

ANNEX 21F**MACHINERY SPACE FIRES****1. The Hazards**

Machinery spaces present a high risk of initiation of fire and a great danger that, once started, the fire will develop into a major conflagration. Fuel leaks, oil spray or mist from defective joints, and oil-soaked lagging are possible sources of outbreaks.

2. Physical Nature of Machinery Spaces

Machinery spaces in warships are usually highly congested, with access generally through hatches. This configuration itself is a most daunting one to approach, and enter, with a major fire burning below. Movement about the spaces is via catwalks at levels appropriate to the machinery, with short connecting ladders as necessary. Catwalks and ladders are generally narrow, making movement of personnel with firefighting equipment difficult. Catwalks and floorplates are often manufactured in chequered plating which effectively degrades high-level spray systems and restricts vision and attack on the seat of the fire.

3. First Aid Portable Appliances (see [Chapter 23](#))

These must always be tried first unless the fire is clearly of such major proportions when discovered that their use would be pointless. Portable extinguishers are supplied for the instant reaction and their use will, quite often, 'knock down' apparently large fires. They will certainly have some effect, not the least of which is to gain time for the firefighting teams to prepare themselves and for fixed installations to be made ready.

4. Water and Water/AFFF High Level Spray Systems

Some water spray systems have an AFFF foam spray capability but the AFFF storage tank capacity allows only a limited period of continuous running. The system should be used in the following manner:

- a. AFFF usage should be restricted to 50% tank capacity - either continuous spraying or sporadic bursts. This holds 50% in reserve for possible use at a later stage.
- b. The decision to spray foam continuously or in burst rests with the IBC/OOD.
- c. There is no need for the compartment to be evacuated before the system is operated, if personnel inside are wearing breathing apparatus. This type of situation could arise if an attempt to deal with the fire by a firefighting team inside the compartment was abandoned and the system was activated while they were vacating.
- d. The continued use of water spray after foam induction has little effect on the foam blanket already laid. Total spraying time should be restricted to no more than 10 minutes it is unlikely that longer spraying will be effective.

5. Gaseous Firefighting Systems



WARNING

ALL PERSONNEL ASSOCIATED WITH FIREFIGHTING SHOULD BE MADE AWARE OF THE POTENTIALLY LETHAL PRODUCTS OF PYROLYSED HALON, THE DECOMPOSITION PRODUCTS OF THE FIRE ITSELF AND THE DANGER OF RE-IGNITION FROM INCOMPLETELY CLOSED DOWN COMPARTMENTS. COMPARTMENT EVACUATION FOLLOWING DRENCH IS ESSENTIAL WITH EEBD BEING USED WHERE AVAILABLE.

These systems that are single or multi-shot (Carbon Dioxide (CO₂), Halon 1211 (BCF) or Halon 1301 (BTM)) are fitted in the main and auxiliary machinery spaces, and their use is authorised by the officer in charge of firefighting (IBC/OOD).



Note. *There are several types of HALON gas including BCF and BTM. To avoid confusion it is essential that personnel are fully aware of the appropriate system and closely follow the respective operating procedure. It is important to understand that HALONS have virtually no cooling effect.*

- a. CO₂ drench systems require concentration of 35% by volume to extinguish fire and, when the compartment is closed down, all ventilation flaps to it should be clipped shut, with the exception of one (which has been pre-designated), which is closed but not clipped (to prevent excessive build up of pressure when the CO₂ gas is released). This atmosphere is lethal if inhaled for even a short period.
- b. BCF requires only about 5% concentration by volume to effectively extinguish most fires. At these concentrations BCF is quite toxic and 1-minute exposures will bring about the onset of first stage anaesthesia, ie a feeling of detachment and a tingling in the fingers. The compartment should be completely closed down; all WT doors, hatches and vent flaps being closed and clipped. BCF installations are normally only found on gas turbine or diesel engine modules and in MM/PP machinery spaces. The compartment should be purged of fumes before re-entry.
- c. BTM requires the same concentrations as BCF to be effective but is less toxic and medical tests have proved that people may inhale concentrations of up to 7% by volume without any risk to health. For single shot systems the compartment should be completely closed down; all WT doors, hatches and vent flaps being closed and clipped. For multi-shot systems the first shot is not to be delayed by compartment isolations or evacuation of personnel. BTM works chemically to stop the combustion process itself. In the process of extinguishing a fire the BTM decomposes to produce highly toxic and corrosive acids, namely hydrogen fluoride (HF) and hydrogen bromide (HBr). The amount of acids produced is minimised by injecting the required 5% concentration into the space in 10 secs or less.

