

Name of equipment	Symbol	Quantity	Capacity and specifications
Powder extinguisher		10 sets	Emission time/distance: 13 seconds/7 m
Portable foam applicator		5 sets	Foam solution flow rate: at least 200 L/min
Photoelectric type smoke detector		20 sets	—
Hydrant		4 places	—
65 mm fire hose		4	20 m long
Water fog applicator		2	1.2 m long

Name of equipment	Quantity	Storage location
Fire-fighter's outfit	3 sets	Fire control room
AED (automatic external defibrillator)	2 sets	Entrance hall
Stretcher	1	Warehouse of starboard side, C deck
Blanket	10	Warehouse of starboard side, C deck

## 6 Identification of fire sources

Add the following matters to the drawing(s):

### (1) Locations and types of materials that can be sources of ignition

<Examples of sources of ignition>

- Electrical
  - Power supply boxes to refrigerator cars (receptacles)
  - Power supply cables to refrigerator cars (plugs)
  - Batteries of trucks
- Mechanical
  - Pulleys and v-belts in refrigerator units of cars
  - Brakes of trucks
- Chemical
  - Rags or waste to which oil is adhered

### (2) Locations and types of combustibles adjacent to items that are potential sources of ignition

<Examples of combustible>

- Trunkings of electrical cable
- Cars and trucks
- Waste in trash bins

### (3) Areas for loading dangerous goods

<Examples of combustible>

- Tanker lorries for transporting kerosene

## 7 Consideration of relevant matters for fire-fighting strategy

In preparing a fire-fighting strategy, you need to consider along the following steps:

- set one arbitrary point among the locations where a fire may occur on the vehicle space;
- assume that a fire has occurred at that point; and
- examine and determine the matters described in (1) to (4) below, and consider concretely the methods for extinguishing the fire by who, when, where, with what, and how.

In this consideration, attention should be given on allocation of the work appropriately to avoid excessive burdens on specific crew, taking into account the contents of the education, training and drills that the crew have received, the skills they have acquired and their qualifications.

In addition, please clearly specify the authority and responsibility of the person who takes supreme command at the bridge and those who take command at the site.

### (1) How to correspond to fire situation after recognition of fire via patrol by crew or the fire detection and alarm system

Examine the actions to a situation from the time when a smoke detector is activated or smoke is observed by patrolling to the time when the fire emergency instruction is ordered at the bridge.

<Example of examination result of corresponding when smoke detector is activated at the bridge>

- 1) The duty officer shall confirm the position of the sensor that detected smoke and instruct the duty crew to hasten to the location where smoke was detected and check it on site.
- 2) The duty officer shall report to the captain by telephone that the fire detector has been activated and announce all officers and crew via transceivers or a public address system.
- 3) The duty crew who receives the instruction to check the site shall wear safety gear such as a helmet, gloves and safety shoes, bring a transceiver and a torch and hasten to the location where the smoke was detected. Before entering the vehicle space, he or she shall take a portable fire extinguisher from the aisle and enter the vehicle space from an entrance away from where the fire is suspected to have occurred.
- 4) The duty crew shall approach the location where the fire is suspected to have occurred and confirm whether the fire has actually occurred or not by paying attention to the smell, light, sound, smoke, flame, etc.
- 5) If the occurrence of a fire is confirmed, the duty crew shall immediately report the following matters to the duty officer with the transceiver:
  - Location where the fire is situated
  - What is burning
  - Whether or not it is an onboard power supplied car
  - Size of flames and amount of smoke
  - Presence or absence of fire source exposure
- 6) The duty crew who has completed the reporting shall immediately commence fire-fighting using the portable fire extinguisher that he or she has brought along.
- 7) The duty officer who has received the report shall convey it to the captain.
- 8) The captain who has received the report shall notify all officers and crew via transceivers or a public address system that the fire has occurred and issue a command of the fire emergency instruction.

- 9) The captain shall notify the search and rescue agency and the operation manager of company the occurrence of the fire.

## **(2) How to determine a method for fire-fighting**

Examine the actions from the time of the issuance of the command to the fire emergency instruction to the time when the method of fire-fighting is determined and conveyed to all officers and crew.

<Example of examination result of determination of method of fire-fighting against the fire of refrigerator car>