**Notes:**

1. *In addition to systems being designed so that full discharge is achieved within 10 seconds of initiation to ensure optimum fire suppression, initiation should take place as soon as possible and within 5 mins of fire discovery. In the event that initiation is delayed, the system will still be effective but there will be more breakdown products produced, more fire damage and more subsequent clean up required. It is therefore important to initiate compartment drench as early as possible.*

2. *Where a BTM 2-shot system is fitted, the operation of the first shot may be authorised by the MEOOW at sea. This will preclude a delay while waiting for the IBC's permission.*

d. Compartments in which CO₂, or BCF is to be used should be vacated and fully closed down before the system is operated. The first shot of BTM may be used when vent fans have been stopped but the flaps open and when personnel are still inside the compartment.

e. Where available, fixed water/foam sprinkler systems may be used for up to 5 mins, before re-entry is attempted, in order to cool closed down compartments. This will significantly reduce the chance of re-ignition and permit re-entry much earlier after the use of gaseous systems.

f. Whenever locally operating a gaseous drench system or checking bottles have discharged within a dedicated Halon/CO₂ bottle stowage/compartment, there is a possibility of dangerously high concentrations of gas in the compartment. Therefore, EDDBA is to be worn 'on air' by anyone entering the compartment/stowage. A BA Controller must be nominated. EDDBA is also to be worn 'on air' whenever investigating gaseous drench system leakage/discharge alarms.

g. The diesel generator acoustic enclosures in Type 23 Frigates are not hermetically sealed and there is a risk to personnel entering the machinery space after remote operation of a module BCF system. BA is therefore to be worn 'on air', when entering the FAMR after such an incident.

6. Bilge Foam Inlet Tubes

If these tubes are fitted, they are for early use when the fire is known to be in the bilge. Even when the seat of fire may be elsewhere in the machinery space, AFFF introduced through the foam inlet tubes may serve to prevent its spread to the bilge. Foam tube caps should be replaced immediately after use, to preserve compartment integrity.

7. Standard Operating Procedures for Machinery Space BTM/BCF/CO₂ Systems

a. The guidance given in the following paragraphs is aimed at assisting IBC/OOD in dealing with main Machinery Space fires in ships fitted with either:

- (1) CO₂/BCF - Single and two-shot system.
- (2) BTM - Single-shot system.

(3) BTM - Two-shot system.

b. Due to variations within these systems ships will need to 'tailor' the instructions when compiling individual aides memoire and procedures. Ships fitted with common gas drench/water spray pipework are to note the precautions detailed at Para 8a [sub para \(26\)](#) and Para 8a [Note 4](#).

c. The procedures are not intended to cover every eventuality. Each Main Machinery Space fire will behave differently, however, by understanding the principles, success is more likely. Whilst the chronological order of events may vary it is essential that a continuous and aggressive attack is maintained on the fire. This includes dressing and deploying a Support Party as quickly as possible whilst the space remains occupied by the First Aid Attack/Attack BA Team. The Support Party will relieve the Attack Team and continue to deal with the incident. This may mean tackling minor fires or carrying out a compartment search following a successful first operation of the gas drench system. Should the second shot become necessary in vessels fitted with a 2-shot gaseous system, the Support Party will evacuate the compartment prior to the second shot.

d. RFAs are required to follow Maritime and Coastguard Agency (MCA) rules. The decision to gas drench must therefore comply with these instructions. As RFA vessels are constructed to commercial standards the use of salt water sprays in Main Machinery Spaces may exacerbate damage rather than reduce it. The decision to water spray these compartments must therefore take into account this risk.