- 1) The chief officer is the commander at the fire site.
- 2) The chief officer wears safety gear, bring a transceiver, a torch and an alarm whistle and hasten to the site.
- 3) The chief officer checks the situation of the fire site and its surrounding areas, determine the following matters and immediately notify all officers and crew by transceiver:
  - Method of smoke extraction
    - Make an air flow from the bow to the stern on the vehicle space.
    - The captain directs to manoeuvre the ship so that the bow is windward
    - The second officer opens the bow ramp door by approximately 1/4 and the stern ramp door by approximately 1/3.
    - Sailor A sets the mechanical ventilation units on the bow side to air supply operation mode and those on the stern side to exhaust operation mode.
  - Location of staging base
    - Decide the location of staging base which is the windward side of the fire site and the entrance of the vehicle space surrounded by Class A-60 divisions.
    - The first oiler shall carry AED, stretchers and blankets to the staging location.
  - Access method to the fire site
    - In order to manage the entry and exit to the fire site and secure safety, access to the fire site is limited to the route via the staging base.
  - Initial fire-fighting operation
    - Initial fire-fighting is carried out using portable fire extinguishers. Since flames are coming from the inside of the refrigerator unit of car and the source of the fire is not exposed, deck man B shall shut off the power supply to all refrigerator cars and collect portable fire extinguishers. The boatswain shall bring a crow bar and force open the cover of the refrigerator unit. The duty crew carries out initial fire-fighting using a portable fire extinguisher.
  - Preparation for full-scale fire-fighting and prevention of fire spread
    - Establish two teams for full-scale fire-fighting.
    - Team 1 consists of the second engineer, the third engineer and the oiler, and the second engineer shall be the team leader.
    - Team 2 consists of quarter master A, quarter master C and sailor B, and quarter master A is the team leader.
    - The teams carry fire-fighting outfits to the staging location.
    - The members of Team 1 put on a fire-fighting outfit after checking its equipment and move to the fire site.
    - Team 2 checks fire-fighting outfits and then moves to the vehicle space for doing following actions:
      - extend the 65mm fire hose from hydrant P2 (second from the bow on the port side), whose location is on the windward side of the fire, toward the stern;
      - connect the 65mm fire hose with 2 lines of 40mm fire hoses by using a Y gate valve and attach a water fog applicator to one of the 40mm fire hoses and a nozzle of dual-purpose type to the other; and

- In addition, in order to use it for water discharging to prevent the fire from spreading, extend the 65mm fire hose of hydrant S3 (third from the bow on the starboard side) from the side of the ship to the centre of the vehicle space, connected through a Y gate valve with two lines of 40mm fire hoses attached with nozzles of dual-purpose type.
- Full-scale fire-fighting operation
 

If it is not possible to suppress the fire by carrying out fire-fighting activities using portable fire extinguishers, full-scale fire-fighting is necessary to carry out immediately.

Team 2 approaches the vehicle on fire while preventing radiant heat by spraying water from the water fog applicator.

Team 1 holds nozzles of dual-purpose type from behind the Team 2 and shoots water onto the source of the fire.

The second officer and sailor A who have completed their work for extracting smoke provide assistance with hose handling after checking the scuppers.
- Operation of fire spread prevention
 

The boatswain, the duty crew and sailor B spray water using nozzles of dual-purpose type onto the vehicles located on the leeward side of the fire and the ceiling above the fire to prevent the spread of the fire.
- Usage of a fixed pressure water-spraying fire-extinguishing system
 

To prevent any influence on fire-fighting operations, avoid to activate a fixed pressure water-spraying fire-extinguishing system until there is a fear of the fire spreading to other vehicles.

**(3) How to manoeuvre a ship and operate machineries at the time of the occurrence of a fire**

Examine following matters:

- controlling the heading of the ship against the wind direction;
- changing course to a port of refuge;
- operation condition of the main engine;
- parallel operation of the generators; and
- starting the fire pumps and bilge pumps, etc.

<Example of examination result concerning ship manoeuvre>

- 1) The captain keeps the heading upwind and sets the course in the direction to the nearest port as far as possible.
- 2) The chief engineer sets the main engine to standby and operates several auxiliary engines and generators in parallel.
- 3) The first engineer starts the fire pumps, general service pumps and bilge pumps.

**(4) How to determine the abandonment of fire-fighting and the evacuation of all passengers and crew**

Examine how to decide following matters:

- whether to continue or abandon fire-fighting;
- when passengers are informed the occurrence of fire taking into account of the state of fire;
- who informs passengers the occurrence of fire; and
- who is in charge of evacuation guidance, etc.

<Example of examination result concerning abandonment of fire-fighting and evacuation of all passengers and crew>



- 1) The on-site commander notifies the captain of the situation if the fire cannot be suppressed and the fire starts spreading to another vehicle, and suggests suspending the fire-fighting by crew and activation of the sprinklers.
- 2) The captain instructs the on-site commander to temporarily suspend the fire-fighting activities and evacuate to the staging base. Once the captain has been notified by the on-site commander that all the crew have been evacuated, he or she instructs the third officer to activate the sprinklers after confirming that the power supply to all refrigerator cars is cut off.
- 3) The on-site commander reports the operation status of the sprinklers and the state of the fire to the captain as appropriate.
- 4) The first engineer checks and monitors the operation status of the sprinkler pumping devices in the pump room, and the number one oiler checks and monitors the operation status of the sprinkler devices in the fire control room.
- 5) If the fire is not suppressed even after the sprinklers are activated, the captain instructs all crew and passengers to evacuate the vessel.
- 6) When full-scale fire-fighting commences, the captain uses a public address system to announce to all passengers that the fire has occurred, and the personnel from the administrative department and the catering department commence the evacuation guidance of the passengers.

## 8 Styles of fire-fighting strategies to be established

- (1) Summarize the matters examined and determined in section 7 in a form of a flow chart with reference to the attached example 1.
- (2) Fill in the important matters identified during the work specified in sections 4 to 6 for the fire-fighting operations on the drawing(s), with reference to the attached example 2, such as:
  - air flow;
  - access route to the fire site;
  - location of staging base;
  - method for extending hoses; and
  - areas for prevention of fire spread.
- (3) After creating both the flow chart and drawing(s), print them on A3-size sheets and laminate them so that they can be easily referred to at the site of a fire.

## 9 Validation of fire-fighting strategies

After creating both the flow chart and drawing(s) on the assumption that fire occurs one arbitrary point, it is essential to examine whether the established fire-fighting strategy is executable in a case that a fire occurs in another location. After thorough examination, if there are locations where fire-fighting operations in accordance with the existing fire-fighting strategy is not executable, review the existing fire-fighting strategy or create a new fire-fighting strategy by following the procedures of sections 7 and 8 for fire occurred in such locations.

When creating multiple fire-fighting strategies through the above mentioned examination, clearly indicate the locations of fire for each fire-fighting strategies.

## 10 Education, training and drills in a company and on board a ship

After the fire-fighting strategies are established, consider the contents of the education, training and drills that are necessary for swiftly and accurately implementing the fire-fighting strategies, and establish a plan of the education, training and drills to ensure implementation of the fire-fighting strategies.

In addition, when conducting the education and training, evaluate and record the skills that the trainees have acquired, and reflect them in the implementation plan for further education and training.

Moreover, if you are aware that there are matters to be improved in the fire-fighting strategies as a result of conducting drills based on the fire-fighting strategies, it is essential to review the fire-fighting strategies accordingly.

### <Examples>

#### Education and training for individuals

Education and training items	Target
Putting on/taking off protective clothing	All officers and crew
Putting on/taking off SCBA (Self-Contained Breathing Apparatus)	All officers and crew
Usage of a water fog applicator	All officers and crew
Usage of a portable fire extinguisher	All officers and crew

#### Training for teams

Training item	Target
Handling of fire hoses	All officers and crew
Fire-fighting training by using portable fire extinguishers	All officers and crew

#### Drills

Drill items	Target	Schedule of implementation
Fire drill in accordance with the fire-fighting strategy for the fore side of vehicle space No. XXX	All officers and crew	To be implemented in the drill scheduled in XX

#### Records of education, training and drills

Name	Education		Training		Drill	
	Date	Content	Date	Content	Date	Content
C/O xxx xxx	01/04/ 2016	Usage of portable fire extinguishers	01/06 /2016	Handling of fire hoses	01/08/ 2016	Fire drill in accordance with the fire-fighting strategy for the fore side of vehicle space No. 3
2/E yyy yyy	01/05/ 2016	Putting on/taking off SCBA	01/07/ 2016	Training on fire-fighting using portable fire extinguishers	01/09/ 2016	Fire drill in accordance with fire-fighting strategy for the aft side of vehicle space No. 2

## 11 Education and training at external specialized institutions

- (1) Consider to utilize an external training to acquire sufficient knowledge about ship fires, fire-fighting on board, features and the use of fire-fighting appliances and equipment, etc.
- (2) It is recommended to have a consultation by experts on fire-fighting when examining established fire-fighting strategies since expert knowledge and experience are necessary for identifying dangerous aspects and examining appropriate fire-fighting methods.
- (3) It would be difficult to conduct appropriate fire-fighting against a blazing flame at the actual fire site for those who have never experience fire-fighting. There are many things that you cannot know until you experience them yourself, such as how to manipulate the nozzle of a portable fire extinguisher to extinguish a fire effectively and how much you can prevent from radiant heat with using a water fog applicator. Therefore, It is important to consider utilizing external specialized institutions for more practical training since it may be difficult to conduct a training by using actual fire-fighting appliances and equipment in your company or onboard a ship. Furthermore, It is recommended to receive a practical training, which includes confronting actual flames to experience the actual heat and smoke, especially for key personnel such as those involved in establishment and review of a fire-fighting strategy, those who take command at the fire site, those who operate a portable fire extinguisher and a fire-fighting nozzle at the forefront of the fire site.

APPENDIX

Example of fire-fighting skills (1) Handling of fire-fighting appliances



**Step 1**  
Attach the Y gate valve to the 65 mm hydrant.



**Step 2**  
Attach the 40 mm fire hose to the Y gate valve.



**Step 3-1**  
Attach the nozzle to the 40 mm fire hose.



**Step 3-2**  
Transporting the hose. It can be hooked on the cylinder of the SCBA.



**Step 4**  
Prepare for extending fire hoses.  
(The photo shows preparing the hose by the coil method)



**Step 5** Check that the nozzle is closed.

**Step 6** Open the hydrant and check that the water is running.

**Step 7** Vent air from the nozzle and check that the water is discharging.

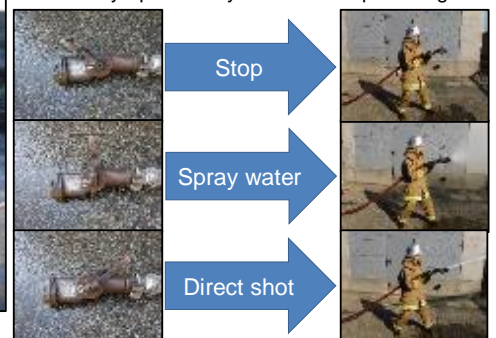
\* Slowly open the hydrant without panicking!!



**Step 8-1**  
Start to extinguish the fire.  
\* Do not forget to obey orders and repeat them for confirmation!!



**Step 8-2**  
In a narrow space, it is also possible to move the coiled hose by rolling its circular section.



**How to use the nozzle of dual-purpose type**

How to attach the water fog applicator to the nozzle of dual-purpose type



**Step 1**  
Remove the chip for spray water.



**Step 2**  
Attach the water fog applicator.



**Step 3**  
Discharge water with the lever set to the spray position.



**Step 4**  
Handle a hose by multiple people



## Example of fire-fighting skills (2) Fire on a vehicle deck (vehicle fire)

### Caution!!

It is important to extract smoke according to the established fire-fighting strategy before conducting a fire-fighting operation. It should be ensured that fire-fighting operations are conducted from the windward side, and not to enter the leeward side. It may need to consider to use an portable fan for smoke extraction.