8. Ships are to adapt the procedures on the following pages to reflect fixed systems:

a. **CO₂/BCF Single and Two Shot System Procedure**

ACTIVITY	ACTION
(1) Person discovering the fire conducts first aid attack and raises a LOUD VOCAL ALARM (including location). Maintain a continuous, aggressive attack (Attack/Attack BA/Support Party are to be deployed if circumstances permit) (see Note 1).	-
(2) Crash stop ventilation and remake breakers. Stop HP air compressors. Start closing down ventilation flaps and compartment accesses. Check HPSW pressure. Start additional HPSW pumps.	SCC/MCR HQ1/VENT

a. **CO₂/BCF Single and Two Shot System Procedure (Cont'd)**

ACTIVITY	ACTION
(3) Has the correct pipe been made and repeated? (a) Location of fire. (b) Muster points for: • Attack Party. • Support Party. • Containment Party. • BA Party.	HQ1 WK
(4) Is the door/hatch open or closed?	I/C FCP
(5) Introduce appropriate quantity of foam to bilge areas via foam tubes and replace foam tube caps.	I/C FCP
(6) Have FRS and adjacent ships been informed and assistance requested?	HQ1 WK/QM
(7) Start additional generators and reconfigure the power distribution system as necessary.	DMESR/MEOOW
(8) Commence system isolations in accordance with the compartment Kill Cards. In vessels fitted with a 2 shot system, closing down is not to delay operation of the first shot of CO ₂ /BCF (see Note 2).	DMESR/OOD/ MEOOW
(9) Establish containment priorities: (a) Adjacent compartments. (b) Remote (any compartments to which the fire could spread by heat transfer through trunking or systems). (c) Magazines - sprays activated? Confirm weapons and ammunition 'cook off times'. (d) Establish smoke boundaries and pipe locations. (e) Are all keys available for adjacent compartments? (f) Conduct full boundary search.	OOD/IBC I/C Containment DWESR I/C Containment Duty Logs I/C Containment

a. **CO₂/BCF Single and Two Shot System Procedure (Cont'd)**

ACTIVITY	ACTION
(10) Debrief the person finding the fire: (a) What is burning and the precise location? (b) Who is still in the compartment? (c) Are there any casualties?	I/C FCP/OOD/IBC
(11) If fire is not extinguished by first aid action: (a) Emergency Clear Lower Deck/Emergency Stations. (b) Account for all personnel - service and civilian. (c) Control use of spare hands.	OOD/POOD/IBC
(12) Pipe SITREP to the Ship's Company.	OOD/IBC
(13) Continue to close down ventilation flaps - for CO ₂ systems, one nominated ventilation flap is closed but left unclipped to relieve excess pressure during system operation.	I/C VENT
(14) Attack BA/Support Party maintains aggressive attack on fire.	I/C FCP
(15) If fire is major and Attack BA/Support Party are beaten back withdraw firefighters, seal compartment and confirm all ventilation flaps are shut (with exception at sub para (13)).	IC/FCP/OOD/IBC
(16) Authorise operation of gas drench to named compartment. (see Note 3). Confirm gas cylinders have discharged their contents. BA to be worn.	OOD/IBC
(17) Have the FRS and assistance from adjacent ships arrived? Assess outstanding tasks: (a) Are all personnel accounted for, is there a need for search and rescue? (b) Has the Support Party been formed for ships operating a Minimum HFEP system? (c) Coordinate FRS and adjacent ships assistance. (d) Are there sufficient BA, are charging points available? (e) Is the fire fully contained, smoke boundaries effective and TMS established? (f) Stability - remove water especially if high in the ship.	OOD/IBC I/C VENT IBC/DMESR

a. **CO₂/BCF Single and Two Shot System Procedure (Cont'd)**

ACTIVITY	ACTION
For operation of single shot gas systems continue to sub para (25)	
(18) Monitor the compartment temperature in accordance with sub para (27) .	I/C Containment
(19) Is the fire considered EXTINGUISHED? - NO - go to sub para (23) .	OOD/IBC
(20) Is the fire considered EXTINGUISHED? - YES . Clip remaining flap (CO ₂ system only), operate water/AFFF sprays and monitor temperature (sub para (26) to sub para (28) refers). Crash stop ventilation carry out re-entry procedure using 3 hose/fixed hatch waterwall technique.	I/C FCP/VENT/ OOD/IBC
(21) Is the fire confirmed EXTINGUISHED by the re-entry team – YES? Re-entry Team to cool down the scene of the fire and place sentry. Carry out smoke clearance.	I/C FCP/ OOD/IBC
(22) Is the fire confirmed EXTINGUISHED by the re-entry team - NO? Re-entry Team attack the fire.	
(23) If Re-entry Team are beaten back or if the fire is not considered extinguished (sub para (19)) re-seal the compartment (for CO ₂ system unclip nominated ventilation flap).	I/C FCP/ OOD/IBC VENT
(24) When compartment confirmed closed down, verified against compartment Kill Cards - authorise second operation of gas drench to named compartment (see Note 2).	OOD/IBC
(25) Allow 5 mins to elapse for BCF chemicals/ CO ₂ to extinguish the fire. Re-clip nominated ventilation flap (CO ₂ systems only).	OOD/IBC
(26) After 5 mins order 'Operate high level water/AFFF sprays'. Spray compartment for 5 mins to effect cooling (see Note 4 and Note 5).	OOD/IBC
(27) Monitor bulkhead temperatures using magnetic thermometers. Prior to making a re-entry confirm the compartment temperature is below 60°C (see Note 5 , Note 6 and Note 7).	I/C Containment
(28) Consideration should be given to using the high level water/AFFF sprays for a further 5 mins to cool the compartment before attempting to make a re-entry.	OOD/IBC
(29) Crash stop ventilation and authorise a re-entry using 3 hose/fixed hatch waterwall technique.	OOD/IBC
(30) Extinguish any remaining fire and secure the compartment.	I/C FCP
(31) FIRE EXTINGUISHED . Post sentry, carry out smoke clearance and remove water.	I/C FCP/OOD /IBC

a. **CO₂/BCF Single and Two Shot System Procedure (Cont'd)**

ACTIVITY	ACTION
(32) Quarantine the narrative, take photographs of incident boards and damaged areas as required. Restrict access to affected compartment and commence assessment of machinery damage. Report incident via the Navy Lessons and Incident Management System (NLIMS) (2013 DIN06-023 refers).	OOD/IBC

Notes:

1. *For ships operating a Minimum HFEP system the forming of the Support Party from the spare hands is to receive high priority.*

2. *Isolations for each space are to be identified on the Kill Card as Primary or Secondary. Primary Isolations are to include all fuel, air, lub oil, 440V and HV systems in the compartment. In most cases it should be possible to make Primary Isolations within 10 mins but Secondary Isolations may take up to 30 mins to complete. The making of isolations, giving priority to the Primary Isolations, should commence as soon as the alarm is raised, however their completion should not delay use of the first shot of the gas drench system. In vessels fitted with a 2 shot system all Primary Isolations should whenever possible be completed before authorisation of the second shot. In 1 and 2 shot systems all Primary and Secondary Isolations should whenever possible be completed before authorising a re-entry to the compartment concerned. If for any reason isolations cannot be achieved the OIC must make a risk management decision when to authorise operation of the gas drench system or make a re-entry.*



3. *Confirm all personnel have been evacuated from the compartment. Before the order 'Operate CO₂/BCF Gas Drench' is given the OIC is to have given consideration to man below boards and last known location of any missing service or civilian personnel. This process must not unduly delay operation of the gas drench system and the OIC must be prepared to make a risk management decision when authorising operation of a toxic gaseous system. Once the order 'Operate CO₂/BCF Gas Drench' is given cabinet doors are to be opened as a coordinated action in the process of operating the gas drench. No more than 1 min is to elapse from opening doors to operating the gas drench system.*