**Step 1**  
Approach the source of fire from the windward side while cooling around of it.



**Step 2**  
Extinguish the fire at the driver's seat and engine section.



**Step 3**  
Extinguish the fire at the cargo and bottom sections while cooling them.



**Step 4**  
If fuel has leaked and caught fire, extinguish it by suppressing and containing the fire by water spray of multiple teams.



**Step 5**  
Overhaul the respective sections.  
(After the smoke is exhausted and the visibility has improved, check that the fire has been fully extinguished.)



You can use the water fog applicator to extinguish the fire in a narrow space.



When fire is caused by leaked fuel, it is effective to use a portable foam applicator to extinguish it.

Example of fire-fighting skills (3) Fire in the engine room (fire at the bilge/spurting flame)

**Caution!!**

It is important to extract smoke according to the established fire-fighting strategy before conducting a fire-fighting operation. It should be ensured that fire-fighting operations are conducted from the windward side, and not to enter the leeward side. It may need to consider to use an portable fan for smoke extraction.



**Step 1**  
Connect the Y gate valve to the hydrant.



**Step 2**  
Connect the line proportioner of the portable foam applicator to the Y gate valve.



**Step 3** (Medium-sized fire)  
Extinguish the fire at the bilge section with the spray water of the water fog applicator facing downward.



**Step 4-A** (Medium-sized or larger fire)  
Use a portable foam applicator to extinguish the fire at the bilge section.  
(Pour the foam into the bilge section by discharging it to the structure nearby fire.)



**Step 4-B** (Medium-sized or larger fire)  
Use a portable foam applicator to extinguish the fire at the bilge section.  
(Pour the foam into the bilge section by discharging it from the bottom of nearside of firefighter.)



**Step 4-C**  
(Spurting flame)  
Approach the flame, which is caused by spurting fuel, with using the water fog applicator to protect the firefighter. If possible, close the valves near the spurting fuel.



**Step 5**  
Conduct an overhaul.  
(After the smoke is exhausted and the visibility has improved, check that the fire has been fully extinguished. If required, cool down it to prevent re-ignition.)



## Example of fire-fighting skills (4) Fire in the cabin



**Step 1**  
Prepare to enter the cabin in front of the access door from the downwind.



**Step 2**  
Cool down the access door.  
Check any hazard around the access door.



**Step 3**  
Check the temperature of the access door with the back of your hand.



**Step 4**  
Open the access door and cool down the ceiling of the cabin by discharging water little by little. Repeat it until water drops from the ceiling. After finished the cooling of ceiling, enter into the cabin with low posture. Do not fully open the access door, but open it a little until a hose can be inserted.



Indirect shot



Direct shot



Overhaul

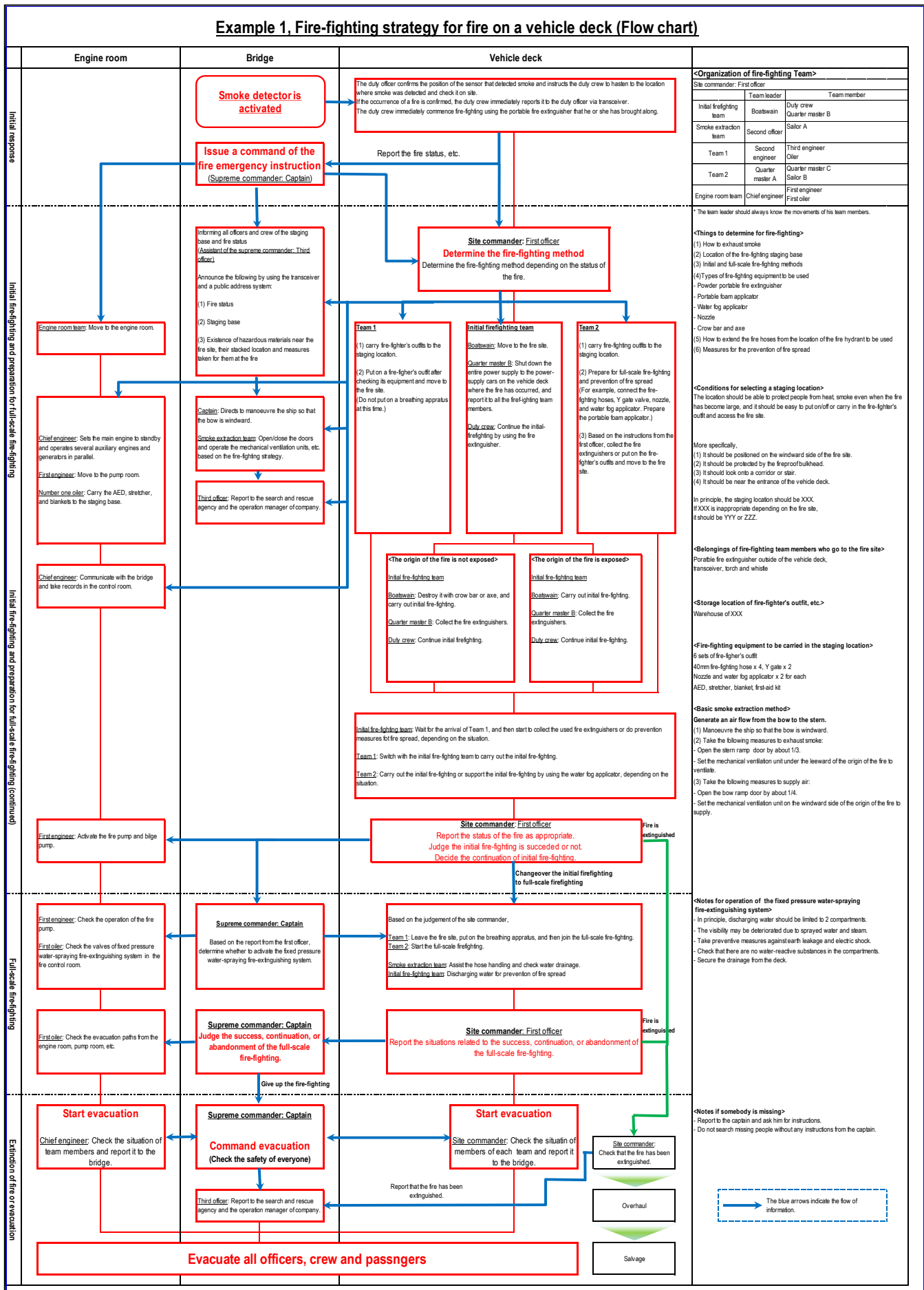
**Step 5**  
Check the burned sections and objects. Conduct indirect and direct shots to the burned sections. When the fire has been extinguished, conduct an overhaul.