4. *In ships fitted with common pipework for gas drench and water/AFFF sprays there is a risk that the cooling effect of the expanding gas will cause water trapped in the pipework to freeze. If a sequence of Gas/Water (AFFF)/ Gas is used, a second operation of the gas system may freeze any remaining water and prevent a successful second gas drench. The risk is greatly reduced if a Gas/Gas/Water (AFFF) sequence is used.*



5. High level spraying quickly reduces compartment temperatures and minimises heat damage. Most high level spray systems are fitted with non-aspirating nozzles - foam is **NOT** produced when AFFF and water is used. Water spray with AFFF greatly improves the cooling effect by reducing the surface tension of the water thereby increasing the wetted area. 'Water only spraying' does not adversely affect bilge foam introduced through the foam tubes. Excessive spraying of any description will increase equipment damage.

6. Positioning of spray heads varies; therefore spraying will not necessarily cool the machinery space deckhead. Deckhead temperatures may therefore remain high due to latent/trapped heat.

7. During State 3 peacetime incidents, personnel safety is a higher priority and there is no Operational or Safety related requirement to regain the effected compartment as quick as possible, consideration should be given to delaying the re-entry until the compartment temperature has dropped to:

a. Ambient temperature **OR**

b. Below the open flash point temperature for POL substances within the compartment. In MMS this temperature can be taken as approximately 60°C for F76.

b. **BTM - Single Shot System Procedure**

ACTIVITY	ACTION
(1) Person discovering the fire conducts first aid attack and raises a LOUD VOCAL ALARM (including location). Maintain a continuous, aggressive attack (Attack/Attack BA/ Support Party are to be deployed if circumstances permit) (see Note 1).	
(2) Crash stop ventilation and remake breakers. Stop HP air compressors. Start closing down ventilation flaps and compartment accesses. Check HPSW pressure. Start additional HPSW pumps.	SCC/MCR/VENT
(3) Has the correct pipe been made and repeated? (a) Location of fire. (b) Muster points for: - Attack Party. - Support Party. - Containment Party. - BA Party.	HQ1 WK

b. **BTM - Single Shot System Procedure (Cont'd)**

ACTIVITY	ACTION
(4) Is the door/hatch open or closed?	I/C FCP
(5) Introduce appropriate quantity of foam to bilge areas via foam tubes and replace foam tube caps.	I/C FCP
(6) Have FRS and adjacent ships been informed and assistance requested?	HQ1/QM
(7) Start additional generators and reconfigure the power distribution system as necessary.	DMESR/MEOOW
(8) Commence system isolations in accordance with the compartment Kill Cards (see Note 2).	DMESR/MEOOW
(9) Establish containment priorities:	OOD/IBC
(a) Adjacent compartments.	I/C Containment
(b) Remote (any compartment to which the fire could spread by heat transfer through trunking or systems).	I/C Containment
(c) Magazines - sprays activated? Confirm weapon and ammunition 'cook off times'.	DWESR
(d) Establish smoke boundaries and pipe locations.	I/C Containment
(e) Are all keys available for adjacent compartments?	Logs
(f) Conduct full boundary search.	I/C Containment
(10) Debrief the person finding the fire:	I/C FCP/OOD/IBC
(a) What is burning and the precise location?	
(b) Who is still in the compartment?	
(c) Are there any casualties?	
(11) If fire is not extinguished by first aid action:	OOD/IBC
(a) Emergency Clear Lower Deck/Emergency Stations.	
(b) Account for all personnel - service and civilian.	
(c) Control use of spare hands.	
(12) Pipe SITREP to the Ship's Company	OOD/IBC
(13) Continue to close down ventilation flaps	VENT

ACTIVITY	ACTION
(14) Attack BA/Support Party maintains aggressive attack on fire.	I/C FCP
(15) If fire is major and Attack BA/Support Party are beaten back withdraw firefighters, seal compartment and confirm all ventilation flaps are shut.	I/C FCP
(16) Authorise operation of gas drench to named compartment. Confirm gas cylinders have discharged their contents. BA to be worn (see Note 3).	OOD/IBC
(17) Have the FRS and assistance from adjacent ships arrived? Assess outstanding tasks:	OOD/IBC
(a) Are all personnel accounted for, is there a need for search and rescue? (b) Has the Support Party been formed for ships operating a Minimum HFEP system? (c) Coordinate FRS and adjacent ships assistance. (d) Is there sufficient BA, are charging points available? (e) Is the fire fully contained; smoke boundaries effective and TMS established? (f) Stability - remove water especially if high in the ship.	I/C Containment
(18) Allow at least 5 mins for BTM to chemically extinguish the fire.	DMESR/IBC
(19) After 5 mins order “ Operate high level water/AFFF sprays ”. Spray compartment for 5 mins to effect cooling (see Note 4).	OOD/IBC
(20) Monitor bulkhead temperatures using magnetic thermometers. Prior to making a re-entry confirm the compartment temperature is below 60°C (see Note 4 , Note 5 and Note 6).	I/C Containment
(21) Consideration should be given to using the high level water/AFFF sprays for a further 5 mins to cool the compartment before attempting to make a re-entry.	OOD/IBC
(22) Crash stop ventilation and authorise a re-entry using the 3 hose/fixed hatch waterwall technique.	OOD/IBC
(23) Extinguish any remaining fire and secure the compartment.	I/C FCP
(24) FIRE EXTINGUISHED. Post sentry, carry out smoke clearance and remove water.	I/C FCP/OOD/IBC

b. **BTM - Single Shot System Procedure (Cont'd)**

ACTIVITY	ACTION
(25) Quarantine the narrative, take photographs of incident boards and damaged areas as required. Restrict access to affected compartment and commence assessment of machinery damage. Report incident via the Navy Lessons and Incident Management System (NLIMS) (2013 DIN06-023 refers).	OOD/IBC

Notes:

1. *For ships operating a Minimum HFEP system, the forming of the Support Party from the spare hands must receive high priority.*
2. *Isolations for each space are to be identified on the Kill Card as Primary or Secondary. Primary Isolations are to include all fuel, air, lub oil, 440V and HV systems in the compartment. In most cases it should be possible to make Primary Isolations within 10 mins but Secondary Isolation may take up to 30 mins to complete. The making of isolations, giving priority to the Primary Isolations, should commence as soon as the alarm is raised; however their completion should not delay use of the gas drench system. All Primary and Secondary Isolations should whenever possible be completed before authorising a re-entry to the compartment concerned. If for any reason isolations cannot be achieved the OIC must make a risk management decision when to authorise a re-entry.*
3. *Confirm all personnel have been evacuated from the compartment. On the order "**BTM GAS DRENCH**", Cabinet doors are to be opened as a coordinated action in the process of operating the gas drench. No more than 60 secs is to elapse from opening doors to operating the gas drench system.*
4. *High level spraying quickly reduces compartment temperatures and minimises heat damage. Most high spray systems are fitted with non-aspirating nozzles - foam is **NOT** produced when AFFF and water is used. Water spray with AFFF greatly improves the cooling effect by reducing the surface tension of the water, thereby increasing the wetted area. 'Water only spraying' does not adversely affect bilge foam introduced through the foam tubers. Excessive spraying of any description will increase equipment damage.*
5. *Positioning of spray heads varies; therefore spraying will not necessarily cool the machinery space deckhead. Deckhead temperatures may therefore remain high due to latent/trapped heat.*





6. During State 3 peacetime incidents, personnel safety is a higher priority and there is no Operational or Safety related requirement to regain the effected compartment as quick as possible, consideration should be given to delaying the re-entry until the compartment temperature has dropped to:

a. Ambient temperature **OR**

b. Below the open flash point temperature for POL substances within the compartment. In MMS this temperature can be taken as approximately 60°C for F76.