**Step 6**  
Conduct a ventilation.  
(Exhaust smoke by discharging spray water from inside the cabin to outside.)  
Once the visibility has improved, conduct an overhaul again and check that the fire has been fully extinguished.

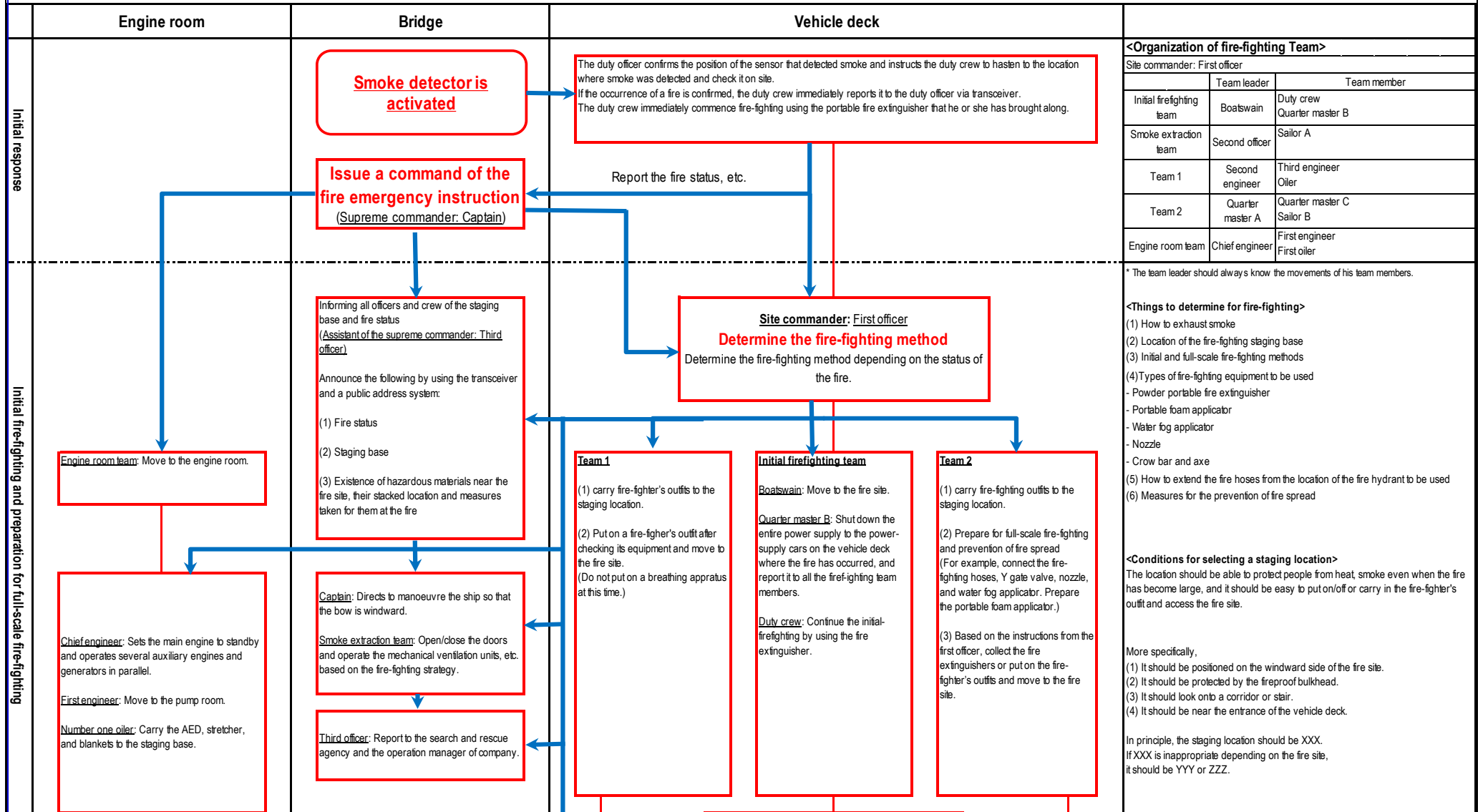


Example 1 (overall view)