c. **BTM - Two Shot Systems Procedure**

ACTIVITY	ACTION
(1) Person discovering the fire conducts first aid attack and raises a LOUD VOCAL ALARM (including location). Maintain a continuous, aggressive attack (Attack/Attack BA/ Support Party are to be deployed if circumstances permit) (see Note 1).	
(2) Crash stop ventilation and remake breakers. Stop HP air compressors. Start closing down ventilation flaps and compartment accesses. Check HPSW pressure. Start additional HPSW pumps.	SCC/MCR/VENT
(3) Has the correct pipe been made and repeated? (a) Location of fire. (b) Muster points for: • Attack Party. • Support Party. • Containment Party. • BA Party.	HQ1 WK
(4) Is the door/hatch open or closed?	I/C FCP
(5) If the fire is not extinguished by first aid action authorise operation of gas drench to named compartment. Personnel not wearing BA are to withdraw from the space at the first opportunity, using EEBD if required. The first operation of BTM must not be delayed because personnel are not wearing respirator protection in the affected space (see Note 2). Confirm gas cylinders have discharged their contents. BA to be available.	OOD/IBC/ MEOOW
(6) Pipe SITREP over the main broadcast, including location of FCP.	OOD/IBC

c. **BTM - Two Shot Systems Procedure (Cont'd)**

ACTIVITY	ACTION
(7) If fire is not extinguished by first aid action: (a) Emergency Clear Lower Deck/Emergency Stations. (b) Account for all personnel - service and civilian. (c) Control use of spare hands.	OOD/IBC
(8) Introduce appropriate quantity of foam to bilge areas via foam tubes and replace foam tube caps.	I/C FCP
(9) Have FRS and adjacent ships been informed and assistance requested?	HQ1/QM
(10) Start additional generators and re-configure the power distribution system as necessary.	DMESR/MEOOW
(11) Commence system isolations in accordance with the compartment Kill Cards. Closing down is not to delay operation of the first shot of BTM (see Note 3).	DMESR OOD MEOOW
(12) Establish containment priorities: (a) Adjacent compartments. (b) Remote (any compartment to which the fire could spread by heat transfer through trunking or systems). (c) Magazines - sprays activated? Confirm weapon and ammunition 'cook off times'. (d) Establish smoke boundaries and pipe locations. (e) Are all keys available for adjacent compartments? (f) Conduct full boundary search.	OOD/IBC I/C Containment I/C Containment DWESR I/C Containment Logs I/C Containment
(13) Debrief the person finding the fire: (a) What is burning and the precise location? (b) Who is still in the compartment? (c) Are there any casualties?	I/C FCP/OOD/ IBC
(14) Continue to close down doors and hatches with the exception of one hatch to allow escape/rescue of firefighters. A hatch waterwall at the nominated hatch is advisable if manpower permits to prevent the escape of smoke/heat/BTM. The rigging of this waterwall must not delay the early use of the first operation of the BTM system.	I/C FCP/OOD/ IBC

c. **BTM - Two Shot Systems Procedure (Cont'd)**

ACTIVITY	ACTION
(15) Personnel fighting the fire will confirm if the fire has been extinguished.	I/C FCP
(16) Pipe SITREP over main broadcast.	OOD/IBC
(17) Account for all non-BA wearers.	OOD/IBC
(18) Have the FRS and assistance from adjacent ships arrived? Assess outstanding tasks:	OOD/IBC
(a) Are all personnel accounted for - is there a need for search and rescue?	
(b) Has the Support party been formed for ships operating a Minimum HFEP system?	
(c) Coordinate the FRS and assistance from adjacent ships.	
(d) Are firefighters in need of reliefs? (see Para 2521 Table 25-1).	
(e) Is the fire fully contained, smoke boundaries effective and TMS established?	I/C Containment
(f) Stability - remove water especially if high in the ship.	DMESR/IBC
(19) Is the fire considered EXTINGUISHED - YES? Attack BA/ Support Party cool down scene of the fire and place sentry. Carry out smoke clearance.	I/C FCP
(20) Is the fire considered EXTINGUISHED? - NO? Attack Party/ Support Party continues to attack the fire.	I/C FCP
(21) Prepare for second operation of gas drench system:	OOD/IBC
(a) Are all ventilation flaps confirmed shut and Primary Isolations completed where practicable? (see Note 3).	VENT/OOD/IBC
(b) Have the Attack Party/Support Party been beaten back?	I/C FCP
(c) Withdraw firefighters, ensuring that the compartment is closed down.	I/C FCP
(d) Authorise second operation of gas drench to named compartment.	OOD/IBC
(22) Allow at least 5 mins for BTM to chemically extinguish the fire.	OOD/IBC