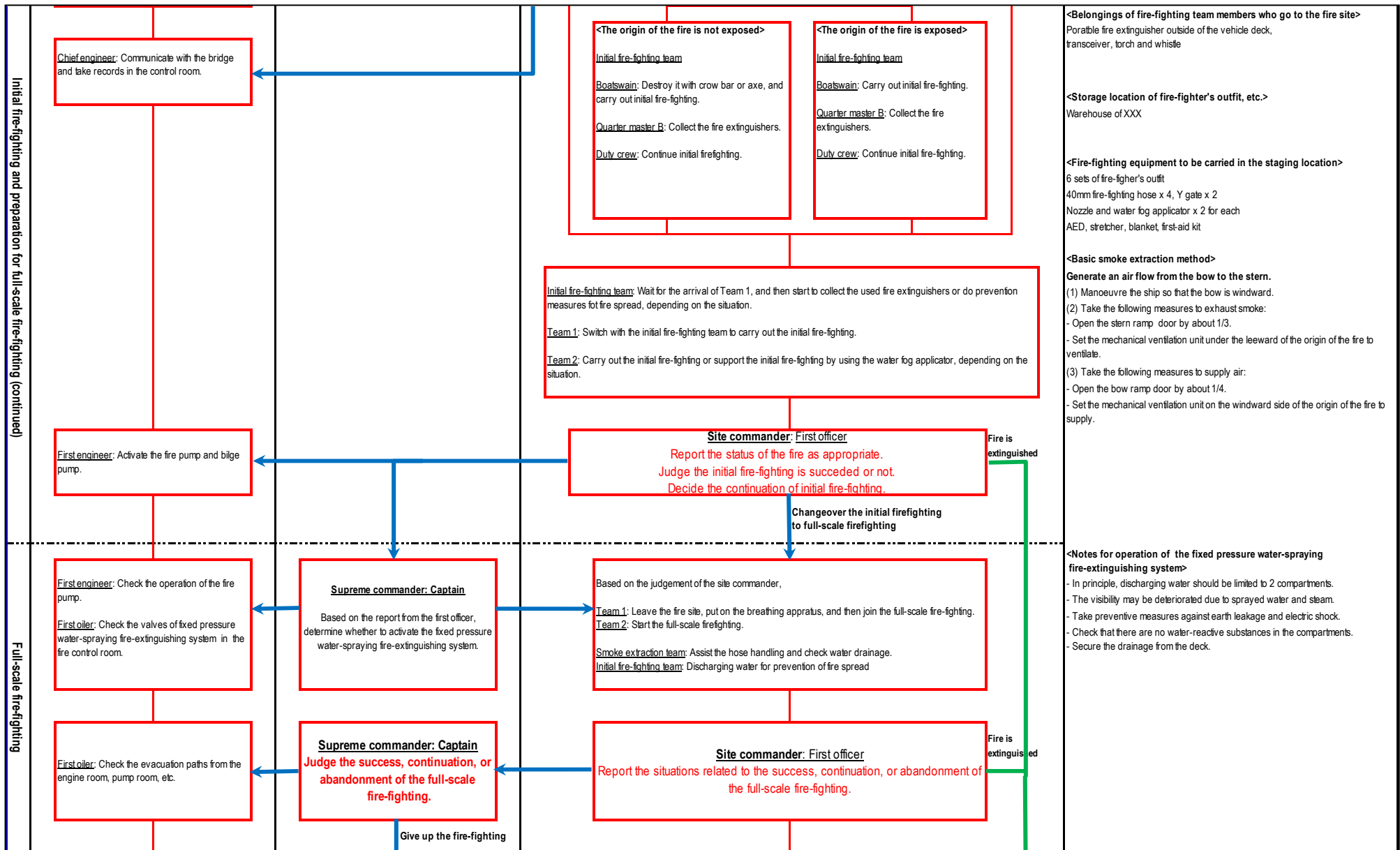


Example 1 (enlarged view 1 of 3)

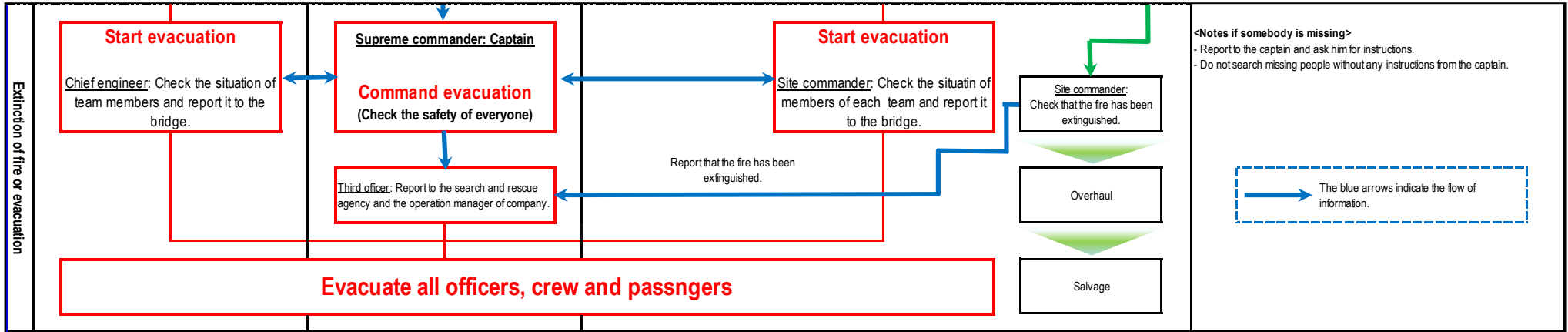
**Example 1, Fire-fighting strategy for fire on a vehicle deck (Flow chart)**



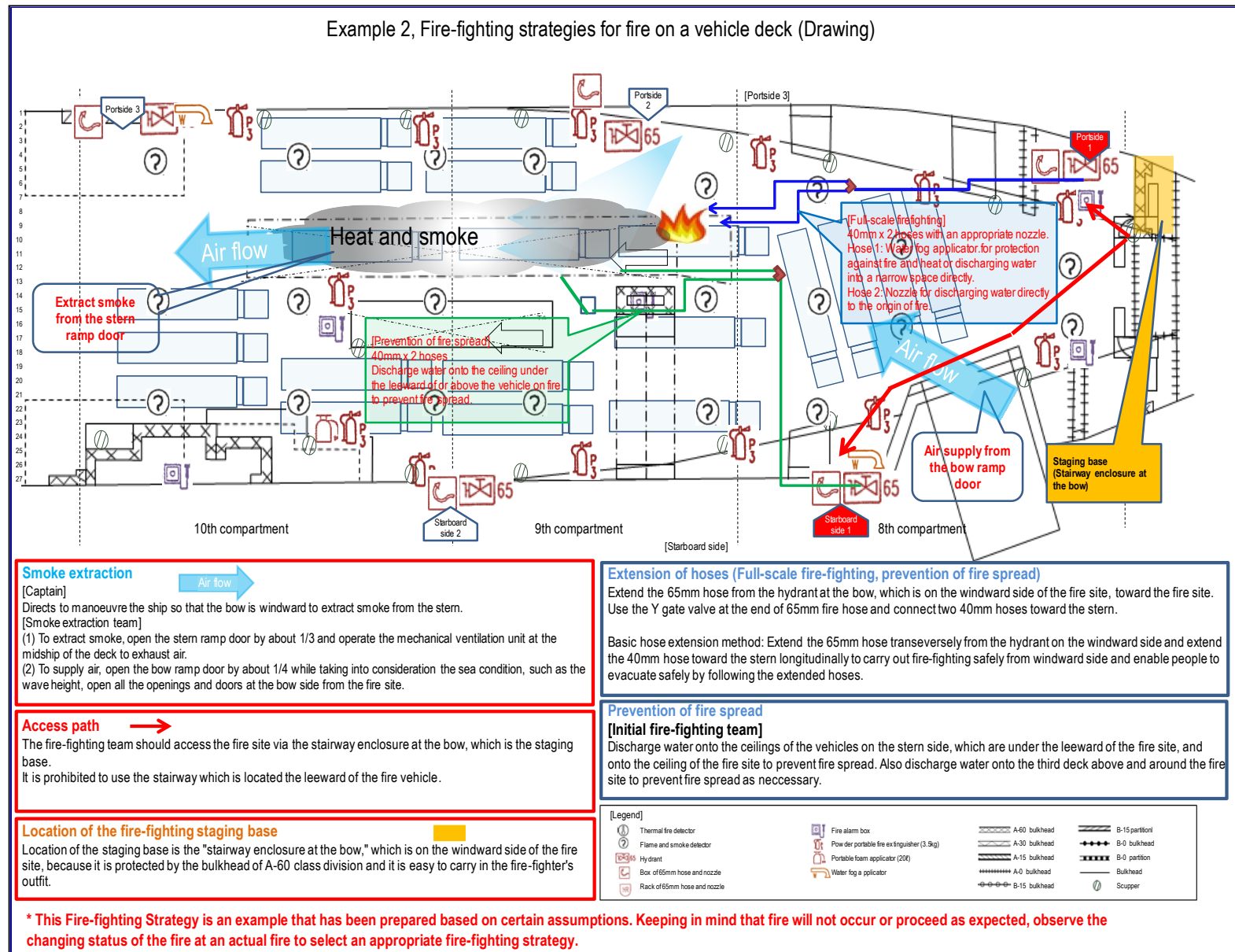
### Example 1 (enlarged view 2 of 3)