c. **BTM - Two Shot Systems Procedure (Cont'd)**

(23) After 5 mins order ' Operate high level water/AFFF Sprays '. Spray compartment to effect cooling (see Note 4 and Note 5).	OOD/IBC
(24) Monitor bulkhead temperatures using magnetic thermometers. Prior to making a re-entry confirm the compartment temperature is below 60°C (see Note 5 and Note 6).	I/C Containment
(25) Consideration should be given to using the high level water/AFFF sprays for a further 5 mins to cool the compartment before making a re-entry.	OOD/IBC
(26) Crash stop ventilation and authorise a re-entry using the 3 hose/fixed hatch waterwall technique.	OOD/IBC
(27) Extinguish any remaining fire and secure the compartment.	I/C FCP
(28) FIRE EXTINGUISHED . Post sentry, carry out smoke clearance and remove water.	OOD/IBC/ I/C FCP
(29) Quarantine the narrative, take photographs of incident boards and damaged areas as required. Restrict access to affected compartment and commence assessment of machinery damage. Report incident via the Navy Lessons and Incident Management System (NLIMS) (2013 DIN06-023 refers).	OOD/IBC

Notes:

1. For ships operating a Minimum HFEP system, the forming of the Support Party from the spare hands is to receive high priority.

2. The Attack Party fighting the fire without BA are at risk from the toxic effects of smoke. The BTM introduced into the space is between 5-7% concentration and is not in itself toxic. However, when BTM is in contact with extremely hot surfaces this will add to the toxicity of the smoke. Firefighters without BA are therefore to evacuate the space as soon as the BTM drench alarm sounds. BTM drench cabinet doors are to be opened as a coordinated action in the process of operating the gas drench. No more than 60 seconds is to elapse from opening doors to operating the gas drench system.



3. Isolations for each space are to be identified on the Kill Card as Primary or Secondary. Primary Isolations are to include all fuel, air, lub oil, 440V and HV systems in the compartment. In most cases it should be possible to make Primary Isolations within 10 mins but Secondary Isolations may take up to 30 mins to complete. The making of isolations, giving priority to the Primary Isolations, should commence as soon as the alarm is raised, however their completion should not delay use of the first shot of the gas drench system. All Primary Isolations should whenever possible be completed before authorisation of the second shot. All Primary and Secondary Isolations should whenever possible be completed before authorising a re-entry to the compartment concerned. If for any reason isolations cannot be achieved the OIC must make a risk management decision when to authorise operation of the gas drench system or make a re-entry.

4. High level spraying quickly reduces compartment temperatures and minimises heat damage. Most high level spray systems are fitted with non-aspirating nozzles - foam is not produced when AFFF and water is used. Water spray with AFFF greatly improves the cooling effect by reducing the surface tension of the water, thereby increasing the wetted area. 'Water only spraying' does not adversely affect bilge foam introduced through the foam tubes. Excessive spraying of any description will increase equipment damage.

5. Positioning of spray heads varies; therefore spraying will not necessarily cool the machinery space deckhead. Deckhead temperatures may therefore remain high due to latent/trapped heat.

6. During State 3 peacetime incidents, personnel safety is a higher priority and there is no Operational or Safety related requirement to regain the effected compartment as quick as possible, consideration should be given to delaying the re-entry until the compartment temperature has dropped to:

a. Ambient temperature **OR**

b. Below the open flash point temperature for POL substances within the compartment. In MMS this temperature can be taken as approximately 60°C for F76.