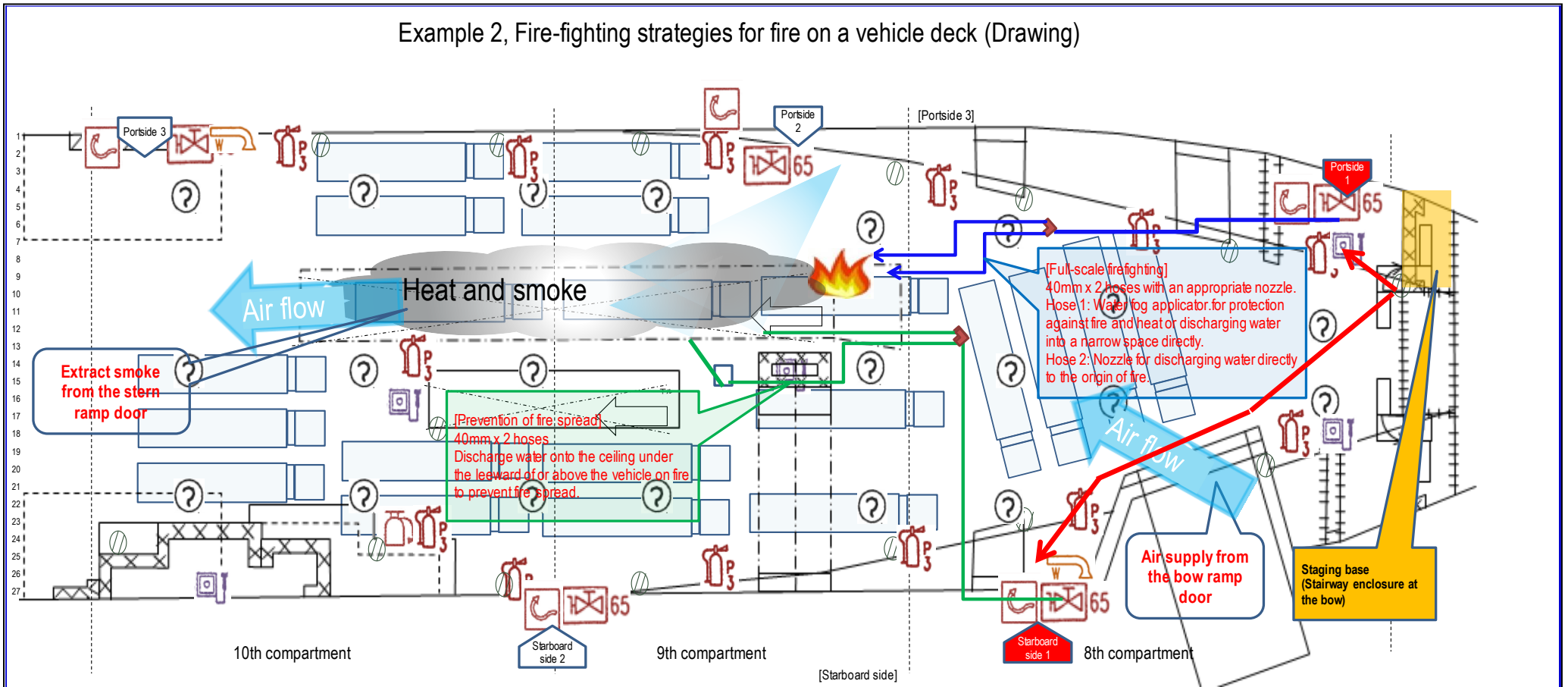
Example 1 (enlarged view 3 of 3)



### Example 2 (Overall view)



Example 2 (enlarged view 1 of 2)



### Example 2 (enlarged view 2 of 2)

#### Smoke extraction



[Captain]  
 Directs to manoeuvre the ship so that the bow is windward to extract smoke from the stern.  
 [Smoke extraction team]  
 (1) To extract smoke, open the stern ramp door by about 1/3 and operate the mechanical ventilation unit at the midship of the deck to exhaust air.  
 (2) To supply air, open the bow ramp door by about 1/4 while taking into consideration the sea condition, such as the wave height, open all the openings and doors at the bow side from the fire site.

#### Access path



The fire-fighting team should access the fire site via the stairway enclosure at the bow, which is the staging base.  
 It is prohibited to use the stairway which is located the leeward of the fire vehicle.

#### Location of the fire-fighting staging base



Location of the staging base is the "stairway enclosure at the bow," which is on the windward side of the fire site, because it is protected by the bulkhead of A-60 class division and it is easy to carry in the fire-fighter's outfit.

#### Extension of hoses (Full-scale fire-fighting, prevention of fire spread)

Extend the 65mm hose from the hydrant at the bow, which is on the windward side of the fire site, toward the fire site. Use the Y gate valve at the end of 65mm fire hose and connect two 40mm hoses toward the stern.

Basic hose extension method: Extend the 65mm hose transversely from the hydrant on the windward side and extend the 40mm hose toward the stern longitudinally to carry out fire-fighting safely from windward side and enable people to evacuate safely by following the extended hoses.

#### Prevention of fire spread

##### [Initial fire-fighting team]

Discharge water onto the ceilings of the vehicles on the stern side, which are under the leeward of the fire site, and onto the ceiling of the fire site to prevent fire spread. Also discharge water onto the third deck above and around the fire site to prevent fire spread as necessary.

#### [Legend]

Thermal fire detector	Fire alarm box	A-60 bulkhead	B-15 partition
Flame and smoke detector	Powder portable fire extinguisher (3.5kg)	A-30 bulkhead	B-0 bulkhead
Hydrant	Portable foam applicator (20l)	A-15 bulkhead	B-0 partition
Box of 65mm hose and nozzle	Water fog applicator	A-0 bulkhead	Bulkhead
Rack of 65mm hose and nozzle		B-15 bulkhead	Scupper

**\* This Fire-fighting Strategy is an example that has been prepared based on certain assumptions. Keeping in mind that fire will not occur or proceed as expected, observe the changing status of the fire at an actual fire to select an appropriate fire-fighting strategy.**